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[redacted]

[redacted] English-language, Soviet manual on a naval radar scope entitled Plan Position Repeater (PPR): Description and Operating Instructions [redacted] The manual consists of 77 pages plus diagrams. Pages 1, 7, and 45 are missing. No date or publishing data appeared in the manual. Although the radar for which the PPR is designed is not identified in the manual, ranges of 5, 20, and 75 miles are given. The radar may be the HIGH SIEVE.

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INFORMATION REPORT INFORMATION REPORT

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PLAN POSITION REPEATER (PPR)
DESCRIPTION AND OPERATING INSTRUCTIONS

(English Language)

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PLAN POSITION REPEATER (P.P.R.)

DESCRIPTION AND OPERATING INSTRUCTIONS

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PREFACE

The plan position repeater (P.P.R.) is designed for observation of the area surrounding the set, for measurements of bearing and range and for determination of target position data.

The P.P.R. screen, like the screen of the main display unit of the warning radar, presents the picture of the aircraft or ships in the area surrounding the ship.

The description of the equipment gives an idea of the performance and design of the P.P.R. (as a whole and of its individual units); it also contains diagrams and lay-outs which are necessary both for studying the design and operating the equipment, as well as for its adjusting and tuning. All figures in circles correspond to reference numbers of the elements in the key diagram and in the component schedule.

The Operating Instructions give principal information on tuning and adjustment of the equipment, its maintenance and inspection.

Since P.P.R. sets supplied from the ship's D.C. or A.C. mains are circuit-connected in the same manner, reference numbers of controls for a P.P.R. set operating from an A.C. mains are given without brackets, while reference numbers of sister elements of a P.P.R. set operating from a D.C. mains are given in brackets.

The following designations are used in the Description and Instructions for P.P.R. units:

MU (БМ) - Motor Unit
TU (БТ) - Tube Unit
RSS (ВСВ) - P.P.R. Rectifiers and Signal-Selector Unit
RU (ДВ) - P.P.R. Range Unit
CP (ПУВ) - P.P.R. Control Panel
GCR (ЗК) - Gyro Compass Repeater
PD (ЗУ) - Protection Device
TDS (ЦУ) - Target Designation System

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PART I

D E S C R I P T I O N

Chapter I

GENERAL INFORMATION

Designation

The plan position repeater (P.P.R.) is designed for presenting the picture of the aircraft and surface targets, for determining the target range and bearing, and target designation.

The P.P.R. reproduces echo signals from targets and local objects, coming from radar stations detecting air and surface targets.

Component Units

The P.P.R. includes a foot pedal switch (device No.12), junction box (device No.7) designed for serving five P.P.R.sets and spare parts.

The device uses monitoring and measuring instruments provided with the radar station set.

The P.P.R. is fed from power units of the radar station through the junction box.

Brief Specifications

Range scales .... 5, 20 and 75 miles
Diameter of display tube ..... 229 mm (9 inches)

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Scale of bearings	Fixed; graduated from 0 to 360° (the value of one division is 1°); the scale has markings of the four cardinal points (N,S,O,W).
Scale of relative bearing	Movable; stabilized according to the course; graduated from 0 to 180° for every side; the value of one division is 1°.
Range measurement	Provided by movable range marker; range indication is provided by 5 fixed calibration rings.
Bearing measurement	Provided by bearing cursor with scale of relative bearing and bearing.
Target range and bearing accuracy:	
for range	2% of the maximum range in use
for bearing	1°
Resolution in range	2 cables
Transmission of target designation data:	
for relative bearing............	by coarse transmitting selsyns with a turn value of 6,000 mils, and

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	by fine transmitting selsyns with a turn value of 200 or 100 mils
for range	by a transmitting selsyn with a turn value of 600 or 300 cables.
Maximum feeder length	250 m.
Time required to start the equipment after it has been fully switched off	1 min.
Continuous operation time	24 hours
Power consumption..............	230 W
Overall dimensions	760x570x1335 mm
Weight	250 kg.

P.P.R. Design

The plan position repeater is made as a separate spray-proof set.

The set housing, front and side covers are cast. Its back is covered with sheet duralumin.

All princip l controls and regulators are on the top cover which is at the same time the control panel. In the centre of the top cover there is an opening for viewing the screen of the cathode-ray tube. The tube screen is provided with a viewing hood for shading it in daylight. For convenience in servicing the top cover is inclined by 15°.

On the set front there are range, bearing and course matching handwheels.

The front opening lid has the range selector knob connected by a rod with the switch itself located in the RU unit.

All the elements of the system are combined into units and placed inside the housing.

All control and adjustment devices are under the upper cover (control panel).

The set top part houses the display tube unit TU consisting of a cathode-ray tube, type 23ЛМ34, focussing and scanning coils, drive elements for rotating the scanning coil, tube framing, thermoswitch and matching mechanism.

In this part are also placed: the signal-selector range potentiometer, power transformers for the 310 V and 415 V D.C. rectifiers, as well as the transformer of the tube heater circuit and of the signal-selector valves.

The RSS and RU units are arranged in the central part of the set.

The RU unit contains the main elements of the circuits of signal discrimination, electron relay ([illegible]-relay), circuits of scanning, calibration, amplifier of target echoes and identification signals, as well as the first four stages of the signal-selector circuit.

The R.S.S. unit contains the rest of the stages of the signal-selector circuit, P.P.R. supply rectifiers and the tube interlock circuit.

The motor unit is situated in the lower part of the set.

Access to the elements of the set is provided through the front door, the upper hinged panel and removable side lids.

For providing access to the wiring, the RU and RSS units are made tilting and sliding. The range potentiometer is accessible through the removable cover fastened with six screws to the centre of the unit front.

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The elements of the synchronous coupling system are arranged in the MU unit and separated from the indication equipment. The control handwheels and the motor unit elements are connected with the aid of universal joints so that after drawing out the RU and RSS units no matching is necessary.

Device No.7 is a cast box.

On the front cover, which serves as a panel of the set there are switches, pilot and neon lamps. The front cover is hinged and can be easily swung open to provide access to the interior part and to the wiring of the set. On the inside of the unit back side the fuses are situated. For leading in cables the housing has eight glands.

The foot pedal switch (device No.12) serves to indicate that the P.P.R. is transmitting data to the target designation system.

Chapter II

PRINCIPLE OF OPERATION

Block Diagram of P.P.R. Display Unit

The block diagram of the P.P.R. display unit is shown in Fig.1.

Mixed trigger pulses and target signals are applied from the main display unit of the radar station via the relaying unit along the common feeder to the inputs of the target signal amplifier and signal separation circuit. The circuit of the target signal amplifier is arranged in such a way as to amplify positive and cut off negative pulses. The amplified target signals and the ship's head signal are applied to the grid of the display tube and appear on its screen in the form of bright marks.

The signal separation circuit is designed for amplifying negative trigger pulses.

The amplified negative trigger pulses are fed to the circuit of the electron relay which operates from every trigger pulse (427 times per second), each time producing two pulses:

(a) a pulse of negative polarity for triggering sweep generator of the display tube, the generator of sawtooth voltage and the generator of calibration pulses;

(b) a pulse of positive polarity applied to the accelerating grid of the display tube for intensifying the forward travel of the beam.

Depending on the setting of the range switch for 5, 20 or 75 miles both pulses coming from the Kipp-relay have a duration of 115, 350 or 1,100 microseconds, respectively.

The sweep generator of the display tube contains one normally open valve. When the negative pulse is applied from the electron relay to its grid, the valve is cut off and due to the presence of capacitors, which shunt the anode of the valve to the earth, and capacitors, switched on when the ranges are changed, the voltage on its anode grows exponentially.

The initial (almost linear) part of this growing voltage is used for the display tube sweep and fed to the grid of the sweep amplifier.

The anode circuit of the sweep amplifier includes the scanning coil of the tube. Thus, the sawtooth current

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pulses generated in the anode circuit of the sweep amplifier with a duration corresponding to the selected range, cause radial deflection of the electronic beam on the screen of the tube from the centre to the edge of the screen. Since the scanning coil rotates round the tube axis in step with the aerial of the radar station, at every given moment the position of the sweep trace on the tube screen corresponds to that of the aerial in the space.

The generator of calibration pulses and the subsequent stages serve for producing calibration marks on the sweep trace every 1,4 or 15 miles for the ranges of 5,20 or 75 miles,respectively. The generator is a normally open valve whose cathode circuit includes one of the impact excitation circuits producing, when the valve is cut off, damped oscillations with a cycle duration of 12.2, 48.8 or 183 microseconds for the ranges of 5,20 or 75 miles,respectively. The purpose of the three subsequent stages is to convert these damped oscillations into acute positive peaks of 2-microsecond duration which coincide in time with the moment at which the value of voltage in the circuit of impact excitation becomes equal to zero.

The produced 2-microsecond pulses are fed to the circuit of the mixer of calibration and strobe pulses. The common anode load of both valves of the mixer develops:

(a) negative calib ation pulses fixed in time with respect to the starting point;

(b) negative strob pulses with a variable timing depending on the setting of the signal-selector range potentiometer. When fed to the cathode of the display tube, they lower the potential on the cathode and bring it closer to the potentials on the grid and accelerating electrode, thus increasing for a moment the brilliance of the image on the tube screen.

Therefore, a number of bright spots appear along the sweep trace. When the scanning coil is rotating, these spots merge into luminous concentric circles. The fixed circles are the calibration rings obtained owing to the operation of the calibration generator circuit, and the two movable circles which are close to each other, are the strobe rings. The distance between the strobe rings and the centre of the screen varies according to the range setting and is achieved with the signal-selector range potentiometer.

The signal-selector circuit with all auxiliary stages serves for producing two signal-selector pulses which provide coarse measurements of the target range.

The negative pulse of the electron relay cuts off the normally open valve of the sawtooth voltage generator. Simultaneously one of the capacitors is being charged. This capacitor is switched into the anode circuit of the valve with the range selector switch. The voltage on the capacitor rises exponentially with time.

The initial (almost linear) part of this growing voltage is supplied to the signal-selector stage, where it levels with the voltage coming from the potentiometer slider.

The voltage supplied from the potentiometer depends on the position of its slider.

The range potentiometer feeds a voltage equal to the voltage on the capacitor of the sawtooth voltage generator. At this time the normally non-conducting valve of the signal-selector stage opens abruptly. The signal-selector pulse produced at the moment of valve opening, is fed via the cathode follower to the circuit where a pulse of 4.6-microsecond duration is obtained. The negative signal-selector pulse cuts off the normally open valve, whose anode circuit includes the circuit of impact excitation with a frequency of 107 - 108 Kc/s.

For controlling the next stage, the first positive half-wave of the oscillations produced by the impact excitation circuit is used. As to the first negative half-wave, it is extinguished owing to the shunting effect of the operating diode. Thus, whenever the valve is cut off one voltage pulse of 4.6-microsecond duration is taken from the circuit.

This pulse is applied to the next stage, whose output feeds a negative pulse almost of the same duration to produce strobe pulses.

This negative pulse of 4.6-microsecond duration cuts off the valve, whose anode circuit includes the circuit of impact excitation with a frequency of 323 - 325 kilocycles. During 4.6 microseconds while the valve is blanked, three half-waves of oscillation are developed in the circuit, of which two are positive and one - negative. When the 4.6-microsecond pulse is no longer applied, further oscillations in the circuit stop due to the shunting effect of the open valve. The two positive half-waves are applied to the grid of the cathode follower and from its cathode resistor they are fed to the mixer circuit.

Thus in every cycle the circuit of strobe pulses generates two positive pulses which, via the mixer, are fed to the cathode of the display tube. The generation of these pulses is strictly timed with that of the signal-selector pulse. Therefore, when the whole circuit of the set is operating, these pulses produce two strobe rings, whose position is invariable with respect to each other but can be varied with respect to the centre of the tube screen by turning the knob of the signal-selector range potentiometer.

When the strobe rings on the tube screen coincide with the target echo so that the latter appears between the rings, the target range is read on the scales connected with the range handwheel. Since the sweep time becomes longer as the range grows, the strobe pulses practically merge into one, when the set operates at the 75-mile range.

Kinematic Diagram of the Set

The kinematic diagram of the P.P.R. is shown in Fig.2.

It was already mentioned in the description of the P.P.R. display unit block diagram that, when the operator turns the range handwheel, the latter drives, through a mechanical gear, the slider of the range potentiometer, and the markers of measuring strobe pulses travel along the sweep trace of the indicator screen.

Besides the range potentiometer slider this handwheel is connected, through a mechanical gear, with two range computers and transmitting selsyn 203.

The gears are selected in such a way that, when the strobe pulses are brought in line with the target, one of the computers shows range in hectometers and the other in navigation cables. Simultaneously the transmitting selsyn 203 is triggered, which transmits the range value in artillery cables to the target designation receiving selsyn.

The system is provided with a mechanical stop which prevents continuous rotation of the range handwheel in the

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same direction, thus protecting the range potentiometer from damage.

The mechanical stop makes it possible to turn the handwheel within the limits of from 0 to 750 artillery cables.

The arrangement of the system provides for two speeds of rotation of the handwheel with a turn value of 10 or 40 cables.

The scales arranged concentrically as regards the P.P.R. tube screen make it possible to take readings of the ship's own course, target bearing and relative bearing.

The target bearing is read off the fixed scale provided with N,S,E,W markings, as an angle between the N-marking on the fixed scale and the cursor which can be turned to coincide with the target image on the tube screen. The target relative bearing is read off the movable scale, as an angle between the zero-marking of the movable scale and the cursor. The angle between the N-marking of the fixed scale and the zero-marking of the movable scale corresponds to the ship's own course.

Selsyn 196 which receives course data operates from the transmitting selsyn which has a turn value of 1° and is situated in the main display unit of the radar station. This transmitting selsyn is started by the course repeater located in the radar station and controlled by the synchronous follow-up system receiving signals from the device ЭК which is the ship's gyro compass repeater. From receiving selsyn 196 course data are conveyed to the extreme part of mechanical differential II. From the middle part of this differential the course data are applied through a mechanical gearing system to the inner movable scale of the set.

The course matching is done with the aid of a matching handwheel. The

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data obtained by rotating the course matching handwheel are supplied to the second extreme part of differential II, from whose middle part they are sent for rotating the movable scale of the tube until the ship's head marker engraved on the movable scale coincides with the ship's head signal on the tube screen.

The course data from differential II are also sent to the extreme part of differential I.

With the aid of the bearing handwheel the cursor is rotated till it coincides with the target mark. Simultaneously the target bearing data are applied to the second extreme part of differential I. On this differential the ship's course data are algebraically added up to the target bearing data as a result of which the target relative bearing is obtained in the middle part of the differential.

Applied from the middle part of the differential the relative bearing data start the coarse transmitting selsyn 202 with a turn valve of 6,000 mils and the fine transmitting selsyn 204 with a turn value of 200 or 1[illegible] mils; both selsyns are synchronously coupled with the target designation receiving selsyn. The coarse and fine scales of relative bearing rotate in step with the rotor axles of the transmitting selsyns.

Built in the bearing handwheel is a light signal push-button contactor indicating that target designation data are transmitted.

Receiving selsyn 195, with a turn value of 300 mils, rotates the tube scanning coil in synchronism with the transmitting selsyn situated in the main display unit of the radar station. The rotor of the transmitting selsyn rotates in step with the aerial of the radar station.

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For more accurate transmission of the tracking angle to the P.P.R. the turn value of the above-mentioned transmitting selsyn and of the corresponding receiving selsyn is 20 times lower than that of the scanning coil. Due to this P.P.R. tube scanning coil rotates in phase with the scanning coil of P.P.I. and, hence, with the aerial of the radar station. The key diagram showing the cophasal rotation of the P.P.R. scanning coil and of the scanning coil of the main set is given in Fig.3.

Disc A has a turn value of 6,000 mils. Through a step-up gear the transmitting selsyn of the main set is rotated with a turn value of 300 mils and it causes the P.P.R. receiving selsyn to rotate with the same turn value. This rotation is imparted to the P.P.R. scanning coil. Since the scanning coil of the P.P.R. 23ЛМ34 tube should rotate synchronously with the P.P.I. scanning coil the rotation transmitted from the receiving selsyn is stepped down 20-fold by a reduction gear. Therefore, disc B coupled to the scanning coil of the P.P.R. tube rotates synchronously with disc A of the P.P.I.

For the purpose of cophasal operation discs A and B have cams which serve for closing the contacts. The cam of disc B closes the circuit of relay R.

When the scanning coils of the main display unit and of the P.P.R. rotate in phase, the cam of disc B closes the contacts at the same time as the disc A cam opens the contacts. Thus relay R remains de-energized and the selsyns - electrically connected with each other.

Let us assume that the display unit scanning coils and, hence, discs A and B do not rotate in phase. In this case when the rotor of the transmitting selsyn turns, the rotor of the receiving selsyn will turn too until the cam of disc B closes the relay circuit. Relay R will operate and throw its contacts in a position which will cause the rotor of the receiving selsyn to stop. The rotor of the transmitting selsyn, still turning, will rotate disc A.

When the cam of disc A opens the contacts, relay R will be de-energized, and release its contacts and connect the phase windings of the receiving selsyn to those of the transmitting selsyn. Further rotation of the scanning coils will be cophasal.

Chapter III

DESCRIPTION OF P.P.R. CIRCUIT

The following voltages are supplied through the common feeder to the plan position repeater from device No.13:

- trigger pulses of negative polarity of 1-microsecond duration with an amplitude of about 1 V and repetition frequency of 427 pulses per sec.;
- target signals of positive polarity of 1-microsecond duration with an amplitude of 1 V and repetition frequency of 427 pulses per sec. (from each reflecting object).

In addition to this, whenever the microcontact located in the radar station device No.1 is closed, voltage of the "ship's head" marker is applied from the device No.7 to the P.P.R.

In detection operation i.e. during continuous automatic rotation of the station aerial the true picture of the reflecting objects in the area surrounding the station should be presented on the tube screen on a corresponding scale.

This is achieved by:

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- continuous rotation of the scanning coil in the plan position repeater in step and in phase with the rotation of the station's aerial;

- application to the P.P.R. of trigger pulses which determine the beginning of radial sweep for every pulse emission;

- application to the grid of the cathode-ray tube of the amplified target and identification signals and of the ship's head signal.

As a result a real map of the reflecting objects is shown on the P.P.R. tube screen.

Coarse measurement of the range to any of the objects visible on the screen of the plan position repeater is ensured by:

- five fixed calibration rings on the tube screen, placed concentrically with respect to the centre of the screen and corresponding to the distances of 1,4 or 15 miles for the ranges of 5, 20 or 75 miles, respectively;

- two movable strobe rings whose distance from the screen centre is varied by the signal-selector range potentiometer.

The range measurement is achieved by bringing the strobe rings in line with the target echo and reading data off the scales connected with the slider of the range potentiometer. In the ranges of 5 and 20 miles both strobe rings are situated at such a distance that the target echo can be set between them. In the 75-mile range both strobe rings practically merge into one which is atched with the target echo.

Coarse measurement of target bearing is carried out with the aid of the bearing cursor which is turned by means of the BEARING (ПЕЛЕНГ) handwheel till it is matched with the centre of the target echo.

The results of these measurements can be read off the bearing and range scales and also automatically transmitted to the target designation system. A detailed description of the operation of all P.P.R. circuits is given below.

Signal Separation Circuit

The signal separation circuit employs two valves 161 and 149 of the 6H4 type (Fig.4) and serves for separating the trigger pulse from target signals.

The positive pulses of target signals and the trigger pulses of negative polarity coming from the device No.13 through a long feeder (up to 250 m.) are applied to the control grid of valve 161. This valve operates as a class A amplifier and serves as a buffer that prevents connection between the electron relay and the signal amplifier input. At the anode load of valve 161 amplified trigger pulses of positive polarity and negative pulses of target signals are formed.

The second valve (149) of the separation circuit is blanked by the control grid with the voltage formed on resistor 153 in the cathode circuit of this valve. As a result the negative pulses of target signals are cut off, whereas the trigger pulses produce across the anode load of this valve voltage pulses of negative polarity with a large amplitude (80 - 100 V). From the anode of valve 149 the trigger pulses via capacitor 2 are fed to the grid of valve 10 in the electronic relay circuit.

Electron Relay

The electron relay has two valves 10 and 14 of the 6C5C type and serves for producing trigger pulses

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for the plan position repeater circuits. When no trigger pulse is applied the first valve (10) of the electron relay is conductive. The second valve (14) is blanked because of the negative bias voltage applied between its cathode and the control grid. This bias is controlled with the aid of potentiometer 45.

When the trigger pulse is applied to the grid of the first valve of the electron relay, the valve becomes non-conducting and its anode voltage increases. Since the grid of the second valve of the electron relay is connected via resistor 12 with the anode of the first valve, the voltage on the grid of the second valve also sharply increases. The second valve opens, and its anode voltage drops. Since by the moment the trigger pulse is applied to the grid of valve 10 capacitor 7 is charged to the full value of anode voltage, it begins to discharge through the second valve of the electron relay and through one of the grid resistors of the first valve (depending on position of range switch 6a). For the first range (5 miles) it discharges through valve 14 and resistor 3. Thus, the discharge current of capacitor 7 creates on the grid of the first valve of the electron relay a negative voltage which decreases according to the exponential law. This voltage keeps valve 10 cut off.

As the capacitor discharges, the first valve of the electron relay begins to open, its anode voltage decreases, thereby lowering the voltage on the grid of the second valve. The second valve begins to get blanked, its anode voltage increases, and capacitor 7 begins to charge through resistors 13 and 3.

The charging current of capacitors 7 develops a positive bias on the grid of the first valve, thus facilitating the return of the electron relay circuit to its initial position. When capacitor 7 is charged, the relay will return to the initial position and will again be ready to operate from the next trigger pulse. The operation period of the electron relay is determined by the repetition frequency of trigger pulses which is equal to 427 pulses per sec., while the duration of pulses produced by the electron relay is determined by the time constant of the discharge circuit consisting of capacitor 7, resistor of valve 14, resistors 43 - 49 and one of resistors 3,4 or 5 depending on the position of the range switch.

Depending on the range - 5,20 or 75 miles, set with the aid of range switch 6a, the duration of the pulses produced by the electron relay equal to 115, 350 or 1,100 microseconds,respectively.

Besides the control grid of the electron relay second valve, the positive pulse formed on the anode of valve 10 is also fed to the second grid of the cathode ray tube, thus providing the intensification for the forward travel of the beam.

The negative pulses formed on the anode of the second valve of the electron. relay are used for triggering the sweep generator of the P.P.R. tube, the circuit for producing calibration pulses, and the sawtooth voltage generator.

By reducing the bias voltage on the grid of valve 14 self-triggering operation of the electron relay can be obtained, i.e. its operation without a trigger pulse. This proceeds as follows: when the bias voltage on the grid of valve 14 is diminished with potentiometer 45, valve 14 begins to open and, hence, capacitor 7 begins to discharge, which increases the negative voltage on the grid of valve 10 and the voltage on its anode, which, in its turn, increases the current in valve 14. This increase of the current is of avalanche type and valve 10 is cut off. From this moment on the operation of the electron relay will be the same as described above with the trigger pulse applied, but the operation period of the electron relay will now be determined by the sum of time constants of charging and discharging circuits of capacitor 7.

The self-triggering operation of the electron relay is sometimes used when checking P.P.R. display unit circuit in the absence of a trigger pulse, but the electron relay self-triggering operation is not permissible when determining the target range under real conditions.

Sweep Circuit

The sweep circuit is formed by the sweep generator employing valve 21 of the 6C5C type and the sweep voltage amplifier employing valve 37 of the 6П3С type; it serves for producing sawtooth voltage to scan the beam of the indicator tube.

Sweep generator 21 is triggered by the negative square pulse coming from the electron relay via capacitor 16 to the valve grid. In the absence of this pulse the valve of sweep generator is completely open. When the negative pulse is applied to the grid of valve 21, the latter is instantly cut off and from this moment on the charging of one of capacitors 29, 31 or 33 begins, depending on the position of the range switch. In the course of charging, the voltage on the capacitor varies according to the exponential law. When the negative pulse from the electron relay is no longer applied, the valve of the sweep generator becomes conducting and capacitor 29, 31 or 33 previously charged instantly discharges through valve 21.

The time constant of the capacitor charging circuit is selected in such a way as to use for operation only the initial, the most linear section of the exponential curve that characterizes the law of voltage increase on the capacitor.

Valve 37 of the sweep voltage amplifier is normally cut off by the voltage on resistor 38. Its anode circuit is connected to scanning coil 112. The control grid of valve 37 receives from the sweep generator a positive pulse of sawtooth voltage and from the anode of valve 65 - a positive square pulse producing the pedestal for the sawtooth voltage pulse. In the anode circuit of this valve and, hence, in the scanning coil sawtooth current flows. The magnetic field of coil 112 causes radial deflection of the electronic beam from the centre to the edge of the display tube screen.

The scanning velocity of the tube beam is varied in accordance with the variation of the range with the aid of switch 6b and is determined by the capacity of one of the capacitors 29, 31 or 33.

The sweep length on the tube screen is varied with potentiometer 39 situated on the control panel and switched into the cathode circuit of valve 37 to vary the value of bias voltage and, hence, the value of sawtooth current in the scanning coil.

Between choke 35 and the slider of switch 6b potentiometer 34 is included which is situated on the control panel and designed for varying the potential on the anode of valve 37 and, consequently, the voltage on resistor 41 by which it is possible to exactly match the beginning of the sweep trace with the centre of the tube screen. To ensure necessary shift of the beginning of the sweep trace with respect to the centre of the screen, resistor 23 or 24, depending on the range set, is connected in series with choke 35 by means of switch 6b. Choke 35 is necessary to preclude the effect of the alternating load, due to potentiometer 34, on the operation of the tube's scanning coil circuit.

Calibration Circuit

The calibration circuit consists of the generator of calibration pulses (valve 65 of the 6C5C type), the amplifier employing a 6C5C type valve 78, the limitor and the amplifier (6C5C type valve 83), the pulse forming stage (6C5C type valve 87), the mixer (6П9 type valves 95 and 99).

The calibration circuit serves for producing calibration pulses which are fed to the cathode of the display tube and produce range marks on the sweep trace. The spaces between the range marks correspond to the ranges of 1,4 or 15 miles depending on the position of the range switch for 5, 20 or 75 miles, respectively.

When the scanning coil and , consequently, the sweep trace rotate, the range marks merge into concentric circles, called calibration rings which make it possible to determine the approximate target range on the screen of the display tube.

Valve 65 of the calibration pulse generator normally operates with a low anode current, whose value determines the energy accumulated in the electromagnetic

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field of the coil in the impact excitation circuit placed in the cathode circuit of the valve. The negative square pulse coming from valve 14 of the electron relay cuts off valve 65 thus stopping its anode current. This gives rise to damped oscillations in the impact excitation circuit which are sent to the grid of valve 78.

Simultaneously, a positive pulse is supplied from the anode of valve 65 to the cathode of valve 37 via capacitor 27 or 28. Its duration is the same as that of the electron relay pulse which together with the sawtooth voltage affects the current of valve 37.

Depending on the range selected, the first, second or third impact excitation circuit is switched on in the cathode circuit of valve 65. The oscillation frequency of each circuit is determined by its parameters. Fine tuning of the circuit is achieved by varying the self-induction value of the coil with the aid of carbonyl cores.

Valve 78 serves for amplifying the oscillations of the generator of calibration pulses. The oscillations produced in the impact excitation circuit are fed via series resistor 76 to the grid of valve 78. Due to the grid current flowing in the grid circuit of this valve the tops of the positive half-cycles of the oscillations are clipped. As a result, in the anode circuit of amplifier valve 78 there appears a number of flat negative pulses and positive voltage half-waves. The calibration rings are removed from the tube screen with switch 101, which is arranged on the control panel and shorts the grid of valve 78 to the housing of the unit (earth).

Valve 83 serves as a limiter and an amplifier of the calibration pulses. Normally this valve is blanked. The oscillations coming from the anode of valve 78 open by their positive half-cycles valve 83 and, as a result, a number of negative square pulses of the same amplitude appear in its anode circuit. These pulses are fed to the grid of the forming circuit valve 87.

A positive bias voltage is applied to the grid of valve 87; the anode load of this valve consists of low inductance coil 86 and resistor 85 connected in parallel.

The negative pulses coming to the grid of this valve cause variations in the anode current, thus setting up the counter-electromotive force in self-inductance coil 86.

Positive and negative pulses of small amplitude and dura ion are formed in the anode load of valve 87. These pulses coincide in time respectively with the leading and trailing edges of the square pulses and are fed to the grid of mixer valve 95.

The mixer employs two valves 95 and 99 operating with a common anode load. Both valves have the same operating conditions and serve to mix two negative pulse voltages: the voltage of calibration pulses and that of signal-selector pulses.

Valve 95 is normally blanked; therefore, the negative pulses coming to its grid do not affect the current of the valve. The positive pulses open the valve, and large-amplitude acute negative pulses are obtained in its anode circuit. The anode load of valve 95 is made up by potentiometer 93 which is located on the control panel and serves for controlling the amplitude of the calibration pulses. From this potentiometer the calibration pulses of required amplitude are fed to the cathode of display tube 110. Depending on the range set, one of the resistors 91 or 92 is switched into the anode circuit of valve 95 with switch 6e. The calibration pulses lower the tube cathode potential, thus brightening the section of the sweep trace corresponding in time to the moment of applying the calibration pulse to the cathode. As a result, a number of bright spots appear along the sweep trace on the tube screen. When the scanning coil is rotating, these spots form concentric circles: calibration rings.

Valve 99 is also normally blanked. Its control grid receives positive pulses from the signal-selector circuit. In the anode load (common with valve 95) negative pulses are formed which coming to the cathode of tube 110, produce on the sweep trace two additional bright spots, the distance between them corresponding to 2.5 cables.

The cathode circuit of valve 99 includes potentiometer 25 which is used to control the amplitude of the strobe pulses. Potentiometer 93 situated on the control panel controls the amplitudes of both the calibration and strobe pulses. The range of control ensured by potentiometers 25 and 93 is such that it permits to control maximum and minimum brightness of the calibration and strobe rings on the tube screen.

Amplifier of Target Signals

The amplifier of target signals contains two valves 124 of 6Ж4 type and 133 6П9 type and is designed for amplifying target signals coming to the amplifier input. In addition to this, valve 133 is used for producing the ship's head marker voltage.

Valve 124 of the amplifier is normally blanked by the bias voltage applied to the grid of the valve from the potential divider consisting of resistors 138 and 139. The grid of valve 124 receives by the common cable from the relaying unit of the radar station, to which the P.P.R.

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is connected, the target signals of positive polarity and the trigger pulse of negative polarity. Since valve 124 is blanked the trigger pulse does not affect the anode current of the valve.

The target signals of positive polarity are amplified and then applied from the amplifier input (in the form of positive pulses) to the tube grid of the plan position repeater, causing a bright spot to appear on its screen.

The target signals follow each other with an interval which can be controlled within 1.5 - 5 micro-seconds in the trigger circuit of the radar station transmitter. The target signal has a duration of 1 microsecond.

The ship's head signal is formed as a result of a momentary application of negative bias voltage to the grid of valve 133 when the microcontact connected to the aerial of the radar station is closed. If switch 269 on the P.P.R. control board is in the ON position the blanking voltage is applied to resistor 137 and then to the grid of valve 133.

When the negative bias is applied, a positive pulse is formed in the anode load of valve 133 and a bright line showing the direction of the ship's head appears on the tube screen.

The ship's head marker voltage together with the amplified target signals is impressed on the grid of the plan position repeater tube.

Self-inductance coil 135 serves for correcting the shape of the pulse in the amplifier output.

Signal-Selector

The signal-selector circuit consists of a sawtooth voltage generator, a range potentiometer and a cathode follower of the potentiometer voltage, a signal-selector stage, a cathode follower of signal-selector pulses, a circuit for producing pulses of 4.6-microsecond duration and a circuit for producing the strobe pulses.

The signal-selector circuit is divided into three parts arranged in different units. Valves 171,179,190 are in the RU unit. The signal-selector range potentiometer is installed in the upper part of the equipment. Valves 217, 232, 240 and 254 are placed in the RM unit.

The signal-selector serves for producing strobe pulses which, coming to the cathode of the tube, produce two bright spots on the sweep trace at a distance corresponding to the actual range of 2.5 cables. In the 75-mile range the two spots practically merge into one. These marks can travel along the whole length of the sweep trace. When the scanning coil is rotating, these marks form strobe rings which provide coarse range measurement on the plan position repeater in all three ranges.

T h e s a w t o o t h v o l t a g e g e n e r a t o r serves for creating sawtooth voltage supplied to the input of the signal-selector stage.

The generator employs a portion (171 b) of 6H8C type valve 171.

The grid of the sawtooth voltage generator valve receives from the anode of the electron relay valve 14 the negative pulse which cuts off the normally open valve 171b. At the same time one of the capacitors 182, 184 or 186 starts charging through resistor 170 and through resistor 331, 330 or 329 depending on the respective range set with switch 6f.

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When the electron relay pulse ceases to be effective, the valve of the sweep generator becomes conducting and capacitor 182, 184 or 186 previously charged instantly discharges through the valve.

The voltage on the capacitor, depending on time, varies exponentially. The time constant of each charging circuit is selected so as to use for operation only the initial, the most linear portion of the exponential curve that characterizes the law of capacitor voltage rise.

From the slider of switch 6f the voltage is supplied via resistor 180 to the signal-selector stage.

The range potentiometer is designed for delivering to the signal-selector stage a D.C. voltage, whose value is regulated by the position of the potentiometer slider. Due to the mechanical coupling between the potentiometer slider, the range handwheel and range scales, the value of this voltage always corresponds to a definite range indicated by the scales.

When measuring the range with the signal-selector the voltage on the potentiometer slider must be set at a value corresponding to the value of the sawtooth voltage at the moment when the target signal arrives.

When the two voltages level with each other at the same moment as the target signal mark appears on the display screen, the actual range is read off the scale. This is how it works. Since the moment when the capacitor of the sawtooth voltage generator starts charging is synchronized with the trigger pulse of the electron relay and, consequently, with the moment when a high-frequency pulse is radiated by the main set's aerial, the

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time interval between the moment when the capacitor begins to charge, and the moment, when the target signal mark appears on the display screen, corresponds to the target range.

When turning the range potentiometer slider the voltage fed to the signal-selector stage becomes equal to the voltage accumulated in the capacitor by the moment the target echo appears on the screen, the mark will be between the strobe rings and, therefore, the target range reading can be taken off the scales connected to the potentiometer slider.

To make the unit more reliable in operation and simpler in manufacture the plan position repeater has a contact (decade) potentiometer with exponential winding, which pr vides sufficiently smooth adjustment of resistance and, hence, of voltage.

The range potentiometer has 25 "coarse" coils connected in series and consisting of 50 sections of equal resistance, and 25 series-connected "fine" coils which also consist of 50 sections of equal resistance. When the range handwheel is turned, the commutation device permits all the 25 fine coils to be parallel-connected with one of the coarse coil sections in succession without breaking the circuit. These connections take place at intervals required by the potentiometer slider, from which the potential (in relation to the beginning of the coarse coil circuit) is taken, to run over all the fine coil sections in succession following the potential increase. Kinematically each successive connection of the fine coils to a coarse coil section takes place at every 130° turn of the potentiometer slider.

Thus, not continuous, but "step-like" potential values, up to 2,500 values in all, are taken from the potentiometer during one run over all the coarse coils. Due to this the voltage taken from the potentiometer varies smoothly depending on the position of the range handwheel.

The potentiometer operates as follows.

At the beginning of the operation slider I (Fig.5) is on the input lamella, slider II - on the first lamella and slider III - on the zero lamella. The simplified potentiometer diagram which corresponds to such position of the sliders is shown in Fig.6 (a), and the equivalent diagram - in Fig.6 (b). For the purpose of simplification the figures show 5 coarse and 5 fine coils.

The potentiometer output voltage (slider III) in this case is equal to zero. At the same time the voltage at the ends of the series-connected fine coil circuit is equal to the voltage in the middle of the first coarse coil. When the range handwheel is turned, slider III makes half a turn moving from the 1st to the 48th lamella, thus contacting in turn 24 fine coils.

After slider III reaches the 48th lamella, the mechanism moving sliders I and II is set in motion. Slider I first moves to the idle lamella, thus disconnecting the beginning of the fine coil circuit from the potentiometer input, and slider III moves to the 49th lamella, leaving only one half of the fine coil switched on.

The simplified and equivalent potentiometer diagrams, which correspond to this position of the sliders, are shown in Figs 6 (c) and 6 (d).

Moving further, slider III will reach the 50th lamella, thus switching off the remaining half of the fine coil, while slider I will contact the second lamella, thus connecting the beginning of the fine coil circuit to the beginning of the second coarse coil. All this time slider II slides along the first lamella, without breaking the circuit.

The simplified and equivalent potentiometer diagrams, which correspond to this position of the sliders, are shown in Figs 6 (e) and 6 (f).

Thus, the potentiometer output voltage grows in steps from zero to a value equal to that in the middle of the first coarse coil.

Since each fine coil is connected to three lamellas, i.e. divided into two sections, the output voltage after one half-turn of slider III will have 50 steps.

When slider I passes from one lamella to another, slider II does not break the contact; the resistance of the series-connected fine coils up to the point where slider III is switched on is much greater than the resistance of one half of the coarse coil added to the resistance first of one fine coil and then of its half. Due to all this the voltage taken from slider III will rise continuously (step-like) without breaking.

Further circuit operation is analogous to that described. During the next half-turn slider III moves from the 51st to the 98th lamella. At the moment when slider III reaches the 98th lamella, the mechanism moving sliders I and II operates again.

The simplified and equivalent diagrams for this position of the sliders are shown in Figs 6 (g) and 6 (h). When slider III passes to the 99th lamella, slider I will disconnect the end of the fine coil circuit from the coarse coil circuit /Figs 6(i) and 6 (j)/, and when slider III reaches the zero lamella, slider II will contact the third lamella and connect the end of the fine coil circuit to the middle of the second coarse coil /Figs 6 (k) and 6 (1)/.

During the second half-turn of slider III the potentiometer output voltage grows continuously (in steps) from the value of the voltage in the middle of the first coarse coil to a value equal to the voltage in the entire coarse coil.

Due to appropriate selection of the resistance values in the coarse coils, t'e potentiometer output voltage varies exponentially.

As was already mentioned above, when the potentiometer axle and, hence, the axle of slider III turn by 180°, sliders I and II jointly move to the next lamella. They are driven by a mechanism whose kinematic diagram is shown in Fig. 7.

The step-by-step mechanism consists of two discs with projections coupled together, and two Maltese crosses fixed on the same axle.

At every half-turn the discs with the aid of the projections alternately turn the Maltese crosses they are connected with. At the same time the gear,placed on the same axle with the crosses,turns and so does another gear connected with it causing sliders I and II to rotate.

Potentiometers 197 and 198 (Fig.4) serve for selecting the initial voltage on the grid of valve 190 when the range potentiometer is in the zero position, while potentiometer 210 serves for selecting the maximum voltage taken from the range potentiometer.

The voltage from the slider of the range potentiometer is applied via resistor 214 to the control grid of cathode follower 6X4 valve 190. Resistor 214 serves for reducing the influence of sharp variations in the range potentiometer resistance on the valve 190 grid circuit during commutation of the fine coils.

From the cathode follower output the voltage is fed to the cathode of valve 179 belonging to the signal-selector stage.

The signal-selector stage is designed for producing the signal-selector pulse. The stage employs 6Ж4 valve 172. The operation of the signal-selector stage is based on contrasting two voltages: D.C. voltage, which comes from the range potentiometer via the cathode follower and A.C. voltage which is supplied from the sawtooth voltage generator output.

When both voltages are equal, the signal-selector pulse is formed at the stage output.

The stage includes 6Ж4 valve 179 which is blanked by a positive potential fed to its cathode.

When the electron relay operates, the potential of the control grid of valve 179 begins to grow because of an increased charge in one of capacitors 182, 184 or 185 belonging to the sawtooth voltage generator. When the value of this voltage approximates the value of the positive voltage taken from the range potentiometer to the cathode of valve 179, the latter opens and a negative voltage pulse is created across its anode load 178.

The time of the beginning of this pulse will depend on the value of the positive potential on the cathode of valve 179.

The signal-selector pulse formed in the anode circuit of valve 179 is fed to the control grid of the cathode follower valve.

The resistors and capacitors 331 and 183, 330 and 185, 329 and 187 serve, depending on the range selected, for more precise matching of the initial sawtooth voltage section with the voltage coming from the range potentiometer. Potentiometer 347 serves for the initial adjustment of the signal-selector pulse when valves 179 and 190 are replaced.

The cathode follower of signal- selector pulses is designed for delivering the signal-selector pulse to the RSS circuit which produces the pulse of 4.6-microsecond duration.

The presence of the cathode follower precludes any influence of the distributed capacitances of the feeder, which carries the signal-selector pulse from RU to the RSS unit, on the steepness of the pulse leading edge. The cathode follower employs one portion (171a) of 6H8C valve 171. The signal-selector pulse formed across the cathode load of the cathode follower valve consisting of resistors 147 and 128 is passed via capacitor 144 and the feeder to the RSS circuit where the 4.6-microsecond pulse is produced.

The circuit for producing the pulse of 4.6-microsecond duration is designed for generating and forming the pulse of 4.6-microsecond duration which appears simultaneously with the beginning of the pulse coming from the cathode follower of the signal-selector stage. This circuit employs valves 217, 240 of the 6Ж4 type and valve 232 of the 6X6C type.

The anode circuit of the normally open valve 217 includes an impact excitation oscillatory circuit which consists of self-inductance coil 223 and capacitors 224 and 225. The negative pulse of the signal-selector applied to the grid of valve 217 cuts the latter off.

Due to the electromagnetic energy accumulated in the magnetic field of coil 223 oscillations with a frequency of 107.5 Kc/s arise in the impact excitation circuit.

First positive half-cycle of the 4.6-microsecond oscillations opens valve 240 which in the absence of this pulse is cut off by the control grid due to the voltage drop across resistor 244. At the same time a 4.6-microsecond negative voltage pulse is created on the anode of valve 240. This pulse is impressed on the grid of valve 254.

The negative half-cycle of oscillations in the impact excitation circuit is damped due to the shunting effect of diode 232.

Thus, each time valve 217 is blanked only one pulse with the duration equal to the half-cycle of the circuit oscillations is taken from the impact excitation circuit.

T h e c i r c u i t f o r p r o d u c i n g t h e s t r o b e p u l s e s is designed to produce two positive pulses each time it operates and to feed them to the grid of valve 99 in the mixer of calibration and strobe pulses. Since the moment when the strobe pulses appear is timed with the moment when the signal-selector pulse is produced, these pulses, when the entire [illegible] system is in operation, will produce on the display tube screen two strobe rings, whose position with respect to the centre of the screen can be varied by turning the signal-selector potentiometer knob.

The circuit employs 6H8C valve 254. The negative pulse coming from the anode of valve 240 blanks the left-hand portion of valve 254. The oscillations arising in this case in the impact excitation circuit formed by self-inductance coil 252 and capacitor 253 are applied to the grid of the right-hand portion of valve 254 serving as a cathode follower.

The frequency of free oscillations in this circuit is three times greater than in the anode circuit of valve 217. Therefore, while the left half of the valve 254 is blanked (4.6 microseconds), three half-cycles of oscillations occur in the circuit, two positive and one negative. When the effect of the 4.6-microsecond pulse ceases further oscillations in the circuit cease too, due to the shunting effect of the open left-hand portion of valve 254.

The positive half-cycles of voltage oscillations are impressed on the grid of the blanked right-hand portion of valve 254, open it and produce strobe pulses in the cathode resistor 258.

The time interval between the amplitude values of these pulses corresponds to the distance of 2.5 cables.

The controlled feedback between the cathode circuit of the output triode and the impact excitation circuit achieved with potentiometer 259 and capacitor 255 keeps the amplitudes of both strobe pulses equal.

Plan Position Repeater Tube

Plan position repeater tube 110 is a cathode-ray tube of the 23ЛМ34 type with magnetic control of the cathode beam.

The tube has a screen with afterglow, 230 mm in diameter.

The brilliance of the display of the tube screen is controlled by means of varying the bias voltage on the grid and the accelerating electrode. Brilliance adjustment is effected with CP potentiometer 102 by means of varying the value of positive voltage fed to the tube cathode.

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The strobe and calibration pulses are also fed to the tube cathode.

The cathode beam is focussed by the magnetic field produced by the focussing coil when energized.

The value of the current in focussing coil 111 is controlled with CP variable resistor 107.

The radial sweep of the tube cathode beam is also effected by the magnetic field of scanning coil 112 deflecting the beam when the sawtooth current of valve 37 passes through it. The coil is rotated round the neck of the tube with the aid of a universal joint shaft coupled with a synchronous motor.

The amplified target signals are applied to the tube grid, increasing the brilliance of the tube beam at the moment of their application. The voltage of the ship's head marker is also fed to the tube grid.

The forward travel of the beam in sweeping is intensified by the positive pulse delivered from the anode of electron relay valve 10 to the accelerating electrode.

The voltage of 5,000 V is fed to the tube anode from the high-voltage rectifier.

PART II

OPERATING INSTRUCTIONS

Chapter IV
SWITCHING THE UNIT ON AND OFF
Preparing the Unit for Use

After the station is switched on, the following must be done to prepare the plan position repeater for use:

(a) turn BRIGHTNESS (ЯРКОСТЬ) knob fully counter-clockwise;

(b) switch on the unit supply voltage with the main on/off switch x) ВИКО-ВКЛ.-ВЫКЛ.);

(c) select the required brightness of the tube scales with the SCALE ILLUMINATION (ОСВЕЩЕНИЕ) knob;

(d) set normal brilliance of the sweep trace with the BRIGHTNESS (ЯРКОСТЬ) knob;

(e) get the best possible focussing of the radial sweep trace with the FOCUS (ФОКУС) knob;

(f) set the necessary range: 5, 20 or 75 miles with the RANGE SWITCH (ПЕРЕКЛЮЧАТЕЛЬ ДИАПАЗОНОВ);

(g) set the sweep length with the SWEEP LENGTH (ДЛИНА РАЗВЕРТКИ) knob so as to give enough space for 5 calibration rings;

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x) The valve for blocking high voltage in the display tube starts operating 30 - 40 secs after the current was applied to the unit.

(h) use the CENTRING (ЦЕНТР) knob to match the starting point of the sweep trace with the cursor centre of rotation;

(i) select with the CALIBRATION RINGS AND SS (КОЛЬЦА КАЛИБР и СС) knob such brightness of the calibration rings and range mark as not to "blur" the target signal marks;

(j) turn on the SHIP'S HEAD (НОС КОРАБЛЯ) switch to obtain a ship's head signal on the tube screen and by turning the MATCHING (СОГЛАСОВАНИЕ) knob line up the ship's head mark engraved on the movable scale of the tube with this signal; after this switch off the ship's head signal;

(k) for coarse measurement of the range and bearing use the calibration rings and the fixed scale;

(l) with the CALIBRATION RINGS ON/OFF (КАЛИБР. КОЛЬЦА ВКЛ.-ВЫКЛ.) switch turn off the calibration rings if they are not necessary for operation;

(m) for fine range measurements use RANGE (ДАЛЬНОСТЬ) knob to bring the range mark in line with the target echo so that its external ring would touch the leading (nearest) edge of the target mark without "blurring" it; in this case it is possible to read the range off the range computers in navigation cables or in hectometers; at the same time as the range mark is travelling, the range transmitting selsyns in the motor unit turn through a corresponding angle and introduce the distance in terms of artillery cables into the target designation system;

(n) for determination of the target bearing set the cursor of the display tube to run through the centre of the target mark; the bearing is read off the fixed scale against the cursor line, the cursor being driven with the BEARING (ПЕЛЕНГ) knob.

When the cursor is moving, the relative bearing transmitting selsyns in the motor unit turn through a corresponding angle, thus introducing the relative bearing into the ship's target designation system.

The transmission of target position data is signalled by pressing the button in the BEARING handwheel. For transmitting the data concerning the range and the relative bearing of the selected target, the foot-pedal switch (device 12) should be pressed, thus sending a signal to the target designation system that the target position data have been determined accurately.

When the reply signal from the ship's target designation system is received, the pilot lamps on the control panel light up; the data transmitted by P.P.R. are considered to have been received.

Note: In the course of operation it is necessary to check up periodically the course matching by momentary applications of ship's head signals. Also check up periodically if the range readings are correct by taking the readings off thecomputers at the moments when the range mark is precisely matched with the corresponding calibration rings.

Caution: The RSS and TU circuits use voltage of 5 kilovolts. Do not touch the high-voltage current-carrying parts of these units.

Switching Off the Plan Position Repeater

To switch off the plan position repeater, it is necessary to do the following:

(a) turn the BRIGHTNESS knob fully counter-clockwise;

(b) switch off the voltage supply of the unit.

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Chapter V
MAINTENANCE OF THE UNIT

Tube Replacement

To replace the display tube of the unit, it is necessary to do the following:

(1) Put on protective glasses (in case the tube bursts).

(2) Take off the bearing cursor.

(3) Loosen the four screws so that the bosses pressing the ring to the tube permit to easily take off the ring and the tube.

(4) Take off the cap of the high-voltage lead from the anode of the tube.

(5) Carefully support with the left hand the upper part of the tube, take the tube with the right hand below the focussing coil, and gradually pull it up till the pins leave panel. After that, holding the tube by its upper part with both hands, pull it out, taking care that the tube does not touch the metallic parts.

(6) When setting in a new tube, carefully lower its neck through the opening in the scanning and focussing coils, taking into account the direction of the tube key with regard to the panel. If the key and the panel do not align with each other, take with the left hand the upper part of the tube and support it, using the right hand for taking the tube below the focussing coil and lifting it till it leaves the panel. After that turn the upper part of the tube a little to the left or to the right and lower it again. Repeat this operation till the tube key and the panel align, after which carefully press the tube on the top till it sets in its place.

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(7) When setting the fastening ring and the cursor take care not to strike the tube screen glass and not to press it unevenly with screws.

(8) After replacement of the display tube it is necessary to centre the tube beam. Coarse centring is done by shifting the focussing coil. For this purpose it is necessary to switch on the unit and to mark the direction in which the starting point of the sweep trace is displaced with respect to the rotation centre of the bearing cursor and then to switch off the unit and shift the focussing coil in the necessary direction with the aid of the focussing coil fastening pins. Fine focussing is done with the CENTRING knob. The shifting of the focussing coil should be done only with the unit switched off.

The beam is considered to be centered if the starting point of the sweep trace is not more than 2 mm off the rotation centre of the bearing cursor.

Valve Replacement

The valves in the plan position repeater are replaced when they are found defective.

Note: After replacement of one or all valves at once (Ref.Nos 171, 179 and 190) check up the unit's range indication, accurately matching the range mark with the calibration rings in all three ranges and taking the readings off the range computer. If the range indication is not any longer within the permissible limits it is necessary to do appropriate trimming with the aid of potentiometers 197, 198, 210 and 347 and capacitors 183, 195 and 187, depending on the range selected.

Chapter VI

PREVENTATIVE MAINTENANCE OF P.P.R. UNITS

Daily Inspection and Maintenance of the Units

Daily inspection and maintenance of the P.P.R. units include external inspection of all units and inter-unit cable joints.

For this purpose proceed as follows:

(a) check up if all bolts and screws on the unit covers are tight;

(b) check up the operation of all unit knobs and switches;

(c) check up if the glass of the unit inspection ports is dry; if moisture is found, open the units and dry them, switching on the heating devices;

(d) check up if the shafts of the BEARING, RANGE and COURSE MATCHING handwheels are properly lubricated;

(e) after the inspection is over, switch on the unit for a 20-minute trial run.

Weekly Inspection and Maintenance of the Units

Weekly inspection of the P.P.R. units includes everything pertaining to daily inspection; in addition to this it is necessary to do the following:

(a) putty and paint all the spots on the units where the paint is off;

(b) check up if the nuts in the gland inlets are tight;

(c) wipe up with a dry rag all the units of device No.4;

(d) inspect and clean the interlocking contact in the units; 50X1

(e) check up if the valves are set tight in the unit panels;

(f) check up the surface x) on the power unit commutators and on the rings of the electric motors in the motor unit;

(g) remove with No.00 glass-paper the carbon deposit from the knife contacts of the port-starboard switch and rub them with alcohol (device No.11);

(h) switch on the unit for a 30-minute trial run;

(i) check up if the unit is timed with the station, and verify range and course data transmission;

(j) check up by the P.P.I. calibration rings if the range mark is accurately set.

For this purpose by turning the RANGE knob match the range mark with each calibration ring in succession. Take the readings off the computers as to the range values at the moments of matching.

The distance between the rings as indicated by the CABLES (КАБЕЛЬТОВЫЕ) computer should be:

(a) in the 5-mile range—9.87±1 cables;
(b) in the 20-mile range—39.5±4 cables;
(c) in the 75-mile range—148.1±10 cables.

Note: The P.P.R. should be checked, adjusted and operated at normal power supply with variations not exceeding ±3 per cent.

Monthly Inspection and Maintenance of the Units

Monthly inspection of the P.P.R. units includes everything pertaining to weekly inspections; in addition to this, it is necessary to do the following:

x) A normally operating commutator should be of a reddish colour with a violet tint. If the inspection reveals carbon deposits on the commutator, it should be rubbed with a clean rag soaked in gasoline. If the dirt cannot be removed with a clean rag, the commutator should be ground with No.00 glass-paper fitted on a wooden block with a cut of the same diameter as the commutator (grinding without a block is not permissible). The paper should be of the same width as the commutator. Grinding of the commutator should be done when the motor operates at the rated number of revolutions. The selsyn rings should be wiped up with clean cotton cloth soaked in alcohol.

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(1) Check up and clean the contacts in all the relays of the P.P.R. If there is a thin carbon deposit on the contacts, it should be removed with a thin plate wrapped in apiece of cloth soaked in alcohol. This should be done carefully in order not to disturb the adjusted relay contacts. Then the carbon-pile voltage regulator should be inspected. Special care should be taken lest the regulator core should touch the coil.

(2) Check up the lubrication of the ball bearings and add lubricant, if necessary.

Lubricants are applied at temperatures ranging from - 60° to + 60°C. A thin layer of ГОИ-54 lubricant should be applied to all the friction parts of the unit (shafts, change-over knobs of the switches) and to the toothings.

Lubrication is done with a brush.

For the selsyn bearings, as well as for all other ball bearings of the unit the МВП lubricant is used.

The lubricant is fed to the unit with the aid of a lubricator.

Lubricant in the bearings is replenished at each monthly inspection of the unit.

To replenish the lubricant in the bearings, it is necessary to do the following:

- unscrew the external cups covering the bearings;
- remove with a clean rag the remainders of the old lubricant and feed fresh lubricant to the bearings.

When adding the lubricant, one should never overbrim the socket. The quantity of lubricant will be sufficient enough for a month's operation, if the ball cage is filled flush with b ims.

When feeding the lubricant to the bearings, care

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should be taken that no threads, filings, shavings, etc., get into the bearing.

After the bearings are filled with lubricant, their protective cups should be returned to their places.

APPENDICES

Appendix I

Component Schedule

Ref. No.	Name and type	Electric and other data	Quantity	Note
1	2	3	4	5
		MU Unit		
195	Receiving selsyn CC-501	Turn value 300 mils	1	2nd precision class
196	Receiving selsyn CC-501	Turn value 1° of the course	1	ditto
202	Transmitting selsyn ДИ-511	Turn value 6,000 mils	1	ditto
203	Transmitting selsyn ДИ-511	Turn value 600 cables	1	ditto
204	Transmitting selsyn ДИ-511	Turn value 200 mils	1	ditto
339	Terminal panel	for 12 terminals	1	
340	Terminal panel	for 12 terminals	1	

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50X1

1	2	3	4	5
341	Terminal panel	for 12 terminals	1	
342	Terminal panel	for 10 terminals	1	
343	Terminal panel	for 10 terminals	1	
344	Terminal panel	for 10 terminals	1	
336	Feeder plug	-	1	
337	Feeder plug	-	1	
338	Feeder plug	-	1	
		<u>RU Unit</u>		
10	Valve 5C5C	-	1	
14	Valve 5C5C	-	1	
21	Valve 6C5C	-	1	
37	Valve 6П3C	-	1	
65	Valve 5C5C	-	1	
78	Valve 5C5C	-	1	
83	Valve 5C5C	-	1	
87	Valve 6C5C	-	1	
95	Valve 6П9	-	1	
99	Valve 6П3	-	1	
124	Valve 5Ц4	-	1	

50X1

1	2	3	4	5
133	Valve 6П9	-	1	
149	Valve 6Ж4	-	1	
151	Valve 6Ж4	-	1	
171	Valve 6Н8С	-	1	
179	Valve 6Ж4	-	1	
190	Valve 6Ж4	-	1	
1	Capacitor KCO-1-250-Б-51-1	51 pF±5%	1	
2	Capacitor KCO-2-500-B-270-1	270 pF±5%	1	
7	Capacitor KCO-4-500-B-2,000-1	2,000 pF±5%	1	
15	Capacitor МКВ-500-0.5	0.5 μF	1	
16	Capacitor KCO-8-500-B-20,000-II	20,000 pF±10%	1	
19	Capacitor МКВ-500-0.5	0.5 μF	1	
27	Capacitor KCO-2-500-Б-24-1	24 pF±5%	1	
28	Capacitor KCO-2-500-Б-24-1	24 pF±5%	1	
29	Capacitor KCO-2-500-Г-270-1	270 pF±5%	1	245 - 270 μμF
31	Capacitor KCO-4-500-Г-1,200-1	1200 pF±5%	1	1,200 - 1,300 μμF
33	Capacitor KCO-4-500-Г-1,100-1	1,100 pF±5%	4	Selected within 4,400 - 5,000 μμF in parallel
40	Capacitor KCO-8-1000-[illegible]-10,000-II	10,000 pF±10%	1	

50X1

1	2	3	4	5
42	Capacitor MKB-500-2	2 μF	1	
51	Capacitor MKB-500-4	4 μF	1	
54	Capacitor MKB-500-4	4 μF	1	
55	Capacitor MKB-500-4	4 μF	1	
63	Capacitor KCO-8-500-B-20,000-II	20,000 pF±10%	1	
68	Capacitor KCO-2-500-Γ-200-I	200 pF±5%	1	
69	Capacitor KTK-1-M-39-1	39 pF±5%	1	
71	Capacitor KCO-5-500-Γ-2,000-1	2,000 pF±5%	1	
74	Capacitor KCO-5-500-Γ-3,300-1	3,300 pF±5%	2	In parallel
75	Capacitor KCO-8-1,000-B-10,000-II	10,000 pF±10%	1	
79	Capacitor KCO-8-500-B-20,000-II	20,000 pF±10%	1	
82	Capacitor KCO-8-500-B-20,000-II	20,000 pF±10%	1	
88	Capacitor KCO-8-500-B-20,000-II	20,000 pF±10%	1	
94	Capacitor MKB-500-1	1 μF	1	
97	Capacitor MKB-500-1	1 μF	1	
105	Capacitor MKB-500-0.5	0.5 μF	1	
113	Capacitor KCO-8-1,000-B-10,000-II	10,000 pF±10%	1	
120	Capacitor MKB-260-0.5	0.5 μF	1	
122	Capacitor MKB-500-0.25	0.25 μF	1	
125	Capacitor KCO-8-1,000-B-10,000-II	10,000 pF±10%	1	
131	Capacitor MKB-260-0.5	0.5 μF	1	
144	Capacitor KCO-8-500-B-20,000-II	20,000 pF±10%	1	

1	2	3	4	5
151	Capacitor МКВ-500-0.1	0.1 μF	1	
152	Capacitor МКВ-260-0.5	0.5 μF	1	
157	Capacitor КСО-5-500-В-10,000-II	10,000 pF±10%	1	
158	Capacitor МКВ-500-0.1	0.1 μF	1	
159	Capacitor КЭГ-МН-2Н-200- $\frac{4}{M}$ -II	4 μF	1	
173	Capacitor МКВ-500-0.1	0.1 μF	1	
175	Capacitor КСО-4-500-1,500-В-1-500-II	1,500 pF±5%	1	
176	Capacitor МКВ-500-0.1	0.1 μF	1	
182	Capacitor КСО-5-500-Г-1,600-I	1,600 pF±5%	1	Selected within tolerance
183	Capacitor КПК-2-25/150	25 - 150 pF	1	
184	Capacitor КСО-4-500-Г-1,500-II	1,500 pF±10%	1	Selected within tolerance
185	Capacitor КПК-2-25/150	25 - 150 pF	1	
186	Capacitor КСО-4-500-Г-1,500-II	1,500 pF±10%		Selected within tolerance
187	Capacitor КПК-2-25/150	25 - 150 pF	1	
189	Capacitor МКВ-500-0.5	0.5 μF	1	
191	Capacitor КСО-1-250-В-51-1	51 pF±5%	1	
192	Capacitor МКВ-500-0.1	0.1 μF	1	
193	Capacitor МКВ-500-0.1	0.1 μF	1	

1	2	3	4	5
212	Capacitor KCO-8-1,000-Б-10,000-II	10,000 pF±10%	1	
321	Capacitor KCO-8-500-Б-20,000-II	20,000 pF±10%	1	
322	Capacitor [illegible]-500-0.1	0.1 μF	1	
348	Capacitor KCO-2-500-Б-100-II	100 pF±10%	1	Selected within the limits of 70 - 100 pF
3	Resistor BC-1-20 kilohms-5%	20 kilohms±5%	1	
4	Resistor BC-1-100 kilohms-5%	100 kilohms±5%	1	
5	Resistor BC-1-470 kilohms±5%	470 kilohms±5%	1	
8	Resistor BC-1-5.1 kilohms-5%	5.1 kilohms±5%	2	In parallel
9	Resistor BC-2-20 kilohms-5%	20 kilohms±5%	2	ditto
11	Resistor BC-1-56 kilohms-10%	56 kilohms±10%	2	
12	Resistor BC-1-51 kilohms-5%	51 kilohms±5%	1	
13	Resistor BC-1-30 kilohms-5%	30 kilohms±5%	2	ditto
17	Resistor BC-1-560 kilohms-10%	0.56 megohm±10%	1	
18	Resistor BC-1-47 kilohms-10%	47 kilohms±10%	1	
20	Resistor BC-1-560 kilohms-10%	0.56 megohm±10%	1	
22	Resistor BC-1-100 ohm-5%	100 kilohms±5%	1	
23	Resistor BC-1-150 ohms-10%	150 ohms±10%	1	
24	Resistor BC-1-1.5 kilohms-10%	1.5 kilohms±10%	1	
33	Resistor BC-1-15 kilohms-5%	15 kilohms±5%	1	Selected within the limits of 10 - 30 kilohms

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1	2	3	4	5
32	Resistor BC-1-1.5 kilohms-5%	1.5 kilohms±5%	1	Selected within the limits of 1.5 - 3.3 kilohms
38	Resistor BC-2-200 ohms-10%	200 ohms±10%	1	
41	Resistor BC-1-15 kilohms-10%	15 kilohms±10%	1	
43	Resistor, tubular, IV-500	500 ohms	1	
44	Resistor BC-1-33 kilohms-10%	33 kilohms±10%	4	In parallel
46	Resistor BC-2-10 kilohms-10%	10 kilohms±10%	1	
47	Resistor BC-1-4.7 kilohms-10%	4.7 kilohms±10%	2	In parallel
48	Resistor BC-1-4.7 kilohms-10%	4.7 kilohms±10%	2	ditto
49	Resistor BC-1-5.6 kilohms-10%	5.6 kilohms±10%	2	ditto
50	Resistor, tubular, IV-5,000	5,000 ohms	1	
52	Resistor BC-2-22 kilohms-10%	22 kilohms±10%	1	
53	Resistor, tubular, II-200	200 ohms	1	
62	Resistor BC-1-1 megohm -10%	1 megohm±10%	1	
64	Resistor BC-2-39 kilohms-10%	39 kilohms±10%	2	In parallel
76	Resistor BC-1-56 kilohms-10%	56 kilohms±10%	1	
77	Resistor BC-1-240 kilohms-5%	0.24 megohm±5%	1	
80	Resistor BC-1-100 kilohms-10%	100 kilohms±10%	1	
81	Resistor BC-1-15 kilohms-5%	15 kilohms±5%	1	
84	Resistor BC-1-100 kilohms-5%	100 kilohms±5%	1	
89	Resistor BC-2-4.7 kilohms-10%	4.7 kilohms±10%	1	

S-E-C-R-E-T

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50X1

1	2	3	4	5
89	Resistor BC-0.5-560 kilohms-10%	560 kilohms±10%	1	
90	Resistor BC-2-100 kilohms-10%	100 kilohms±10%	1	
91	Resistor BC-2-1.2 kilohms-10%	1.2 kilohms±10%	1	
92	Resistor BC-2-1 kilohm -5%	1 kilohm ±5%	1	
96	Resistor BC-1-62 kilohms-5%	62 kilohms±5%	1	
100	Resistor BC-0.5-100 kilohms-10%	100 kilohms±10%	1	
104	Resistor BC-1-1 kilohm -10%	1 kilohm ±10%	1	
106	Resistor BC-2-10 kilohms-10%	10 kilohms±10%	3	In parallel selected within the limits of 10 - 15 kilohms
115	Resistor BC-1-62 kilohms-5%	62 kilohms±5%	1	
116	Resistor BC-1-30 kilohms-5%	30 kilohms±5%	1	Selected within the limits of 22 - 30 kilohms
119	Resistor BC-0.5-100 kilohms-10%	100 kilohms±10%	1	
121	Resistor BC-1-33 kilohms-10%	33 kilohms±10%	1	

S-E-C-R-E-T

50X1

1	2	3	4	5
123	Resistor BC-1-5.6 kilohms-10%	5.6 kilohms±10%	1	
125	Resistor BC-1-82 ohms-10%	82 ohms±10%	1	
127	Resistor BC-0.5-100 kilohms-10%	100 kilohms±10%	1	
128	Resistor BC-1-2 kilohms-5%	2 kilohms±5%	1	
129	Resistor BC-0.5-22 kilohms-10%	22 kilohms±10%	1	
130	Resistor BC-1-330 ohms-10%	330 ohms±10%	1	
132	Resistor BC-1-1.5 kilohms-5%	1.5 kilohms±5%	1	
136	Resistor BC-0.5-20 kilohms-5%	20 kilohms±5%	1	
137	Resistor BC-0.5-10 kilohms-5%	10 kilohms±5%	1	
138	Resistor BC-0.5-120 kilohms-10%	120 kilohms±10%	1	
139	Resistor BC-0.5-22 kilohms-10%	22 kilohms±10%	1	
140	Resistor BC-0.5-100 kilohms-10%	100 kilohms±10%	1	
141	Resistor BC-0.5-10 kilohms-10%	10 kilohms±10%	1	
142	Resistor BC-0.5-10 kilohms-10%	10 kilohms±10%	1	
143	Resistor BC-0.5-6.8 kilohms-10%	6.8 kilohms±10%	1	
145	Resistor BC-0.5-22 kilohms-10%	22 kilohms±10%	1	
146	Resistor BC-1-68 kilohms-10%	68 kilohms±10%	1	
147	Resistor BC-1-2 kilohms-5%	2 kilohms±5%	1	
148	Resistor BC-1-22 kilohms-10%	22 kilohms±10%	1	
150	Resistor BC-1-100 kilohms-10%	100 kilohms±10%	1	
153	Resistor BC-2-5.6 kilohms-10%	5.6 kilohms±10%	1	
154	Resistor BC-1-100 kilohms-10%	100 kilohms±10%	1	
155	Resistor BC-1-2.2 kilohms-10%	2.2 kilohms±10%	1	
156	Resistor BC-1-18 kilohms-10%	18 kilohms±10%	1	

S-E-C-R-E-T

No Foreign Dissem

50X1

1	2	3	4	5
160	Resistor BC-0.5-100 kilohms-10%	100 kilohms ±10%	1	
162	Resistor BC-2-10 kilohms-10%	10 kilohms ±10%	1	
163	Resistor BC-1-8.2 kilohms-10%	8.2 kilohms ±10%	1	
164	Resistor BC-1-5.6 kilohms-10%	5.6 kilohms ±10%	1	
165	Resistor BC-0.5-330 ohms-10%	330 ohms ±10%	1	
166	Resistor BC-0.5-100 kilohms-10%	100 kilohms ±10%	1	
157	Resistor BC-1-560 ohms-10%	560 ohms ±10%	1	Selected within the limits of 330 - 2,000 ohms
168	Resistor BC-1-3 megohms-10%	3 megohms ±10%	3	In series
172	Resistor BC-1-1 megohm-10%	1 megohm ±10%	1	
174	Resistor BC-2-5.1 kilohms-5%	5.1 kilohms ±5%	3	In series
177	Resistor BC-1-51 kilohms-5%	51 kilohms ±5%	1	
178	Resistor BC-2-510 kilohms-5%	0.51 megohm ±5%	1	
180	Resistor BC-0.5-330 ohms-10%	330 ohms ±10%	1	
189	Resistor BC-1-510 kilohms-5%	0.51 megohm ±5%	1	
199	Resistor BC-0.5-330 ohms-10%	330 ohms ±10%	1	
214	Resistor BC-1-100 kilohms-10%	100 kilohms ±10%	1	
263	Resistor BC-1-200 kilohms-10%	200 kilohms ±10%	1	
323	Resistor BC-0.5-220 kilohms-10%	220 kilohms ±10%	1	

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1	2	3	4	5
324	Resistor BC-0.5-33 kilohms-10%	33 kilohms±10%	1	
325	Resistor BC-0.5-56 kilohms-10%	56 kilohms±10%	1	
326	Resistor BC-1-10 kilohms-10%	10 kilohms±10%	1	
327	Resistor BC-0.5-330 ohms-10%	330 ohms±10%	1	
328	Resistor BC-0.5-330 ohms-10%	330 ohms±10%	1	
329	Resistor BC-0.5-5.1 kilohms-5%	5.1 kilohms±5%	1	
330	Resistor BC-0.5-5.1 kilohms-5%	5.1 kilohms±5%	1	
331	Resistor BC-0.5-560 ohms-10%	560 ohms±10%	1	Selected within the limits of 560 ohms - 5.8 kilohms
334	Resistor BC-0.5-330 ohms-10%	330 ohms±10%	1	
335	Resistor BC-1-120 ohms-10%	120 ohms±10%	1	
346	Resistor BC-1-220 kilohms-10%	220 kilohms±10%	1	198 - 242 kil-ohms
6	Range switch	-	1	
35	Low-frequency choke	3.5	1	H
25	Variable wire-wound resistor	600 ohms	1	
36	Wire-wound resistor	50 ohms±5	1	

1	2	3	4	5
45	Variable wire-wound resistor	20,000 ohms ±5%	1	
117	Wire-wound resistor	150 ohms ±5%	1	
134	Wire-wound resistor	50 ohms ±5%	1	
169	Wire-wound resistor	20,000 ohms ±1%	1	
170	Wire-wound resistor	0.375 megohm ±1%	2	
181	Resistor СП-1-2а-10А-13	10 kilohms	1	
197	Variable wire-wound resistor	1,000 ohms ±5%	1	
198	Variable wire-wound resistor	1,000 ohms ±5%	1	
210	Variable wire-wound resistor	5,000 ohms ±5%	1	
211	Wire-wound resistor	16,700 ohms ±1%	1	
347	Variable wire-wound resistor	20,000 ohms ±5%	1	
67	Self-inductance coil	11 - 16.5 mH	1	Common self-inductance with carbonyl core
70	Self-inductance coil	25 - 36 mH	1	Common self-inductance with carbonyl core
73	Self-inductance coil	110 - 160 mH	1	Common self-inductance with 2 carbonyl cores
86	Self-inductance coil	1mH ±5%	1	
135	Self-inductance coil	300mH ±5%	1	
297	Terminal panel	for 8 terminals	1	
298	Terminal panel	for 6 terminals	1	
299	Terminal panel	for 8 terminals	1	

1	2	3	4	5
300	Terminal panel	for 8 terminals	1	
305	Feeder plug	-	1	
305	Feeder plug	-	1	
313	Feeder plug	-	1	
314	Feeder plug	-	1	
315	Feeder plug	-	1	
316	Feeder plug	-	1	
332	Feeder plug	-	1	
320	Monitoring jack	-	17	
		RSS Unit		
59	Valve 5Ц4C	-	1	
60	Valve 5Ц3C	-	1	
217	Valve 6Ж4	-	1	
232	Valve 6X6C	-	1	
240	Valve 6П4	-	1	
254	Valve 6H8C	-	1	
276	Valve 6Ж6C	-	1	
286	Valve B1-0.02/20	-	1	
57	Capacitor MKB-500-8	8 µF	1	
58	Capacitor MKB-500-8	8 uF	1	
215	Capacitor KCO-5-500-B-2,000-II	2,000pF±10%	1	
220	Capacitor KCO-1-250-3-51-1	51 pF±10%	1	
225	Capacitor KCO-2-500-B-150-I	150 pF±5%	1	
223	Capacitor MKB-500-1	1 uF	1	

50X1

1	2	3	4	5
229	Capacitor МКВ-500-0.5	0.5 μF	1	
230	Capacitor МКВ-500-1	1 μF	3	In parallel
231	Capacitor МКВ-500-0.1	0.1 μF	1	
234	Capacitor КСО-5-500-В-5,100-I	5,100 pF±5%	1	
235	Capacitor КСО-1-250-В-51-1	51 pF±5%	1	
24[illegible]	Capacitor МКВ-500-0.5	0.5 μF	1	
245	Capacitor МКВ-260-1	1 μF	1	
246	Capacitor МКВ-500-0.5	0.5 μF	1	
247	Capacitor КСО-8-1,000-Б-10,000-II	10,000 pF±10%	1	
251	Capacitor МКВ-500-0.5	0.5 μF	1	
255	Capacitor КСО-3-500-В-1,000-I	1,000 pF±5	1	
256	Capacitor КСО-5-500-Б-2,000-II	2,000 pF±10%	1	
260	Capacitor КСО-8-1,000-В-10,000-II	10,000 pF±10%	1	
254	Capacitor МКВ-500-8	8 μF	1	
258	Capacitor МКВ-500-4	4 μF	1	
271	Capacitor МКВ-500-4	4 μF	1	
231	Capacitor КБГ-П-0.1-6-1	0.1 μF	1	
232	Capacitor КБГ-П-0.1-6-1	0.1 μF	1	
223	Self-inductance coil	10±0.5 mH	1	Part of circuit
224	Capacitor КПК-2-25/150	25 - 150 pF	1	

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1	2	3	4	5
252	Self-inductance coil	3.0±0.2mH	1	Part of circuit
253	Capacitor КПК-2-25/150	25 - 150 pH	1	
215	Resistor ВС-0.5-5.6 kilohms-10%	5.6 kilohms±10%	1	
218	Resistor BC-0.5-56 kilohms-10%	56 kilohms±10%	1	
219	Resistor BC-0.5-51 kilohms-5%	51 kilohms±5%	1	
221	Resistor BC-1-3 megohms-10%	3 megohms±10%	1	
222	Resistor BC-1-3.3 kilohms-10%	3.3 kilohms±10%	1	
226	Resistor BC-2-120 kilohms-10%	120 kilohms±10%	1	
227	Resistor BC-0.5-33 kilohms-10%	33 kilohms±10%	1	
233	Resistor BC-0.5-56 kilohms-10%	56 kilohms±10%	1	
235	Resistor BC-0.5-56 kilohms-10%	56 kilohms±10%	1	

50X1

1	2	3	4	5
237	Resistor BC-0.5-33 kilohms-10%	33 kilohms±10%	1	
238	Resistor BC-0.5-56 kilohms-10%	56 kilohms±10%	1	
239	Resistor BC-0.5-1 kilohm -10%	1 kilohm ±10%	1	
242	Resistor BC-2-100 kilohms-10%	100 kilohms±10%	2	In parallel
243	Resistor BC-1-30 kilohms-5%	30 kilohms±5%	1	
244	Resistor BC-0.5-2 kilohms-5%	2 kilohms±5%	1	
248	Resistor BC-0.5-100 kilohms-10%	100 kilohms±10%	1	
249	Resistor BC-0.5-1 kilohm -10%	1 kilohm ±10%	1	
250	Resistor BC-2-20 kilohms-5%	20 kilohms±5%	2	In series
257	Resistor BC-0.5-1 megohm±10%	1 megohm±10%	1	
258	Resistor BC-0.5-3.3 kilohms-10%	3.3 kilohms±10%	1	
274	Resistor BC-1-560 kilohms-10%	560 kilohms±10%	1	
275	Resistor BC-1-560 kilohms-10%	560 kilohms±10%	1	
278	Resistor BC-1-270 kilohms-10%	270 kilohms±10%	10	In series
280	Resistor BC-1-270 kilohms-10%	270 kilohms±10%	12	In series
295	Resistor tubular П-15	15 ohms	1	
296	Resistor BC-1-220 kilohms-10%	220 kilohms±10%	3	In series
304	Resistor BC-1-270 kilohms-10%	270 kilohms±10%	2	In series
312	Insulator	-	1	
56	Choke	1.3 H±20%	1	
270	Choke	1.3 H±20%	1	
287	Transformer	-	1	
288	Transformer	-	1	

No Foreign Dissem

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1	2	3	4	5
259	Variable wire-wound resistor	3,000 ohms	1	
303	Terminal panel	for 6 terminals	1	
307	Terminal panel	for 10 terminals	1	
308	Terminal panel	for 6 terminals	1	
309	Terminal panel	for 6 terminals	1	
310	Feeder plug	-	1	
311	Feeder plug	-	1	
317	Monitoring jack	-	2	
	Tube Unit			
110	Tube 23ЛМ34	-	1	
103	Capacitor			
	КСО-8-1,000-В-10,000-II	10,000 pF±10%	1	
302	Thermoswitch	-	1	
108	Terminal plate	for 8 terminals	1	
109	Terminal plate	for 10 terminals	1	
111	Focussing coil	-	1	
112	Scanning coil	-	1	
113	Brightening lamp, type 17	26 V; 0.15 A	6	In parallel
318	Brightening lamp, type 17	26 V; 0.15 A	2	In parallel
319	Hatching mechanism	-	1	
	CP (P.P.R. Cover)			
267	Relay КДР-1	-	1	
[illegible]	Ship's head switch	-	1	

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1	2	3	4	5
289	Scale illumination switch	for 3 positions	1	
205	Heater switch	for 1 position	1	
290	Switch	P.P.R. supply	1	
63	Station change-over switch	for 3 positions	1	
101	Calibration rings switch	-	1	
34	Centring potentiometer	10 kilohms	1	
39	Sweep length potentiometer	1 kilohm	1	
93	Calibration rings and SS wire-wound potentiometer	10 kilohms	1	
102	Brightness wire-wound potentiometer	20 kilohms	1	
107	Focussing wire-wound potentiometer	10,000 ohms	1	
207	Fuse in a holder	for 2 A	1	
207a	Fuse in a holder	for 2 A	1	
261	Brightening lamp, type 17	25 V; 0.15 A	1	
261a	Brightening lamp, type 17	25 V; 0.15 A	1	
	Elements not included in TU, RU, RSS or HU Units but Housed in P.P.R. Case			
194	Capacitor KB-260-2	2 μF	9	In parallel

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1	2	3	4	5
194a	Capacitor MKB-260-2	2 μF	9	In parallel
265	Resistor, tubular II-50 ohms	50 ohms	1	
266	Resistor, tubular II-50 ohms	50 ohms	1	
345	Resistor, tubular IV-500 ohms	500 ohms	1	
61	Transformer	-	1	
272	Transformer	-	1	
273	Transformer	-	1	
200	Decade potentiometer	-	1	
201	Contact unit	-	1	
206	Heating device	-	1	
208	Retaining contactor	-	1	
208	Blocking jaws	-	1	
208a	Retaining contactor	-	1	
208a	Blocking jaws	-	1	Situated on the upper and front covers

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Appendix 2

Table of Valve D.C. Characteristics

Ref. No. of valves	Nos of valve pins								Note
	1	2	3	4	5	6	7	8	
161	-	-	5±1.5	0.1±0.1	5±1.5	248±20	-	215±35	
149	-	-	12±2.5	0.1±0.1	12±2.5	240±20	-	280±15	
10	-	-	133±35	-	0.3±0.2	-	-	0	
14	-	-	280±15	-	133±35	-	-	150±35	Potent.pos.45 when there is no self-locking in all three ranges
21	-	-	-25±4	-	-25±4	-	-	-27.5±4	
37	-	-	270±20	300±30	-25±4	-	-	9±2.5	Potunt.pos.39 when there are 5.5 calibration intervals on the screen
55	-	-	94±20	-	2±0.5	-	-	1.1±0.6	
78	-	-	19±5	-	-0.3±0.3	-	-	0	
83	-	-	70±10	-	-2±0.5	-	-	0	

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Ref. No. of valves	Nos of valve pins 1	2	3	4	5	6	7	8	Note
87	–	–	95 ± 10	–	2.6 ± 1	–	–	0	
95	–	–	0	-9.5 ± 3	0	45 ± 6	–	95 ± 10	
99	–	–	0	-10 ± 3	0	95 ± 10	–	95 ± 10	Potent.pos.25 in the extreme left position
124	–	–	0.25 ± 0.25	-4 ± 1.5	0.25 ± 0.25	170 ± 25	–	250 ± 25	Potent.pos.181 in the extreme right position
133	–	–	–	-8 ± 1.5	1.1 ± 0.3	280 ± 15	–	80 ± 15	
171a	–	–	–	8.5 ± 2.5	300 ± 30	21 ± 3	–	–	
171b	0.25 ± 0.25	1 ± 0.9	0	0	–	–	–	–	Range 75 miles, distance–7.38 cables
179	–	–	225 ± 15	15 ± 5	225 ± 15	–	–	400 ± 20	ditto
190	–	–	425 ± 25	215 ± 15	215 ± 15	425 ± 25	–	425 ± 25	ditto
217	–	–	–	0.3 ± 0.2	0	38 ± 10	–	265 ± 15	ditto
240	–	–	–	0	7 ± 1	110 ± 10	–	280 ± 20	ditto
254	-0.4 ± 0.25	65 ± 10	0	0	280 ± 20	12 ± 3.5	–	–	ditto

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Ref. No.110. Second anode (anode cap) 5,000 V±500 V.

Accelerating electric terminal 3 of terminal panel 1, Ref. No.109, 133 V±35 V.

Modulator grid, terminal 4 of terminal panel 1, Ref. No.109, 80 V±15 V.

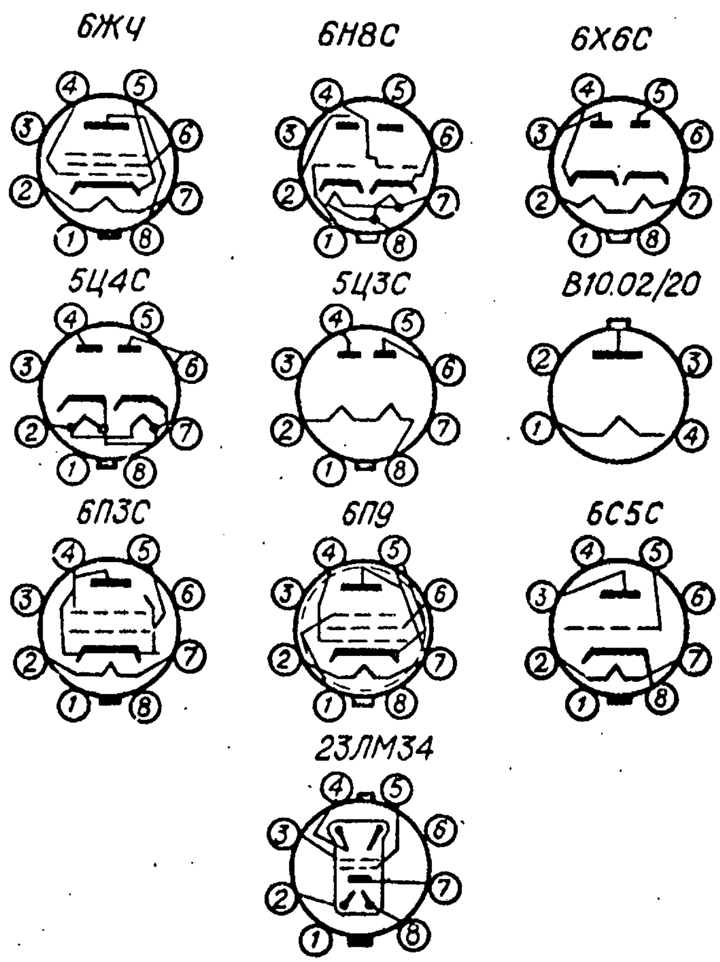
Cathode, terminal 5 of terminal panel 1, Ref. No.109. From 340 V± 35 V to 125 V ± 40 V.

The focussing coil, terminals 1 and 2 of terminal panel 1 Ref. No. 109 - not less than 75 V and not more than 190 V; terminals 5 and 6 of terminal panel Ref. No. 309 - 315 V ± 35 V; terminals 2 and 10 of terminal panel Ref. No. 307 - 400 V ± 25 V; terminals 3 and 5 of terminal panel Ref.No. 303 - 340 V ± 35 V (at the beginning of heating Ref.No. 276); terminals 3 and 5 of the terminal panel Ref. No. 303 - 125 V ± 40 V (at the end of heating Ref.No.276).

Note:
1. The voltage values are given with respect to the unit body.
2. Measurements should be taken with an avometer ABO-5.
3. Measurements should be taken in the 50-mile range unless 75-mile range is specified in the table.
4. The A.C. characteristics tables of device No.4 are given in corresponding Specifications for the device units.

Appendix 3

BASE CHART OF RADIO VALVES



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50X1

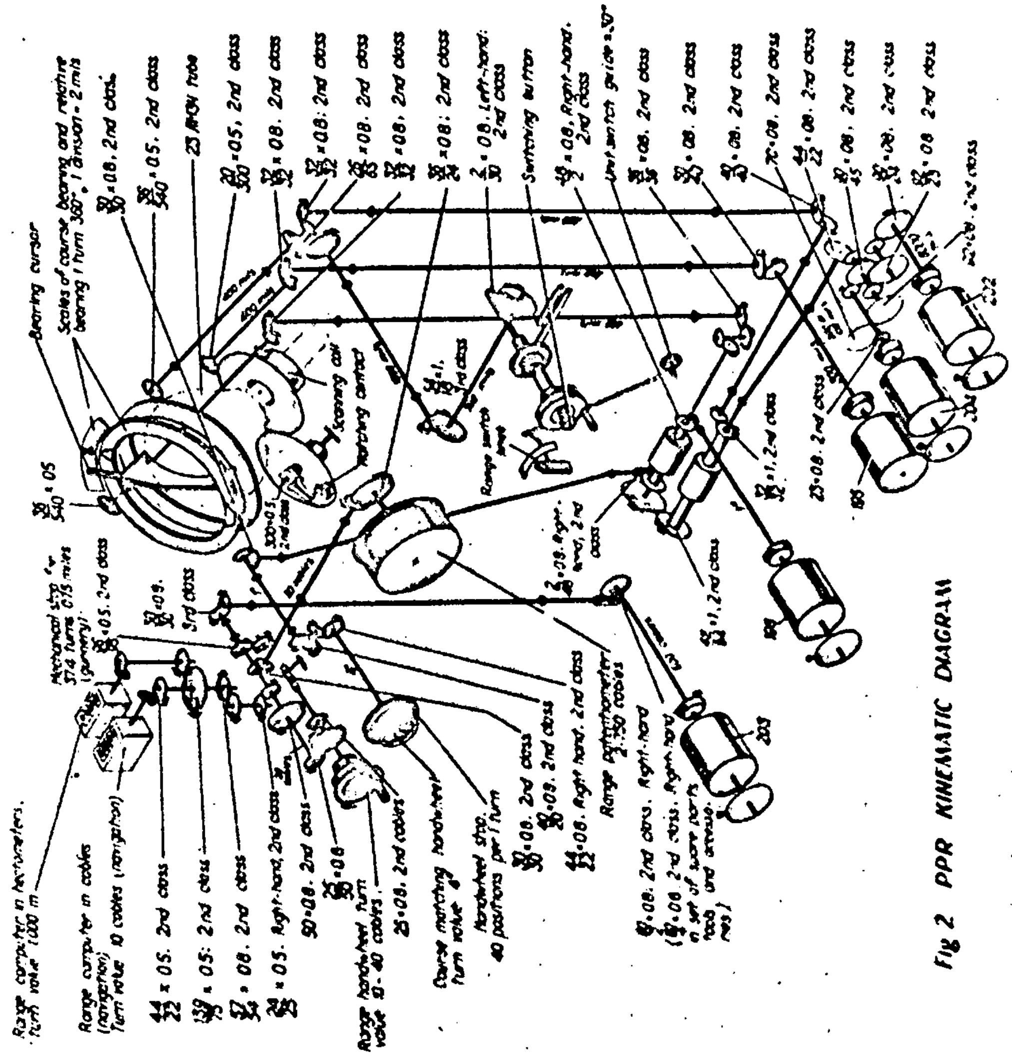


Fig 2 PPR KINEMATIC DIAGRAM

50X1

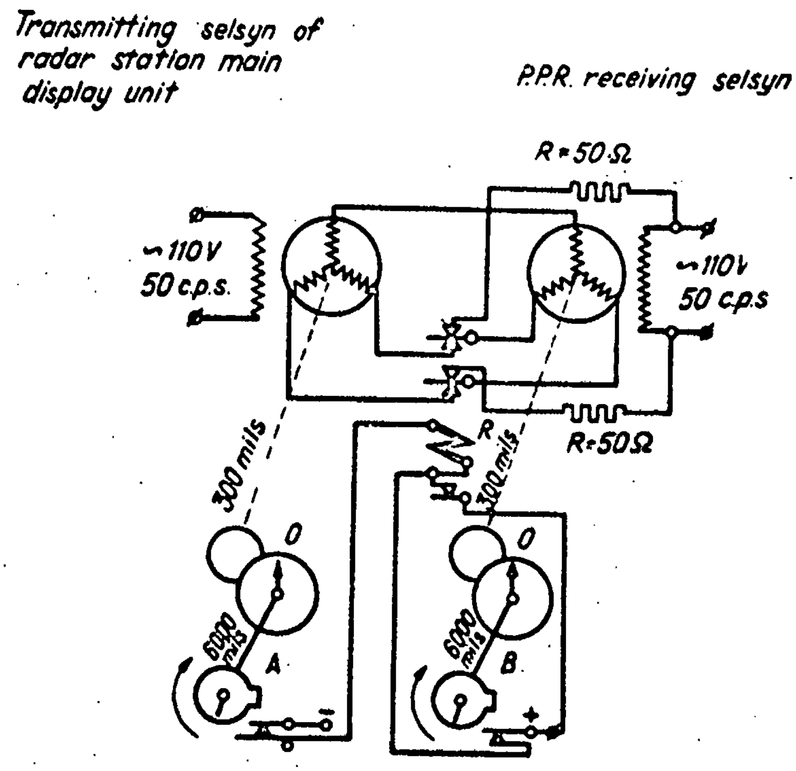
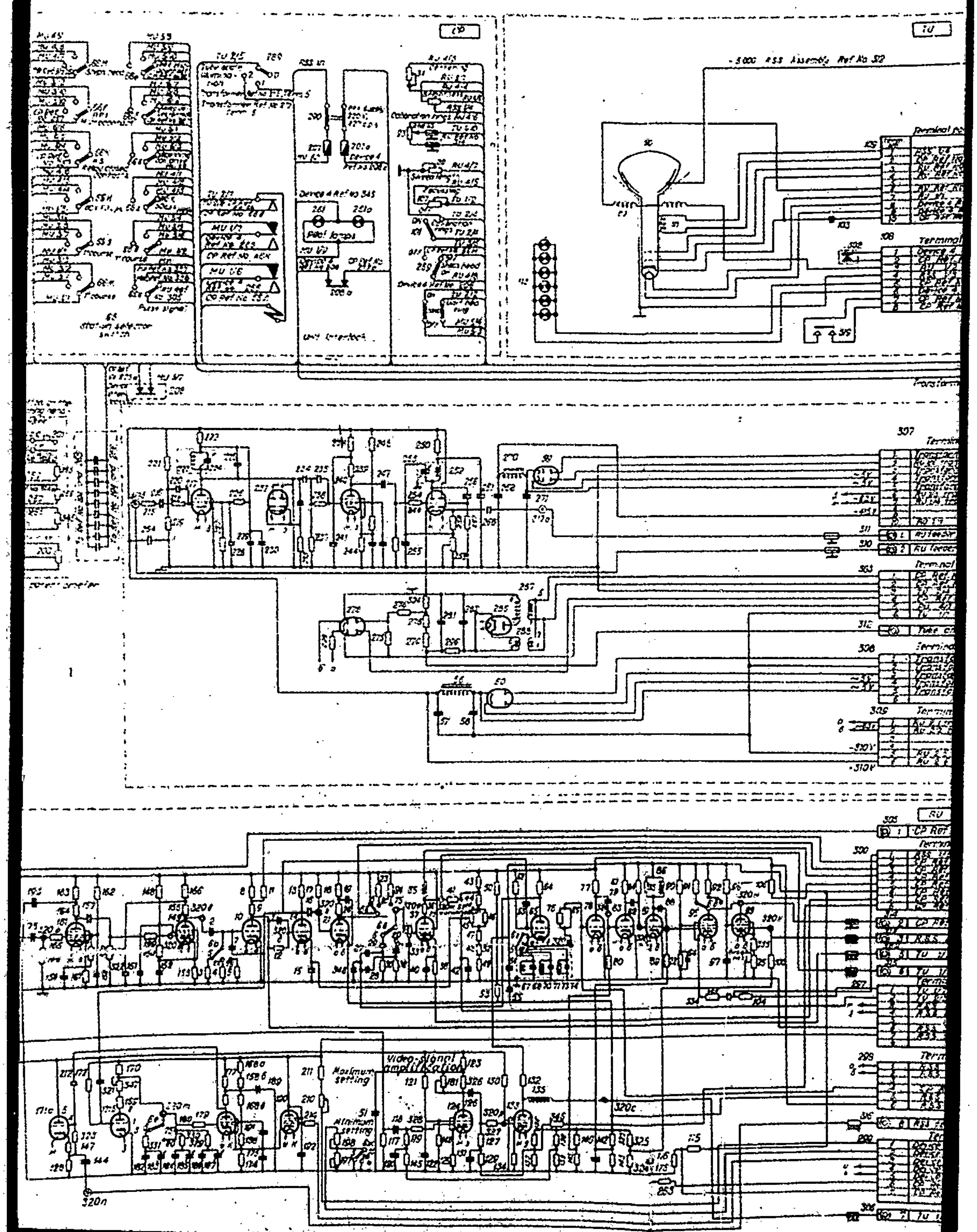


Fig.3. KEY DIAGRAM OF PHASE-ALIGNMENT

50X1



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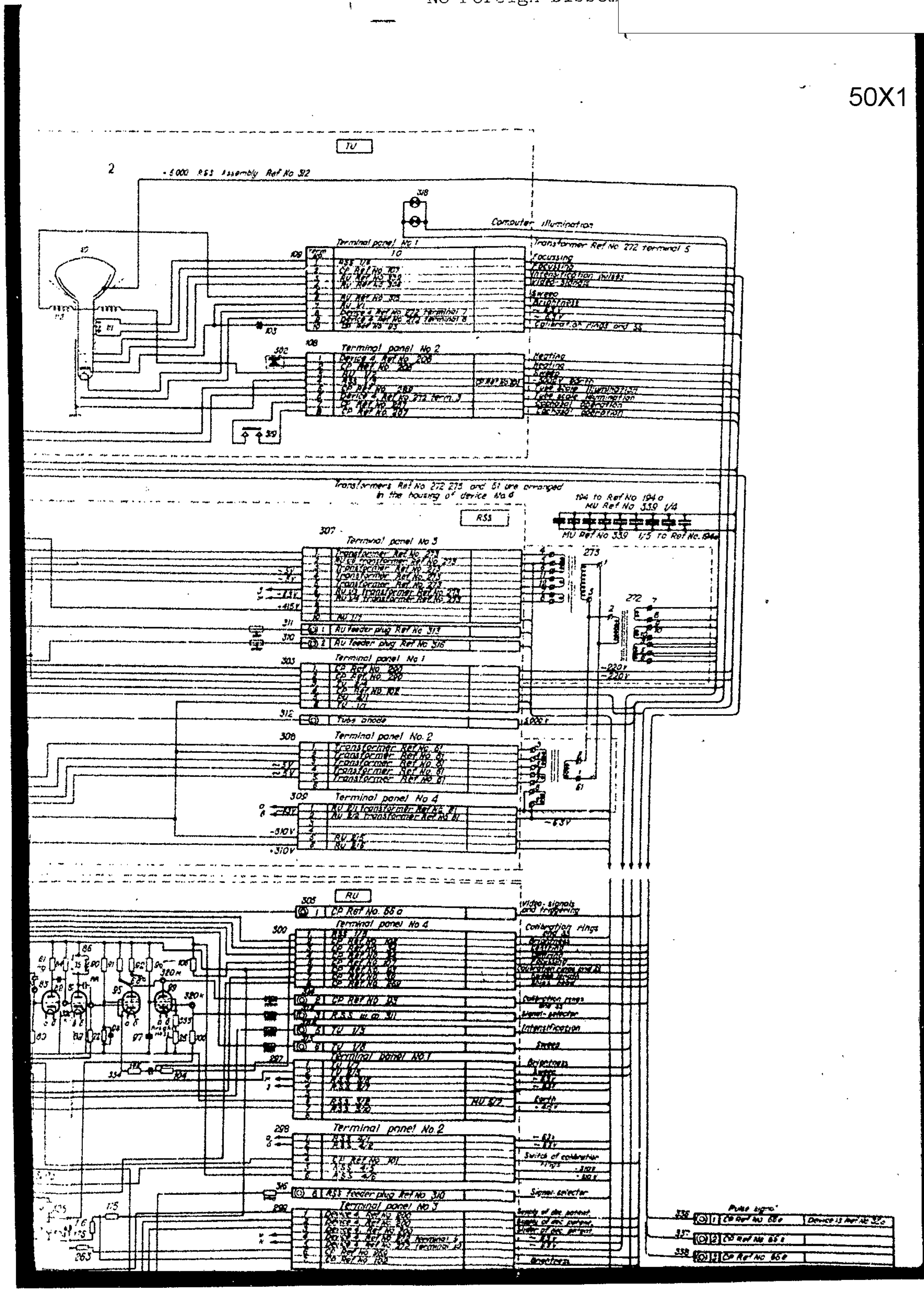


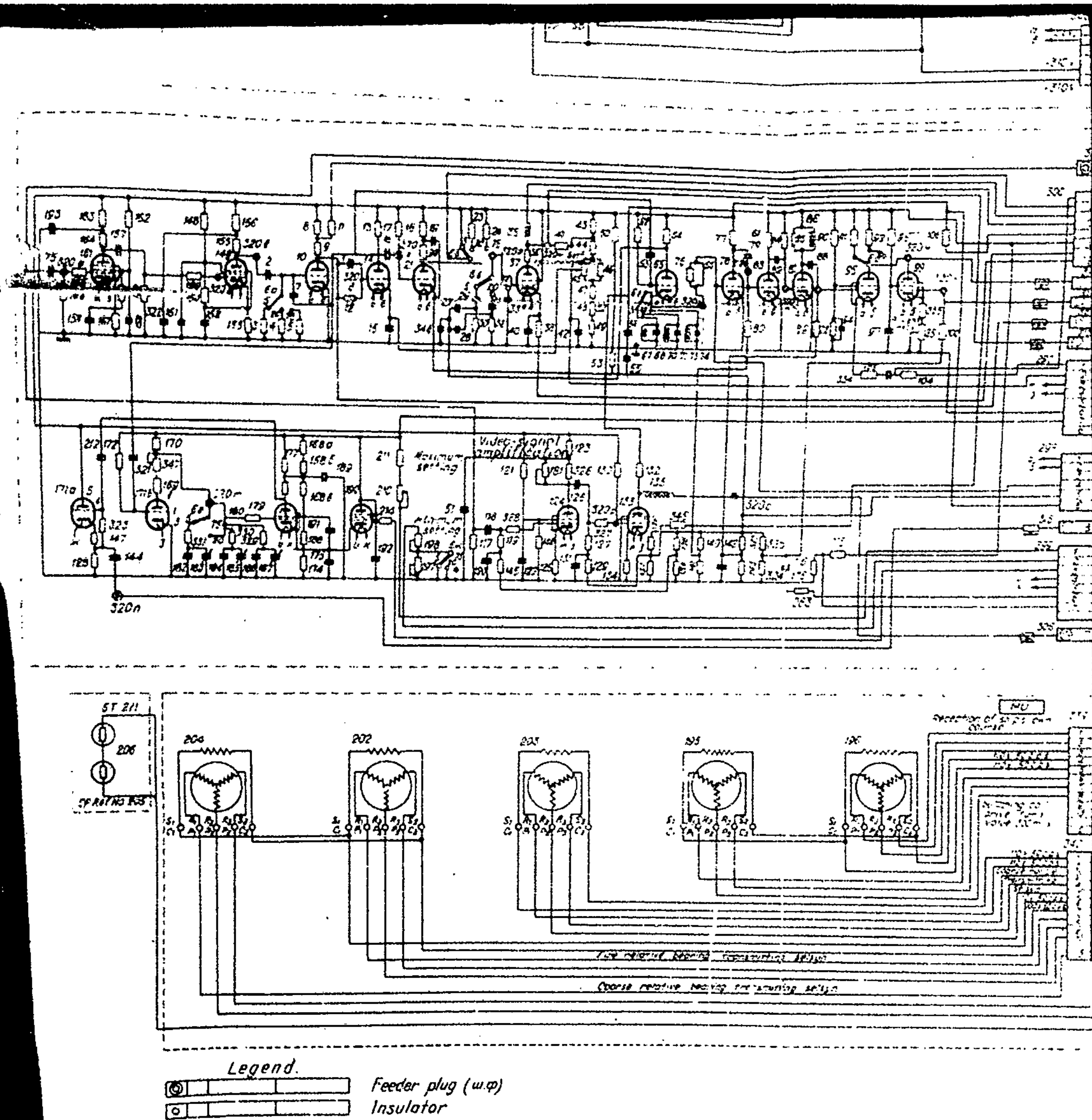
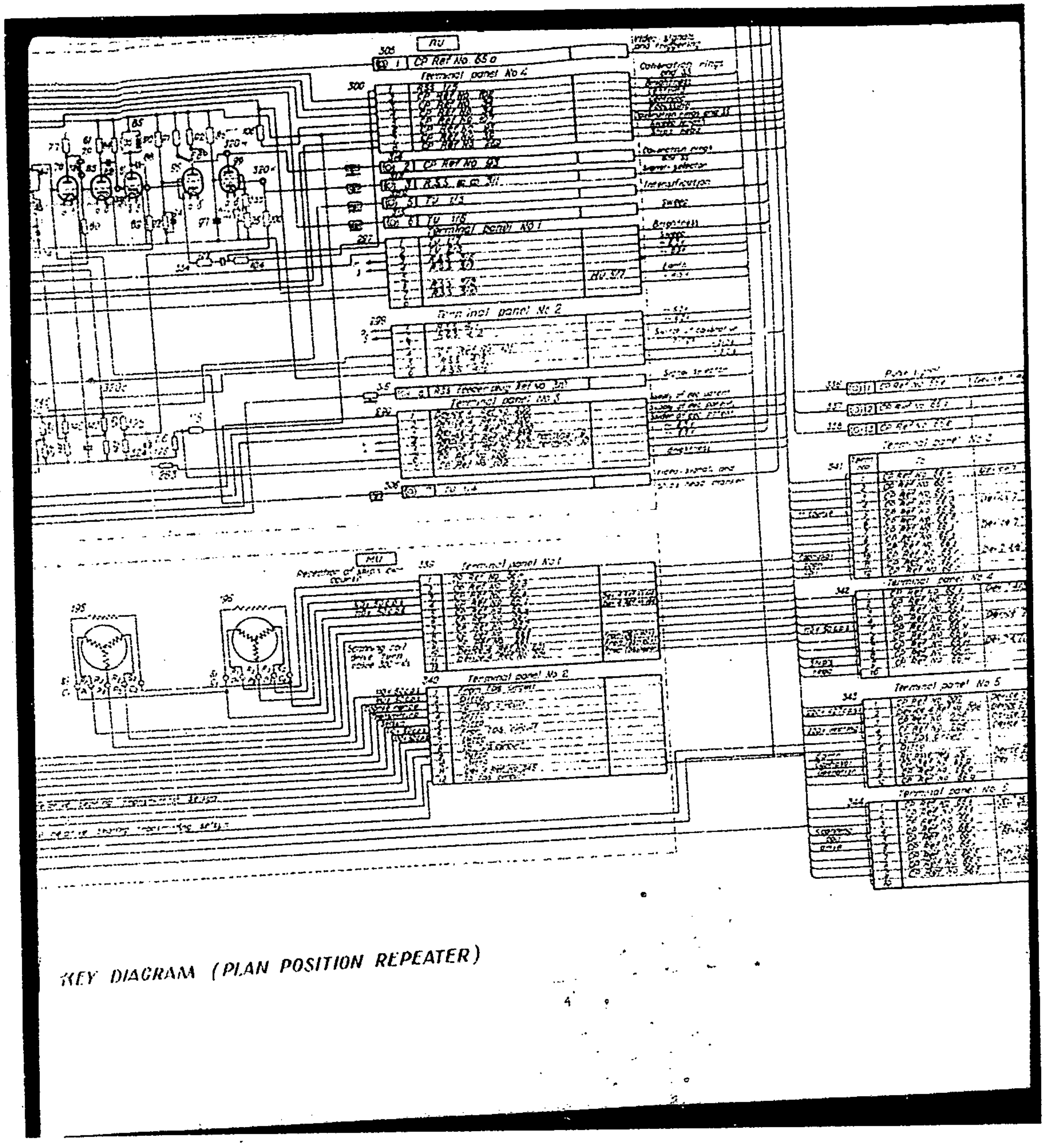


Fig. 4. **KEY DIAGRAM (PLAN POSITION REPEATER**

3

50X1



KEY DIAGRAM (PLAN POSITION REPEATER)

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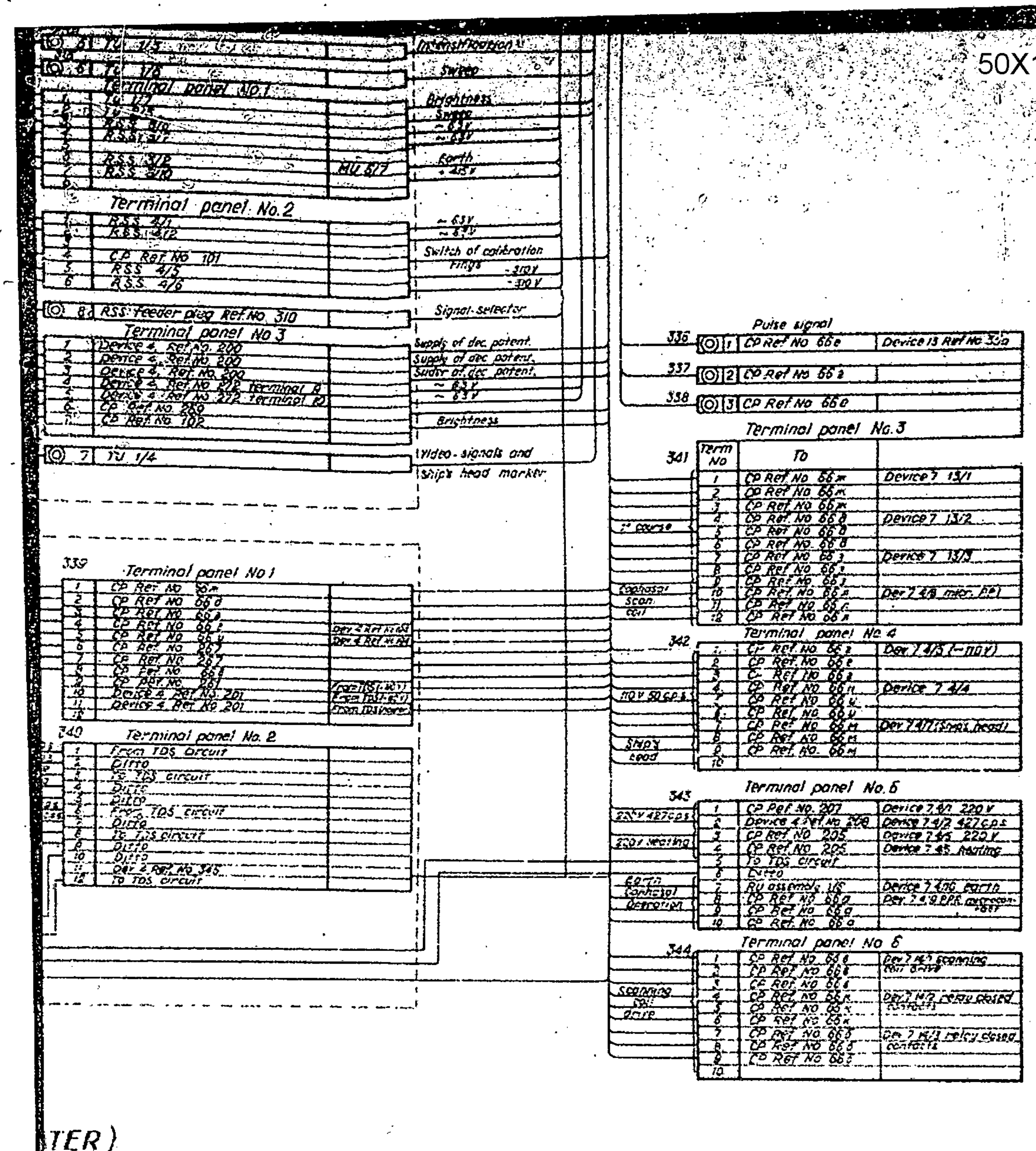
50X1



5

S-E-C-R-E-T

No Foreign Dissem

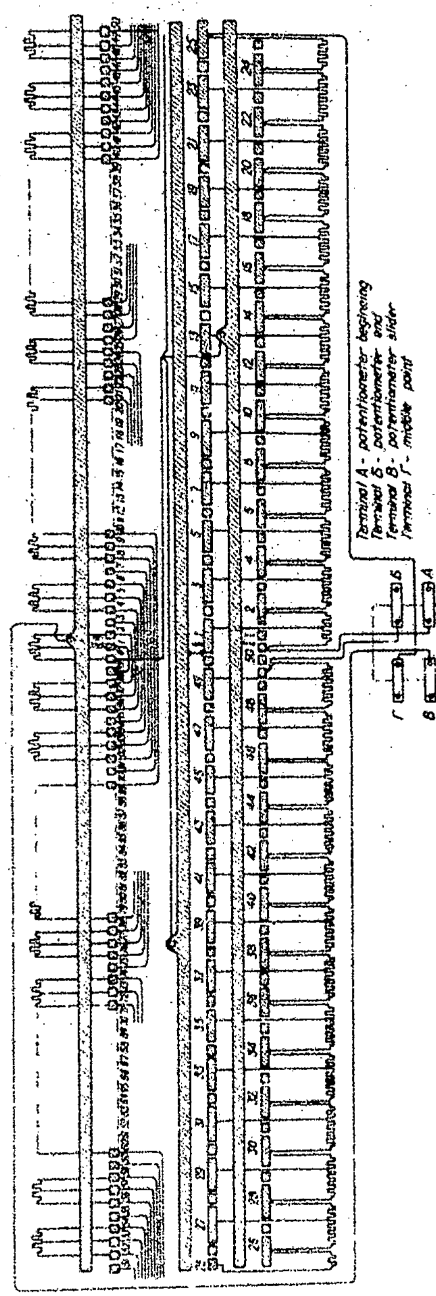


Fig 5 DECADE POTENTIOMETER CONNECTION DIAGRAM

50X1

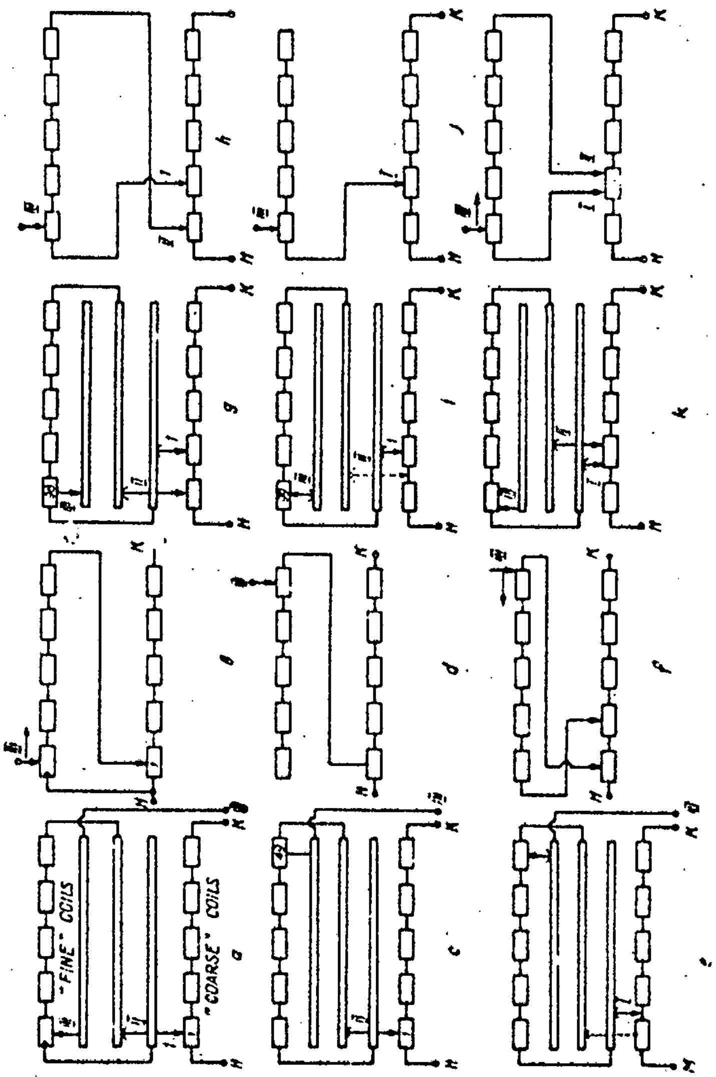


Fig 6 SIMPLIFIED DIAGRAMS OF RANGE POTENTIOMETER

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No Foreign Dissem

50X1

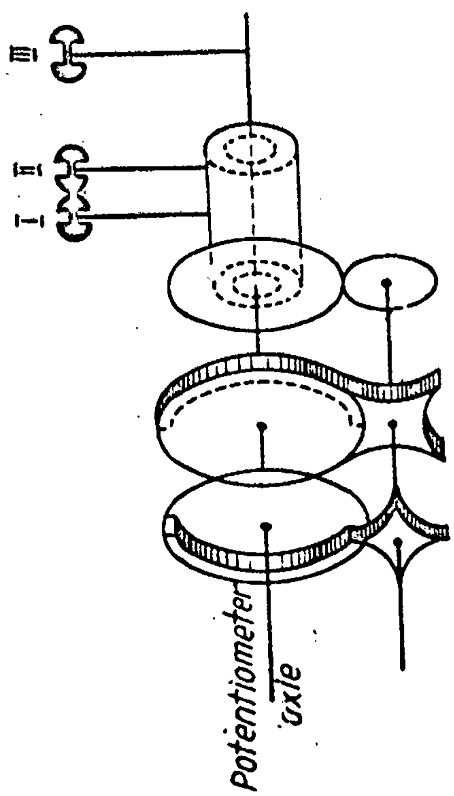

Fig.7. Kinematic Diagram of Range Potentiometer

S-E-C-R-E-T

50X1

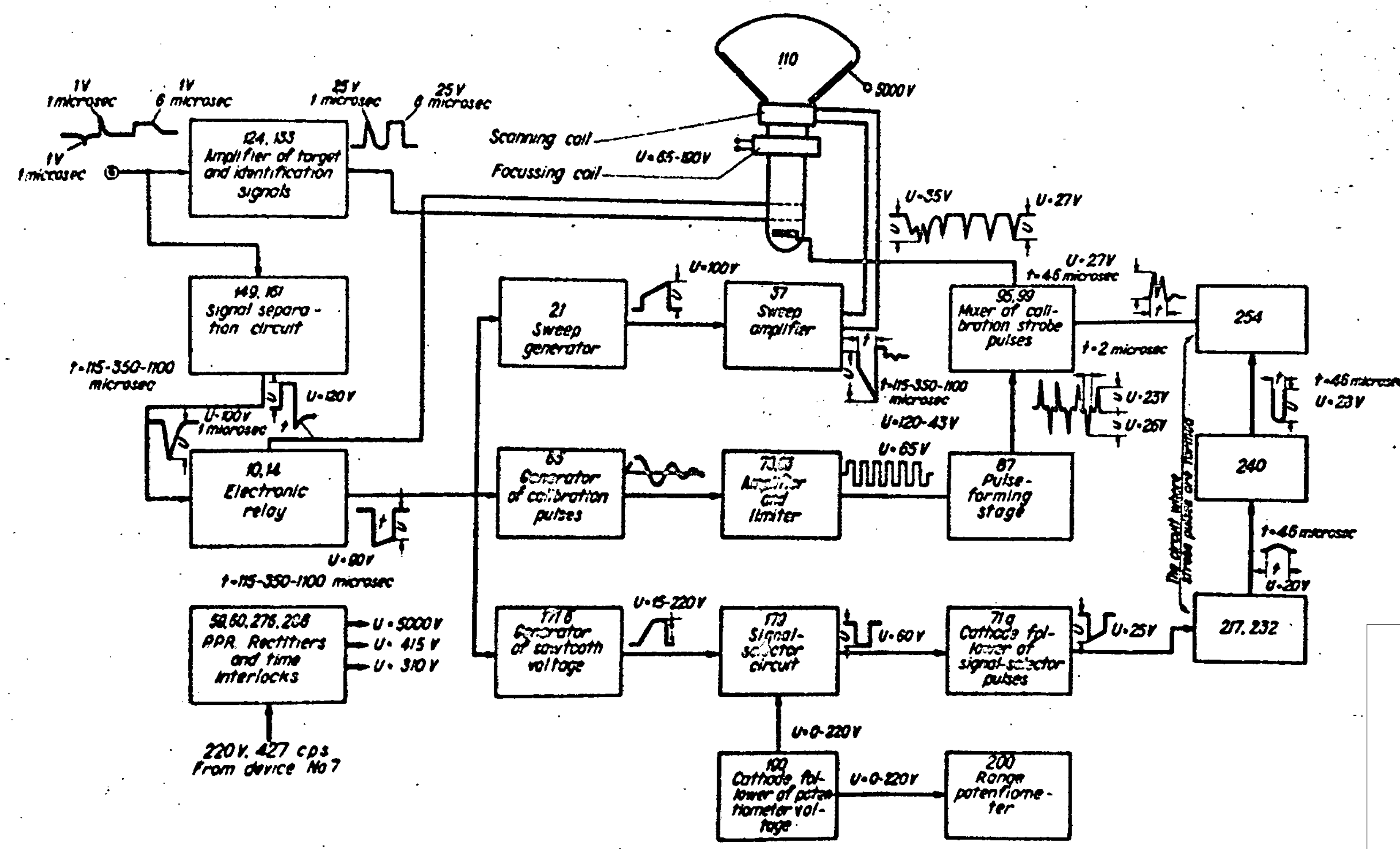

Fig 1. BLOCK-DIAGRAM OF P.P.R. DISPLAY UNIT

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