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INFORMATION REPORT INFORMATION REPORT

TENTATIVE DESCRIPTION AND INSTRUCTIONS FOR THE R-642 RADIO TRANSMITTER

(English Translation)

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TENTATIVE DESCRIPTION AND INSTRUCTIONS FOR THE R-642 RADIO TRANSMITTER

I. INTRODUCTION

[p 1]
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The R-642 type radio transmitter is designed for operation aboard ship with any of the following modes of transmission:

1. Telegraph key using continuous wave.

2. Telegraph key using tone-modulated wave.

3. Telephone.

4. Printing by a method of frequency modulation with varying carrier frequency (on quartz-stabilized frequencies).

5. Facsimile operation by a method of audio frequency modulation in the telephone mode of the transmitter.

The R-642 radio transmitter consists of the following basic parts:

1. Transmitter.

2. VSR-5 type rectifier.

3. Control panel.

4. Radio operator station (PRO).

5. Remote station (VPS) with speaker.

6. Quartz-heating element.

7. Power unit for supplying the transmitter from a DC network.

Note: When AC current is provided, the power unit is not supplied.

The description given here is only for the transmitter, control panel, radio operator position, and remotely located station. That concerning the rectifier and power unit is contained in a separate attachment.

In the event that the transmitter includes a receiver, a special antenna must be provided for it.

With manual telegraph operation, an automatic half-duplex allows reception during pauses in sending; with telephony, the half-duplex operation is controlled from the microphone.

The transmitter provides communications, (without searching and without tuning) over a continuous frequency range, using a crystal heterodyne wavemeter which serves as the periodic control of the calibration or frequency setting.

The transmitter can establish communication by setting its frequency to that of a received signal. 50X1

The transmitter is calibrated in kilocycles, and the frequency is read directly from a continuous tuning dial. [p 2]

The transmitter can operate on quartz-stabilized frequencies.

An actuator for teletype operation, excluding frequency deviation elements, is used when operating on a quartz-stabilized frequency.

The R-642 radio transmitter can be supplied from any of three possible primary power sources:

a) a 220/380-volt AC circuit,

b) a 220-volt DC circuit, or

v) a 110-volt DC circuit.

When a DC power source is supplied to the transmitter, a motor-generator convertor with a 220 or 110-volt PN-85 type motor and a 230-volt APNT-85 type three-phase generator are added.

Further voltage conversion is accompanied by means of a VSR-5 rectifier connected to the transmitter.

The rectifying arrangement consists of a number of selenium rectifiers which supply the various circuits of the transmitter.

An AC voltage is fed directly to the tube filament circuit of the transmitter form a step-down transformer.

The radio transmitter has several stand-by circuits to prepare it for operation. These are:

a. the thermostat of the continuous-range master oscillator in transmitter Unit No 1.

b. the thermostat of the "Kh" unit in the transmitter Unit No 5, and

v. the preliminary heater thermostat of the "Kh" units in the quartz-heating element.

Current is supplied to these circuits directly from the DC network, if available; and directly from an AC source, if available.

Thus, the arrangements for supplying the stand-by circuits are different.

Forced air is used to cool the transmitter and rectifier.

II. GENERAL DESCRIPTION OF THE TRANSMITTER [p 3] 50X1

The complete schematic of the transmitter is shown on Diagram R-97918. The high-frequency section of the transmitter consists of 5 stages.

The master oscillator has an electron coupling and incorporates a GU-50 type pentode for operation at reduced plate and screen voltages.

Manipulation is accomplished by breaking the circuit of the screen grid potentiometer and pressing a button to supply a negative cut-off voltage to it.

The second stage amplifier operates with a GU-50 type pentode.

The third stage operates as a doubler and amplifier with a GU-50 type tube having a plate voltage of 600 volts.

The fourth stage operates with two parallel-connected GU-50 type tubes in the doubling and amplifying mode.

The fifth stage operates with two parallel-connected GU-80 type tubes having a plate voltage of 2500 volts.

The transmitter pentode is modulated by varying the bias to the pentode grids of the fifth stage tubes. The low-frequency section of the transmitter, designed for modulation, consists of a three-stage low-frequency amplifier and audio-oscillator for obtaining audio-modulated oscillations.

The modulating equipment has a compressing device which maintains a constant percentage modulation of the transmitter within certain limits.

In the transmitter the circuit of the first stage is gang-tuned with the second; and that of the third stage with the fourth. The fifth stage is tuned with a separate knob. Three control knobs are used for continuous tuning of the transmitter circuits: one for stages 1 and 2, one for stages 3 and 4, and one for stage 5.

The frequency range of stages 1 and 2 are divided into 4 sub-bands which cyclically repeat on ranges I, II, and III of the remaining stages of the transmitter. All of the subband switches in all five stages are mechanically ganged to each other and are under the control of a 12-position master control knob located on the forward panel of the transmitter.

Dotted lines joining the tuning controls shown on the master diagram of the transmitter indicate the mechanical connection between the controls.

The order of the designations for the subbands handled by the transmitter indicates the frequency change: i.e., the first subband corresponds

to the lowest frequencies (or longest wave lengths), and the 12th subband corresponds to the highest frequences (or shortest wave lengths). [p.4] 50X1

The antenna circuit of the transmitter is coarse-tuned by means of a switch; and continuously fine-tuned by means of a coil with a slide contact.

Coupling with the antenna circuit is capacitive, and varying the coupling is done by means of an 11-position switch.

Continuous tuning of the transmitter is done in the following steps:

1. Place the subband selector switch in the required position.
2. Tune the circuits of stages 1 and 2.
3. Tune the circuits of stages 3 and 4.
4. Tune the circuits of stage 5.
5. Coarse tuning of the antenna by means of the antenna switch.
6. Continuous fine-tuning of the antenna.
7. Selection of the best coupling of the antenna circuit with the circuit of stage 5.

III. DESCRIPTION OF THE ELECTRICAL SYSTEM (SEE DIAGRAM R-97918)

1. The Master Assembly

The master assembly for the continuous-frequency range has 2 stages which operate with GU-50 pentodes.

The first stage, the master oscillator (Figures 1 and 2), comprises a circuit with electron coupling. The inner circuit of the master oscillator (which determines the frequency) has as a continuous tuner a variometer with a shorted turn, providing overlapping of frequencies K = 1.2.

The entire range of the master oscillator from 1.5 to 3.0 Mc consists of four subbands; variometer 2 incorporates capacitors 6, 7, and 8; capacitor 5, controlling the 4th subband, is connected permanently to the circuit.

The distribution of frequencies by subband in the master oscillator is as follows:

1.5 - 1.75	megacycles	1, 5, 9
1.75 - 2.1	"	2, 6, 10
2.1 - 2.5	"	3, 7, 11
2.5 - 3.0	"	4, 8, 12

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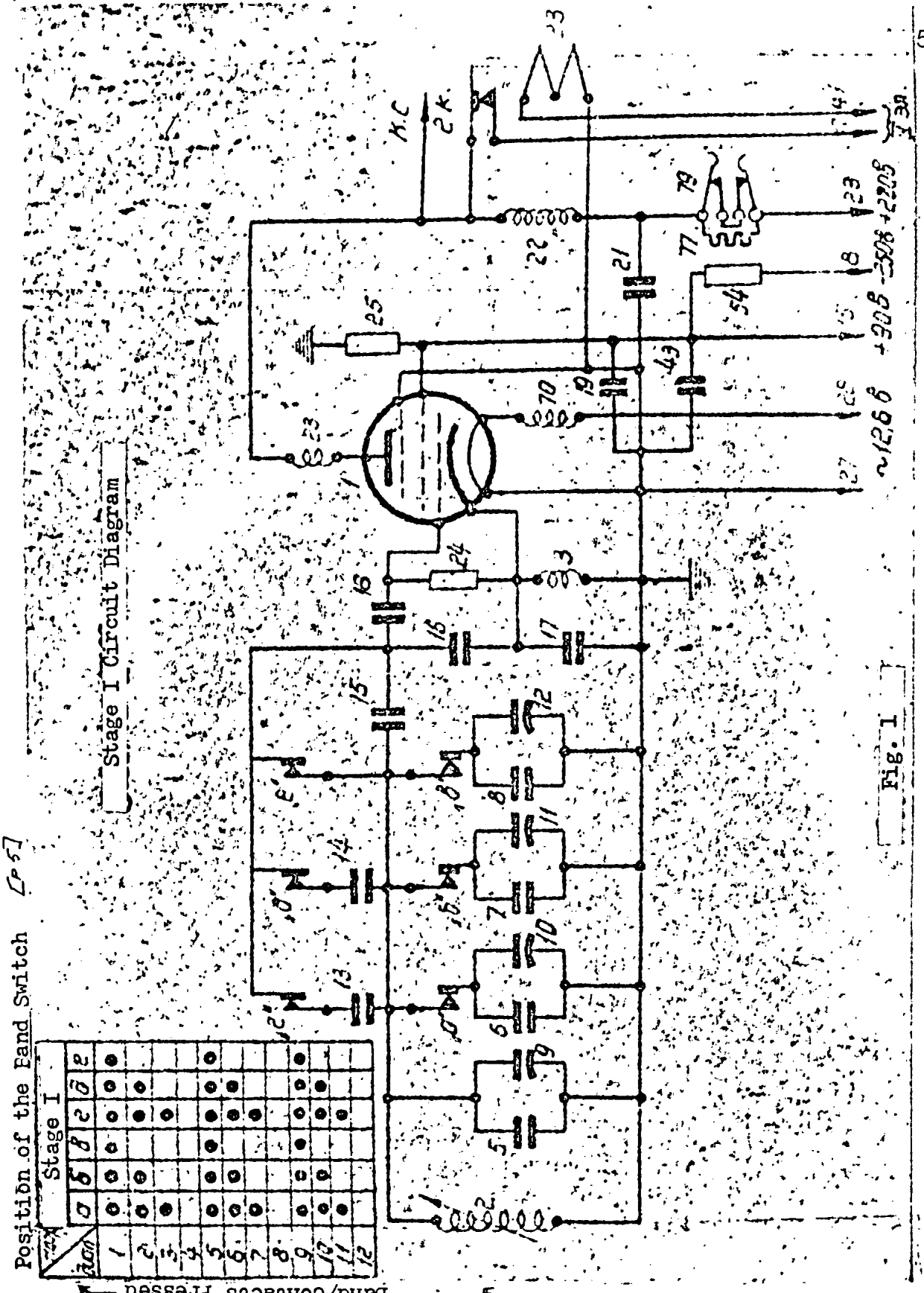

Fig. 1

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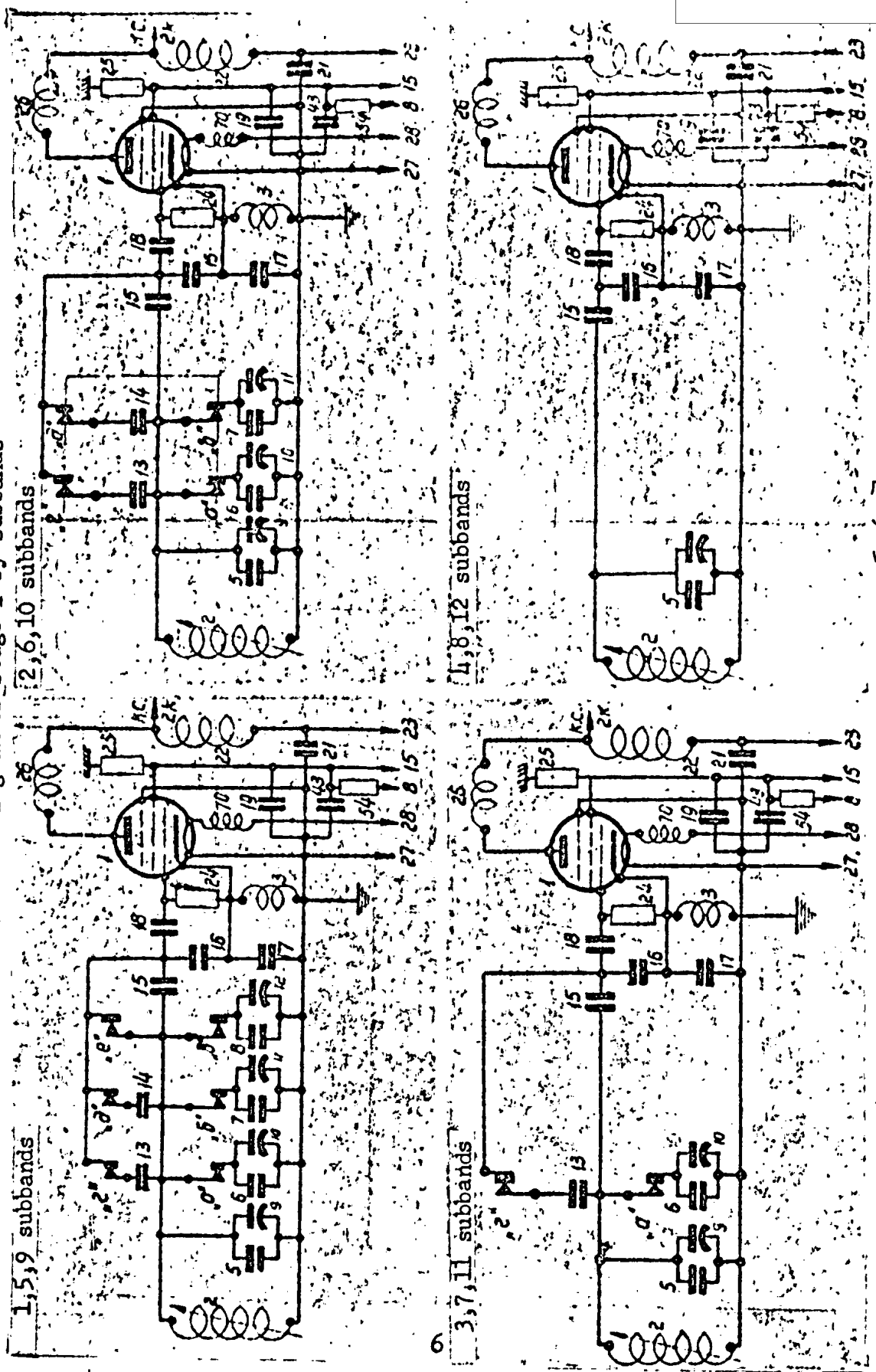

Circuit Diagram of Stage I by Subbands

Fig. 2 [p 64]

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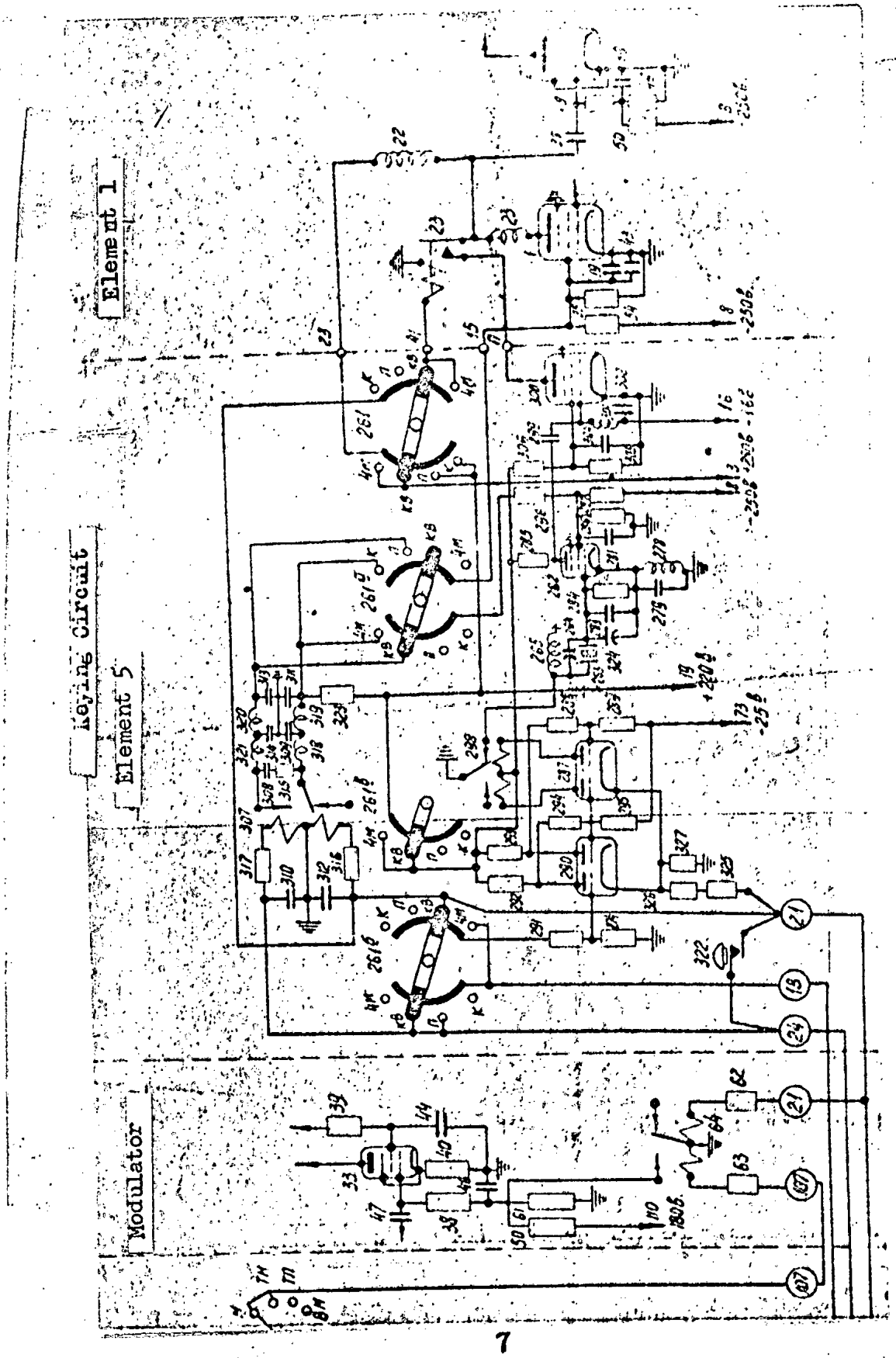

Fig. 3 [p 61]

To calibrate the dial for the subbands there are trimming capacitors 9, 10, 11, and 12. 50X1

The inner circuit is connected to the tube by means of a capacitive potentiometer.

Capacitor 16 of the potentiometer serves as a feedback element. [p 7]

Capacitor 15 and capacitors 13 and 14 connected in parallel to the other subbands determine the degree of coupling of the circuit with the tube.

All the capacitors of the inner circuit, as well as the capacitor of grid leak 18, are of a hermetically sealed KGK type.

The master oscillator operates in a self-bias mode from grid current. The screen grid is fed from a potentiometer comprising resistors 25 and 323, and the high frequency component is grounded through capacitor 19.

Modulation (Figure 3) is obtained by breaking the circuit of the screen grid potentiometer and pressing a key to feed into it a negative cut-off voltage through resistor 54.

Capacitors 20 and 41 in the filament circuit of the driver tube block out high frequencies from the filament circuit. Since the cathode of the tube of the master oscillator is under a high-frequency potential, the circuits of the plate and screen DC components are closed through cathode choke coil 3.

The plate of the master oscillator tube has an aperiodic load in the form of choke coil 22. An oscillating voltage from the plate load of the master oscillator through decoupling capacitor 38 is applied to the grid of the 2nd stage tube (Figures 4 and 5).

A bias is applied to the grid of the 2nd stage tube from potentiometer 49 - 50 through resistor 48.

The screen grid is fed through dropping resistor 51, and the high frequency component is grounded through capacitors 40 and 42.

The plate circuit of the tube, tuned to the frequency of the inner circuit, consists of variometer 28, capacitor 30, and supplementary subband capacitors 31, 32, and 33. The high-frequency component of the circuit is grounded through capacitor 44.

The inner circuit of the master oscillator and the circuit of the 2nd stage are gang-tuned.

For ease of ganging, each subband in the circuit of the 2nd stage has ceramic trimming capacitors 34, 35, 36, and 37 and trimming choke coil 29. The voltage of the driver is fed to the grid of the 3rd stage through decoupling capacitor 46.

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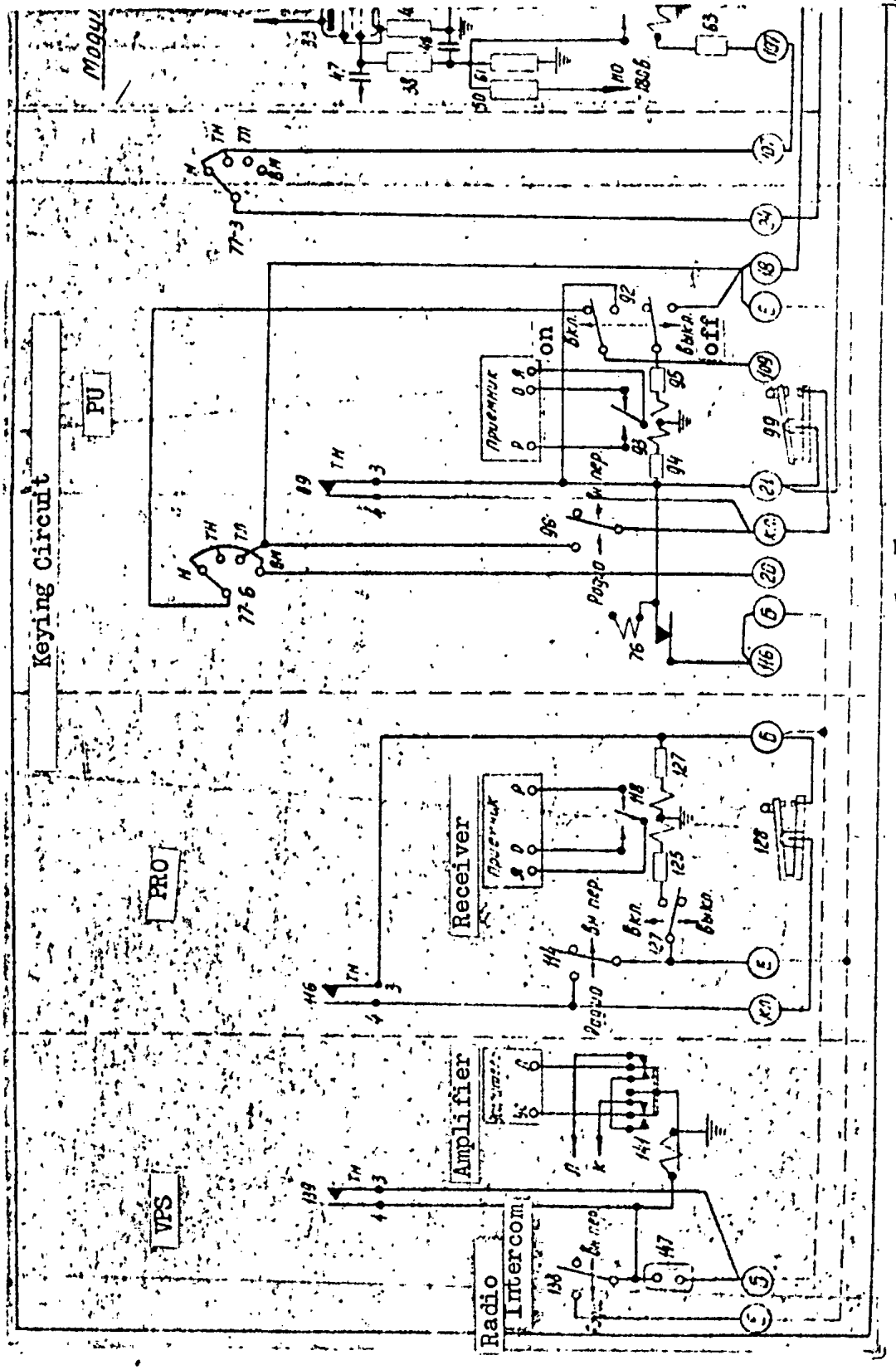

Fig. 3 [p8]

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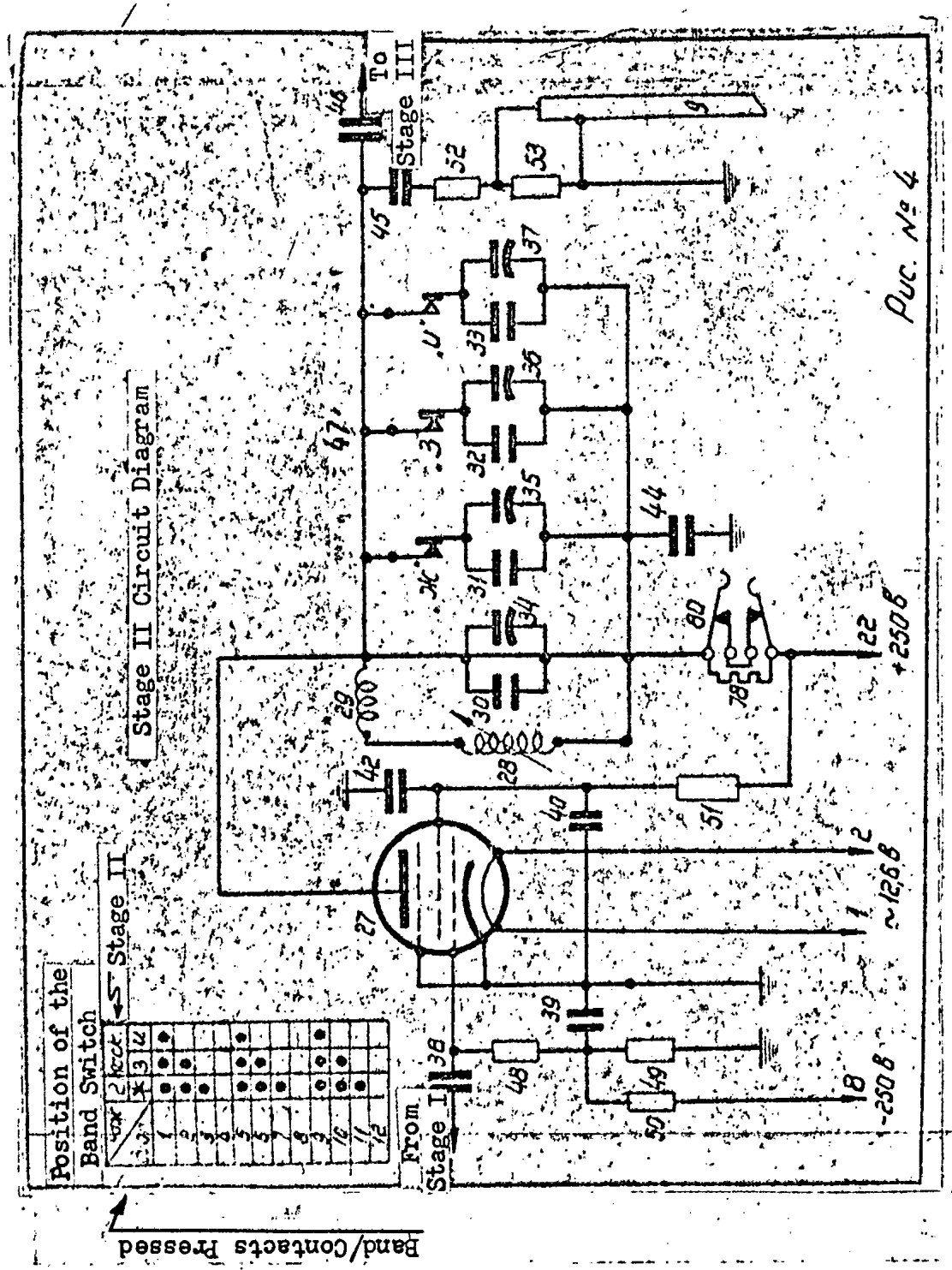

Fig. 4 [p 9]

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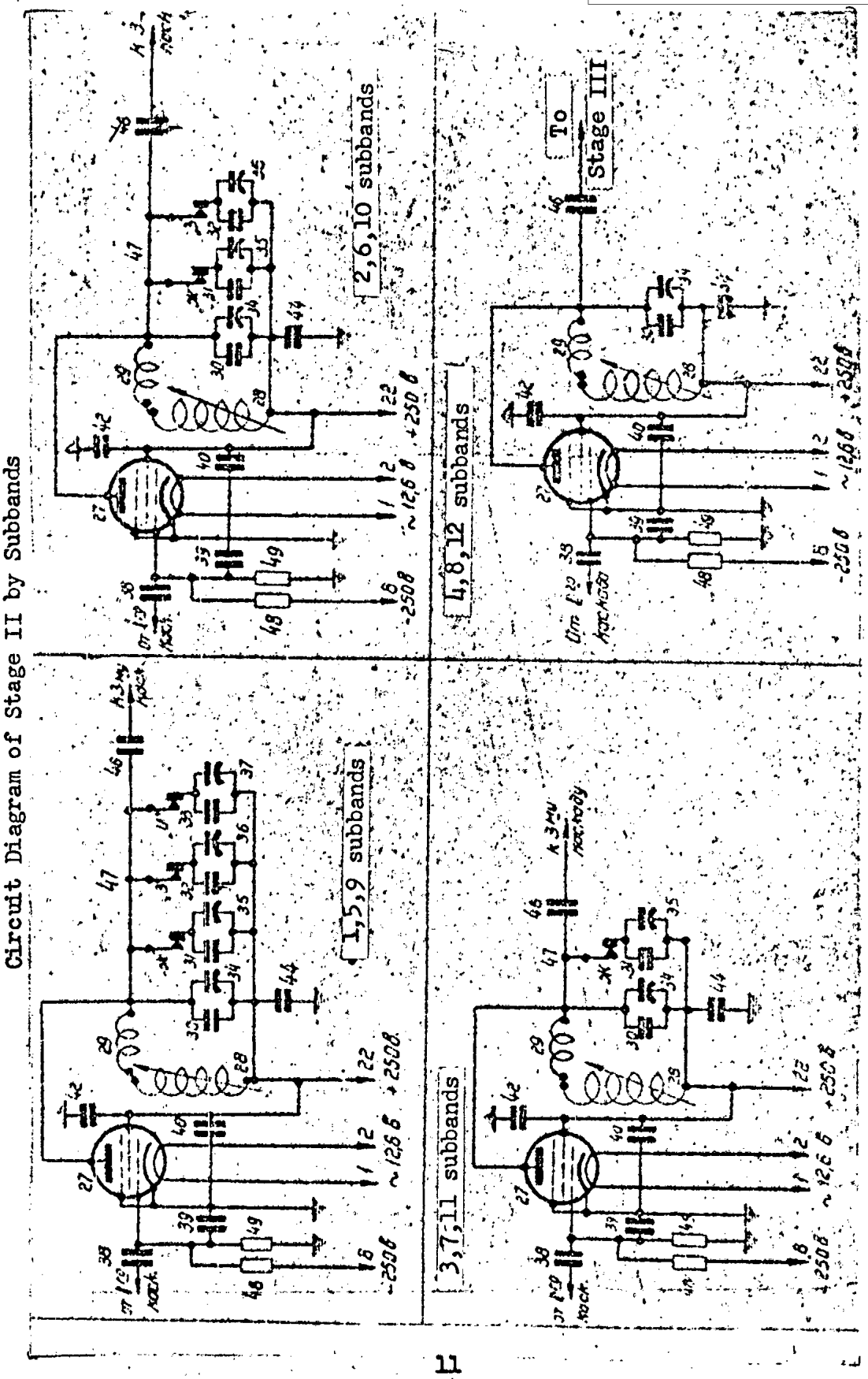

[p 10]

Fig. 5

The driver frequency is controlled by a voltage divider comprising resistors 52 and 53 and connected to the plate of the 2nd stage through capacitor 45. 50X1

Plug-in jacks 79 and 80 are provided in the master assembly for controlling the plate currents of the tubes.

A 220-volt DC current is fed to the thermostat of the master oscil- [p 11] lator (Fig. 6) by means of toggle switch 76. Since blower motor 55 is designed to operate on 110 volts, dropping resistors 56 and 57 are included in its circuit. The power supply to heater relay 67 is from a potentiometer consisting of resistors 58 and 59.

Relay 67 is controlled by mercury thermoregulator 65. The power for heater 63 comes directly from the 220-volt circuit through thermofuse 64 and shunt 61 of signal light 66.

A spark quencher, consisting of capacitors 74 and resistor 62, is connected in parallel with the breaking contacts of the thermostat relay. Blocking capacitor 75 is used for motor noise suppression.

Power can also be supplied directly to the circuits of the heater, blower motor, and heater relay from the DC network (Figure 6a). In this case, the intermediate relay is excluded, and the heater relay is supplied from a potentiometer consisting of resistors 58 and 59. Dropping resistors 56 and 57 are connected to the motor circuit on the inside of the unit.

2. The Third Stage

A GU-50 type tube is used in the third stage of the transmitter (Figures 7 and 8). The plate circuit of the tube is tuned by variometer 92. The capacitances of the tube and trimming capacitors serve as capacitances for the second and third bands of the third stage: capacitor 102 for the second band, and capacitor 103 for the third band. In this case the stage operates as a frequency doubler, generating frequencies of 3 to 6 megacycles in the plate circuit. For the first band the stage operates as an amplifier of the fundamental frequency, for which purpose capacitor 101 and trimming capacitor 107 are connected in parallel to the tube. To adjust the frequency range of the circuit during tuning, trimming choke coils - coil 94 for the first and second bands, and coil 93 for the third band - are connected to the 3rd stage.

A potential of +600 volts from the recifier is applied to the plate of the tube through blocking choke coil 95. The high-frequency component is grounded through capacitor 99.

Excitation is applied to the grid of the fourth stage tube through capacitor 104.

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Master Oscillator Crystal Heating Circuit (ac)

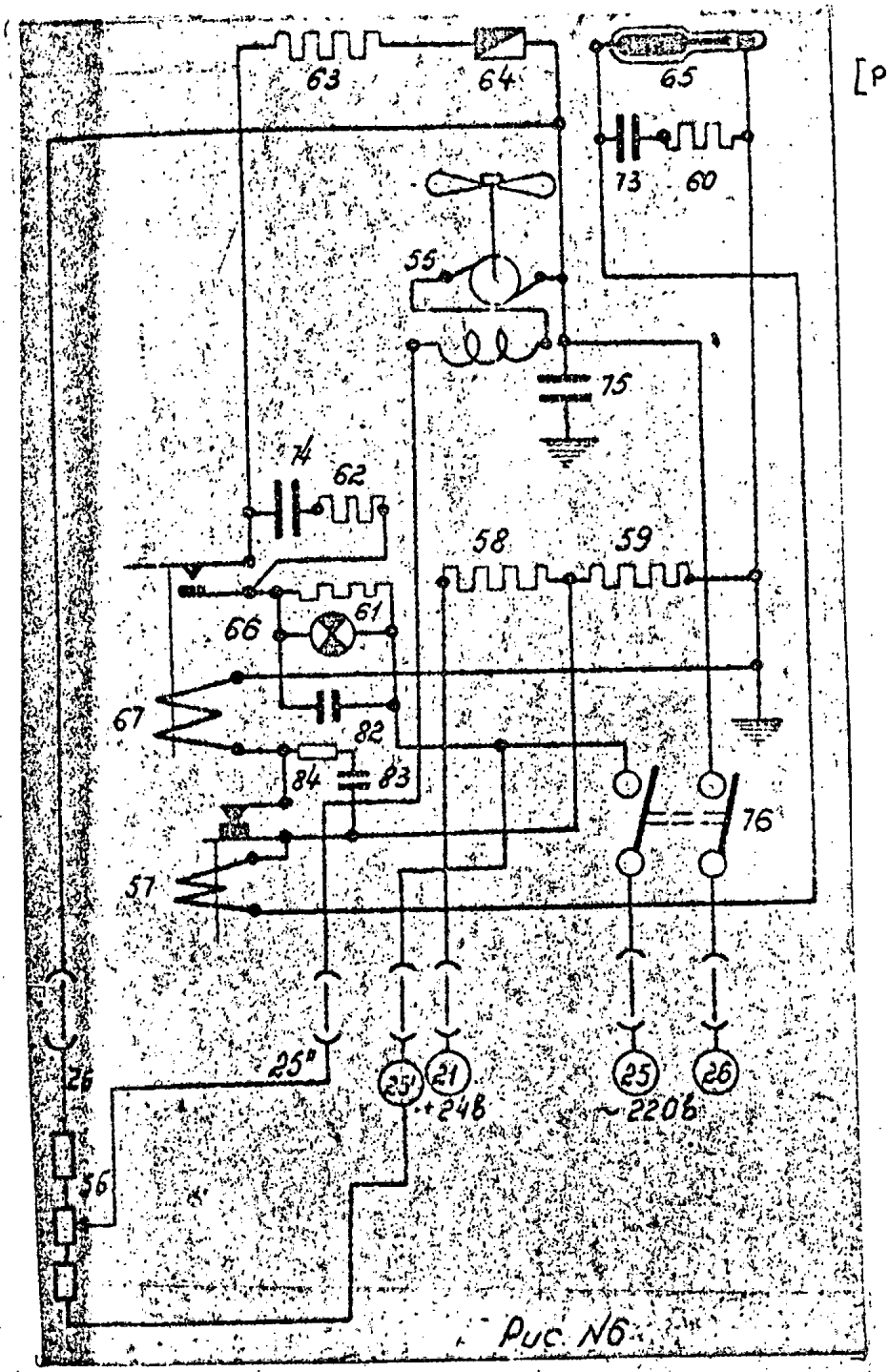

Fig. 6

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[P 13]

Master Oscillator Thermostat Heating Circuit (dc)

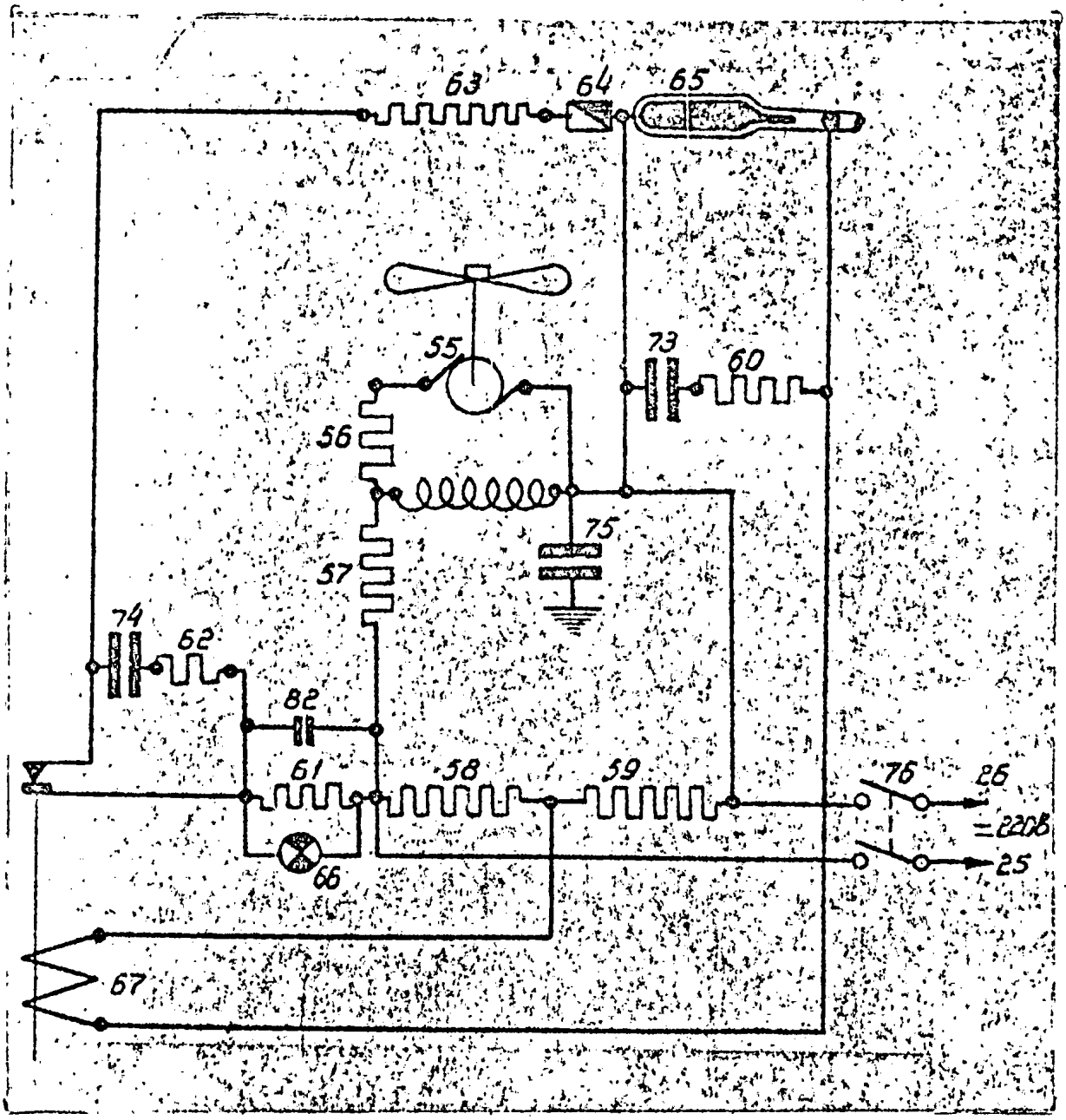

Fig. 6a

[P 14] 50X1

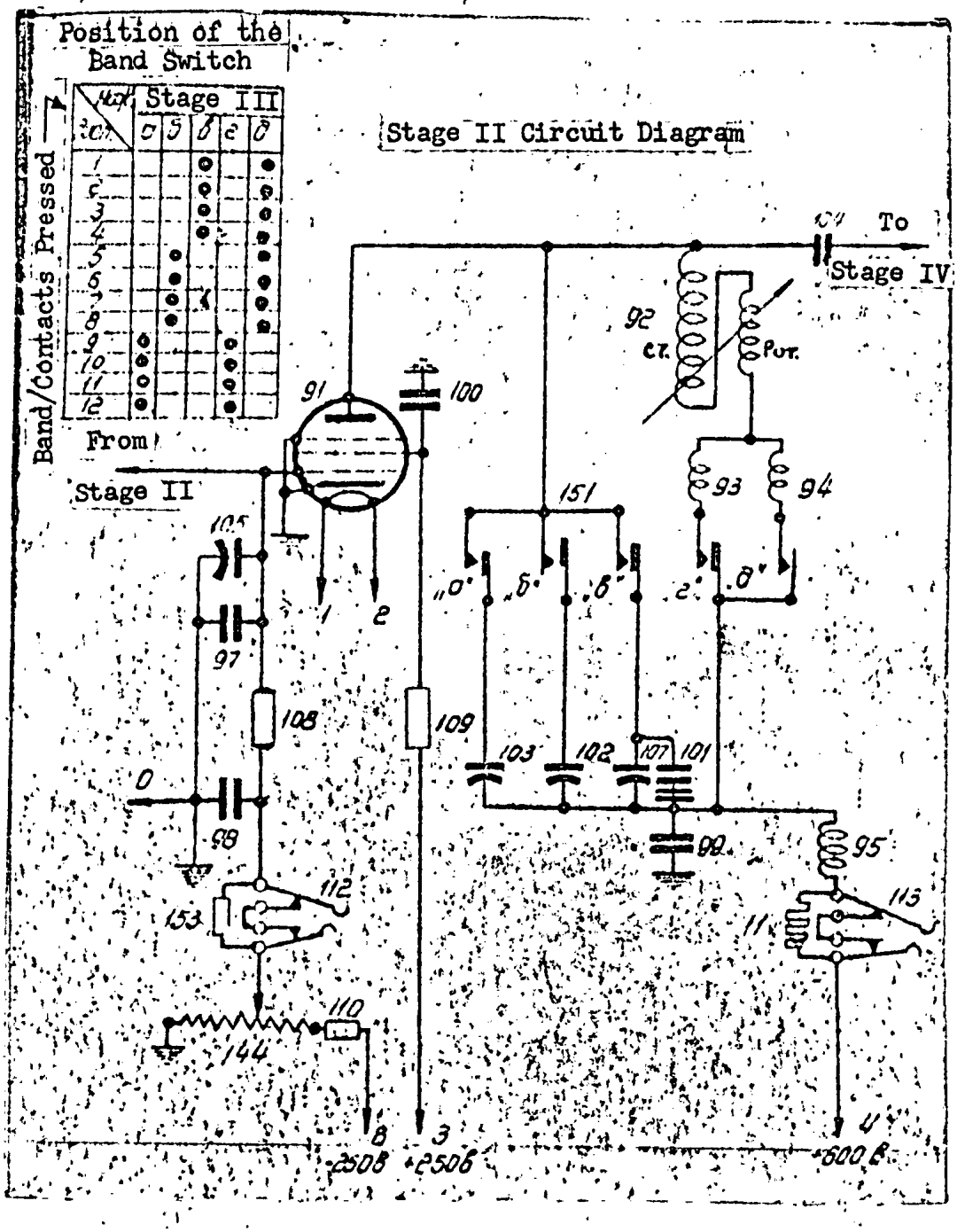

Fig. 7

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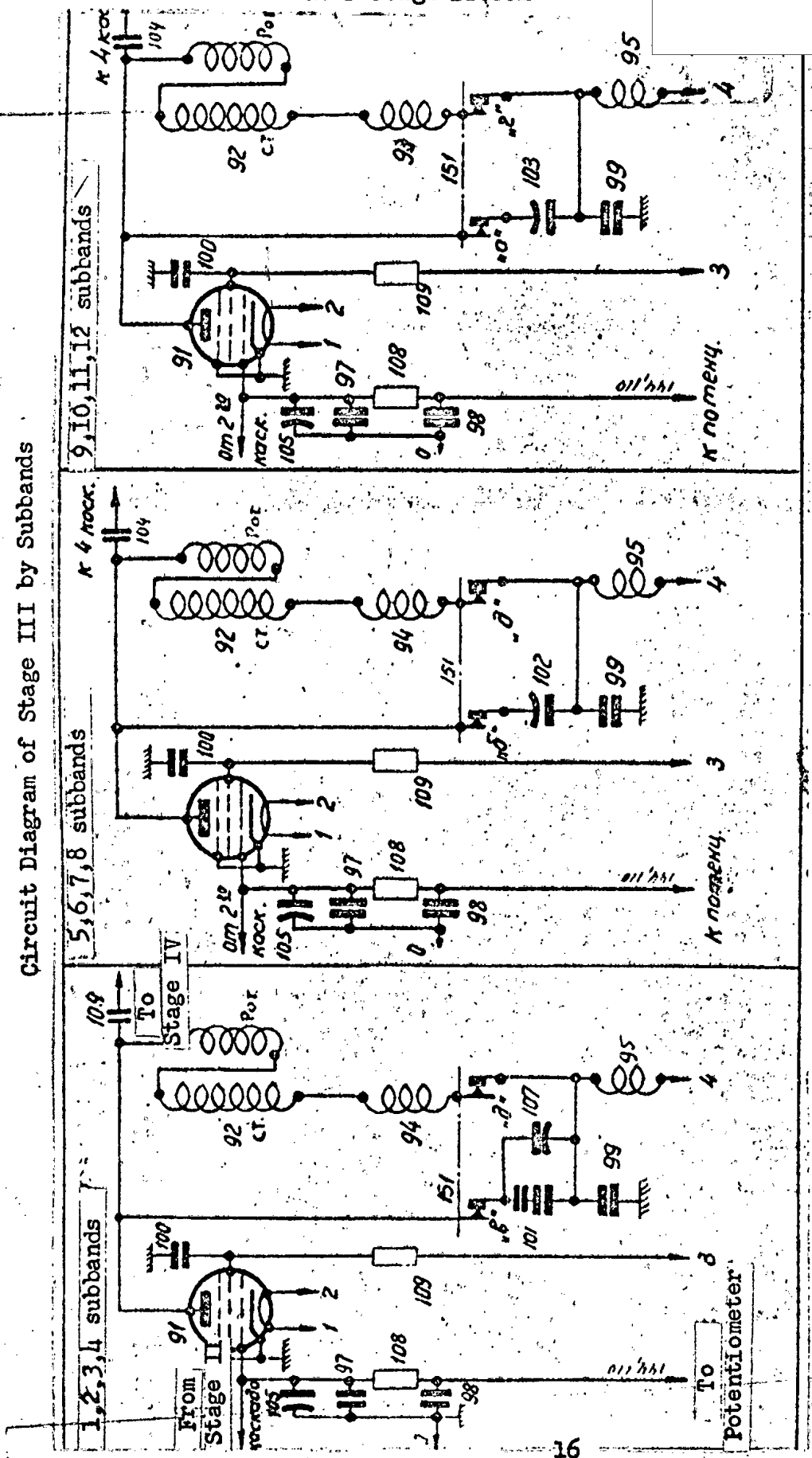

Circuit Diagram of Stage III by Subbands

Fig. 8 [p 15]

The necessary switching in the circuit is done by means of switch 151. The bias on the control grid of the tube is obtained from potentiometer 144 - 110. 50X1

In the circuit of the control grid is resistor 108 which provides a certain bias potential as a result of the grid current.

The screen grid of the tube is fed through resistor 109 from the screen grid rectifier, from which the high frequencies have been blocked out by capacitor 100. Plug-in jacks 112 and 113 are provided for controlling the plate and grid currents of the tube.

3. The Fourth Stage [p 16]

Two GU-50 type tubes, connected in parallel, are used in the fourth stage of the transmitter (Figures 9 and 10).

The fourth stage serves as an amplifier of the fundamental frequency for the first and second bands and as a doubler for the third band.

Voltage is applied to the control grids in the tubes of this stage from the preceding circuit through decoupling capacitor 104. The fixed bias voltage from potentiometer 144 - 110 remains constant for the entire range of operating frequencies of the band.

Resistor 145 adds a certain DC potential obtained from the grid currents. As the voltage increases, the grid currents increase and, consequently, the self-bias in the resistor also increases. The grid bias circuit is blocked by capacitor 122.

The plate circuit of the fourth stage is tuned by a variable self-inductance comprising two variometers 116 and 117.

The variometers for the first and second bands are connected in series; the variometers for the third band are connected in parallel.

Besides the switching of the variometers, there is also a change of capacitance in the circuit whenever there is a shift in frequency bands.

The initial capacitance of the circuit and the capacitance of trimming capacitor 127 serve as the capacitance of the circuit for the third band; and the capacitance of trimming capacitor 129 for the second band. For the first band, capacitors 137 and 138 are connected in series, and variable capacitor 128 is connected parallel to them.

The use of trimming capacitors and trimming inductances 118 and 119 for the first and second bands and 119 for the third band makes it possible to gang-tune the circuit of the fourth stage with the third stage of the transmitter.

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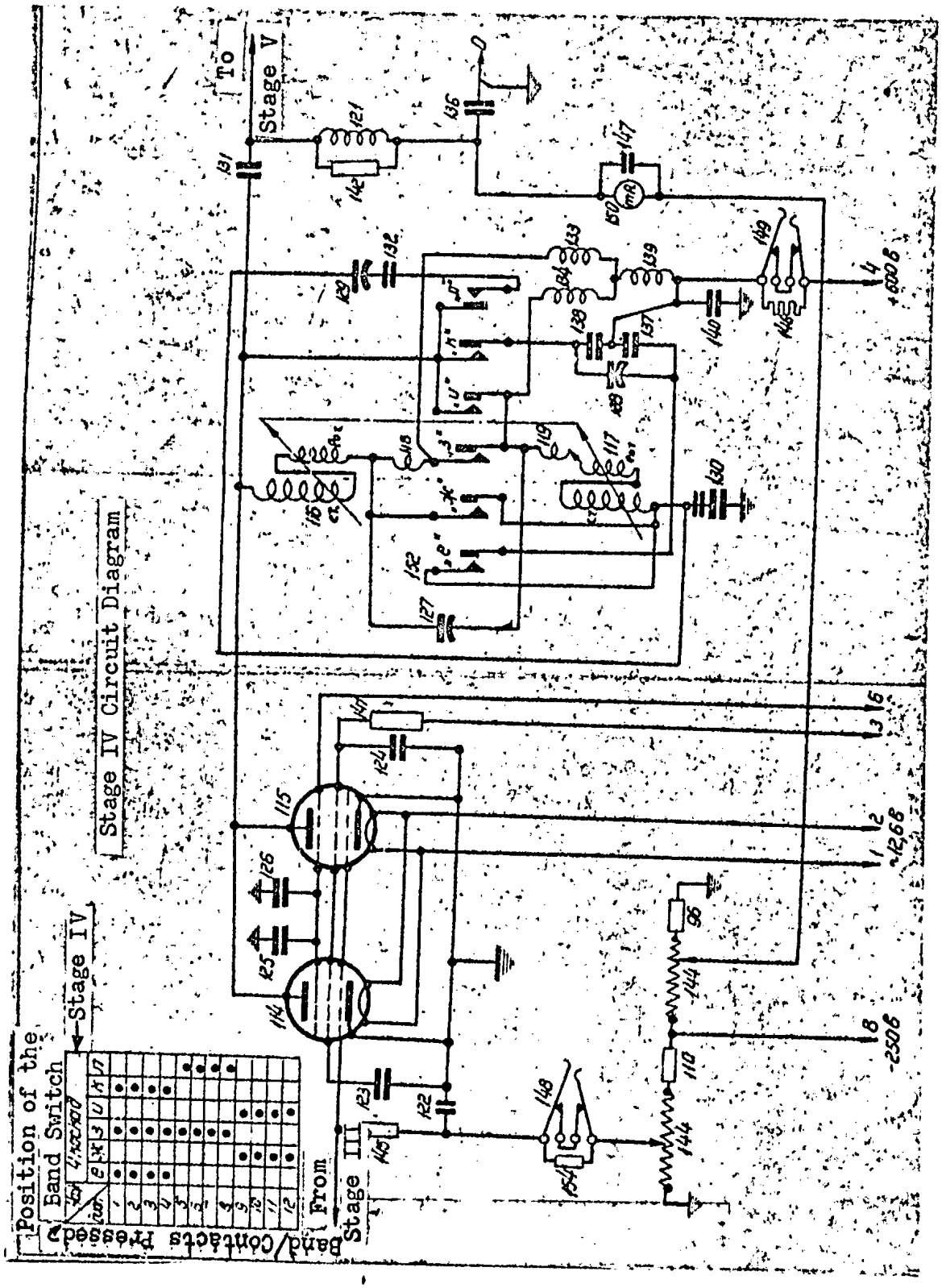

Fig. 9 [P 17a]

Circuit Diagram of Stage IV by Subbands

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From Stage III

To Stage V

[p 18]

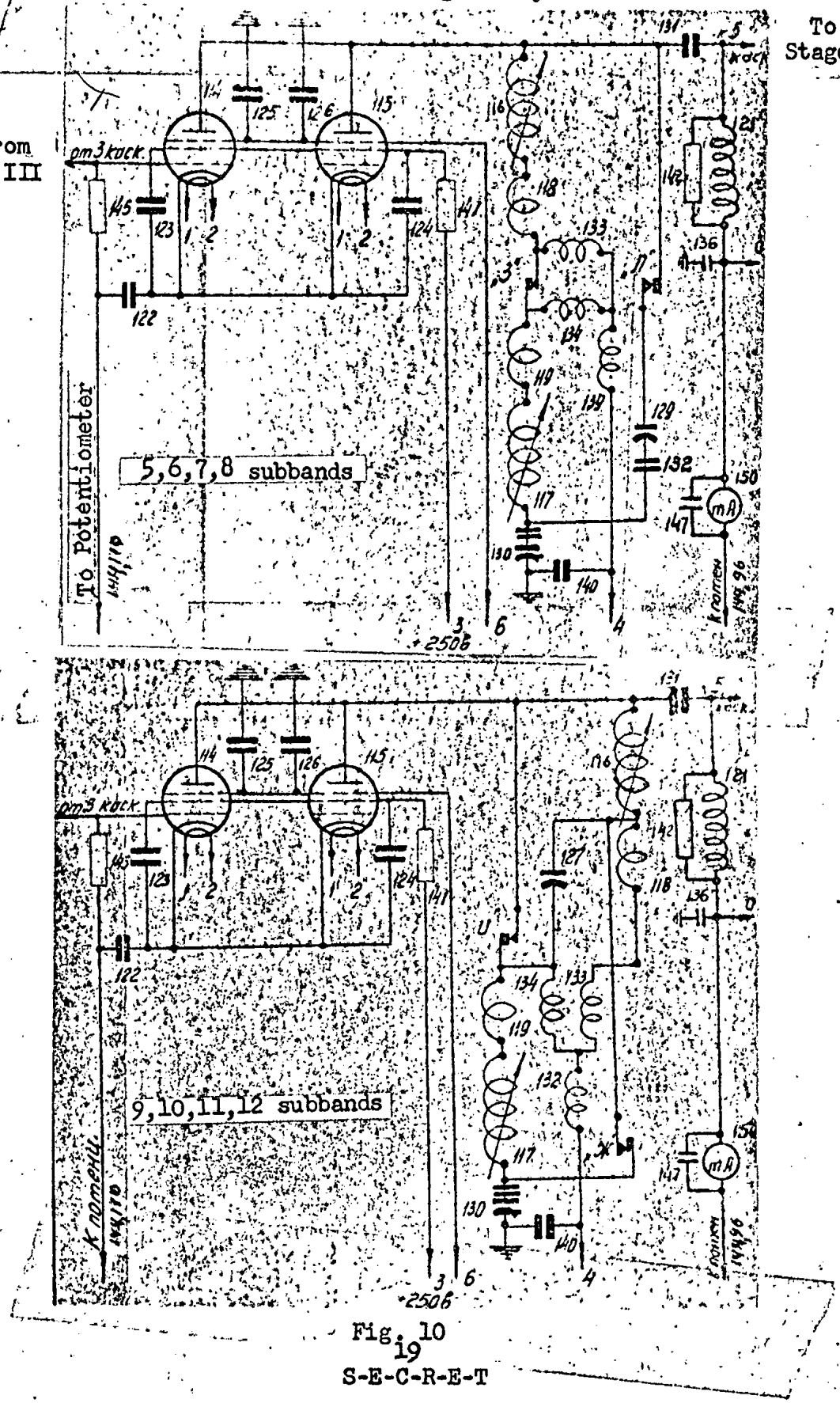

Fig. 10

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[p 18]

Circuit Diagram of Stage IV by Subbands

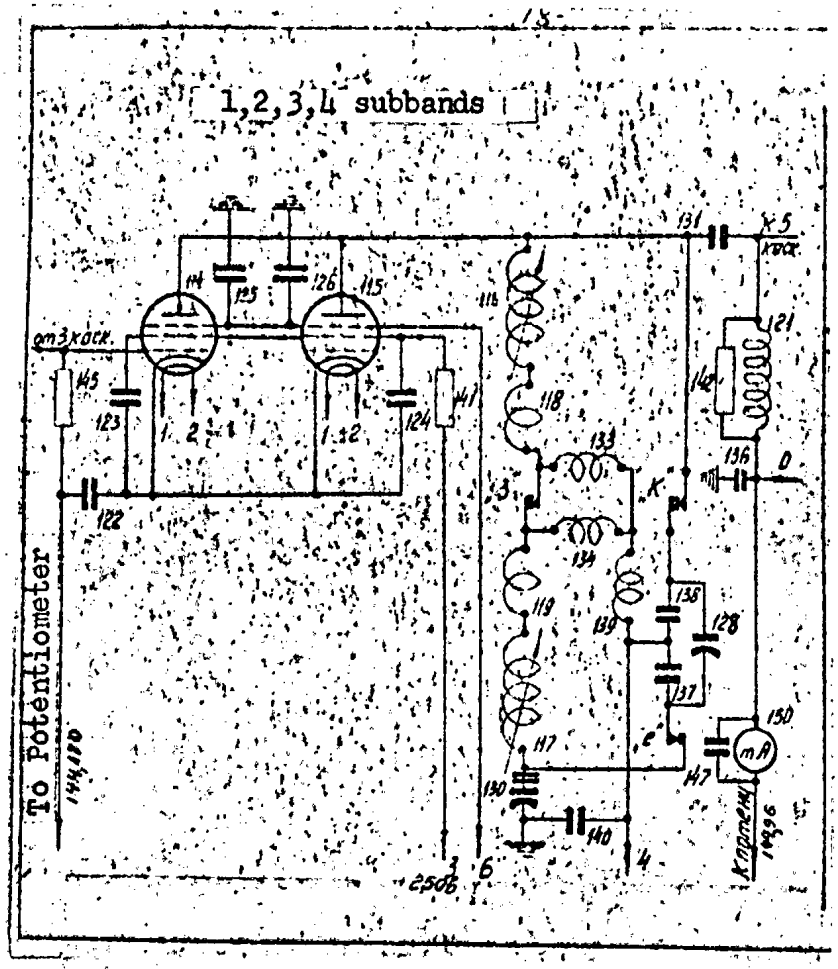

Fig. 10

A +600-volt potential from the rectifier is applied to the plates of the tubes through blocking choke coil 139. The high-frequency component is grounded through capacitor 140. 50X1

The screen grids of the tubes are fed from the screen grid rectifiers through resistor 141, and the high-frequency components are grounded through capacitors 123 and 124.

Voltage is supplied to the control grids in the tubes of the power stage through capacitor 131.

121 is a blocking choke coil.

Plug-in jacks 148 and 149 are provided in the circuit for controlling the grid and plate currents of the tubes.

The necessary switching in the circuit is done by means of switch 152.

4. The Fifth Stage [p 19]

The fifth stage (Figures 11 and 12) is the final stage of the transmitter and operates in the antenna circuit.

Two GU-80 pentodes, connected in parallel, are used as oscillator tubes.

The control grids of the tubes are coupled to the circuit of the fourth stage through separating capacitor 131.

Bias voltage is fed from potentiometer 144, 96 through grid choke coil 121.

Resistor 142, bypassing the choke coil, is used to improve the damping of the grid circuit of the 5th stage. This prevents self-oscillation. 136 is a blocking capacitor.

The use of tubes in the power stage with steep characteristic curves makes it necessary to take a number of measures to eliminate the possibility of self-oscillation in the stage, operational as well as parasitic.

This is attained by:

1. Careful mounting.

2. Including anti-parasitic resistors 205 and 206 and choke coils 163 and 164 in the control grid circuit.

3. Using - in addition to the ordinary capacitors - capacitors 186, 187, 188, and 189 to block the filaments of the screen and suppressor grids; capacitors 184, 185, 192, and 193 to block the upper and lower outputs of the suppressor grid; capacitors 182 and 183 of special non-inductive

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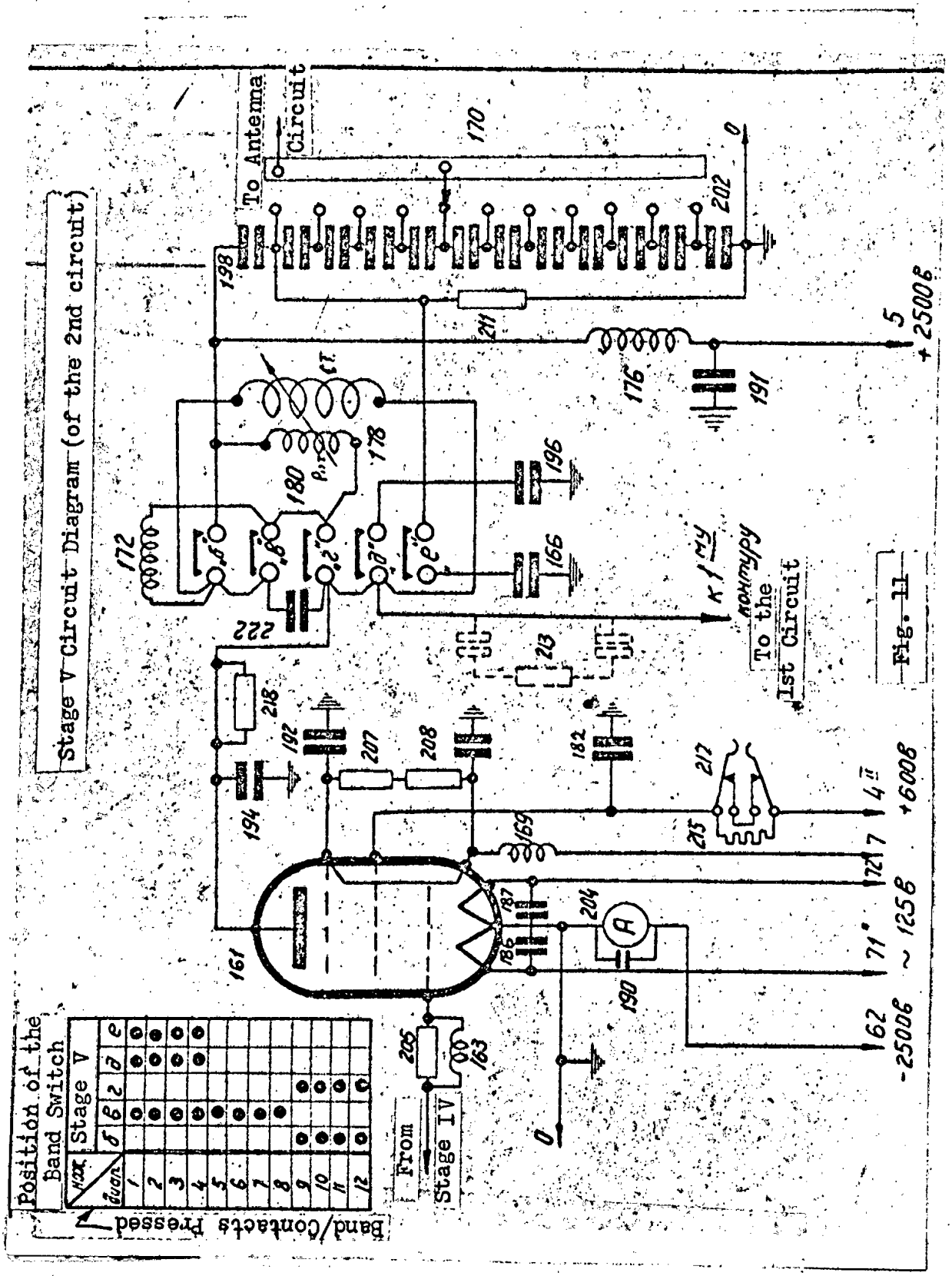
[p. 20]



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[p. 21]

Circuit Diagram of Stage V by Subbands (of the 2nd circuit)

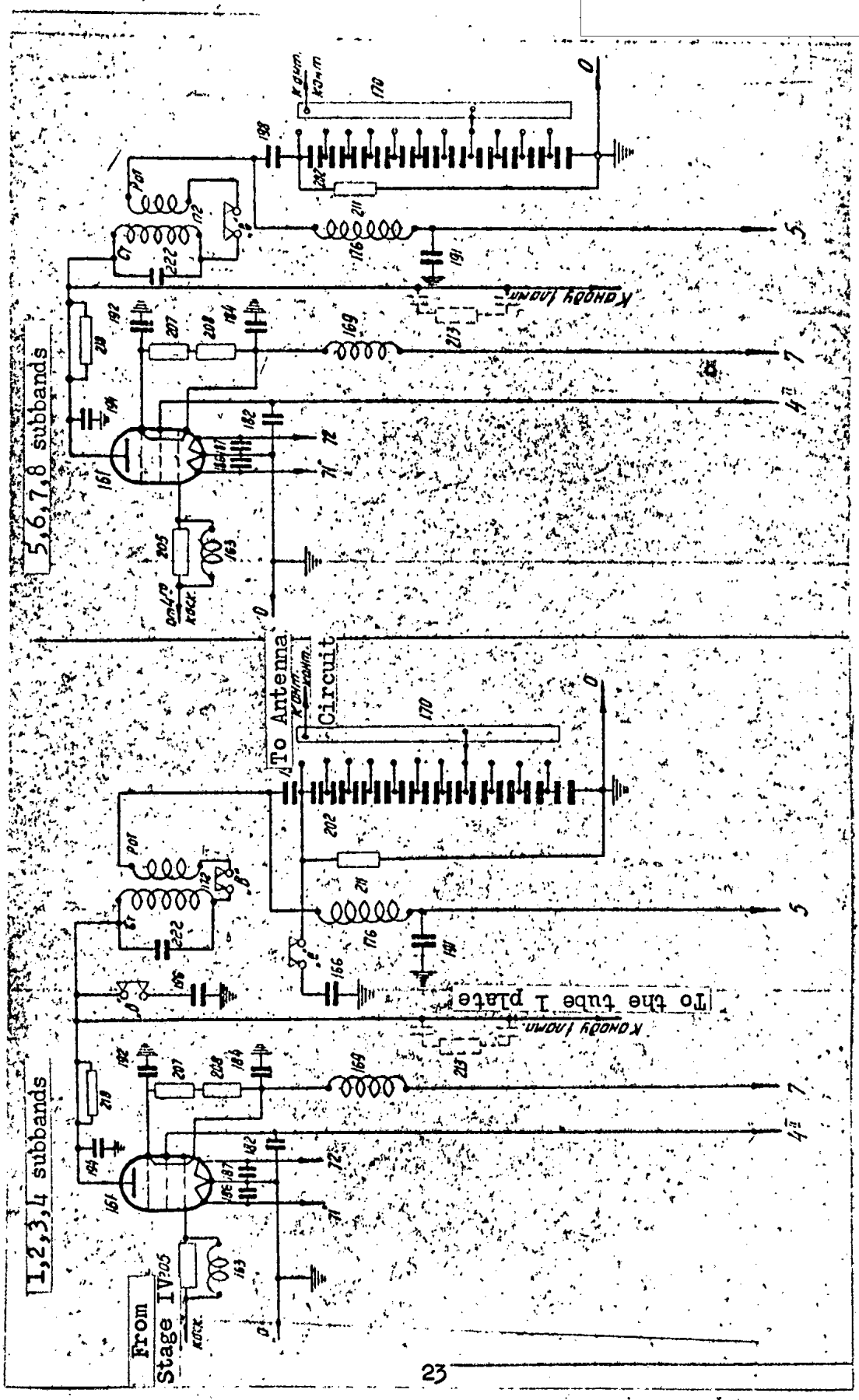

Fig. 12

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[p. 21b]

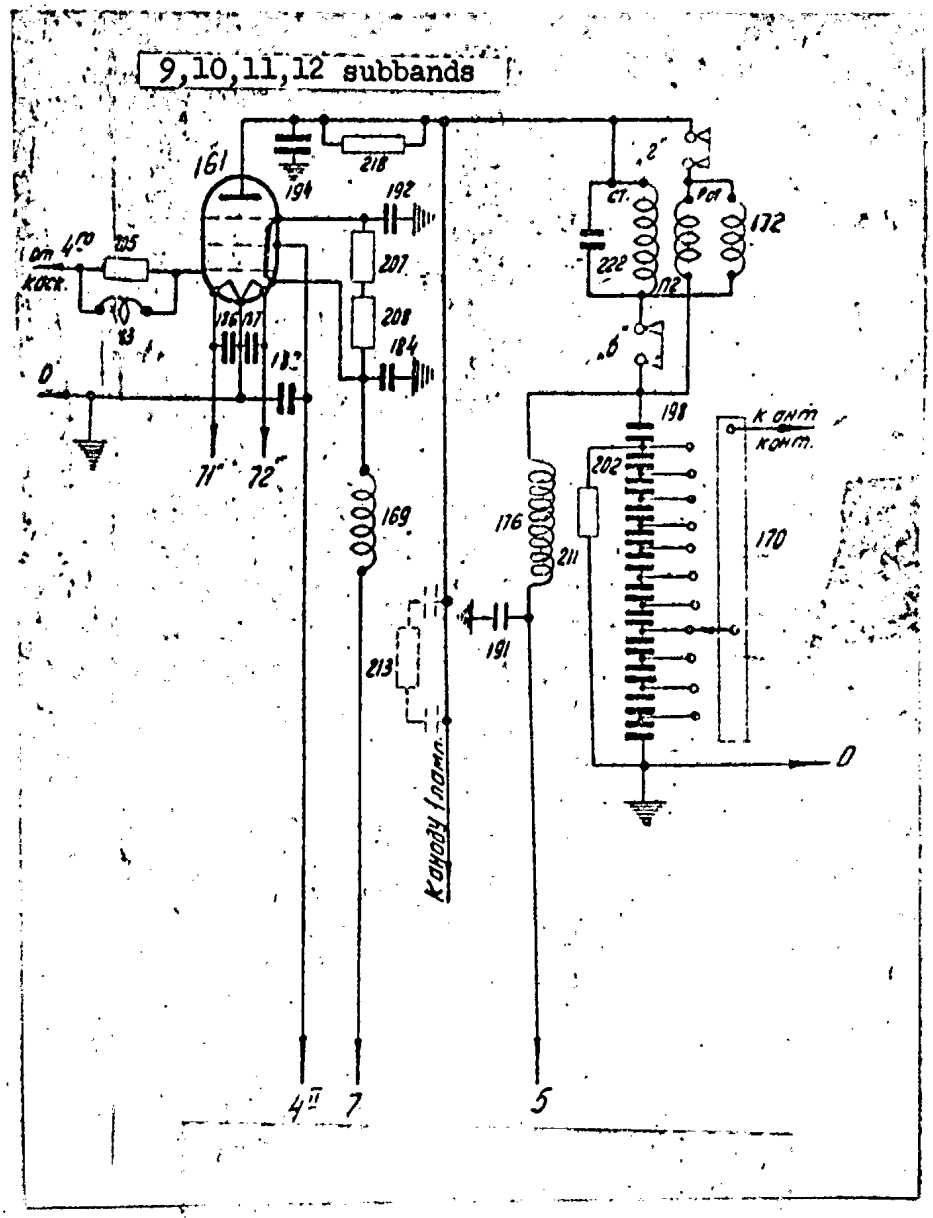

Fig. 12

construction, situated in the immediate vicinity of the electrodes of the tubes, to block the screen grid; capacitors 174, 175, 200, and 201 to block the filament; capacitors 165 and 167 to block the suppressor grid; and capacitors 172 and 173 to block the screen grid. 50X1

4. By shunting the bus bar connecting the upper output of the suppressor grid to the cathode by means of resistors 207, 208, 209, 210, and 221, thus increasing its damping of the VHF frequencies.

A plus-600-volt current is supplied to the screen grids of the tubes through resistors 333 and 334, which serve to limit the screen grid currents.

The suppressor grids in the tubes of the fifth stage, operating in the telegraph mode at 100% power, are grounded through blocking choke coil 169. In the telephone mode a negative bias of 170 to 180 volts is applied to them.

Power is supplied to the pentode grids by means of a "Mode of Opera- [p 22] tion" switch situated on the control panel of the transmitter.

Plug-in jacks 216 and 217 are provided for controlling the screen grid currents. Since the shunts for the milliammeter are soldered to the plug-in jacks in all stages of the transmitter - with the exception of 112 and 148, it is necessary to multiply the readings of the portable instrument by a factor indicated on the frame next to each jack.

The control grid current of the fifth stage is regulated by instrument 150, blocked by capacitor 147.

The tuning and loading of the fifth stage is regulated by instrument 204, blocked by capacitor 190.

The circuit of the power stage is series-connected. A plus-2500-volt current is applied from a rectifier to the plates of the tubes through blocking choke coils 176 and 177. 191 is a blocking capacitor.

Two oscillator circuits, operating in parallel, are connected to the plate circuit of the tubes. The circuits consist of variometers 178 and 179, capacitive potentiometers for coupling with antennas 202 and 203, and the capacitances. For the first and second bands, the stator and rotor of each variometer are connected in series; for the third, in parallel.

The capacitance in the circuit changes whenever the transmitter shifts frequencies or the variometer windings are switched.

For the second and third bands the capacitance of the circuit consists of capacitive potentiometers for coupling with antennas 202 and 203 and capacitors 194 and 195 connected in series in each arm.

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For the first band, capacitors 196 and 197 are connected in parallel to capacitors 194 and 195; and to preserve the electromotive force of the coupling, capacitors 166 and 168 are connected in parallel to each potentiometer 202 and 203.

For all bands, capacitors 222 and 223 connected in parallel to the stator of the variometers serve as trimming capacitors.

198 and 199 are blocking capacitors.

All circuit switching is done with switch 180, 181.

The fifth stage for all three bands operates in the amplifying mode, ensuring coverage of frequencies from 1.5 to 12 megacycles. The degree of coupling of the power stage with the antenna is varied by means of 11-position switches 170 and 171.

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[p. 23]

Circuit Diagram of the Antenna Circuit

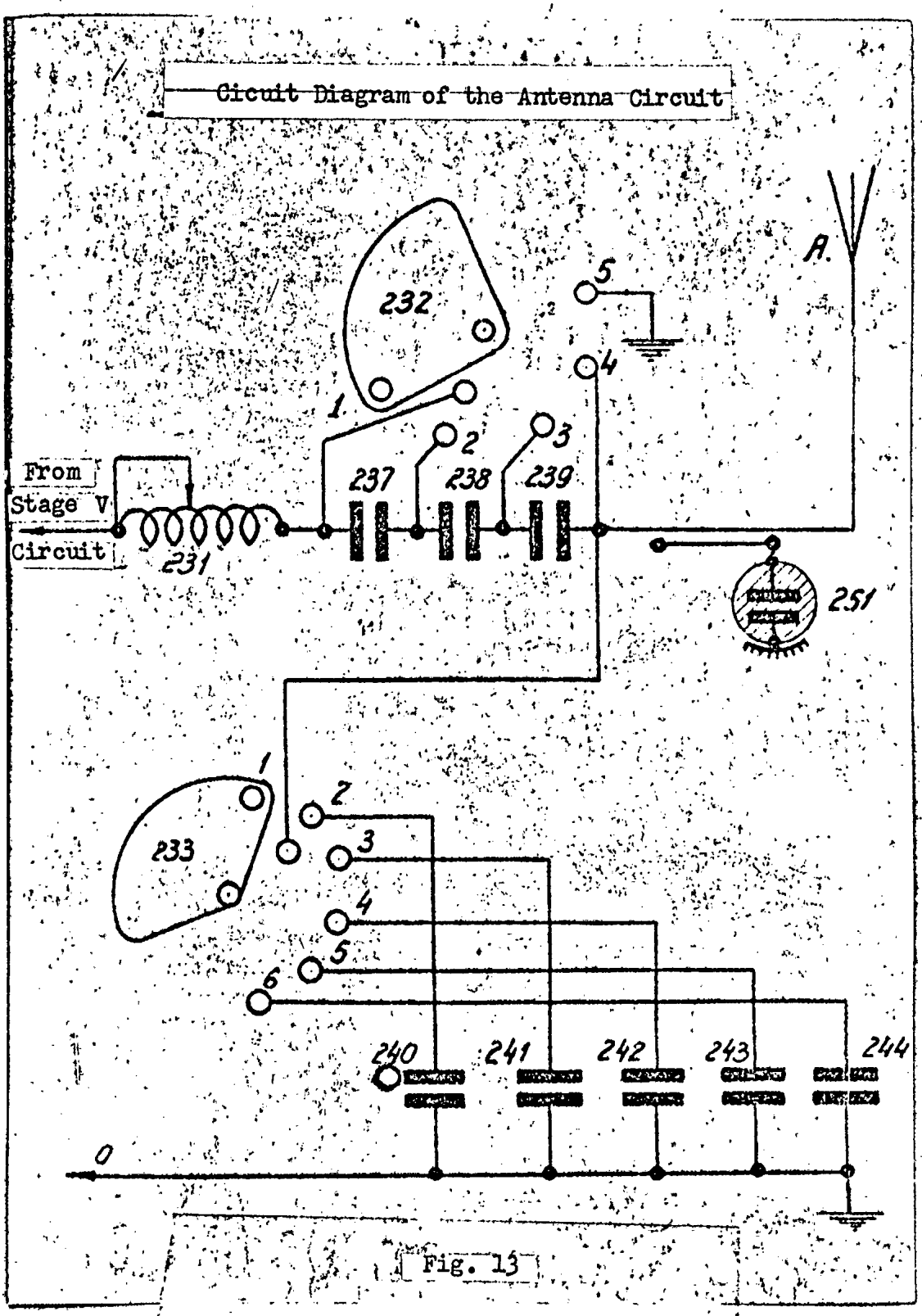

Fig. 13

5. Antenna Circuit

[P 24]

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The antenna circuit is coupled to the intermediate circuits through capacitive coupling potentiometers which provide step coupling adjustment.

It is known from the theory of antennas that the equivalent resistance of an antenna operating in a wide frequency range on wavelengths that are shorter than that of the natural frequency attains rather large values at certain points of the frequency range. It is well known that for balancing an antenna, whose natural wave length is greater than the operating wave of the transmitter, it is necessary to resort to a "shortening" of the antenna wave through the use of a series-connected capacitor.

Both theory and experience indicate that with such a circuit it is impossible to obtain normal coupling between the antenna and the circuit and, consequently, a normal antenna power, because the necessary coupling value may be very large and technically impracticable.

In this case a parallel antenna feed is used where the capacitance is connected in parallel to the antenna input. Such a hookup makes it possible to transmit normal power to the antenna with relatively weak couplings.

Thus the antenna circuit (Figure 13) provides both series and parallel antenna feed circuits. One or the other circuit connection is obtained by means of multiway switches for series-connected or parallel-connected capacitors.

Multiway series-connected-capacitor switch 232 has 4 positions and makes operation possible without a shortening capacitor - position 4, or with 400-micromicrofarad shortening capacitors - position 3, or with two shortening capacitors (400 and 150 micromicrofarad) - position 2, or with three series-connected capacitors (400, 150, and 40 micromicrofarad) - position 1.

The 233 multiway switch connects parallel-connected capacitors 240, 241, 242, 243, and 244 for parallel antenna feed.

If a simultaneous connection of parallel-connected and series-connected capacitors is used, then the parallel capacitance determines primarily the antenna coupling value and thereby the resistance introduced into the antenna circuit. In this case, the series-connected capacitors control the tuning of the antenna circuit.

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[p. 25]

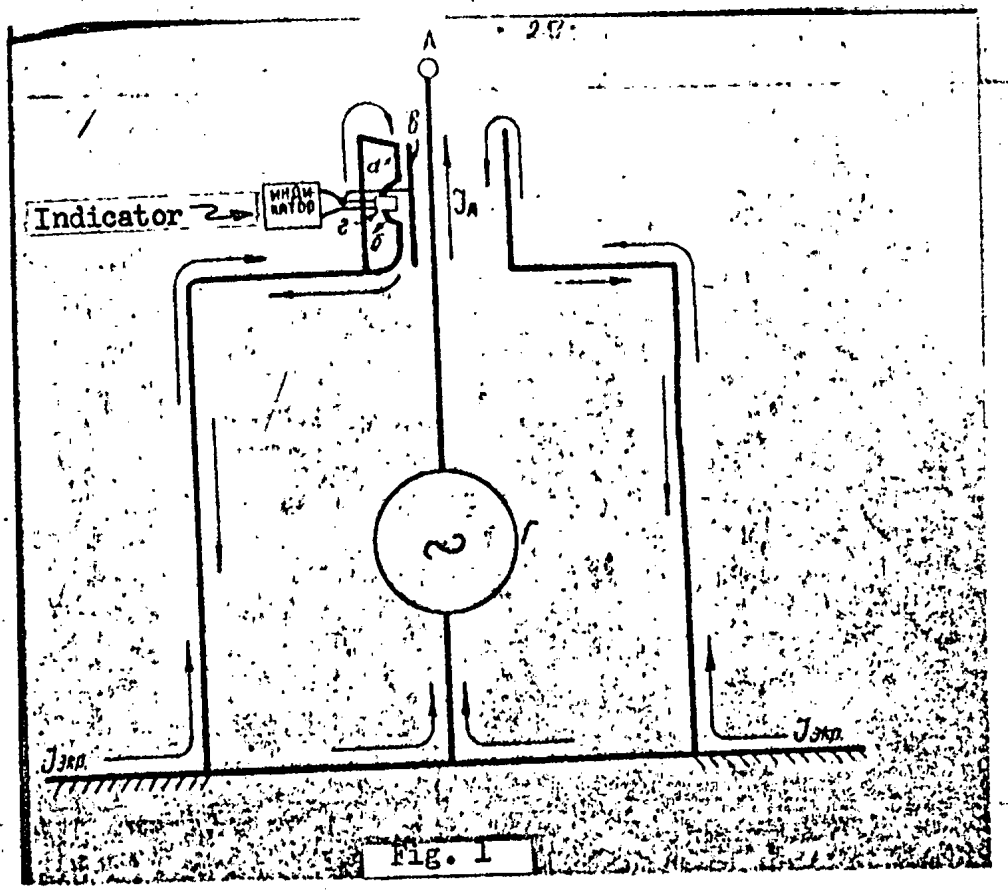


Fig. 1

[p 26]

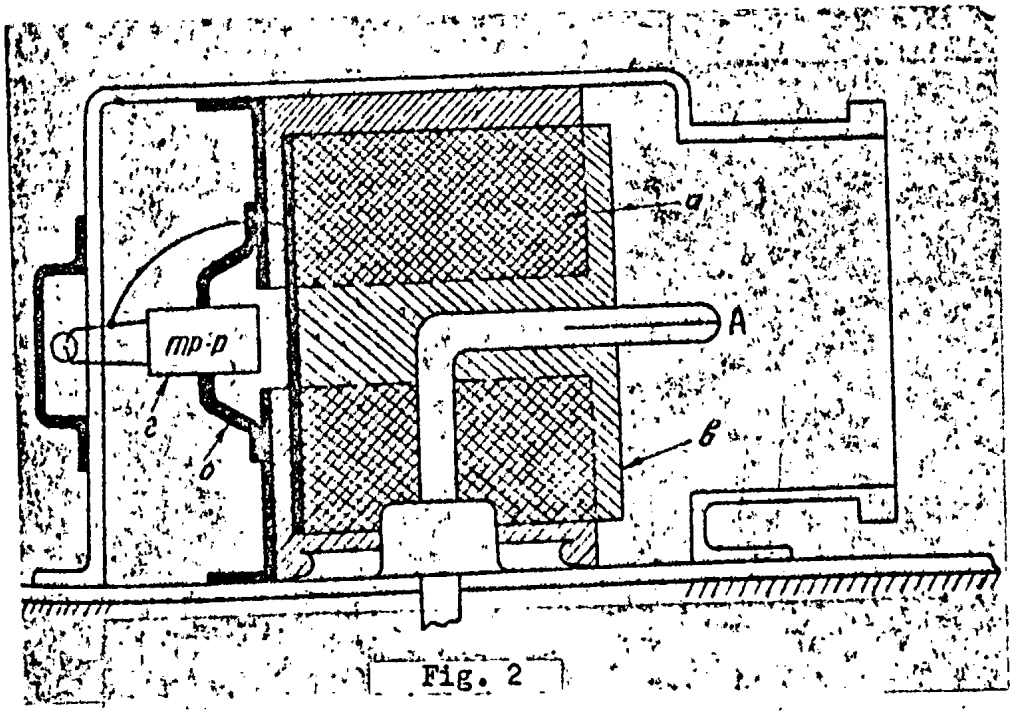


Fig. 2

Antenna Tuning Indicator

50X1

The antenna tuning indicator, used in the transmitter, provides a tuning control of the transmitter for various types of antennas with widely varying parameters.

The principle on which the indicator operates is clearly shown in Figure 1, which schematically describes the high-frequency generator "G" placed in a grounded shield (chassis). [P 27]

When the antenna is connected to the lead-in "A", current will be passing through it and create around the antenna an electrical field which is shortcircuited to the ground. Consequently, currents will flow from the ground through the shield (transmitter chassis) to the lower pole of the high-frequency oscillator, as indicated by arrows in Figure 1.)

If, along the path of the current flowing through the transmitter shield (at the antenna lead-in), a shunt is placed ("a" - "b") in form of a primary winding of the current transformer, then part of this current will branch off into this shunt and induce in the secondary winding of transformer "G" an electromotive force of high frequency. This electromotive force is supplied to tube detector 351 of the antenna indicator, and the rectified current passing through milliammeter 234 will cause deflection of the instrument needle. Furthermore, if an insulated (from the chassis) metal plate "v" is placed in the antenna lead-in and connected to tube detector 351, then the electromotive force created by the capacitive coupling of plate "v" with the current-carrying rod of lead-in A will be supplied to the tube detector; and the rectified current passing through the milliammeter will cause a deflection of the instrument needle.

Thus, as a result of the current in the shield (of the primary winding in the current transformer) and of the capacitive coupling of the plate with the current-carrying rod of the antenna lead-in, two electromotive forces are supplied simultaneously to the tube detector. When a heavy current flows in the antenna, the dominant response of the antenna indicator will be to the current in the shield (at this time the current in the shield and the primary winding of the current transformer will be greatest) - "current" activated.

With a weak current (large resistance) in the antenna, the dominant response of the antenna indicator is to the capacitive coupling of the plate with the current-carrying rod, which at this time would be under high voltage - "voltage" activated.

With average currents in the antenna, the antenna indicator is both "current" and "voltage" activated.

Thus, the antenna indicator provides easily read off deflections of the instrument needle during tuning of antenna with widely varying parameters.

Design

[no page 28 in original]

50X1

[P 29]

Coupling elements of the antenna indicator are located in the antenna lead-in, and are in a form of two cylindrical copper plates, Figure 2. The first plate "a" ("current") is cut horizontally into two halfs and the adjoining sides are connected with a copper pipe ("b"), which serves as the primary winding of the current transformer. The upper end of one of the semicylinders and the lower end of the other are secured (with a good electric contact) to the wall of the lead-in.

The second "v" plate ("capacitive") is insulated from the lead-in and is connected by a conductor to the secondary winding ("g") of the current transformer. The antenna indicator circuit, incorporating a 6A7 tube, is located in a separate shielded box placed on top of the transmitter housing next to the antenna lead-in. The instrument (milliammeter M-52 0-1 ma) is located on the front panel 4 of the transmitter unit. Located in the same place under the instrument is a toggle switch of the type 631-84, used for selecting sensitivity of the indicator (the instrument dial).

Description of the Antenna Indicator Circuit

The antenna indicator circuit is given in Figure 3.

The electromotive force (voltage) taken from the coupling elements of the antenna indicator is supplied to the plate of the 6A7 tube 351.

The cathode of this tube is connected through milliammeter 234 to the low-voltage end of the current transformer. The plate current passes through the milliammeter, causing deflection of the instrument needle.

To obtain higher transconductance of the plate current, voltages of 24 - 30 volts are supplied from rectifier terminal 21 to screen grids 2, 3, and 4.

Capacitors 352, 353, 354 and 355 are blocking capacitors. Grids 1 and 5 are connected to the cathode of the tube.

Neutralization of the residual tube current is done by the reverse current from the 24-30-volt source and is controlled by potentiometer 357. Resistor 356 prevents shunting of the instrument by the reverse current circuit.

During large emf outputs (at high currents and voltages in the antenna) resistor 246 cuts into the plate circuit of the indicator tube, which decreases the steepness of the plate current characteristic and reduces the indicator instrument reading.

With small emf inputs (at weak currents or voltages in the antenna) resistor 246 is short-circuited by switch 245, and the reading of the indicator instrument increases. 50X1

In the "M" (less sensitive) position of the switch the resistor is connected to the tube plate, and in position "B" (more sensitive) the resistor is disconnected.

Thus is the sensitivity of the antenna indicator varied (the value of the scale division is changed).

In addition to that, a neon light, which serves as an auxiliary indicator of antenna circuit tuning, is installed in the antenna circuit of the transmitter.

Because the transmitter may be used with various antennas, the selection of coupling of the lamp with the circuit must be made at the installation site at the time of the adjustment of the tramsmitter. [P 30]

The voltage in the antenna circuit varies widely along with the frequency range, and therefore, the glow of the lamp at different points of the range will also vary, and at some points, where the voltage is small, the lamp may not glow at all.

6. Frequency-Modulated Driver

The main purpose of the driver (Figure 15) is to "deviate" the frequency of the quartz heterodyne by introducing into the circuit a crystal choke 265, which lowers the frequency of the generated oscillations; the higher the inductance introduced, the greater the departure or deviation of the frequency.

By changing the inductance of the quartz circuit, specifically by connecting choke 265 and disconnecting it, it is possible to vary the frequency of generated oscillations within the required limits.

The driver consists of the 6Zh7 tube 262.

The quartz, inserted between the control grid and the screen grid, is under relatively light load (the oscillating voltage of the quartz is of the order of several volts).

The high-frequency component of the screen grid is grounded. The plate circuit, coupled to the generator section by electron flux, contains resistor 285. In the cathode circuit is place choke 278, which is shunted by capacitance 279.

The grid circuit contains grid leak - resistor 248, and capacitors 283 and 324. The basic elements determining the generated frequency, - quartz 263, trimming capacitor 264 and frequency deviation choke 265, are located in a special unit "Kh".

50X1

[p. 33]

Element 5 Crystal Heating Circuit Diagram (ac)

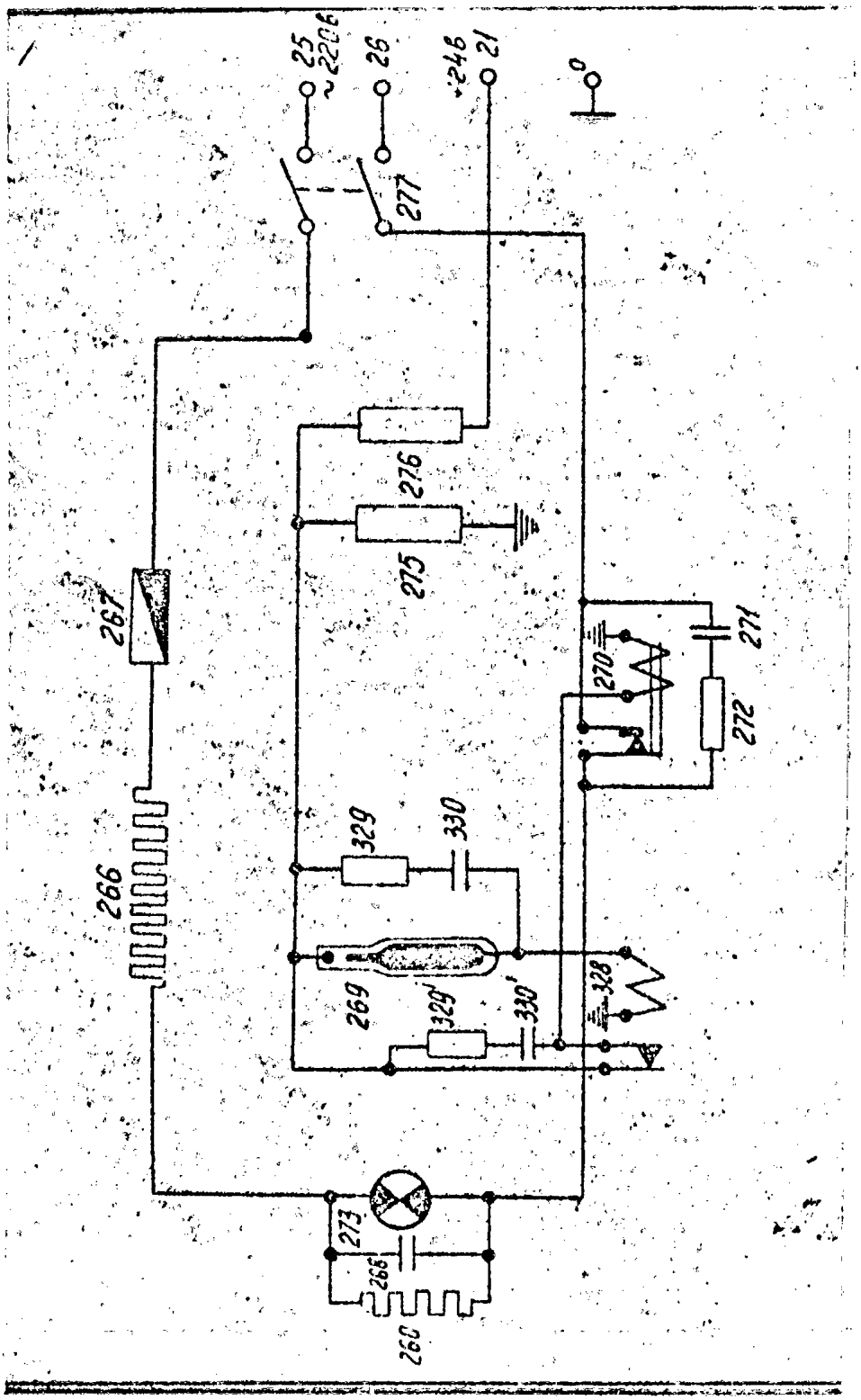


Fig. 15a

At the input of the frequency-modulated driver there is a tube relay, which consists of two 6N7S tubes 287 and 290, and is employed for matching the driver input with the output circuits of telegraphs ST-35 and Bodo. Polarized relay 298 (type TRM-43A), the contacts of which open and short-circuit frequency-deviation choke 265, operates with the assistance of the tube relay and in accordance with telegraph current pulses. 50X1

At the output of the driver is a GU-50 amplifier tube 300. The plate of this tube is connected, through the contacts of relay 23 in the first unit, to the plate of the continuous-range master oscillator. Relay 23 is controlled by means of "Mode of operation" switch 261.

[Pages 31, 32 and 34 are missing]

In the DC current supply version (Figure 15b), the power fed to the heater and relay circuit is taken directly from the DC power line. [P 35] In this case the intermediate relay is excluded, and the heater relay is fed from the potentiometer, consisting of resistors 275, 276 and 328.

7. Modulator

(Circuit Diagram R-97562)

The basic circuits of the modulator (Figures 16, 17) include tube 2 (microphone input amplifier with a self-adjusting amplification factor), tube 20 (voltage amplifier), and tube 21 (output power amplifier).

To the basic circuits belongs also tube 56, which serves as a rectifier of the self-adjusting percentage-modulation circuit.

A 6A7 is used as input tube 2.

The audio signal is supplied from the inset of the MK-3 microphone to contact "101" of the modulator terminal block and fed to the primary winding of microphone transformer 1. The other end of the primary winding goes through terminal block contact "102" to switch 77 on the control panel, from where it returns through contact "112" to modulator relay winding 65, the other end of which goes through contact "111" and, after filtering, terminates in + 24 volts. This provides microphone current. When the microphone is removed from the lever, the following take place simultaneously: high-voltage is switched on, current is supplied to the microphone and (from the microphone current) relay 65 operates, switching the transmitter to the telephone mode.

The secondary winding of the microphone transformer is loaded by resistor 12, which serves at the same time as a modulator gain control and grid leak of tube 2. From the moving contact of this resistor the audio frequency voltage is fed on the grid of the tube.

[50X1]

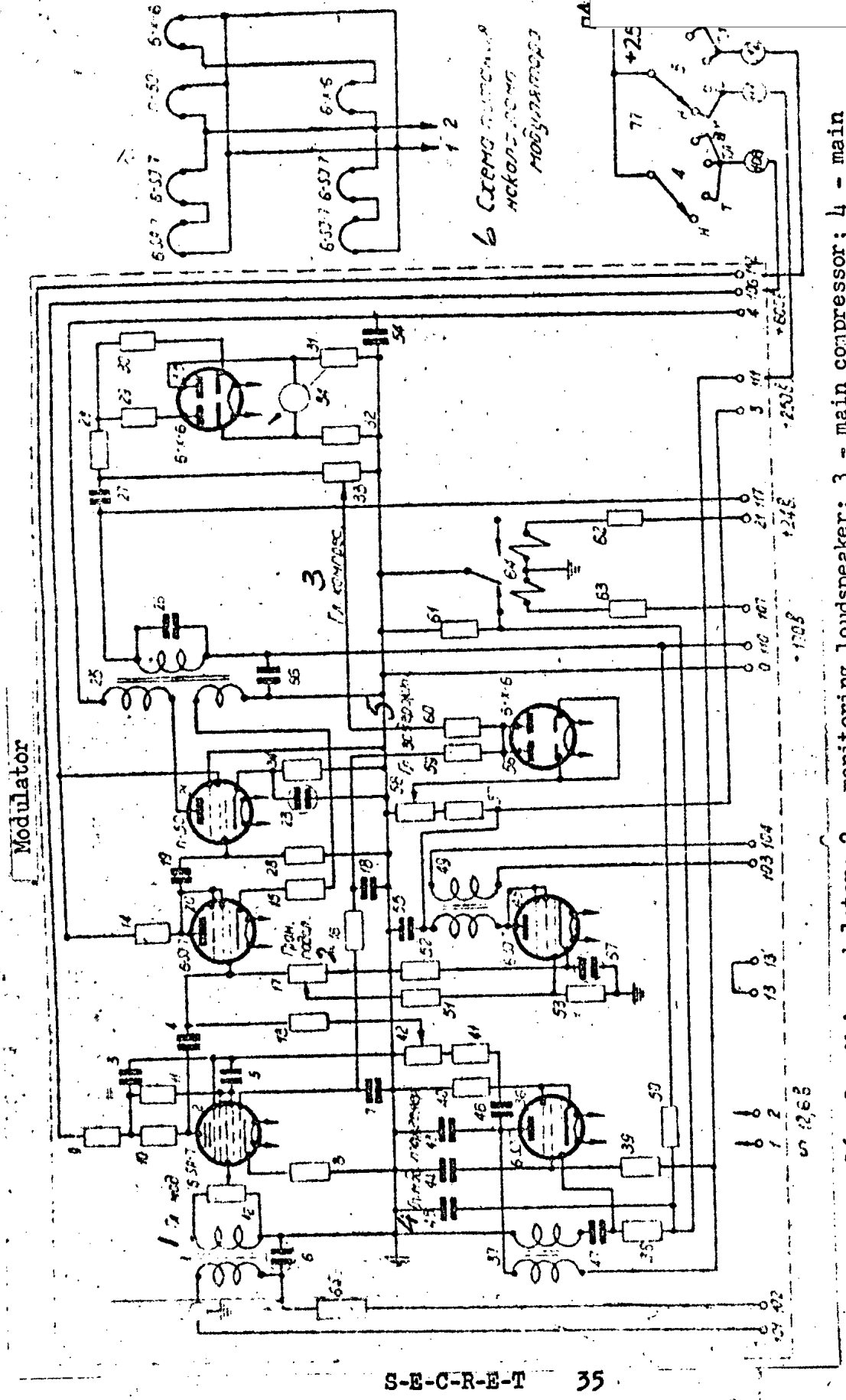


Fig. 16. 1 - Main modulator; 2 - monitoring loudspeaker; 3 - main compressor; 4 - main modulator of the audio frequency oscillator; 5 - main delay line; 6 - modulator tute filament supply circuit.

[p. 37]

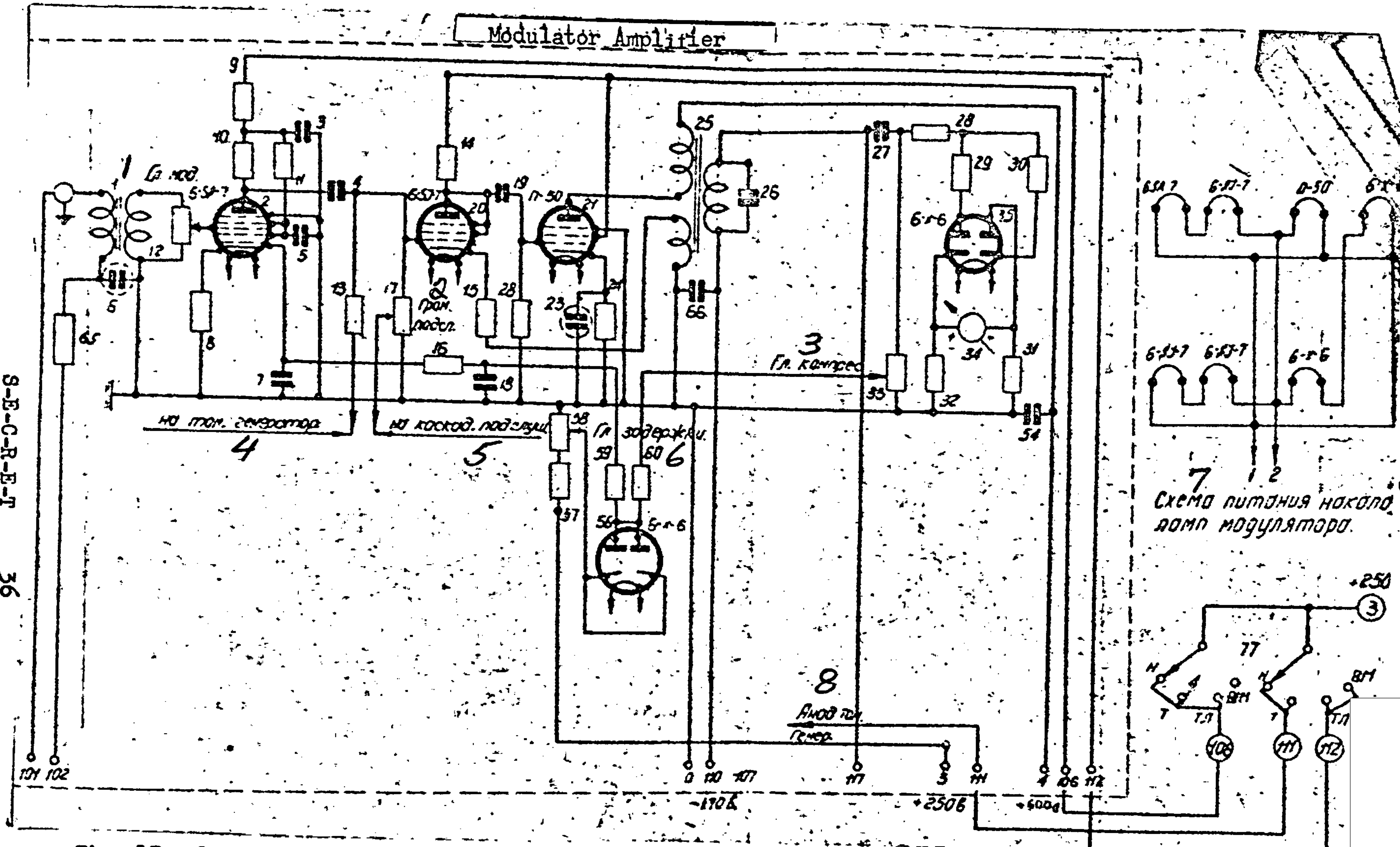


Fig. 17. 1 - main modulator; 2 - monitoring loudspeaker; 3- main compressor; 4 - to audio frequency oscillator; 5 - to the monitoring stage; 6 - main delay line; 7 - modulator tube filament supply circuit; 8 - plate of the audio frequency oscillator.

50X1

[p. 38]

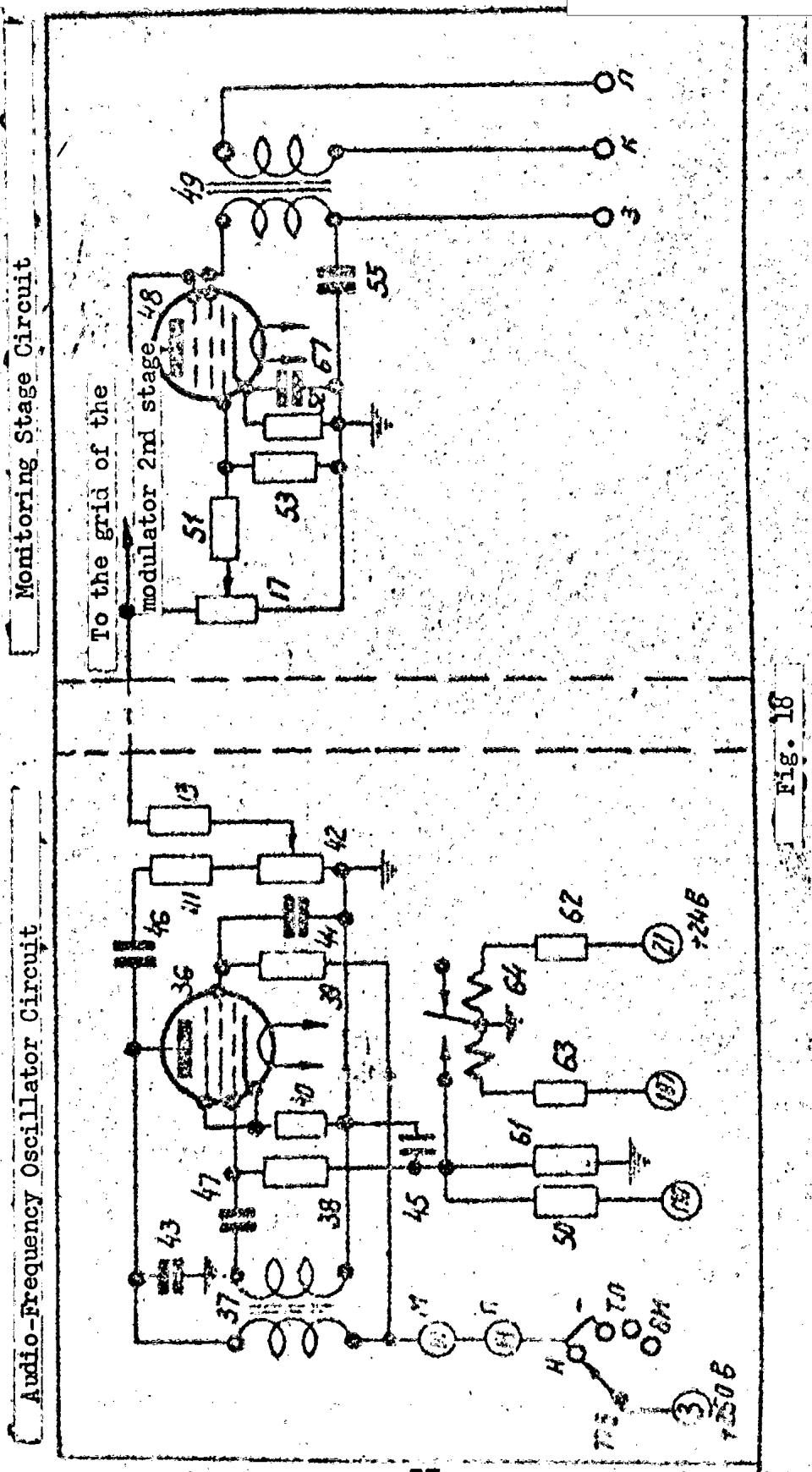


Fig. 18

The tube obtains grid bias from the voltage drop across cathode resistor 8. 50X1

A tube-amplified audio-frequency voltage appears across plate resistor 10 and is fed through capacitor 4 to the grid of tube 20.

A triode-connected 6Zh8 tube is used as tube 20, which serves as a second voltage amplifier and receives bias voltage from the voltage drop across cathode resistor 15.

The amplified audio frequency voltage appears across plate resistor 14 and is fed through capacitor 19 to the grid of output tube 21.

A GU-50 tube serves as the output tube. The grid bias of this tube is supplied from resistor 23, which is connected to the tube cathode.

The plate of the output tube is connected to modulation transformer 25. [P 39]

The secondary winding of the modulation transformer is connected by the contacts of relay-65 (during telephone operation) to the pentode grids of the transmitter output tubes.

The last two stages of the modulator are provided with a negative feedback circuit. The feedback voltage is taken from a special winding of the modulation transformer and fed to the cathode circuit of driver-stage tube 20.

From the secondary winding of the modulation transformer the audio-frequency voltage is also supplied to the potentiometer of compression control 33 through capacitor 27.

From the cursor of this potentiometer the audio-frequency voltage is fed through resistor 60 to the plates of the 6H6S diode 56, which rectifies it. The rectified voltage is fed through a ripple filter to the first grid of tube 2; the greater the voltage at the output of the modulator, the smaller the amplification of the tube. For delaying the operation of the compressive circuit, a positive delay voltage from potentiometer 58 is supplied to the cathode of the 6H6S tube.

8. Audio Oscillator

In the audio oscillator (Figure 18) a 6Zh8 is used as tube 36.

The circuit is made up of the plate winding of transformer 37 and capacitor 43. From the plate of the oscillator tube, the audio-frequency voltage is fed through capacitor 46 and resistor 41 to potentiometer 42. From potentiometer 42 the voltage is supplied through resistor 13 to the control grid of tube 20, which amplifies it for transmitter modulation during voice-frequency carrier telegraphy.

50X1

[p. 40]

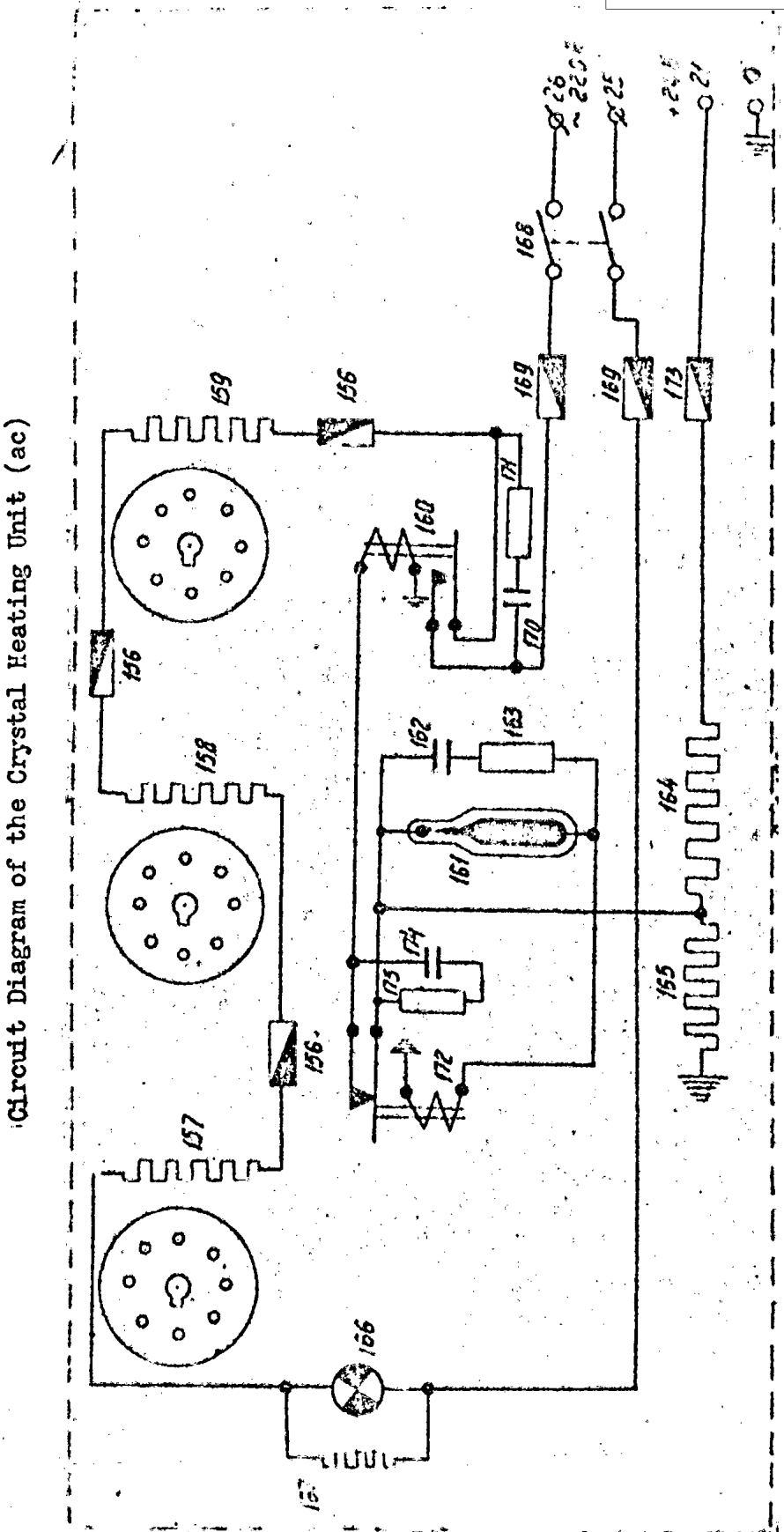
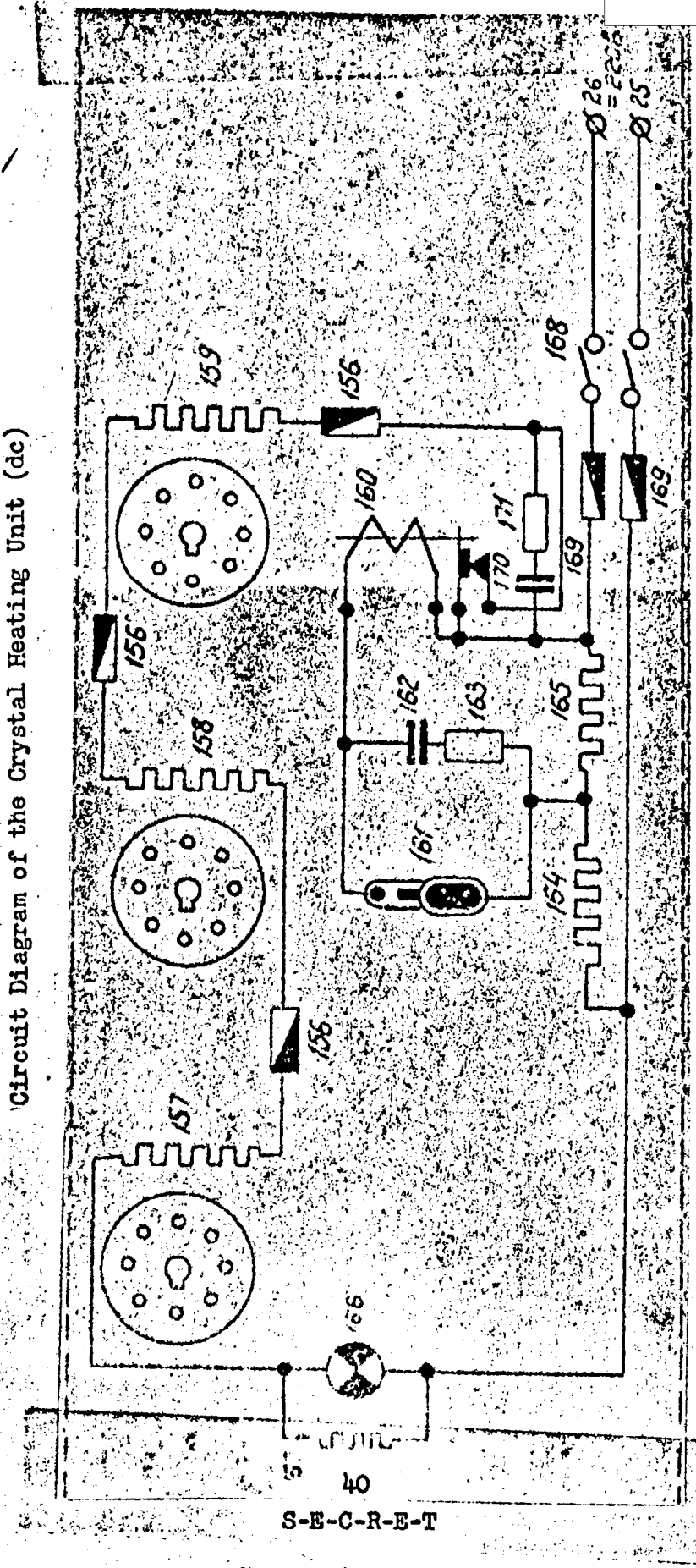


Fig. 19

50X1

[p. 41]



Circuit Diagram of the Crystal Heating Unit (dc)

Fig. 19a

Simultaneously, the voltage is supplied from potentiometer 17 to the grid of tube 48 for monitoring the performance of the telegraph key. 50X1
A large negative voltage (-185 v) is fed through resistors 38 and 50 to the control grid of oscillator tube 36, which completely blocks the tube.

When the key is pressed, keying relay 64 operates and with its contacts unloads the negative voltage from the tube grid, connecting with the chassis the common point of resistors 38 and 50. At the same time the audio oscillator begins to operate.

To improve the shape of the curve of the generated voltage, negative feedback is used in the oscillator. This is produced by resistor 40 in the tube cathode.

9. Operation Monitoring Stage

This stage (Figure 18) operates with tube 48, which is a 6Zh8 triode. The tube receives bias from the voltage drop across cathode resistor 52. [P 42]

From potentiometer 17, part of the audio-frequency voltage which is present on the grid of tube 20 during telephone operation, enters the control grid of the tube. This amplifies the microphone voltage, and, during telegraph operation, the audio oscillator voltage. The plate of the monitoring stage tube is connected to transformer 49, from the secondary winding of which the amplified audio frequency voltage is supplied to monitoring lines 103, 104, which are connected to the telephones of the control desk, the PRO and BPS, as well as the receiver output.

10. Percentage Modulation Indicator

A 6H6S tube voltmeter 35 with a double diode is used to control the transmitter percentage modulation. The voltmeter measures the voltage on the secondary winding of modulation transformer 25. The latter is fed to the voltmeter through capacitor 27 and shunt resistor 28. Indicator 34 is a milliammeter [which is graduated in whole milliamps].

11. Quartz Heating Element

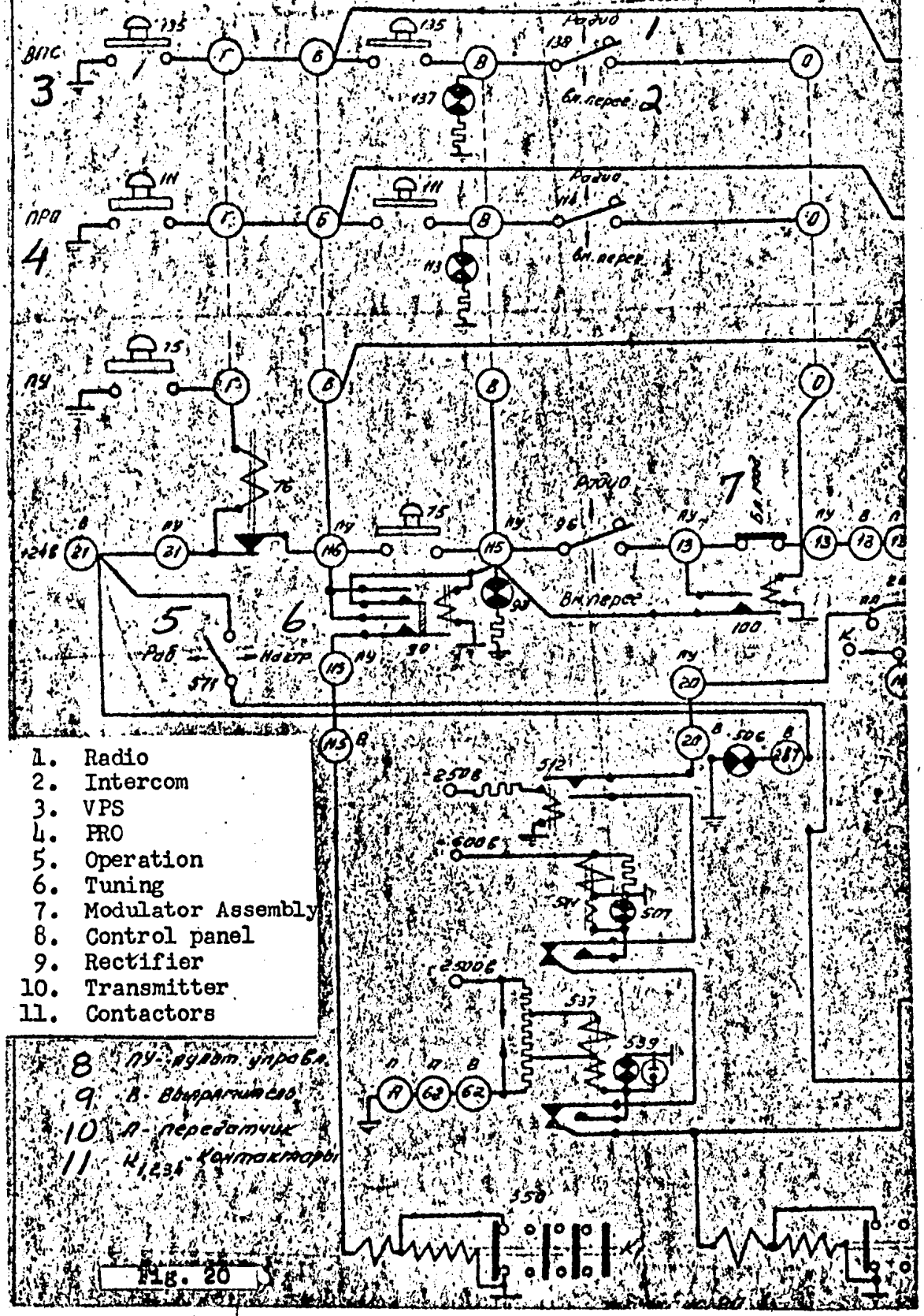
(See Circuit Diagram R - 97918)

The quartz heating element (Figures 19 and 19-a) is designed for preliminary heating units "Kh" which contain quartz crystals.

The quartz heating element has three jacks, heated by special windings, into which units "Kh" are placed for pre-heating.

Radio Station Control Circuit

[p. 43] 50X1

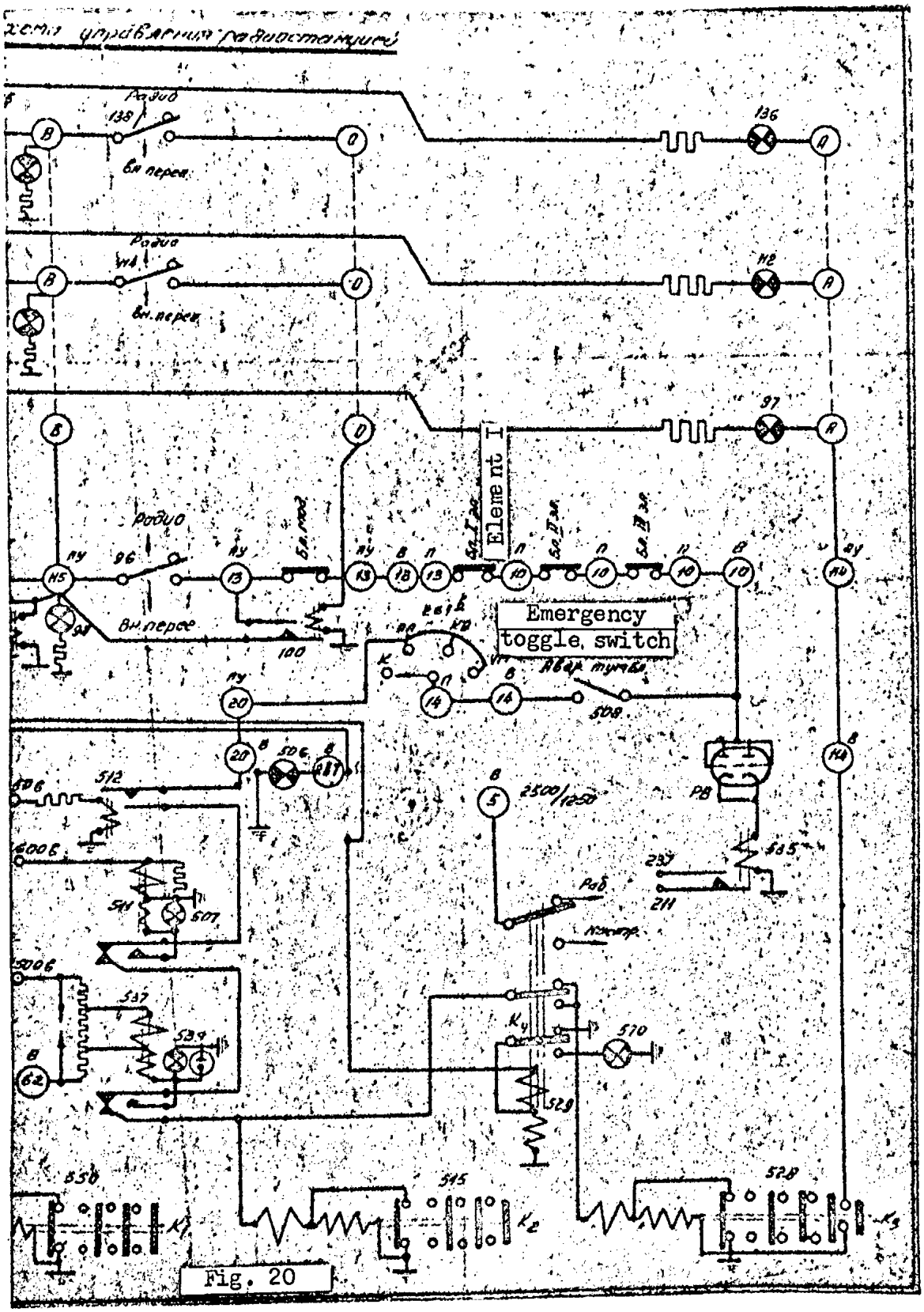


1. Radio
2. Intercom
3. VPS
4. PRO
5. Operation
6. Tuning
7. Modulator Assembly
8. Control panel
9. Rectifier
10. Transmitter
11. Contactors

8 ПУ - пульт управл.
9 В - выпрямитель
10 А - передатчик
11 К1,2,3,4 - контакторы

Fig. 20

50X1
[p. 43a]



50X1

[p. 44a]

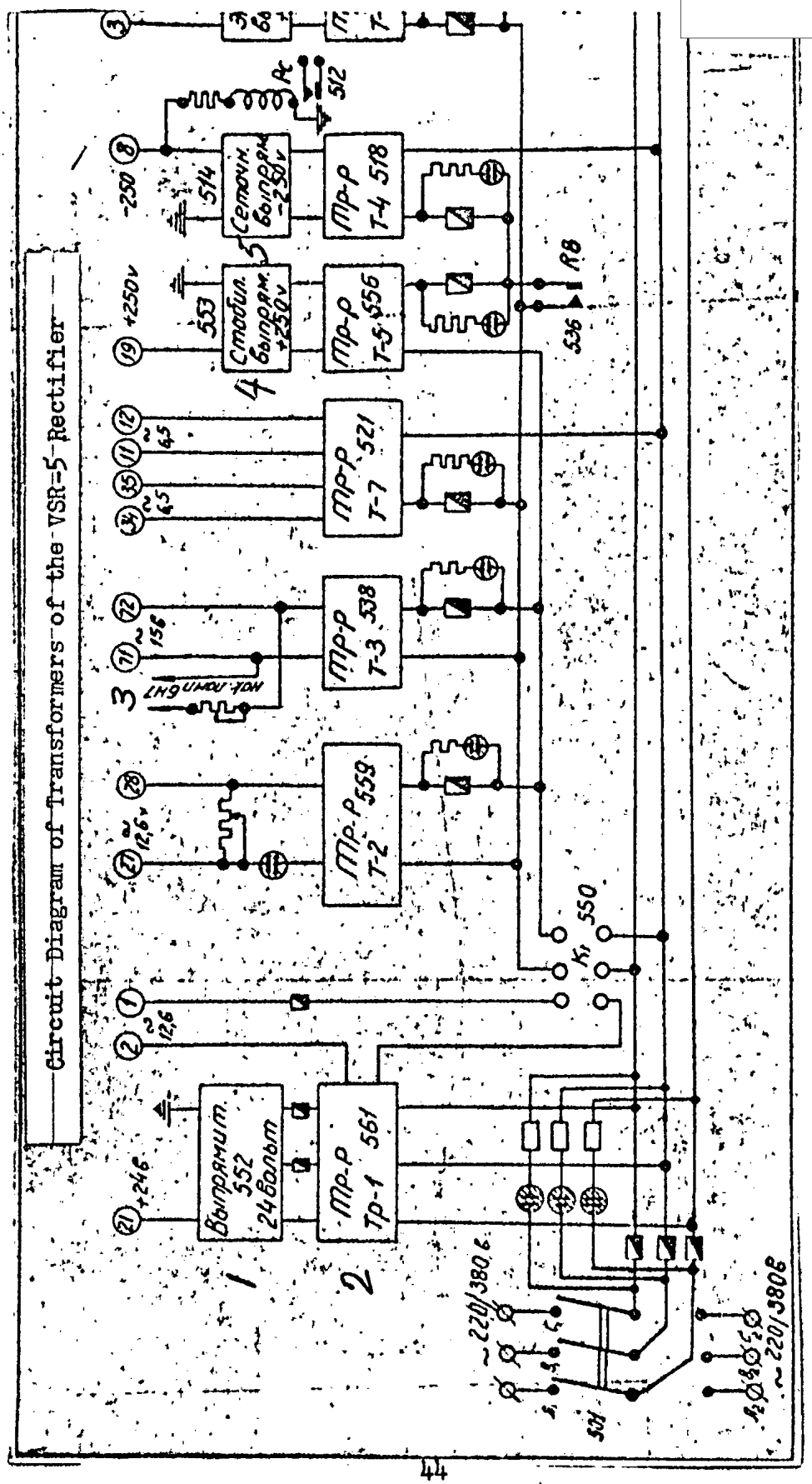


Fig. 21. 1 - rectifier; 2 - transformer; 3 - filament of 6Kh7 tubes; 4 - controled rectifier; 5 - grid rectifier.

S-E-C-R-E-T

50X1
[p. 44b]

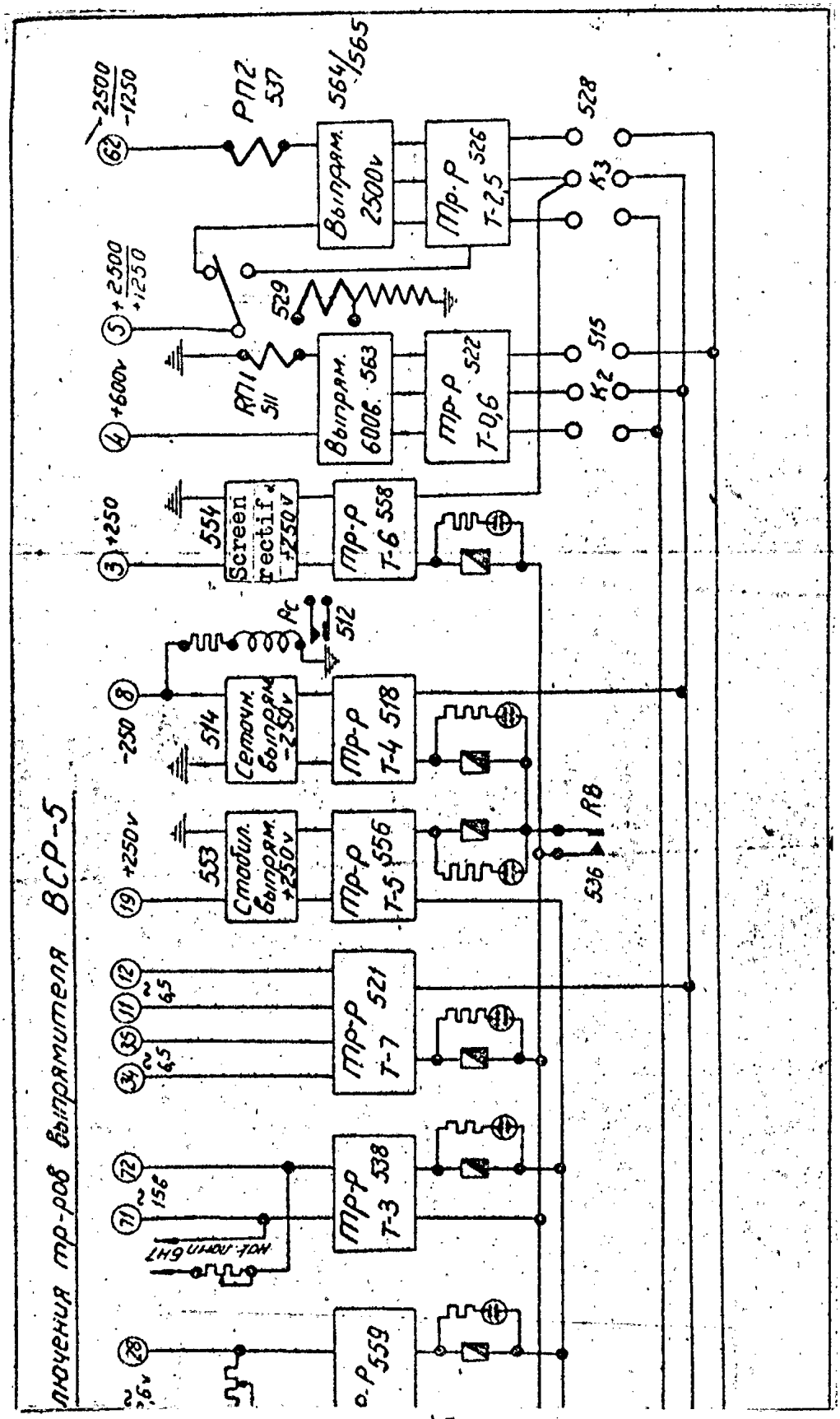


Fig. 21

The three windings are connected in series.

50X1

One of the heating jacks has a mercury contact thermometer, which by acting on a type RM relay, controls the heating of the jack by switching it on and off.

With the DC current supply (See Diagram R-97918), the quartz heating element is connected directly to the DC power supply line.

In this case, thermofuses 156 are connected in series with the heater winding circuit. These fuses are designed for cutting off supply to the windings in case of an accidental overheating of the thermostats.

Under normal conditions, the quartz heating element allows continuous operation over a period of several days.

IV. CONTROL OF THE RADIO STATION [P 45]

(See Diagram R-97562)

1. TURNING ON THE POWER SUPPLY

The AC voltage is supplied to the rectifier from the PNT-85 generator or from an AC circuit through switch 501 located in the second unit of the rectifier (Diagrams 20, 21).

When the AC circuit switch is on, the transmitter filament can be turned on by pressing the "on" button 75 which is located on the control panel (PU). From the rectifier a voltage (+ 24 volts) is supplied along conductor 21 to the control panel. When the button is pressed the same voltage is supplied through the normally closed contacts of stopping relay 76, then through the contacts of button 75, along conductor 115 into the rectifier to the switch-on contactor of transmitter filament 550. Contactor 550 operates, and, by means of auxiliary contacts, locks itself, receiving + 24 volts along conductor 116 from the PU. Here the voltage goes from conductor 116 through the auxiliary contacts of contactor 550 into conductor 115, and, in the PU, turns on the green-colored signal lamp 98 marked "filament."

During operation, contactor 550 provides filament voltage to all the tubes of the transmitter.

The transmitter is switched off by pushing "stop" button 75 in the PU. When the "stop" button is pressed the + 24 volts is admitted across the winding of stopping relay 76, across the closed contacts of the pressed button "stop", to the chassis (ground), then to a minus 24 volts. The stopping relay breaks the power supply to contactor 550 by means of its contacts across conductor 116. Contactor 550 will release and

50X1

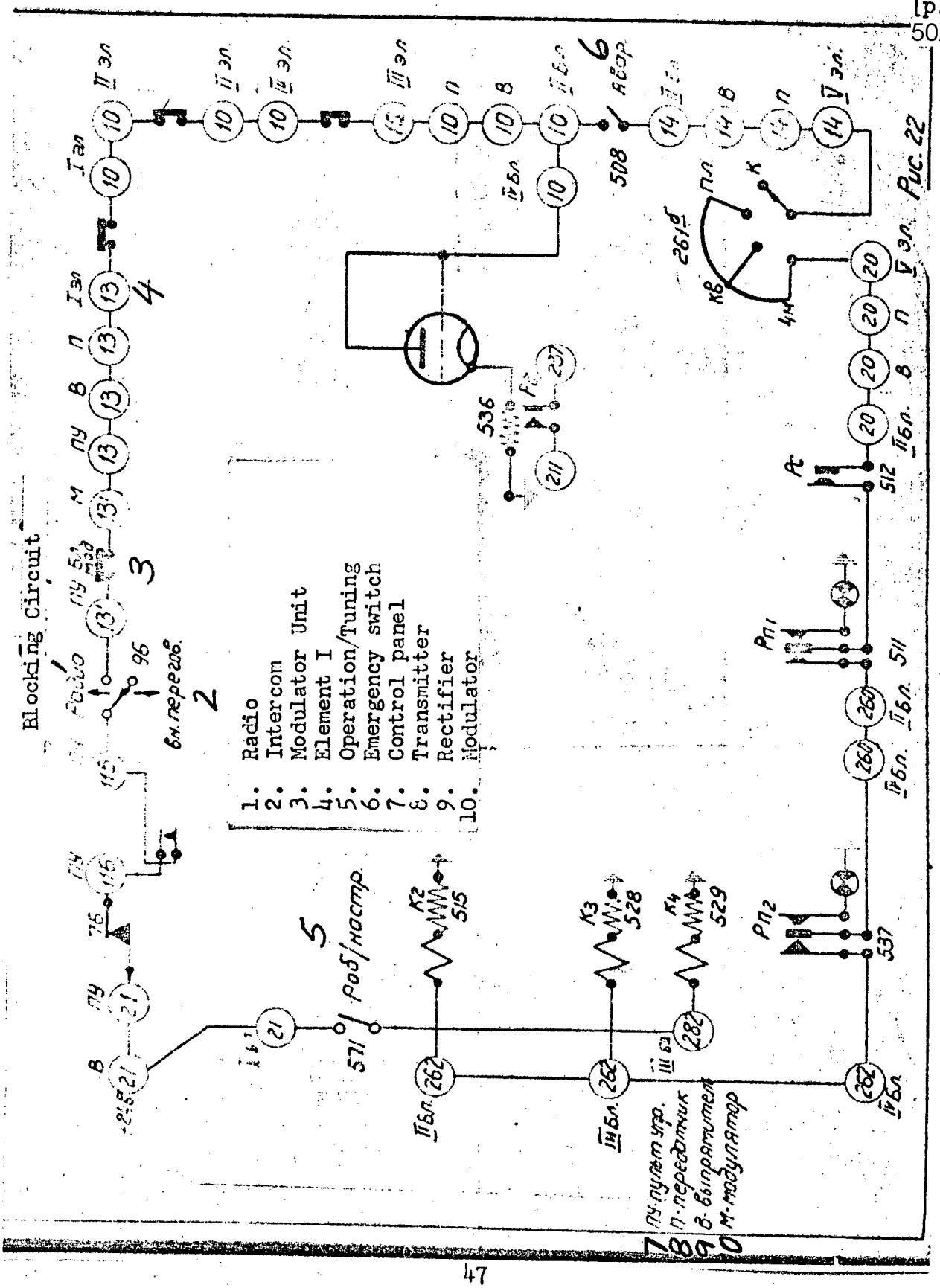


Fig. 22

turn off all the filament voltages of the transmitter tubes. Simultaneously, the auxiliary contacts will turn off the voltage (+24 volts) from conductor 115, and signal lamp 98 (green colored, "filament") in the PU will go out. 50X1

In the rectifier of transformer filament circuit 538 of the transmitter power stage tubes, time-relay tube 536 prepares the high voltage switch-on circuit approximately 15-20 seconds after the filament voltage has been supplied to the transmitter tubes.

The high voltage is turned on by tumbler 96 (Figure 22) in the PU, or by the removal of microtelephone receiver 89 from leverarm 90. A voltage of plus 24 volts goes from conductor 131 into the modulator, then into the transmitter to the contacts of the unit; from here it goes along conductor 10 to the rectifier, across time-relay tube 536 to the relay winding and then across the frame to a minus 24 volts. In operation the relay supplies circuit voltage to the rectifiers: plus 250 volts to the plates of master oscillator 553 and the second stage, and minus 250 volts to the bias circuits of transmitter tubes 514. [P 47]

In order to protect the transmitter tubes in the rectifier bias circuit (minus 250 volts) there is an undervoltage relay which, by means of its contacts, closes the circuit of high-voltage contactors 515, 528. Therefore high voltages for the intermediate and terminal stages of the transmitter will be supplied only in the presence of minus 250 volts. The contacts of high voltage rectifiers 515 and 528 receive a plus 24 volt supply from conductor 10 in the transmitter through operating-mode switch 261-v, along conductor 20 into the rectifier, through the contacts of undervoltage relay 512, through the contacts of overload relay 511 of +600-v rectifier 563, through overload relay 537 of the 2500-v rectifiers 564 and 565, to contactor winding 515, and through contactor contacts 529 to contactor winding 528.

During operation, contactors 515 and 528 supply power line voltage +250, +600 and +2,500 volts to the rectifiers. In switching on the +2500-volt rectifier contactor 528, the auxiliary contacts on conductor 114 close the supply circuit of red signal lamp 97, "High voltage", in the PU. When the lamp lights up, high voltages are being supplied.

During a shorting or an overloading in the +600 or +2500 high-voltage circuit, overload relays 511 and 537 operate and break the supply circuit of contactors 515 and 528.

The overload relay simultaneously blocks itself, and signal lamp 507 or 539 at the rectifier indicates the overloaded circuit. To release the overload relays and return them to their initial positions, one must turn off the high-voltage switch-on tumbler of the PU.

To lower the terminal stage plate voltage during tuning in the plus 2500-volt rectifier circuit on the high-voltage side, contactor 529 is provided, which lowers the plate voltage to a value on the order of 1250 volts.

50X1

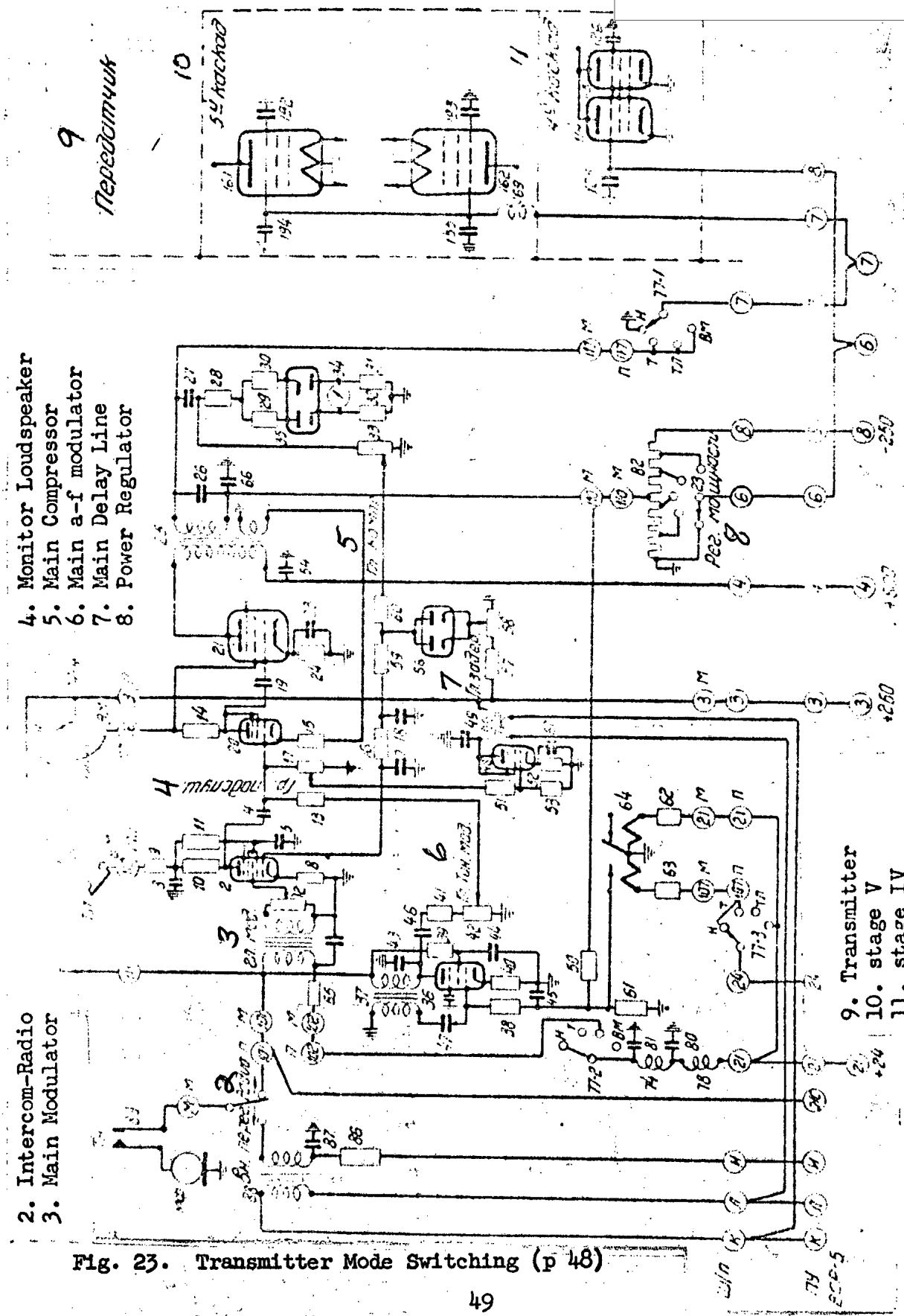


Fig. 23. Transmitter Mode Switching (p 48)

50X1

2. SELECTING THE TYPE OF OPERATION

The transmitter permits the following types of operation:

a) continuous wave,

b) tone-modulated wave,

c) telephone transmitter,

d) facsimile.

The type of operation is selected at the control panel by means of switch 77, See Diagram R-97562.

In the first position (Diagram 23) of switch 77, the operation [p 49] is carried out by the key for continuous waves --mode A_1. The telegrapher's key 99 is connected to a two-wire circuit. When the key is pressed, a voltage of plus 24 volts from control-panel connector 21 is admitted across telegrapher key 99 to the control panel and into the transmitter.

In the transmitter the plus 24 volts is admitted from contactor 18, across switch 261b when it is in the position "Continuous range" or "crystal operation", to the winding of modulation-relay 307. The relay armature flips over from the idle contact to the operating contact, thus providing current to the master-oscillator screen grid. Simultaneously plus 24 volts is admitted across switch 261b through conductor 24 from the transmitter to the control panel; and then across segment 3 of switch 77, along conductor 107, into the modulator, and to the winding of monitoring relay 64. The relay contacts close and turn on the audio oscillator for self-monitoring operation. For convenience during adjustment, transmitter button 322 duplicates the telegraph key. The self-monitoring audio signals are admitted through pulse separator tube 48, transformer 49, to conductors K and L to the telephones of the radio operator.

50X1

In the second position of switch 77, the operation is performed by the key for tone modulated waves--mode A_2. The telegrapher uses the same key as the one used in the first position of switch 77; the passage of current is as described above. The plate voltage to the modulator tubes is supplied from contactor 3 of the rectifier through segment 4 of control-panel switch 77, along conductor 106, and into the modulator to the plates of the tubes. The operating bias to the pentode grids of the transmitter fifth-stage tubes goes from the control panel to the modulator through conductor 110, then through the winding of output transformer 25, through conductor 117, through segment 1 of the PU switch 77, through conductor 109, through the contacts of telephone relay 65, through conductor 7, and into the transmitter to the pentode grids of the fifth-stage tubes.

In the third position of switch 77, the operation is performed from the fascimile apparatus. In this position, modulation relay 307 receives a + 24 volt supply independent of the telegraph key.

Monitor relay 64 in the modulator is turned off by switch 77 on conductor 107. A +24-volt voltage is admitted from the control panel across segment 3 of switch 77, along conductor 24, into the transmitter and then to the winding of modulating-relay 307. The armature of the relay flips over to the operating contact and, while on it, will maintain a constant voltage of plus 24 volts independent of the key being pressed by the telegrapher. Telephone relay 65 will receive power from the control panel through conductor 111; the other end of the relay winding, through conductor 112 and segment 2 of switch 77, is connected to the chassis; relay 65 shifts the transmitter into the telephone mode. [p 50]

Audio pulses from the facsimile apparatus are supplied along line "Zh" to the control panel, then along conductor 101 into the modulator and to the primary of transformer 1.

The second end of the primary winding of transformer 1, for audio frequency, is closed to the chassis by means of 50 microfarad capacitor 6; for direct current, it is isolated from the chassis and from the other circuits by control-panel switch 77 on conductor 102.

The telephone transmitter is operated by the first or second (either) position of switch 77. Then the transmitter is switched over to telephone operation automatically when the micro-telephone receiver is lifted from its lever arm, which closes contacts 90. Telephone relay 65 is connected in series with the microphone circuit and operates from the current which passes through it.

The microphone supply voltage is admitted from the control panel across two-section smoothing filter 78, 90, 79, 81, through conductor 111 into the modulator, to relay 65, through conductor 112 into the control panel and to switch 77; then, through conductor 102 again to the primary

of the transformer-microphone, through conductor 101 to the control panel, and across switch 96 to microphone 89, which is connected to the chassis through the closed contacts of micro-telephone-receiver lever arm 90.

Thus the circuit is closed, the microphone receives operating voltage, and relay 65 shifts the transmitter into the telephone-operation mode. Speech current goes to the microphone, then through tumbler 96, the primary winding of microphone transformer 1, across capacitor 6 to the chassis. Radiation control (the carrier frequency of the transmitter) is accomplished through conductor 18 by means of the microphone-receiver press-level which is connected in parallel to the telegraph key. When the press-lever is pressed, modulation relay 307 operates, supplying operating voltage to the master oscillator; the carrier frequency is fed to the antenna.

When the press-lever is released, the master oscillator cuts off, and the carrier frequency disappears. This provides a half-duplex telephone.

In circuits which have a reduced number of conductors going from the control panel to the remotely located and radio operated stations, VPS and PRO respectively, the telephone transmitting and facsmile-apparatus signal transmitting are done over conductors "Zh" and "O" (ground).

3. Selecting the System of Operation [p 51]

(See Diagram R-97918)

The system of operation (Diagram 15) is selected by means of four-position switch 261 located in the unit 5 of the transmitter; it provides:

a) calibration control of the continuous-range master unit, and control of the power supply;

b) operation on the continuous range of the transmitter;

c) operation on the fixed, crystal-stabilized frequency;

d) operation of the teletype apparatus by means of quartz-driver frequency modulation.

50X1

First Position of Switch 261 ("Control")

In this position the screen grid of the continuous-range driver receives an operating voltage through switch sector 261a on conductor 15 (independent of the voltage from the relay-modulating contacts) directly from the stabilized voltage source through resistance 323 from conductor 19. As a result, the continuous-frequency-range driver operates independent of the position of the contacts of manipulation-relay 307.

Switch sector 251v interrupts the supply circuit of the high-voltage contactors (conductors 20 and 14); the contactors in the rectifier will open and disconnect the high voltages from the transmitter(plus 2500, 600, and 250 volts).

The +250 volts to the plate and screen circuits of the continuous-frequency-range master unit and the -250 volts bias do not switch off and continue to supply the transmitter. Thus, in this position of switch 261 only the first two stages of the transmitter are in operation. The master oscillator plate-circuit receives its power through conductor 23, the first sector of switch 261, and conductor 19, from the stabilized voltage source in the rectifier.

For calibration control during tuning ("mains"), a high-frequency voltage is supplied from the second-stage grid through high-frequency cable 9 leading from the transmitter.

Second Position of Switch 261

("Continuous range")

In this position, the screen grid of the continuous-frequency-range driver receives from the stabilized-voltage source an operating voltage through switch sector 261a, the contacts of manipulation relay 307, resistor 323, and conductor 19.

Switch sector 261b connects the manipulation line (conductor 18) [p 52] to the winding of manipulation-relay 307, and, through conductor 24, to the winding of relay 64 of the automatic signal monitor (in the modulator).

The manipulation relay is operated from the plus 24-volt telegraph-key pulses along manipulation line 18, as described above in the section "SELECTING THE TYPE OF OPERATION."

50X1

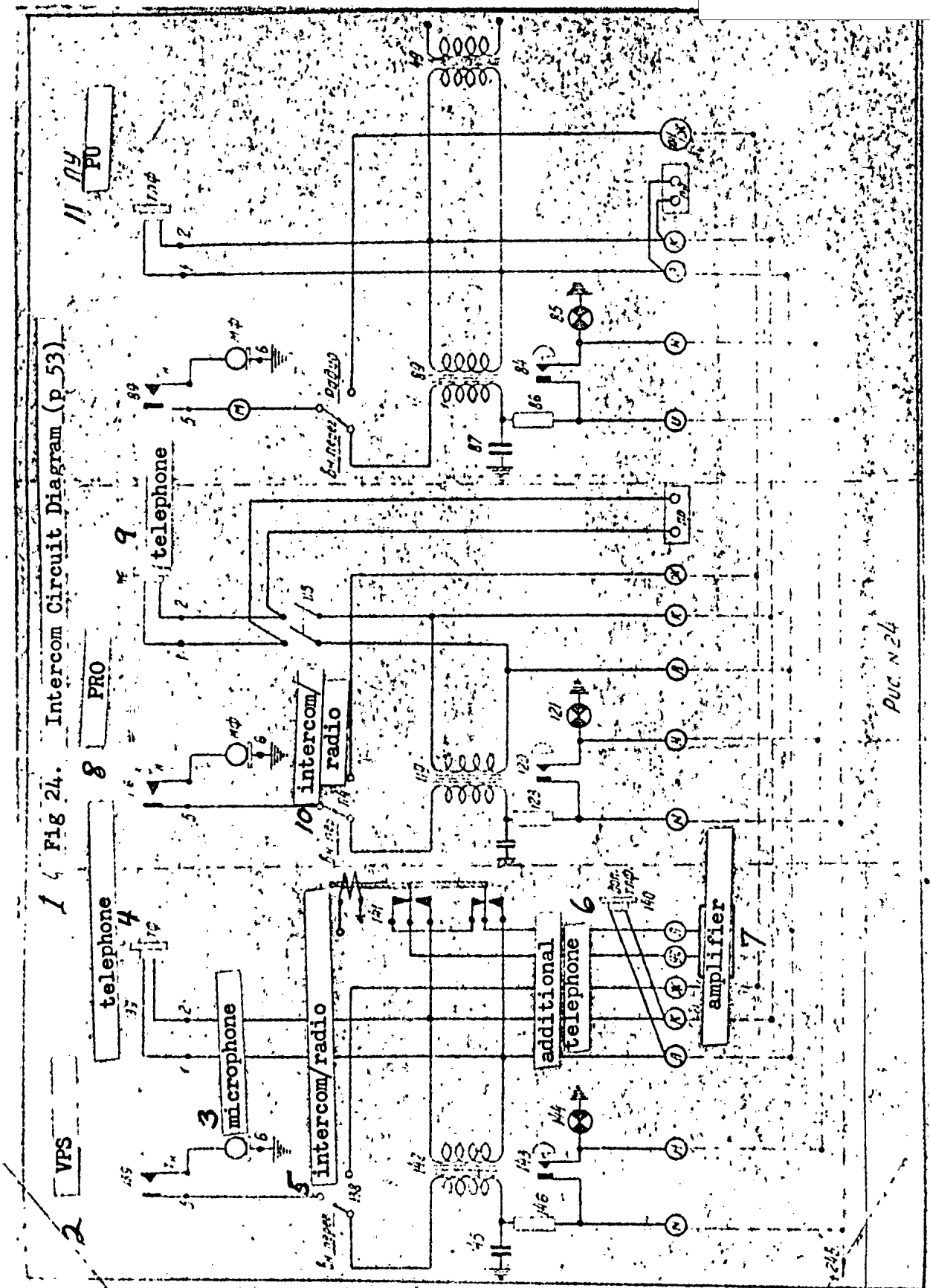


Fig 24.

S-E-C-R-E-T

No Foreign Dissem

When the contacts of manipulation relay 307 are closed, the continuous-frequency-range driver generates a high frequency; when open, the driver is cut off by negative voltage through resistance 54. Switch sector 261a will close the supply circuit of the high-voltage contactors; conductor 20 will be connected to conductor 14, and it will be possible to supply high voltages to the transmitter continuously. The master-oscillator plate will receive a power supply through conductor 23 as in the first position of switch 261.

50X1

Third Position of Switch 261 ("Quartz")

In this position, the continuous-frequency-range driver's screen grid, by means of switch sector 261a, is isolated from manipulation relay 307 which by this very same switch is connected to the screen grid of driver 262 through resistance 296. Thus, the continuous-frequency-range driver will be cut off, and the quartz-driver tube will operate on voltage supplied through the contacts of manipulation-relay 307.

Manipulation line 18 in this case is connected to the manipulation-relay winding by switch sector 261v, as in the second position. In as much as in this (third) position the elements of frequency deviation are excluded by means of relay 298, when the telegrapher's key is pressed, only the frequency of crystal 263 will be radiated; and when released, the quartz driver tube will be cut out through resistance 297; the antenna will not receive the oscillations.

Switch sector 261b, from conductor 19, supplies a stabilized voltage to the quartz-driver tubes through the sector of switch 261, and from conductor 3 a plate voltage is supplied from amplifier tube 300, and by means of conductor 41, relay 23 is turned on. The arm of high-frequency relay 23 pulls up and connects the plate of amplifier-tube 300 to load coil 22. As before, conductor 14 is connected to conductor 20 by switch 261v; therefore it is possible to supply all the high voltages to the transmitter just as in the second position.

Fourth Position of Switch 261

("Frequency-modulation Driver")

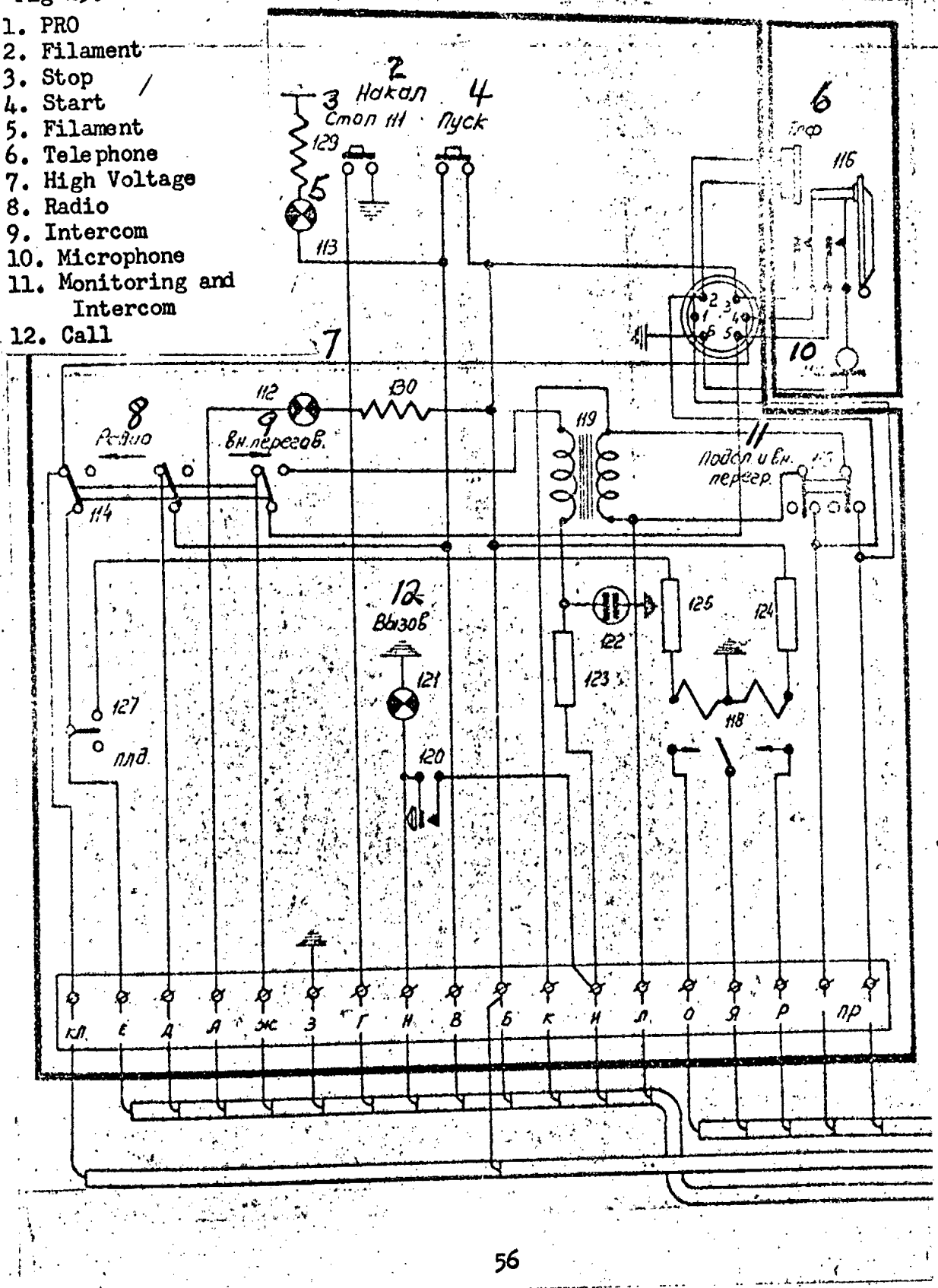
The quartz-driver screen grid in this position receives an opera- [p 54] tional voltage through switch sector 261a -- independent of the manipulation-relay contacts--from the stabilized voltage source which comes from conductor 19 through resistances 323 and 296, resulting in the fact that the quartz driver oscillates independent of the position of the contacts of manipulation-relay 307.

[p 55]

50X1

Fig 25.

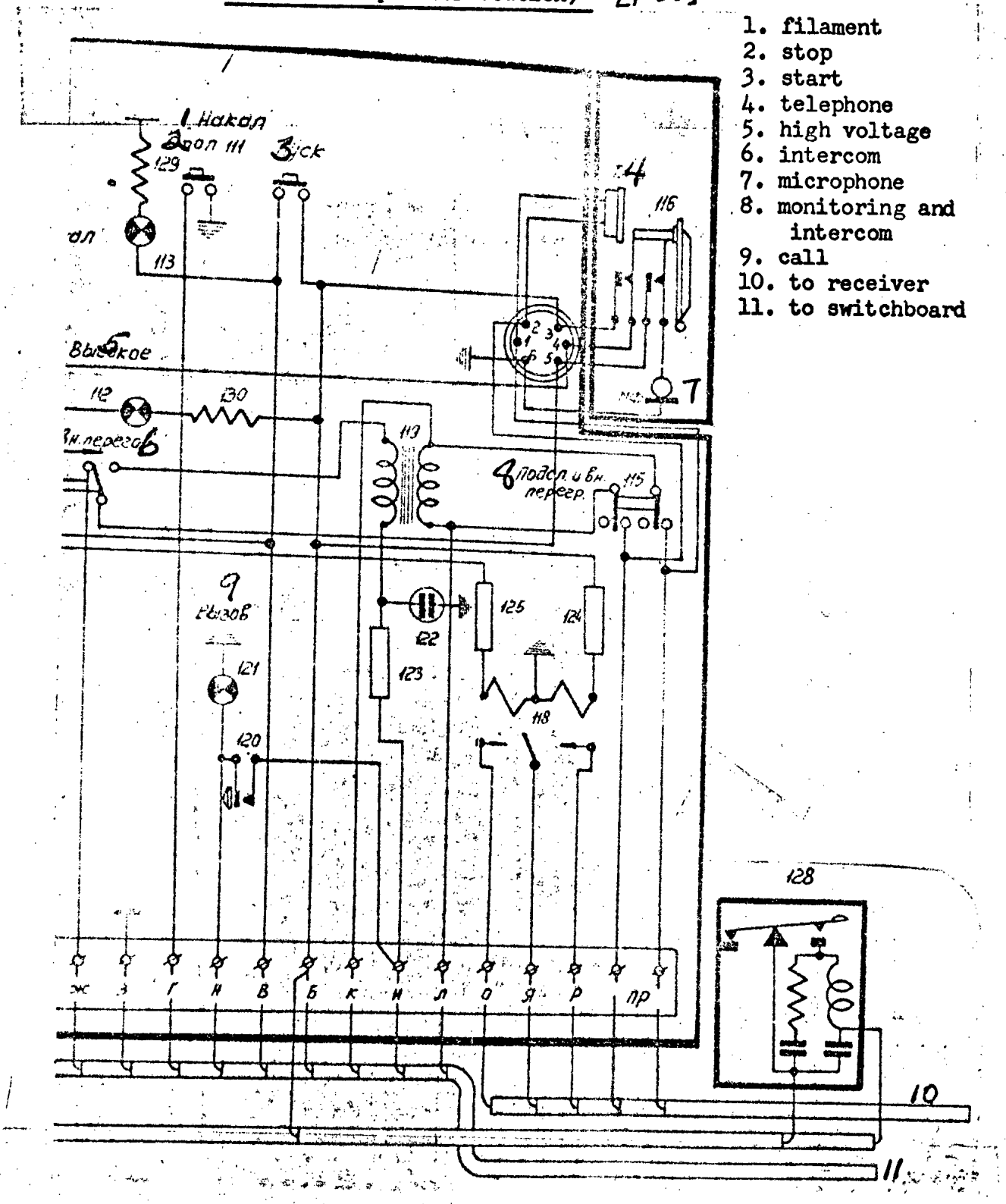
1. PRO
2. Filament
3. Stop
4. Start
5. Filament
6. Telephone
7. High Voltage
8. Radio
9. Intercom
10. Microphone
11. Monitoring and Intercom
12. Call



S-E-C-R-E-T

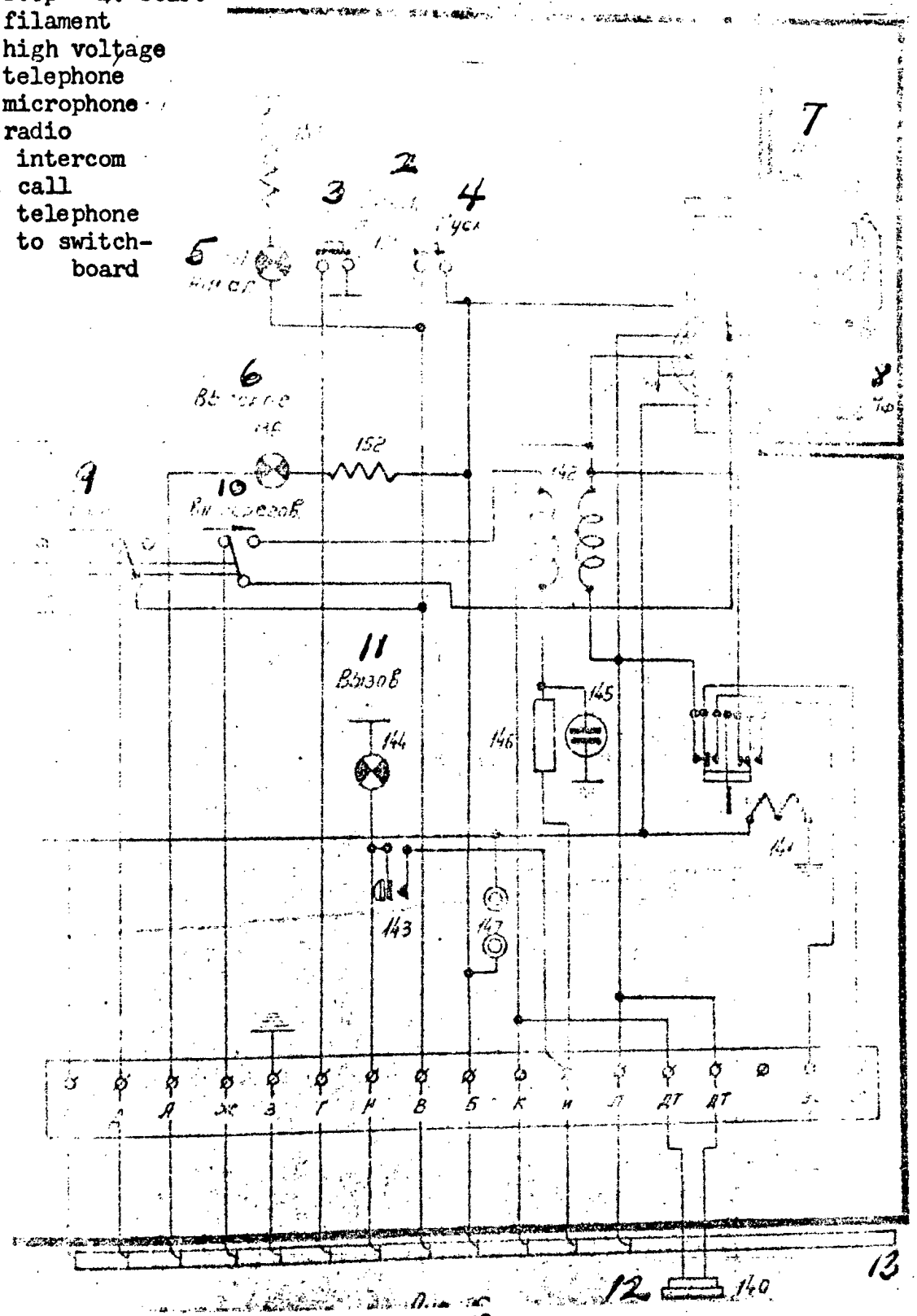
50X1

Fig 25. PRO (Radio Operator Station) [p 56]



1. VPS(remote station)
2. filament
3. stop 4. start
5. filament
6. high voltage
7. telephone
8. microphone
9. radio
10. intercom
11. call
12. telephone
13. to switch-board

Fig 26.



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Manipulation line 18 through switch 261b is connected to the input of tube 290 which, through tube 287, controls deviation relay 298. 50X1 Quartz-driver frequency modulation is used to transmit teletype signals by radio. In order to reduce the number of connecting conductors, the teletype-apparatus pulse is transmitted through manipulation line "Ye" and conductor 18. All the remaining circuits are switched on as described for the third position.

4. INTERCOMMUNICATION CONVERSATIONS AND SELF-MONITORING

Intercom conversations (Diagram 24) are conducted with the same telephone receiver (89) used in broadcasting.

Switching is done with control-panel switch 96 in the position "Intercommunication Conversations"; then microphone 89 is switched on to line "I" and then to a switchboard for remotely-located (VPS) and radio-operated (PRO) stations through switch 96, the primary winding of transformer 88 and decoupling resistor 86.

A call from the switchboard to the control panel is made by means of audio-signal pulses through lines "K" and "L" to the telephone, with a simultaneous voltage pulse from the local battery of the switchboard through line "N" to signal tube 85.

A call from the control panel to the switchboard is made by pressing "call" button 84. When the button is pressed, a voltage is supplied from the switchboard through line "I" and the closed contacts of the call button to line "N", and back to the switchboard.

Self-monitoring of the telegraph or telephone operation is done from either the audio oscillator or the first modulator stage through the potentiometer of the volume control of monitoring signals 17, 51, 53, through pulse separator tube 48, transformer 49, along conductors "K" and "L" into the control panel, and then farther along conductors "K" and "L" to the telephones. Pulse separator tube 48 provides protection against accidental radio transmission into space during conversation over intercommunication circuits. It also serves as a protection for signals received by the receiver, since the receiver output is connected through the PRO to conductors "K" and "L".

Thus, the monitoring signals are supplied unidirectionally to lines "K" and "L" through tube 48.

5. REMOTE CONTROL OF THE RADIO SET

[p 57]

The transmitter's remote-control elements PRO and VPS were designed to increased the operational capability and improve the operational quality of shipboard radio-communication.

The PRO is usually placed by the receiver and facilitates transmitter control by the radio operator in charge of receiving calls. 50X1

The VPS is located in a place far removed from both the receiver and the transmitter, and serves for the control of the radio-station directly by the ship commander or by other person in command, the circuits for the PRO and the VPS are shown on Diagrams 25 and 26.

Full radio-station control from the PRO and the VPS takes place on 12 line conductors through the switchboard. To facilitate this the following connecting lines are provided:

"A" -- high-voltage signal (readiness of the transmitter for operation),

"B" -- plus 24-volts control-circuit supply,

"V" -- transmitter start and start signal (turning on the filament),

"G" -- stopping the transmitter (turning off the filament),

"D" -- turning on the high voltage,

"Ye"-- telegraph-key or press-lever manipulation on the microtelephone receiver,

"Zh"-- microphone operation through the transmitter,

"I" -- the power-supply circuit of the microphone during intercommunication conversations,

"K" -- self-monitoring of the telegraph and telephone operations, monitoring of intercommunication conversations, and
"L" -- low-frequency output of the receiver,

"N" -- call circuits and call signals,

"Z" -- return circuits of all the lines (ground).

Line "Zh" must have separate shielding; shielding of lines "K" and "L" (in one shield) is also desirable.

Starting and stopping the transmitter from the PRO or the VPS is accomplished in a manner similar to that from the control panel (see 1). After the stop button is pressed, +24 volts from line "B" is supplied through the start-button's contacts, through line "V", the switchboard,

and into the transmitter control panel; then it goes through conductor 115 to contactor 550 of the rectifier. Contactor 550 locks itself on conduc 50X1
116 and turns on the transmitter filament. Then +24 volts will be supplied to line "V" through the secondary contacts of contactor 550; this will light the green-colored "Filament" signal lamps along all of line "V", and on the switchboard as well.

Stopping the transmitter from a VPS or PRO (connected to the transmitter) is accomplished by pressing the "Stop" button. Plus 24 volts is supplied through the winding of stopping-relay 76 in the control panel, through line "G" and the switchboard to the corresponding PRO or VPS, across the closed contacts of the "Stop" button to the chassis. [P 58]

Control-panel relay 76 operates and disrupts the power-supply to conductor 116, contactor 550 opens and removes +24 volts from line V, and all the "filament" signal-lamps on line "V" will go out.

Turning on the high voltage from the PRO or the VPS (Diagram 20) is done in the following manner: during telegraph operation in mode A_1 or A_3, a high voltage to the transmitter is switched on by means of tumbler 148 or 126.

Plus 240 volts is supplied from line "V" through tumbler 148 or 126, tumbler 138 or 114, through line "D" and the switchboard, and into the control panel to the winding of remote-control-relay 100 (the relay contacts close conductor 115 to conductor 113 into the PU and to the transmitter.

During normal blocking with the time-delay-relay contacts closed, high-voltage contactor 515 and 528, in the rectifier, operate and supply all the high voltages to the transmitter. Through the auxiliary contacts of contactor 628, all the red-colored signal lamps "High-voltage on" will light up along all of line "A" and on the switchboard as well.

Turning off line "D" by tumbler 138 or tumbler 114 while in the position "Inter. Conv." precludes the possibility of the high voltage being turned on during intercom. conversations from the PRO or VPS when the telephone receiver is lifted.

Key or hand-set button manual manipulation, in the PRO or VPS (Diagram 3) microphone operation, is carried out by +24 volt pulses through line "Ye", the switchboard, the control panel, and conductor 18, to the winding of transmitter manipulation-relay 307. These +24 volt pulses are supplied from line "Ye" to the manipulation relay by receiver 118

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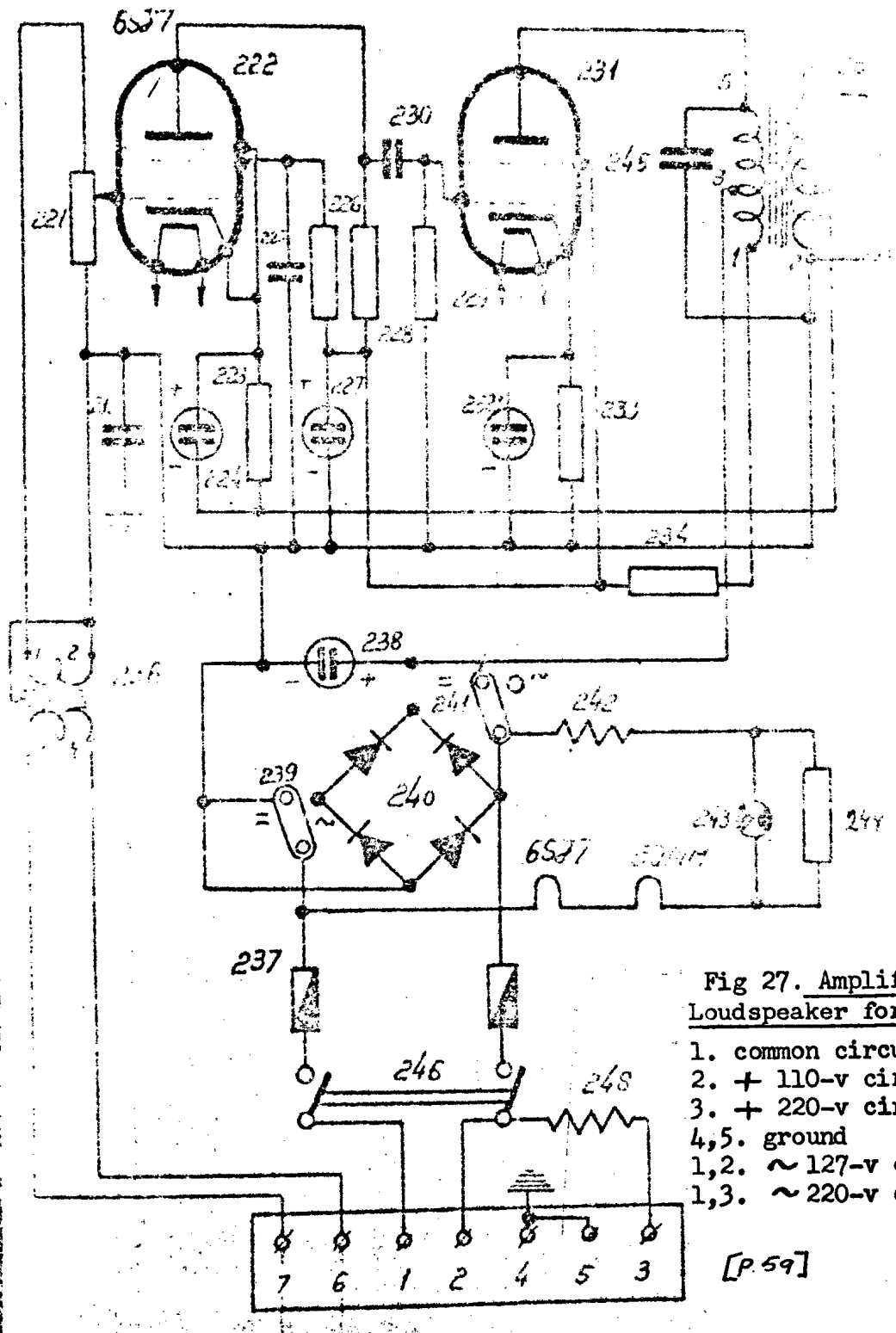

Fig 27. Amplifier & Loudspeaker for VPS

1. common circuit
2. + 110-v circuit
3. + 220-v circuit
4,5. ground
1,2. ~ 127-v circuit
1,3. ~ 220-v circuit

[P.59]

when the position of the PRO 127 half-duplex tumbler is on "ON". Thus, transmitter and receiver manipulation relays 307 and 118 operate simultaneously; as indicated above in section 3, teletype-apparatus pulses are also supplied along line "Ye". The line Ye switchover from manipulation relay 307 to the frequency-modulation input tube is provided by transmitter switch 261b. For teletype-operation signal reception a special receiver must be installed, having output circuits connected not to lines "K" and "L", but directly to the teletype apparatus. 50X1

PRO or VPS microphone-operation is perfomed with tumbler 138 or 114 in position "Radio".

The remotely located post is supplied with a dynamic-loudspeaker amplifier (Diagram 27) to provide for loudspeaker reception of the correspondent both during intercom conversations or radio operation. [p 60]

The amplifier has two stages. Tube 222 (6Zh8) operates in the first stage and is hooked-up to the resistance circuit. The audio voltage is admitted from plate-loading resistor 228 through separating capacitor 230 to the control grid of output tube 231 (30 PIS beam tetrode). The output tube supplies power to transformer 235 which is loaded for a dynamic loudspeaker. To lower the nonlinear distortion, both stages are encompassed by a negative feedback voltage which is taken from a part of the secondary of the output-transformer and supplied to the cathode of the first tube (-222).

Voltage from lines "K" and "L" is applied to input transformer 236 from the VPS through relay 141. To avoid acoustic feedback between both the microphone and the dynamic loudspeaker, the relay shunts the amplifier input when the microphone is turned on--(when the press-to-talk lever is pressed).

The amplifier power supply comes directly from the 110, 127, or 220-volts DC or AC current network.

With the 127 volt AC network, the plate voltage comes from the selenium rectifier 240 which has been fitted together with the amplifier and dynamic loudspeaker into one jacket. Part of the primary winding of the output transformer is used as a filter choke coil in tandem with resistor 234. Thus the plate circuit of output-tube 231 is suppled with power from the choke coil, but because of the specially calculated number of turns in both parts of the transformer primary, the AC background voltage which is induced in the transformer secondary from plate portions 3-5 of the primary, is compensated by an equal voltage (out of phase 180 degrees) from the second half of the winding 1-3.

With the 110-volt DC network, the plate voltage is supplied directly from the network through the very same filters 238, 235, 234, and 227, by passing the selenium rectifier. Now it is important to watch the network polarity. 50X1

The tube filaments in all cases are fed directly from the network, and the filaments are connected in series; the excess voltage is consumed by resistor 242 and inductor lamp 243 which is shunted by resistor 244.

With the 220-volt network, the excess voltage is consumed by resistor 248.

The chassis of the dynamic-loudspeaker amplifier is isolated from the supply network.

V. DESCRIPTION OF CONSTRUCTION

[p 61]
50X1

General Information

Structurally, the transmitting section of the radio set consists of:

1. the transmitter, mounted over the rectifier;
2. the rectifier.

In addition to the transmitting section, the following pieces of equipment, installed separately, are included in the radio set:

1. control panel and modulating equipment;
2. radio operator position (PRO);
3. remotely located position (VPS);
4. telegraph key;
5. quartz-heating element;
6. a DC-to-AC converter consisting of a DC motor, a three-phase AC generator, and a voltage stabilizer, installed on a common frame;
7. power supply panel with ship circuit switch;
8. SML-2001 21A1 / 22A2 type automatic starter; and
9. RZV-21-A type generator-excitation rheostat.

Overall dimensions and installation space of all equipment making up the radio, as well as the weights given in the wiring and installation diagram, are included in this description.

The Transmitter

The transmitter consists of 5 pull-out units, installed on a common frame.

The main frame can be taken apart in 4 pieces for the purpose of passing the transmitter through the ship's hatches.

The transmitter is installed on the cabinet of the rectifier on 8 rubber cushions; in addition, there are 2 cushions on the after wall of the frame to further secure the transmitter to the bulkhead of the ship. The chassis of the rectifier, on 8 rubber cushions, is secured to a special frame having an opening for fastening to the deck.

A description of the individual units of the transmitter follows.

Unit No. 1 [p 62] 50X1

Here are located the thermostat with the master oscillator and dial and the 2nd stage.

The after section of the chassis is occupied by the 1st stage with the optical dial, the drive gear for the band-selector switch, and the knob of the optical dial.

In the forward section of the chassis, near the front panel, is the 2nd stage of the driver, consisting of a ceramic variometer, ceramic capacitors, a switch, and a GU-50-type tube.

On the right side of the forward section of the chassis is the motor for the circulating heating system.

On the forward panel of the chassis are the:

1. tuning knob for the 1st and 2nd stages and the knob catch;
2. frosted glass of the optical dial;
3. coarse tuning dial;
4. thermostat indicator light;
5. thermostat toggle switch;
6. socket for telephone to monitor frequencies;
7. socket for plugging in to measure plate currents of the 1st and 2nd stages; and
8. dial light toggle switch.

A description of the master equipment of the 1st stage follows.

In order that the master oscillator frequency be highly stabilized, the master oscillator has the following features in its construction:

1. The housing of the master oscillator is made of a ceramic material, and shielding of the inner parts is done by means of a metallic coating of the internal surface of the housing.

2. The variometer of the master oscillator is ceramic. The windings of the stator and rotor are applied by a method of burning-in with subsequent electrolytic plating with silver.

3. The circuit capacitors are ceramic and hermetically sealed.

4. The conductors and capacitors with fixed capacitance have ceramic supports with metal bands for their soldered connections.

5. A spring-type switch is located on the ceramic base. The spring is contracted by means of cams soldered to a ceramic shaft.

The path of the bearing tip of the cam has a circular shape, described from the center of the axis of rotation, thus ensuring a stationary position of the contact springs even for a slight error in the positioning of the switch shaft. 50X1

When the spring is released, it rests on a special bearing, so that again a stationary position is ensured.

6. A circulating heating system for the circuit, with an external heating element, is used. [p 63]

The heated air is circulated by means of a vane which is rotated by an electric motor installed on soft rubber pads on the chassis of the unit.

7. The shaft of a variometer has 2 bearings. One of them, a thrust bearing, is located between the variometers of stages 1 and 2 and is rigidly secured to the wall of the ceramic housing. The second bearing rests in a yoke attached to a flat rectangular spring. The latter is secured to the housing and exerts tension along the axis, thus taking up the play in the ball bearings.

8. The safety stop is in the form of a bronze disc, located on the ceramic shaft of the variometer, and a steel clamp attached directly to the ceramic housing.

Continuous tuning control of the 1st and 2nd stages is accomplished separately from the tuning control of the 3rd and 4th stages. For purposes of simplifying the tuning of the transmitter, beside each figure indicating the frequency on the coarse tuning dial is another number (in red) for setting the drive mechanism to the variometers of stages 3 and 4. Stage 5 has a separate turning knob and dial.

The course tuning dial is a 12-position drum-type. It and the switches for the 1st and 2nd stages are controlled by the common knob of the band-selector switch located on the forward panel of Unit No. 4.

On the upper part of the dial is indicated the number of the particular subband.

The optical dial is mounted on a cast support attached to the ceramic housing and consists of an illuminating bulb, a capacitor, a lens, and two mirrors, one of which rotates.

The latter is connected to the switch of the master oscillator by a special lever arm, by means of which the selection of the desired subband appears on the frosted glass of the dial.

Unit No. 2

50X1

Unit No 2 is divided (cast partition) into 2 sections.

In the first section (near the forward panel) are located the circuit and tube of the 3rd stage. The circuit of the 3rd stage consists of a variometer and ceramic capacitors. Switching of the capacitors is accomplished by a spring switch.

In the second section is the circuit and 2 tubes of the 4th stage. The circuit of the 4th stage consists of 2 variometers and ceramic capacitors. Switching of the capacitors is done by means of a spring switch, as in the case of the 3rd stage.

Both spring switches are activated from a common shaft by means of a connecting rod.

On the forward panel are the: [p 64]

1. knob for the tuning control of the 3rd and 4th stages and the safety stops;
2. jacks for plugging in instrument to measure grid and plate currents;
3. milliammeter for the control grid of the 5th stage.

Master control of particular subbands is accomplished from a common control knob, as in the case of the first unit.

The worm drives to the variometers of the 3rd and 4th stages have a reduction ratio of 1 : 16.

The construction of the drive is such that the rotors of each variometer can be installed separately. This work is done at the factory during the gang-tuning of the 3rd and 4th stages.

Shifting the individual rotors of the variometers during operation is STRICTLY PROHIBITED.

Unit No. 3

Unit No. 3 contains:

The power stage, capacitive potentiometer connected to the antenna circuit, and switch for the capacitive potentiometer.

The power stage consists of 2 parallel connected GU-80 types tubes operating in two circuits comprising 2 variometers and mica capacitors connected in series with the antenna-coupling potentiometers.

On the forward panel of the unit are the:

50X1

1. tuning knob for the 5th stage;
2. knob for the antenna-coupling switch;
3. ammeter for measuring the plate current of the 5th stage;
4. jacks for plugging in the instrument to measure screen grid currents; and
5. peep hole for observation of the anode of the tube in the power stage.

Unit No. 4

Unit No. 4 contains the antenna circuit, consisting of a variable inductance coil with a slide contact, ceramic capacitors and capacitor switches.

On the forward panel of the unit are the:

1. antenna circuit tuning knob;
2. knob for the series-connected capacitor switch;
3. knob for the parallel-connected capacitor switch;
4. tuning indicator for antenna circuit; and
5. knob for the master control switch of all stages.

Unit No. 5

[p 65]

Unit No. 5 contains the quartz driver.

On the forward panel of the unit are the:

1. Jack for plugging in "Kh" components;
2. knob of switch for mode of operation;
3. thermostat toggle switch;
4. thermostat indicator light; and
5. button duplicating the telegraph key.

A vertical cast partition divides the 5th unit into two sections. In the first section (on the side of the forward panel) in the immediate vicinity of the thermostat of component "Kh" are located the quartz driver (6Zh7) and an MRS-44 type keying relay.

In the upper part of the second section are a GU-50 amplifier tube, two 6N7 tubes, and a TRM-43 A common keying relay. In the lower part are the switch for mode of operation, a plate with resistors, and a cut-in relay for supplying power to the winding of the quartz thermostat (RMU type).

Control Switching

50X1

The electrical system of the transmitter is such that the frequency band for the 1st and 2nd stages is divided into 4 subbands, while the band for the 3rd, 4th, and 5th stages has 3 subbands.

The knob of the subband selector switch is located on the forward panel of the 4th unit. To the main housing behind the forward panel of the 4th unit is attached a clamping device. A shaft extends from the main control knob toward the after side of the transmitter, where a drive gear for the switches in the 1st, 2nd, and 3rd units is located. [p 66]

The principle upon which the drive gear operates is as follows:

When the main shaft is turned (positions for every 90°) from the 1st position to the 2nd, 3rd, and 4th, only the switches of stages 1 and 2 (in Unit No. 1) turn.

When the main shaft is turned from the 4th to the 5th position, the "Maltese Cross" of the transmitting mechanism shifts position, as a result of which the switches of stages 3, 4, and 5 (in Unit Nos. 2 and 3) change from the 1st to the 2nd position.

When the main shaft is turned to positions 6, 7, and 8, only the switches of stages 1 and 2 turn, repeating positions 2, 3, and 4.

When the main shaft is turned from the 8th to 9th position, the "Maltese Cross" again turns, and, consequently, the switches of the 3rd, 4th, and 5th stages turn.

Positions 8, 10, 11, and 12 in the 1st and 2nd stages are similar to positions 1, 2, 3, and 4.

The Cooling System

The transmitter and rectifier have a common forced air cooling system.

A current of air is passed through the cooling unit in the following manner:

a) Unit No. 3 - The current of air, passing through air filters located on the left side of the cabinet of the transmitter, cools the variometers, switches, and coupling capacitors, and then goes out into an air tank through openings in the upper part of the housing. From there the air goes through an exhaust pipe into the intake of the blower or into the ship's main ventilating system.

b) Unit No. 4 - The cooling action of the air in this unit is similar to that for Unit No. 3, except that there is only one air filter, located on the right side of the transmitter; and since the amount of the heat liberated here is considerably less than that in Unit No. 3, the amount of air passing through Unit No. 4 can be correspondingly less. 50X1

c) The rectifier - A current of air passes through filters located on the front panels of the two lower units and then through the units proper leaving by way of a special pipe connecting the main housing of the rectifier with the air tank of the transmitter.

There are two vents on the tank: one circular, on the upper part of the tank; and the other rectangular, on the left side.

Either on the above mentioned vents is used to exhaust the air, depending on which one is more suitable for the exhaust pipe. The vent which is not in use is plugged.

Removal and Replacement of Transmitter Units

To remove a unit of the transmitter, it is necessary to take out the 4 bolts at the corners of the front panel. In Unit No. 4, in addition, it is necessary to take out the screw holding the knob of the band-selector switch. Then the unit can be removed.

No special measures are required in replacing Units 4 and 5.

It is mandatory that the following rules be observed in replacing Units 1, 2, and 3 in the main housing:

1. Place the subband selector switch in the first position by turning the control knob in a counterclockwise direction up to the stop.

In this position the red marks on contactor sleeves 1A, 2A, and 3A must coincide with corresponding red marks on the housing.

2. In Unit No. 1 the red mark on connector sleeve 1 must coincide with the red mark on the housing of the unit and, at the same time, the lever arm of the rotating mirror of the optical dial must be in the highest position (on pivot No. 1).

3. In Units 2 and 3 the red marks on connector sleeves 2 and 3 must coincide with the corresponding marks on the housing of the units. [P 67]

The units go into position easily when these rules are observed. Failure to observe them can lead to detuning of the circuits or even to breakdown of individual components of the transmitter.

Dismantling and Assembly of Main Housing of Transmitter

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Dismantling of the main housing can be full: i.e., in 4 pieces; or partial, in 2 pieces. Full dismantling is necessary only for the purpose of passing the radio set through the ship's hatches.

It is recommended that when the housing is dismantled in two pieces, the operation be done horizontally: i.e., remove the lower section, with Units 1, 2, and 5, and then the upper section, with Units 3 and 4.

The Remote Unit [p 68]

The control desk

The radio-station control devices are assembled as a separate unit -- the control desk; the modulation unit is also there.

The control desk is a cabinet placed on a table; it is equipped with shock-absorbing cushions. The control devices and the modulation unit are mounted on separate pull-out chassis:

a) the desk chassis (upper) and
b) the modulator chassis (lower).

On the front panel of the desk chassis are:

1. on and off buttons for the transmitter tube filaments;
2. the high-voltage tumbler switch;
3. the switchover tumbler for the microphone ("intercom-radio");
4. the half-duplex tumbler;
5. the transmitter power-regulating knob;
6. the switch-knob for mode of operation;
7. the signalization lamp for the transmitter-tube filaments (green color) and high voltages (red color);
8. the lamp which signals a call from the switch board; and
9. the switch board call button.

On the front panel of the modulator chassis are:

1. the regulating-knob for the degree of modulation;
2. the regulating-knob for signal strength monitoring; and the
3. Percentage-modulation meter.

External equipment can be hooked up to the back of the control desk [p 69] at a general terminal block, where connections are made withthe terminal sockets of the desk and modulator chassis. On the right side of the cabinet is a handset, the lever of which is connected to the jack switches on the inside wall of the chassis.

50X1

The Remote Station (VPS)

The remote communication station is enclosed in a cast chassis which has an air-tight lid.

The front panel with the instruments mounted on it is hinged.

The hand set arrangement is similar to that on the control desk, however, it has an additional telephone.

On the front panel of the VPS are the:

1. on and off buttons for the transmitter tube heaters;
2. high-voltage toggle switch;
3. microphone change-over switch ("Intercom-Radio");
4. signal lights, one for turning on heaters of the transmitter tubes (green light), and the other one for high-voltage (red light);
5. light signaling a call from the switchboard;
6. button for ringing the switchboard; and
7. jack for connection of the telegraph key.

The outside wiring leads in through air-tight ducts in the lower portion of the chassis.

The wires are connected to the terminal block inside the chassis.

The Radio Operator Station (PRO)

The radio operator station is similar in design to the remote station except that it does not have an air-tight cover.

The front panel of the PRO contains the same instruments as that of the VPS, however, instead of the jacks for the telegraph key it has two additional switches:

1. half-duplex toggle switch ("on-off"), and
2. toggle switch for disconnecting the outside telephone line and the monitoring of the intercom telephones.

The Power-Supply Panel

The power-supply panel belongs to the supplementary power-supply equipment which supplies power to the radio-station from the DC power source.

The front panel contains the following instrumen

50X1

1. the power-supply switch;
2. the signal lamp for the power supply ("Right side", "Left side");
3. the voltmeter and ammeter of the power-supply;
4. the start and stop key of the electric motor;
5. the power-supply fuses;
6. the SML starter fuses in the line-contactor signal-bulb circuit, and the fuses in the thermostat warm-up circuits.

VI. Instructions For Tuning and Servicing the Transmitter

Proper performance of the transmitter can be ensured only when one has a clear understanding of the elementary manipulations which must be made during the retuning from one wavelength to another, a change of operating mode, the turning on and off of the transmitter, the exact tuning in to the desired frequency, etc.

Information on correct tuning of the transmitter during the continuous-range operation, quartz operation, as well as information on change of operating mode and so on, is given below.

A. Continuous-Range Tuning of Transmitter

If maximum accuracy is required in obtaining and maintaining a transmitting frequency, then 2.5 to 3 hours prior to operation it is necessary to turn on the thermostat heater in Unit 1 in order that all parts of the circuit of stage 1 which determines the frequency attain the temperature at which the master oscillator was calibrated.

The following steps are necessary to put the transmitter into operation:

1. place the rectifier knife switch for the power supply in position 1 or 2, depending on which side AC voltage is supplied (while machines are in operation);

2. press the button on the control desk to turn on the filaments of the transmitter tubes;

3. select the required frequency band withthe band-selector switch;
4. obtain the desired frequency with the fine tuning dial;
5. place the switch in Unit 5 in the "Continuous Range" position;
6. place the high-voltage switch in the 1st component of the rectifier in the "Tuning" position; then place the "Mode of Operation" switch on the control panel in the "NZT" position, turn on the high voltage, and press the key;

7. with tuning knob of the 3rd and 4th stages adjust the circuit for maximum current in the control grid of the 5th stage; in order to eliminate errors in tuning the intermediate stages, the graduations on the knob of the 3rd and 4th stages should be checked against the red numbers on the coarse tuning dial on Unit 1; [p 71] 50X1

8. with the tuning knob of the 5th stage adjust the intermediate circuit for minimum plate current of the 5th stage (antenna switch in position 1);

9. Increase the degree of antenna coupling by several positions and tune the antenna circuit for maximum reading of the antenna testing instrument or the plate testing instrument;

If tuning is not attained, experiment with different combinations of switch positions for the series-connected and parallel-connected capacitors in the antenna circuit. When the antenna has been tuned, adjust the degree of antenna coupling so that the plate current does not exceed much 0.5 amperes and a small detuning of the antenna circuit will not cause a detuning of the intermediate circuits.)

10. turn off the high voltage and place the high-voltage switch on the 1st component of the rectifiier in position "Operate;" Turn on the high voltage;

11. press the key and test the tuning adjustment of the antenna and intermediate circuits;

12. obtain a plate current of 0.7 to 1.0 ampere (covered by the red sector on the dial) by adjusting the degree of coupling; and

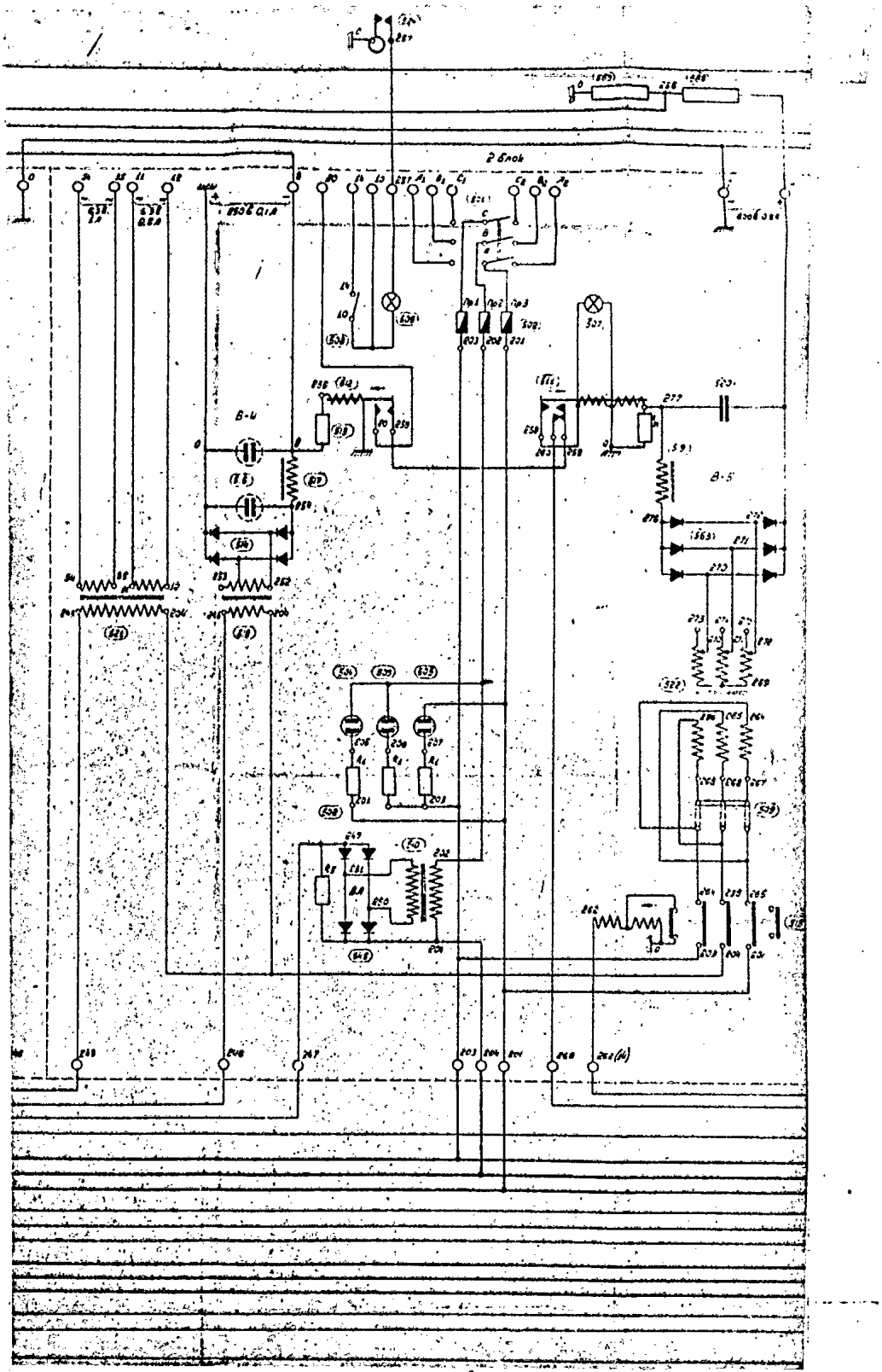
13. begin operating.

NOTE: When a tuning album is available, the settings for the knobs of the antenna circuit and antenna coupling should be made as indicated in the album.

B. Operation in Telephone Mode

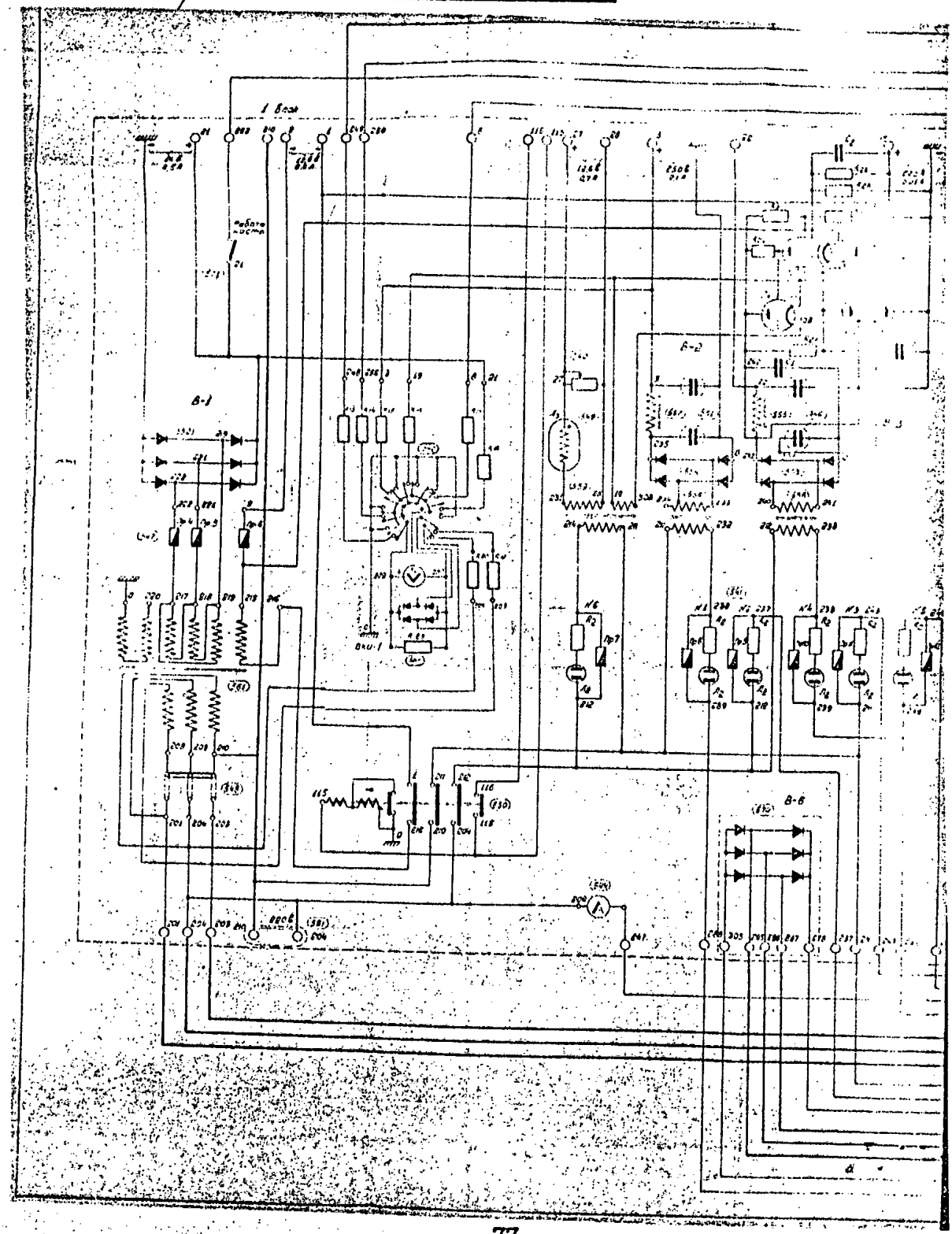
1. Tune the transmitter as indicated in Section A.
2. With the switch for the type of operation in the "NZT" or "TON" position, take the handset, press the button on it, and begin to transmit.
3. For operation in voice-frequency telegraph, the switch for the mode of operation should be placed in the "TON" position.
4. For facsimile operation, the switch for the mode of operation should be placed in the "VN. MOD" position.

[p 71a] **Circuit Diagram of the VSR-3 (left side)**

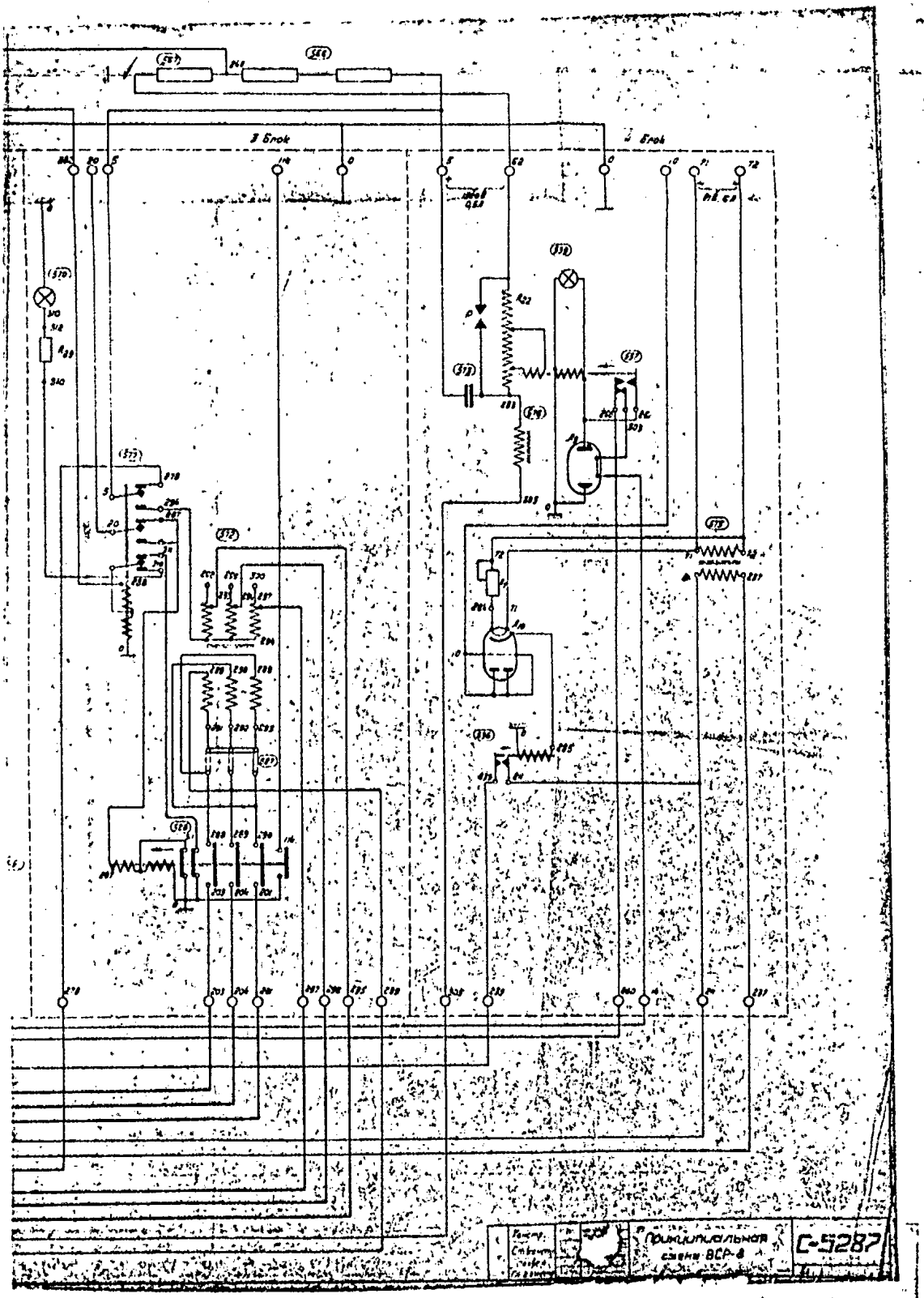


50X1

- [p 71b] Circuit Diagram of the VSR-3 (center)



[p 71c] Circuit Diagram of the VSR-3 (right_sid



S-E-C-R-E-T

No Foreign Dissem

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NOTE: Percentage-modulation can be determined by the needle of the modulation indicator or by monitoring one's own receiver.

To stop the operation, turn off high voltage at the PU and press the "Stop" button, then switch off the rectifier circuit switch and stop the apparatus. [p 72]

V. Adjusting the Transmitter for Operation with Crystals

Depending on requirements and accuracy of the crystal frequency, operation is possible by preheating of without preheating the thermostats.

The order of tuning of the transmitter with crystal oscillator must be as follows:

1. select element "Kh" for required frequency and place it into element V;
2. set the selector switch, in Unit V, in position "Crystal";
3. set the band selector to correspond with the required frequency;
4. with the tuning knob in Unit I, adjust the circuit of the second stage for maximum current in the circuit of stage three;
5. adjust stages three and four for maximum current in the control grid of stage five;
6. adjust stage five circuit for minimum plate current;
7. tune the antenna circuit and adjust the coupling with the antenna; and
8. switch to full plate current by putting the high-voltage selector knob in position "Operation".

G. Tuning the Transmitter While Operating with Frequency-Modulating Driver

The transmitter is tuned in the same manner as when operating with crystal.

The selector switch, however, must be placed in position "VChM".

The signal from instrument ST-35 is supplied to control desk terminals 18 and 0.

NOTE: During operation of the "VChM" it is necessary to set the half-duplex toggle switches 127 and 92 to the off position.

VI. Instructions for Operation from the Two Other Positions

A. Operation with PRO

1. Switch the microphone toggle switch to "Intercommunication" and the monitoring toggle switch to "on". Remember, that during intercommunication the monitoring switch must always be on.

2. Remove the hand set and press the call button. Having received an answer fromthe switchboard, carry on conversation. [p 73]

3. If you wish to speak to another subscriber of the system, ask the switchboard to ring and connect you with him, then carry on conversation.

4. If you are being called, which will be known by the glow of the call light and by the sound in the telephone, switch the microphone toggle switch to "intercommunication" and the monitoring switch to "on," then remove the hand set and answer the call.

5. During reception on a wave length different from that of transmission, or during a prolonged reception, set the half-duplex toggle switch on "on".

6. During a prolonged reception, set the monitoring toggle switch on "off". Remember that during intercommunication the monitoring toggle switch must be in position "on".

B. Operation with VPS

With telegraph

1. Switch the microphone toggle switch to "Intercommunication". Remove the hand set and press the call button.

2. Having received an answer from the switchboard, request specific frequency and mode of operation, then hang up the hand set and switch the microphone toggle switch to "Radio".

3. When the transmission signal has been received, press the "start"button. A green light will go on. After 20-25 seconds switch the high voltage toggle switch on "on". A red light will go on, after which transmission may be started.

4. After finishing transmission, return the high voltage toggle switch to position "off"; the red light will go out.

5. Having completed communication, press the "stop" button; the green light will go out. Transmitter is now completely turned off.

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With telephone

1. As soon as the transmission signal has been received, switch the microphone toggle switch to "Radio".

2. Press the "Start" button - a green light will go on; remove the hand set - a red light will go on, after which transmission may be carried on.

3. Press the flap on the hand set and speak into the mike.

Having finished speaking, release the flap and listen to the reporter's answer.

4. Having completed communication, hang up the hand set; the red light will go out. Press the "Stop" button; the green light will go out. The transmitter is off.

VII. Operating Instructions [p 74]

a) Before switching on the transmitter, check the transmitter and rectifier grounds.

b) When testing units outside the chassis, use cables in strict conformity with the unit numbers.

c) It is strictly forbidden to turn trimmers of any stage, and especially the trimmer of the crystal.

d) Adjusting the keying relay TRM-43 A is not allowed. The keying relay of the crystal undergoes at the factory a thorough adjustment for high-speed operation.

e) During operation of the transmitter do not permit overheating of GU-80 tube plates. Critical heating of the plates produces a dark cerise color. In the event of plate overheating:

1. Reduce the coupling with the antenna; and
2. fine-tune the circuit of stage five.

f) It is strictly forbidden to operate for more than 10 minutes without ventilation.

g) The optical indicator light should be switched on only when the frequency is being adjusted.

h) Handle the equipment with care.

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To protect the transmitter from dust during operation of the blower, the air is sucked into the transmitter through special dustproof filters made of multilayer metal screens.

For better filtration of the dust, filters should be dipped in liquid mineral oil.

When the filters become dirty, they should be washed in kerosine.

After the washing and drying of the filters, they must again be oiled by immersion into liquid oil.

The dust collecting on components inside the units may cause undesirable leakages and breakdowns. Units should be checked periodically and the dust removed fromthe components with a brush, a clean rag, or compressed air.

Table of Approximate Currents for the Telegraph Mode of Operation [p 75]

Stage	Plate current in ma	Control Grid current in ma	Screen Grid current in ma	Screen Grid Voltage and Grid Supply Voltage
I	14 - 35	-	-	220
II	30 - 70	-	-	250
III	10 - 90	0 - 4.2	-	250
IV	50 - 180	0 - 7.0	-	250
V	700 - 1000	8 - 40	70 - 180	600
V (TEF)	350 - 500	8 - 40	70 - 180	600