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Automatic Navigation Direction Finder ARP-50: Brief Description and Operating Instructions,

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INFORMATION REPORT INFORMATION REPORT

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AUTOMATIC NAVIGATION DIRECTION FINDER АРП-50

BRIEF DESCRIPTION AND OPERATING INSTRUCTIONS

Declassified in Part - Sanitized Copy Approved for Release 2013/03/18 : CIA-RDP80T00246A064800280001-2

I. PURPOSE

The automatic navigation direction finder АРП-50 is designed for mounting on shipboard.

The main purpose of the automatic direction finder is to determine the place of a ship in the sea by taking bearings from omnidirectional radio beacons and stations.

As compared with aural direction finders the R.D.F. АРП-50 has better operating properties which are ensured by:

1. The use of the follow-up system which makes it possible to obtain automatically radio relative bearing and bearing as well as to follow continuously a bearing direction.

2. The use of electrical and mechanical radio deviation compensators that almost entirely eliminate radio deviation (within $\pm 0.5^{0}$).

3. The use of automatic minimum cleaning (up to 2 - 3 per cent), manual control being used during aural bearing operation.

4. The use of tuning pointer indicator. To obtain a radio bearing (or radio relative bearing) when employing R.D.F. АРП-50 it is necessary to tune the receiver to the desired radio beacon frequency, after which the goniometer indicator is automatically set in the radio bearing position. This reduces the time required to obtain results several times as compared with the time required for aural bearing operation.

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If necessary, the automatic direction finder can be used as an ordinary aural direction finder.

II. COMPONENTS

The commercial R.D.F. АРП-50 set general view is shown in Fig.1.

The operating R.D.F. АРП-50 set consists of the following parts:

1. Loop antenna unit.
2. Non-directional two-wire antenna.
3. Antenna box.
4. Receiver-and-goniometer unit in a casing with a mounting frame.
5. Supply unit with a mounting frame.
6. Control distribution board.
7. Two signalling boards.
8. Two dynamic loudspeakers.
9. Headphones with a headband (ТА-4)
10. Cords complete with plugs to plug in dynamic loudspeakers.
11. Converter ОП-120 (only with D.C. mains supply, 110 or 220 V).
12. Autotransformer 220/127 V (only with A.C. mains supply, 220 V).

The commercial set differs from the operating set by the presence of following additional parts:

1. Tester ТТ-1.
2. Shipboard set of spare parts, tools and accessories.

Overall dimensions and weights of individual parts of the direction finder operating set are given in the following table:

No.	Description	Quantity, piece	Weight, gr	Height, mm	Width, mm	Length, mm	Note
1	2	3	4	5	6	7	8
1	Loop antenna unit 1.2-m. diameter 0.6-m. diameter	1	21500 14000	1592 1000	1200 600	1200 600	The set is provided with one of the given antennas
2	Loop antenna unit support	1	9000	1600	240	240	Composed according to a letter index
3	Antenna components kit		3500				
4	Antenna box	1	1600	175	77.5	190	
5	Receiver-and-goniometer unit in casing with a mounting frame	1	40000	353	310.5	600.6	
6	Supply unit with mounting frame	1	27000	515	171	356	
7	Control-distribution board	1	3800	270	115	330	

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6	Supply unit with mounting frame	1	27000	515	171	356	
7	Control-distribution board	1	3800	270	115	330	

1	2	3	4	5	6	7	8
8	Signalling board	2	1200	185	89	186	
9	Dynamic loudspeaker	2	1500	204	95.5	160	
10	Headphone TA-4	1	800	190	-	122	Resultant D.C. resistance 4400 ohms
11	Cords with plugs for connecting dynamic loudspeakers	3	-	-	-	1000	
12	Converter ОП-120	1	25000	345	260	460	Composed according to a letter index
13	Autotransformer 220/127 V	1	9000	268.5	134.5	152	Composed according to a letter index

The direction finder units are interconnected with cables, while the loop antenna unit and antenna box are connected with the receiver-and-goniometer unit by means of a feeder.

III. DIRECTION FINDER MODES OF OPERATION

1. Automatic Bearing Operation "A"

Automatic bearing operation is the principal mode of operation of the direction finder. During automatic bearing operation the direction finder, when tuned to the transmitting station frequency, automatically sets the goniometer pointer in the position corresponding to the radio station bearing read off the movable goniometer scale.

The station signals can be heard in the headphones and dynamic loudspeaker only if the station employs modulated oscillations, as in this mode of operation the second heterodyne is switched off.

2. Aural Bearing Operation "C"

During aural bearing operation the automatic direction finder operates as a conventional aural direction finder.

On tuning to the transmitting station frequency the direction finder makes it possible while listening to the station signals and turning the goniometer search coil, to find the search coil position corresponding to the minimum reception.

In this position the goniometer pointer indicates the radio bearing (on the movable scale). The radio station signals can be heard in the dynamic loudspeaker and headphones irrespective of whether the station transmits modulated or unmodulated oscillations as the second heterodyne operates in the receiving unit.

3. Frequency Watching "Д"

During frequency watching the direction finder can be used as a conventional communication receiver, highly sensitive and interference-proofed. It may be used for navigation by approach beacons as well.

In this mode of operation the direction finder allows the signals of the stations, that employ modulated and unmodulated oscillations, to be heard in headphones and dynamic loudspeaker.

With a crystal filter used, it is possible to decrease interference in all direction finder modes of operation.

IV. DIRECTION FINDER BLOCK DIAGRAM AND PRINCIPLE OF OPERATION

1. Direction Finder Block Diagram

The direction finder block diagram (Fig.4) includes the following main elements:

(a) loop antenna unit;
(b) goniometer;
(c) phasing commutator;
(d) loop amplifier;
(e) non-directional antenna;
(f) receiver;
(g) telephone output amplifier;
(h) control circuit;
(i) direction finder output amplifier;
(j) audio oscillator;
(k) motor, rotating the goniometer search coil with reducing gear.

2. Direction Finder Operation Principle and the Purpose of Individual Components of the Block Diagram (Fig.4)

1. The direction finder loop antenna unit consists

of two loops fitted at right angles to each other. Each loop is connected to a separate stationary goniometer field coil. The two field coils are similarly at right angles. The incoming electromagnetic wave induces currents in the loops and consequently in the goniometer field coils. These currents set up a magnetic field within the field coils. Inside these field coils there is a rotating coil called the search coil. Electromotive force set up in the seach coil depends on the coil angle of rotation in the field inside the field coils. This relationship resembles the relationship between the E.M.F. set up in a simple loop and the direction of a transmitting aerial (See Fig.5).

As seen from the figure there are two positions of the goniometer search coil in which the resulting E.M.F. induced by the signal field across the terminals is equal to zero. In all other positions the E.M.F. set up by the field is not zero and changes with an angle of rotation increasing to some maximum value.

Polarity or phase of the E.M.F. set up by the transmitter in the right-hand direction are opposite to those induced by the transmitter in the left-hand direction, the directions being read from the minimum signal strength line - the bearing line.

Voltages and currents obtained in the loop depending on the transmitter direction are shown graphically in Fig.6. Voltage developed across search coil terminals is given in part "a" of Fig.6.

As is seen from the figure with the goniometer search coil directed towards the radio station, the search coil terminal voltage equals zero. With the goniometer search coil displaced to the right or to the left from the transmitter direction the electromotive forces across the search coil terminals are opposite in phase.

2. The signal voltage from the goniometer search coil terminals is supplied to the phasing commutator (Fig. 4-c). The phasing commutator controlled by the audio oscillator (Fig. 4-j) shifts this signal phase by 180° each half-cycle of the audio oscillator frequency. Fig. 6-b illustrates the voltage at the phasing commutator output. The figure shows a periodic signal phase change and opposite phases corresponding to the search coil displacement to the right and left from the bearing direction at every given moment.

3. After the phasing commutator the signal is supplied to the loop amplifier (Fig. 4-d), amplified in it, and fed to the receiver input (Fig. 4-f).

4. The non-directional antenna voltage is supplied to the receiver input as well (Fig. 4-e). The E.M.F. induced by the signal field in the non-directional antenna does not depend in value and phase on the direction of signal arrival. In other words, the radiation pattern of such antenna is a circle.

Fig. 6-c illustrates the receiver input voltage from the non-directional antenna. The receiver input voltages from the non-directional and loop antennas are either added or subtracted in accordance with their phase relation. If the phases of these signals coincide, the signals are added and the resulting oscillation amplitude increases; if the signals are opposite in phase, they are subtracted and the resulting signal amplitude equals to the amplitude difference. As the loop input voltage periodically changes by 180° in phase, it either adds to the antenna signal or subtracts from it causing the amplitude of the resulting signal at the receiver input to change periodically - amplitude-modulated oscillation (Fig. 6-d). Amplitude changes of

this resulting oscillation take place at the commutating frequency of the loop input signal which is determined by the local audio oscillator. In other words, the envelope frequency of the amplitude-modulated signal developed at the receiver input is the frequency of the audio oscillator.

The envelope phases resulting from the search coil displacement to the right and left from the bearing direction are shifted by 180°.

It is explained in the following way. Suppose that with the search coil displaced to the right from the radio station direction the input signal phase is such that in the first half-cycle of the commutating frequency this signal adds to the antenna signal. Thus, the envelope phase of the resulting oscillation during this half-cycle of the commutating frequency is positive.

Now, let us change the direction of the search coil displacement. Suppose that it deflects to the left from the bearing direction. The goniometer search coil terminal voltage shifts by 180° in phase. Thus, during the same commutating half-cycle it will be subtracted from the antenna signal. The amplitude of the resulting oscillation is lower than the antenna signal amplitude, i.e. the envelope phase during the same commutating frequency half-cycle will be negative (See the right and left Sections of Fig. 6-d).

With the search coil in the bearing position the signal voltage across the goniometer unit terminals becomes equal to zero and the receiver input is supplied only with the non-directional antenna voltage (See the middle Section of Fig.6-d).

5. Amplitude-modulated signal developed at the receiver input is further amplified in the receiver, frequency-converted, detected and from the detector load

its low-frequency envelope is supplied to the direction finder output amplifier. This stage tuned to the audio oscillator frequency discriminates and amplifies only this component of the detected signal.

This voltage, whose shape is shown in Fig. 6-e, is supplied to the control circuit from the automatic channel output stage.

6. The signal causes voltage to be developed in the control circuit (Fig. 6-f) which is supplied to the induction motor control winding and drives it. Across the motor second winding (excitation winding) the voltage has a constant value and phase.

Direction of the motor rotation is determined by the voltage phase supplied to its control winding which in its turn is determined by commutating frequency signal phase arriving at the control circuit input.

Thus, when the search coil deflects, for example, to the left from the bearing direction signal appeares at the goniometer output whose high-frequency phase is determined by the side of the search coil deflection. This voltage is commutated in the phasing commutator and, being added to the non-directional antenna voltage at the receiver input, is converted into amplitude-modulated oscillation. In this new voltage the low-frequency envelope phase is determined by the high-frequency signal phase from the goniometer unit, i.e. by the search coil deflection direction. After the detector, the commutating frequency component, discriminated in the bearing output amplifier, is converted in the control circuit into new voltage having a phase that is determined by the phase of the signal applied to the control circuit input. Motor switching on is adjusted so that it starts rotating counter-clockwise, i.e. to the left, when the voltage of this phase is fed to its control winding.

The motor axle is coupled through the reducing gear with the goniometer search coil, and the motor while rotating will turn this coil to the left, i.e. to the radio station bearing direction.

In the bearing position, when the output signal at the direction finder loop input becomes equal to zero, the receiver input voltage is no longer amplitude-modulated, the signal does not arrive at the control circuit, and voltage is not supplied to the motor control winding. The motor stops. When the search coil deflects to the left from the bearing direction, the voltage that establishes across the goniometer unit terminals is 180^{o} out of phase as compared with the voltage developed during the search coil deflection to the right from the bearing. The final voltage supplied to the motor control winding is also 180^{o} out of phase, thus making the motor rotate clockwise. While rotating, it turns the goniometer search coil to the right, i.e. back to the bearing direction.

It should be noted that when the goniometer search coil deflects 180^{o} from the bearing (back bearing direction) the voltage of the loop input, as is seen from Fig.6, is equal to zero. In this case only the antenna supplies the receiver input and the motor does not rotate. However, this equilibrium position is unstable. With slight deflection from this position the loop channel feeds voltage, amplitude-modulated oscillation is developed at the receiver input and the motor rotating as in the previous cases sets the search coil in the bearing position.

Thus, at any deflection of the system from the bearing position, voltage automatically generated in it causes the motor to rotate, thus bringing the system back in the bearing position.

7. A pointer is secured on the same axle with the search coil. When the search coil is rotating, the pointer is moving along the scale which is calibrated every 1°. Zero position on this scale corresponds to the pointer position with the search coil adjusted to indicate the bearing of the radio station located along the ship's fore-and-aft line. Thus, the pointer reads an angle formed by the radio station direction and the ship's fore-and-aft line, i.e. the radio station relative bearing.

The goniometer is provided with one more scale. This scale is movable and is coupled to the gyro-compass by means of selsyns; this scale pointer reads the radio station bearing.

8. This discussion deals with the use of this unit as an automatic direction finder. If used as an aural direction finder (in "C" mode of operation) the phasing commutator operates as a high-frequency amplifier, the audio oscillator and control circuit are switched off and the direction finder receiver serves simply for amplification of the signal coming from the goniometer unit. The bearing position is determined by the minimum of signal strength when the goniometer search coil is turned.

V. DIRECTION FINDER KEY DIAGRAM AND PRINCIPLES OF OPERATION

1. Direction Finder Circuit

For the direction finder key diagram see Fig. 25. It may be divided into the following sections:

(a) loop antenna unit and non-directional two-wire antenna;

(b) receiver-and-goniometer unit;

(c) supply unit;

(d) control distribution board.

The loop antenna unit and two-wire antenna make possible directional and non-directional reception.

The main and most complicated unit of the direction finder is the receiver-and-goniometer unit which ensures the direction finder performance.

Voltages required for the receiver-and-goniometer unit are fed from the supply unit.

The distribution board serves to check the voltages fed from the supply unit.

(a) Loop Antenna Unit and Non-Directional Two-Wire Antenna

1. The loop antenna unit consists of two loops fitted at right angles to each other. Screening and mid-point grounding of the loop windings through a capacitor serve for decreasing the antenna effect.

2. The non-directional two-wire antenna consists of main and compensating wires.

(a) During automatic direction finding the main wire ensures normal direction finder operation. During aural direction finding this wire is used for manual compensation of the antenna effect (zero cleaning) while during frequency watching it serves for signal reception.

(b) The second - (the so-called compensating) wire serves for automatic compensation of the antenna effect during aural and automatic bearing operation. The signal from this wire is taken to one of the goniometer field coils through a high-frequency filter (LI-47, CI-133) and zero sharpening control (BI-7) by means of a jumper П1-10.

Both wires are coupled to the antenna box partition insulators and furhter (with the help of a feeder) to the receiver-and-goniometer unit. For draining electric charges both wires are grounded through resistors R6-1, R6-2. Neon lamps protect the direction finder from overvoltages that can be applied to the antenna wires.

(b) Receiver-and-Goniometer Unit

For the general view of the receiver-and-goniometer unit see Fig.10 (a, b, c, and d).

Let us analyse individual elements of the receiver-and-goniometer unit key diagram.

(1) Goniometer

As shown above, the goniometer consists of two field coils (LI-1a, b), (LI-2a,b) and one search coil (LI-3). The loop ends are connected to the goniometer field coils by means of a feeder. The goniometer search coil is included into the loop circuit. The loop circuit is a resonance circuit tuned to the frequency of an incoming signal. Its inductance is formed by search coil, circuit coil and antenna variometer rotor. The capacitance includes variable capacitors C1-11a, C1-11 б, a fixed capacitor and a trimmer. The variable capacitors are the sections of the variable capacitor assembly and are switched on in all bands. The circuit coils, trimmers and parallel fixed capacitors are switched over from one band to another with a special switch ganged with a band selector switch. A coil L1-6, a trimmer C1-5 and a fixed capacitor C1-6 are switched on in the first band; a coil L1-5, a trimmer C1-3 and a capacitor C1-4, in the second band; and a coil L1-4, a trimmer C1-1 and capacitors C1-2, C1-12 and C1-13, in the third band.

In all the bands a neon lamp is connected in parallel with the circuit. Its purpose is to limit valve grid voltage of the phasing commutator. In all the bands the variometer rotor of the manual antenna effect compensation is connected in series with the search coil.

The loop circuit is shunted by a resistance R1-18 in "A" mode of operation so as to decrease the antenna effect (if detuning is present) on direction finder accuracy.

The capacitors C1-1, C1-4, C1-6, C1-7 and C1-13 are thermocompensating devices.

The loop circuit is connected to the phasing commutator valve grids.

(2) The phasing commutator (Л1-1, Л1-2)

The phasing commutator employs 6Ж4 valves. High-frequency voltage of the loop antenna supplied to the phasing commutator valve control grids from the loop circuit is of the same phase and amplitude. Simultaneously, low-frequency voltage of the same amplitude but shifted by 180° in phase is supplied to the phasing commutator valve control grids from the audio oscillator.

As the result of the phasing commutator and audio oscillator operation high-frequency currents of the loop antenna flow intermittently in the plate circuit of the first or the second valve.

Initial bias is supplied to the phasing commutator valves from resistors R1-16 and R1-17 through leak resistors R1-13 and R1-15.

Valve plate voltage is supplied through R1-21 resistor blocked by C1-21 B capacitor. These elements form a decoupling filter cell. C1-21 б capacitor blocks cathode resistors for high frequency.

A circuit consisting of L1-7, L1-8 and L1-9 coils is connected into the phasing commutator valve plates. The circuit is designed so that electromotive forces induced by valve currents in the secondary winding of the circuit (L1-9) differ by 180^{0}.

In addition the phasing commutator shifts the phase of the loop input signal by 90^{0}. This phase shift is found necessary to bring the signals applied from the loop and antenna inputs in phase. To ensure such phase shift the resonance frequency of the phasing commutator circuit is selected higher than the highest frequency of the band.

The circuit coils L1-7 and L1-8 are connected to the phasing commutator valve plates. They are made as one coil with a middle tap and are connected so that, as it was shown above, operation of one phasing commutator valve causes voltage of one phase to be induced in the L1-9 coil, whereas operation of the other valve induces in it voltage 180^{0} out of phase with the first. The L1-9 coil in its turn is connected to the loop amplifier grid circuit.

The phasing commutator performs its main function with the function switch in "A" position. With the function switch in "C" position one of the phasing commutator valves (Л1-1) operates as a high-frequency amplifier, whereas the second valve (Л1-2) is cut off by high negative bias by way of disconnecting the common point of R1-13 and R1-14 resistors from the ground (which is provided by B1-3a switch).

The audio oscillator is switched off by removing the plate voltage from the valve with the B1-3н switch.

With the function switch in "Д" position the phasing commutator is off. Plate and screen voltages are taken from the phasing commutator valves by a B1-3x switch.

(3) The loop channel amplifier (Л1-4)

The loop channel amplifier amplifies high-frequency voltage applied from the loop antenna. The loop channel amplifier employs a 6Ж4 valve. Resistors R1-24 and R1-25 shunted by a C1-23a capacitor and connected into the valve cathode circuit develop bias.

Valve plate is fed through L1-12 and L1-13 chokes and R1-26 resistor. The L1-13 choke and C1-24 capacitor as well as R1-26 resistor and C1-23 B capacitor are decoupling filter cells. Three coils (one for each band) inductively coupled to the input antenna circuit are connected to the loop amplifier plate circuit. These coupling coils serve at the same time as coupling coils in connection with the antenna. A C1-26 capacitor is an isolating capacitor. The loop amplifier stage is switched on with the function switch B1-3x in "A" and "C" positions and is off (voltage is not supplied to the valve plate) with the switch in "Д" position.

(4) The audio oscillator (Л1-3)

The audio oscillator uses a push-pull generator circuit based on a 6H8C valve. Its purpose is to control the phasing commutator and control circuit valves (Л1-14, Л1-15).

The element determining generated frequency is a tank circuit whose function is performed by a tuned transformer Tp1-4. The transformer has two windings: primary with the middle point tapped, the ends of this winding being connected to the audio oscillator valve plates, and valve plate supply voltage of the audio oscillator being fed to the middle point, and the secondary, the step-up winding, with the middle point grounded. The secondary ends are connected to the screen grids of the control circuit valves. The primary is tuned to generated frequency by the capacitor C1-16. Audio-frequency voltage generated by the oscillator and fed to the phasing commutator valve grids through a circuit consisting of resistor R1-4, R1-5 and capacitors C1-14, C1-15 is of same amplitude but in antiphase. Voltage from the two ends of the Tp1-4 transformer secondary supplied to the control valve screen grids is in antiphase but of the same amplitude.

(5) The superheterodyne receiver

(a) High-frequency amplifier (Л1-5).

The receiver H.F. amplifier employs a 6K3 valve.

The antenna tank circuit is connected to the amplifier grid circuit.

The signal voltage from the non-directional antenna and the loop antenna voltage conveyed via the loop channel are simulteneously applied to the tank circuit with the function switch in "A" position.

In "C" position only the loop channel supplies high-frequency voltage to the tank circuit, whereas in "Л" position only the non-directional antenna does.

The signal voltage from the loop channel is supplied to the antenna tank circuit by means of inductive-capacitive coupling. The signal voltage from the non-directional antenna is also supplied to the antenna tank circuit by inductive-capacitive coupling. Inductive coupling is provided by coupling coils L1-14, L1-15, L1-16; capacitive coupling - by a capacitor C1-38. The tuned antenna circuit includes a self-indicator, a trimmer, a fixed capacitor and a variable capacitor C1-11B. The variable capacitor is a section of the receiver variable capacitor assembly and together with the capacitors C1-26 and C1-38 remains connected over all the bands. Other elements included into the antenna circuit are switched when changing over from one band to another; L1-19, C1-34, C1-35, C1-36 are switched on over the first band; L1-18, C1-31, C1-32, C1-33 - over the second band; L1-17, C1-27, C1-28, C1-29, C1-30 - over the third band. Over all bands a neon lamp НЛ6-1 is connected in parallel with the high-frequemcy amplifier grid circuit in the antenna box. With the function switch in "A" and " Д " positions one end of the circuit coupling coils is connected to the non-directional antenna through a switch B1-3 and an isolating capacitor C1-37. With the function switch in "C" position the antenna circuit is connected to the variometer stator of the manual zero sharpening control, while a capacitor C1-25 that is an equivalent of the antenna and antenna lead-in is connected to the antenna tank circuit. It serves to prevent the tank circuit from detuning when antenna is disconnected from it.

The capacitors C1-32 and C1-35 are thermocompensating capacitors.

A high-frequency circuit serves as a high-frequency amplifier load. A coupling coil tuned to a frequency below the lowest frequency of respective band is connected to the amplifier plate circuit and a tuned circuit - to the mixer grid circuit. The coupling between them is inductive-capacitive for balancing the frequency characteristic. The high-frequency amplifier circuit includes: a variable capacitor C1-11Д, inductances, trimmers, fixed capacitors. A variable capacitor which is a section of the variable capacitor assembly and a coupling capacitor C1-59 are connected in all bands; other elements are switched by a band selector switch when changing over from one band to another. Coils L1-29, L1-32 and capacitors C1-58, C1-66, C1-67, C1-68 are switched on over the first band; coils L1-28, L1-31 and capacitors C1-57, C1-63, C1-64, C1-65 over the second band and coils L1-27, L1-30 and capacitors C1-56, C1-61, C1-62, C1-69 and C1-70 over the third band. Capacitors C1-65 and C1-66 serve for thermocompensation.

High-frequency amplifier valve is fed through the filter cells: the plate is supplied through a resistor R1-32 blocked by capacitor C1-71, the screen grid, through a resistor R1-31 blocked by a capacitor C1-39a.

The amplifier cathode circuit includes: a rejector L1-20, C1-40, a resistor R1-28 determining initial bias, and variable resistors R1-29 and R1-30a blocked by a capacitor C1-39б. The resistor R1-29 serves to adjust receiver gain in three modes of operation, its screw-driver operated control being brought out to the receiver front panel and marked RECEIVER GAIN (УСИЛ. ПРИЕМ). The resistor R1-30a serves as a manual gain control in "Д" and "C" modes of operation, its shaft being brought out to the front panel and used as a volume control. Secured to the same shaft is a variable resistor R1-30б (in the Л1-16 valve cathode) which serves as volume control in "A" mode of operation.

A rejector consisting of a coil L1-20 and a capacitor C1-40 serves to increase intermediate frequency selectivity, which is provided by cathode current negative feed-back of the high-frequency amplifier valve.

(b) The first heterodyne (Л1-6).

The first heterodyne uses a 6K3 valve in an inductive-coupled circuit. The heterodyne circuit consists of coils, a variable capacitor, trimmers, compensation capacitors, tracking capacitors and coupling capacitors. A variable capacitor C1-11г and a coupling capacitor C1-55 are fixed for all bands; other elements included into the circuit are switched over from one band to another by a band selector switch. Over the first band coils L1-23, L1-26, capacitors C1-47, C1-48, C1-49, C1-52 are switched on; over the second band-coils L1-22, L1-25 and capacitors C1-44, C1-45, C1-46, C1-50, C1-51 are; over the third band coils L1-21, L1-24, capacitors C1-41, C1-42, C1-43 and C1-54 are. Plate voltage to the heterodyne is supplied through a decoupling cell R1-35 and C1-72B and a high-frequency choke L1-34. A useful load in the heterodyne plate circuit is a choke L1-33 connected in parallel with a capacitor C1-74 from which high-frequency voltage is fed to the mixer grid through a coupling capacitor C1-75. Elements used in the heterodyne circuit (self inductors, fixed and variable capacitors) have a positive temperature coefficient with the result that the circuit tuning frequency will decrease as ambient temperature increases if no measures are taken. To avoid this, thermocompensating capacitors whose capacitance decreases as temperature increases are connected into the high -frequency and heterodyne circuits. In the heterodyne circuit capacitors C1-44, C1-47 are compensating capacitors of this type.

(c) The mixer (Л1-7)

The mixer uses a 6И4 valve operating as a single grid converter. D.C. negative voltage is fed to the control from a resistor R1-38 blocked by a capacitor C1-72б connected into the cathode circuit. The mixer plate voltage is supplied through a resistor R1-39 blocked by a capacitor C1-78 б and the circuit winding of intermediate frequency filter 1. I.F. filter 1 is a mixer load. It consists of two circuits tuned to intermediate frequency and interconnected by means of a capacitor. The first filter circuit is formed by a coil L1-35 and a capacitor C1-76 connected into the converter plate circuit. The second circuit consists of a coil L1-36 and a capacitor C1-77 and is coupled to the first coupling capacitor C1-80.

To reduce noise during unmodulated signal reception it is desirable to employ a narrower pass band of the receiver. For this purpose, a crystal filter is inserted into intermediate frequency filter I. The crystal filter consists of a crystal, a trimmer C1-82, a coupling capacitor C1-81 and capacitors C1-79 and C1-53 which serve to compensate for detuning of the circuit of I.F. filter I when the crystal is switched off. Resistors R1-82 and R1-83 shunting the plate and grid circuits of filter I are connected into the crystal filter circuit. These resistors reduce the detuning effect of the above circuits on the crystal filter band.

Intermediate frequency voltage from the second circuit of I.F. filter I is supplied to the first intermediate frequency amplifier grid.

(d) The first intermediate frequency amplifier stage (Л1-8).

The first intermediate frequency amplifier stage uses a 6K3 valve. The valve cathode is connected through a resistor R1-42, determining initial bias and blocked by a capacitor C1-83a, to the receiver manual gain control circuit by means of variable resistors R1-29 and R1-30a across which additional bias is developed. The valve plate is supplied through a decoupling cell, formed by a resistor R1-44 and a capacitor C1-83в, and through the plate circuit coil of intermediate frequency filter II. An amplifier load is intermediate frequency filter II including two circuits. The first filter circuit consists of a coil L1-37 and a capacitor C1-84, whereas the second, of a coil L1-38 and a capacitor C1-85. The circuits are coupled with each other by a coupling capacitor C1-86. Intermediate frequency voltage from intermediate frequency filter II is fed to the second intermediate frequency amplifier grid.

(e) The second intermediate frequency amplifier stage (Л1-9).

The second intermediate frequency amplifier stage employs a 6K3 valve. The valve cathode is connected through a resistor R1-46 blocked by a capacitor C1-87a to the receiver manual gain control circuit. The valve plate is supplied through the decoupling cell consisting of a resistor R1-48 and capacitor C1-88б and through the plate circuit coil of intermediate frequency filter III. An amplifier load is formed by intermediate frequency filter III including two circuits. The first filter circuit consists of a coil L1-39 and a capacitor C1-89, while the second, of a coil L1-40 and a capacitor C1-90. The circuits are connected with each other by a coupling capacitor C1-91. The second filter circuit feeds intermediate frequency voltage to the detector. Simultaneously, voltage from the intermediate frequency amplifier valve plate is supplied to the detector plate of the automatic gain control.

(f) The detector and automatic gain control stage (Л1-10).

The detector and automatic gain control stage use a 6x6 valve.

The detector in the receiver employs a diode director circuit and one of the 6x6 valve diodes is used for this purpose. Resistors R1-50, R1-51 and R1-52 form a detector load. Detected voltage from the portion of the load R-1-51a and R1-52 is fed to the low-frequency amplifier grid through a resistor R1-49 and an isolating capacitor C1-96. The second 6x6 diode serves as an automatic gain control detector. The automatic gain control uses a delay circuit based on resistors R1-57 and R1-58 blocked by a capacitor C1- 88B. A resistor R1-60 is a load of the automatic gain control stage. The valve grids of the high-frequency amplifiers, I and II, and intermediate frequency amplifier are supplied with control voltage from the load through a common decoupling cell R1-61, C1-100a and decoupling cells R1-27, C1-39 B and R1-40, C1-78a, C1-78 B and R1-45, C1-87 B, C1-87 б, respectively.

(g) The low-frequency amplifier (Л1-12).

The low-frequency amplifier uses one of the 6Н8С valve triodes. The amplifier load is a resistor R1-64 from which low-frequency voltage is supplied to the amplifier input circuit of the telephone and direction finder outputs. The valve plate is blocked for high frequency by a capacitor C1-102.

(h) The telephone output amplifier (Л1-16).

The telephone output amplifier employs a 6П6 valve. The voltage from the low-frequency amplifier load R1-64 is supplied to the telephone output amplifier valve grid through an isolating capacitor C1-108. The valve screen grid is supplied directly from the supply circuits, while the plate is fed through the primary winding of the transformer included into the transformer unit Tp1-5. The telephones are connected to a part of the transformer primary winding through an isolating capacitor C1-123; the transformer secondary winding is loaded by a dynamic loudspeaker. In addition to a fixed resistor R1-78 (blocked by an electrolytic capacitor C1-115) across which grid bias is developed, a variable resistor R1-30 б, across which additional bias is obtained to enable volume control, is connected to the cathode circuit with the function switch in "A" position. The shaft of this resistor is brought out to the receiver front panel as a knob VOLUME (ГРОМКОСТЬ).

(i) The second heterodyne (Л1-11).

The second heterodyne employs a 6K3 valve in a circuit with inductive coupling. The second heterodyne circuit consists of coils L1-41 and L1-42, a fixed capacitor C1-97 and a semi-variable capacitor (a trimmer) C1-98. Plate voltage to the heterodyne valve is applied through a resistor R1-53 which is a stage load at the same time. The voltage generated by the second heterodyne is taken from this load through a coupling capacitor C1-101 to the detector plate.

(j) The tuning indicator amplifier (Л1-12).

The tuning indicator supply stage uses one triode of the 6H8C valve. A D.C. milliammeter, a tuning indicator which serves for visual receiver tuning, is connected to the cathode circuit. The control valve grid is fed with D.C. voltage (from a portion of the detector R1-52 load through a resistor R1-63) proportional to the A.C. component across the detector load. To provide more reliable operation a capacitor C1-103 is connected between the grid and the cathode of the valve.

(6) The Direction Finder Output Amplifier

(Л1-13)

The direction finder output amplifier used a 6Ж4 valve. Low-frequency signal voltage is fed to the stage control valve grid from the low-frequency amplifier load through an isolating capacitor C1-104, and a phasing cell R1-66, C1-105, C1-106. Due to this cell that audio voltage phase is obtained which is necessary for correct operation of the control circuit. Simultaneously, noise-proof characteristics somewhat increase because voltages of higher frequencies will be clipped due to this circuit. The direction finder output amplifier operates as a low-frequency amplifier. The valve is fed as follows: the plate is supplied through a decoupling cell Rl-69, Cl-107B and the transformer primary winding Tpl-1; the screen grid through the same decoupling cell and a damping resistor Rl-68 blocked by a capacitor Cl-107б. A resistor Rl-67 is connected to the cathode circuit blocked by an electrolytic capacitor Cl-109. Fixed bias is developed in this circuit. The stage is loaded by the transformer Tpl-1, the secondary of which is tuned to the audio oscillator frequency by capacitors Cl-110, Cl-111, Cl-112, and Cl-113. From the Tpl-1 transformer secondary amplified local modulation frequency voltage is fed to the control circuit valve grid in the same amplitude.

(7) The automatic control circuit of the search coil rotation (control circuit).

The control circuit employs two plate detectors based on 6Н6С valves, and a balancing bridge with magnetic amplifiers (Fig.7). Plate voltage is supplied to the plate detectors through a filter consisting of a low-frequency choke (ДРl-3), an electrolytic capacitor Cl-114 and chokes with saturated cores Tpl-2, Tpl-3. Voltages of the same amplitude but 180^{0} out of phase are supplied to the valve screen grids from the audio oscillator. Fixed bias is supplied to the valve control grids through a resistor Rl-72 blocked by a capacitor Cl-107a. This bias is taken from resistors Rl-73 and Rl-74, the resistor Rl-74 being a variable resistor. With a positive half-period of audio voltage applied to the screen grid of one of the control valves and with a positive half-period of local modulation voltage across its control grid this

valve becomes conducting and current flows through it. The plate circuit of the control valves includes magnetic amplifiers Tp1-2, Tp1-3, which allow alternating current of considerable power to be controlled with the help of small direct currents. The magnetic amplifier is a special self-inductance coil with a core made out of magnetic material characterized by quick saturation. Thus, even with a small direct current flow through Tp1-2 transformer winding 1-2, self-inductance of winding 3-4 decreases sharply. Windings 3-4 of the both magnetic amplifiers together with Tp3-3 transformer winding 3-4-5 (in the supply unit) form a bridge. A capacitor C1-121, winding 3-1 of a motor ДРК-627 rotating the goniometer search coil together with the bearing indicator are connected to the bridge diagonal. A.C. voltages between points 3 - 4 and 5 - 4 of the Tp3-3 transformer winding are equal in magnitude and are shifted by 180^{0} in phase; that is why with the same self-inductances of windings 3-4 of the both magnetic amplifiers, currents, equal in magnitude but opposite in phase, flow through the bridge arms and, consequently, current does not flow through motor winding 3-1. If one of these resistances decreases, the bridge
14 balance will be disturbed and current will flow through the motor winding.

As soon as local modulation voltage is applied to the control grids of the control valves (due to deflection of the search coil from the bearing position) the plate current will increase because of the phase coincidence of the grid and screen voltages in the circuit of one of the control valves (Л1-14). This leads to magnetic saturation of the Tp1-2 transformer core and thus, to reduced inductive resistance of winding 3-4 of this transformer. Hence, the bridge balance will be disturbed, current will start to flow through motor winding 3-1, the motor rotor will begin rotating and drive the search coil.

ДРК-627 motor is an A.C. two-phase induction motor. It has two windings, 3-1 and 2-4, which when supplied with current of the same frequency having a phase shift appoximating +90°, set up a rotating magnetic field causing the motor rotor to rotate.

At a supply current phase shift approximating -90° the direction of magnetic field rotation becomes opposite to that in the previous case and the motor rotor begins rotating in the opposite direction. Besides alternating current, retardation direct current flows through ДРК motor winding 3-1. This current sets up a permanent magnetic field retarding rotation of the motor rotor. To obtain currents with a phase shift near 90° in motor windings 2-4 and 3-1, capacitors C3-13, C3-14, C3-15 are connected to winding circuit 2-4 and a capacitor C1-121, to winding circuit 3-1. The latter capacitor is simultaneously an isolating capacitor for the direct component in motor winding 3-1.

Thus, motor winding 3-1 is a control winding whose current value and phase are determined by a search coil position relative to a bearing direction. Supply of motor winding 2-4 is constant and independent of a search coil position. With the search coil in the bearing position voltage of local modulation signal frequency is not supplied to the control grids. In the valve plate circuits and consequently, in primaries 1-2 of the magnetic amplifiers Тр1-2 and Тр1-3, small currents, equal in magnitude, flow since large bias is constantly supplied to both valves (for balancing the circuit a variable resistor R1-75 is connected into the cathodes of the both control valves, its screw-driver operated control being arranged on the side wall of the chassis for adjusting the circuit after replacement of control valves). The self-inductances of magnetic amplifier secondaries 3-4 are equal and large in magnitude which accounts for small and equal currents that flow through them. As these currents are shifted by 180^0 in phase, current does not flow through motor winding 3-1, the motor rotor does not rotate, and the goniometer search coil is inoperative.

When the search coil deflects to one side from the bearing position, low-frequency voltage of the local signal modulation is applied to the control grids. One of the control valves begins conducting and large current will flow through its plate circuit and magnetic amplifier primary 1-2, while the other control valve is cut off by a negative half-wave of the audio oscillator voltage applied to its screen grid and current does not flow through its plate circuit. Large current flowing through one of transformer primary windings 1-2 leads to sharp reducing of the secondary winding (3-4) self-inductance, the bridge circuit will be no longer balanced as the secondary winding (3-4) self-inductance of the magnetic amplifier of the inoperative valve remains considerable. As the result, the difference current which is in phase with the current in magnetic amplifier winding 3-4 of the conducting valve (current phase in magnetic amplifier winding 3-4 of the inoperative valve is shifted by 180^0) will start to flow in motor winding 3-1, rotating the motor rotor, thus turning the search coil in the direction of the bearing position. With the search coil displaced to the other side from the bearing position the local modulation frequency voltage shifted by 180^0 is applied to the control valve grids causing current to flow through the plate circuit of another control valve. As the result, the motor rotates in the other direction bringing the search coil again in the bearing position. The control circuit operates only with the function switch in "A" position. With this switch in "C" position (Fig.8) motor control winding 3-1 is supplied only through a switch B1-6. In this case motor control winding 3-1 is connected to the ends of Tp3-3 transformer winding 3-4-5 through resistors R1-80 and R1-81 or R1-81.

Valve arrangement in the receiver-and-goniometer unit is shown in Fig.9.

(c) Supply Unit

The supply unit consists of a power transformer, three selenium rectifiers (Д3-1, Д3-2 and Д3-3), 400 c.p.s. driver (Л3-1) and a power amplifier (Л3-2 Л3-3).

Voltage from the power supply (A.C. ship mains, 127 V or A.C. voltage from the converter ОП-120) is fed through the distribution board to the power transformer primary. The primary taps correspond to voltages applied: 100, 110, 127 and 140 V.

At 220 V A.C. the apparatus is connected through the autotransformer, 220/127 V.

To convert A.C. voltage into D.C. voltage selenium rectifiers are used. The 210 V rectifier (Д3-2, Д3-3) uses four selenium piles АВС-35-16; each of them includes two legs of a single-phase bridge circuit. The rectifiers employ two bridges connected in series. D.C. voltages taken from each of the two bridges are added. Voltage to the bridges are taken from Tp3-1 transformer windings 1-5 or

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2-6. Rectifier voltage is applied to the receiver-and-goniometer unit through a mid-shunt filter formed by a low-frequency choke (Др3-1) and two capacitors C3-4, C3-5.

Voltage, 100 V, is taken from one of the bridges and through the three-section mid-shunt filter is applied to the receiver-and-goniometer unit. The first filter section consists of a choke Др 3-2 and capacitors C3-6, C3-7; the second section - of a choke Др 3-4 and a capacitor C3-8; and the third - of chokes Др 3-3, L3-1, L3-2 and capacitors C3-1a, C3-1B, C3-2, C3-3.

Rectified voltage, 210 V, is applied to the receiver-and-goniometer unit to supply the phasing commutator valves, loop amplifier, control circuit valves and audio oscillator as well as to feed the power amplifier valves in the supply unit.

Rectified voltage, 100 V, is fed to supply the rest of the receiver-and-goniometer unit and supply unit valves.

The retarding voltage rectifier (Д3-1) employs a selenium pile ABC-35-17 designed as a single-phase bridge circuit.

Retarding voltage is supplied to the receiver-and-goniometer unit through a choke Др3-5.

Power transformer winding 12-16 serves to supply the supply unit valve filaments.

Power transformer winding 4-8 serves to supply the receiver-and-goniometer valve filaments.

Power transformer taps 8-9 and 4-9 supply lamps used for brightening.

The A.C. convertor of 400 c.p.s. designed for supplying the motor ДРК-6Б7 consists of a push-pull oscillator employing a 6Н8С valve and power amplifier which uses two 6П6-С valves in a push-pull circuit.

The tuned transformer Tp3-2 determines driver frequency. Transformer primary 1-2-3 is connected to the driver valve plates, whereas its mid-point is supplied with the driver plate voltage. Ends 4 and 6 of transformer secondary 4-5-6 are connected to the control grids of the 400 c.p.s. oscillator power amplifier through resistors R3-6 and R3-7. The mid-point of the secondary is connected via a resistor R3-5 to a variable resistor R1-74 arranged in the receiver-and-goniometer unit casing compartment, from which bias voltage is taken to the control valve control grids. The primary is tuned to generated frequency, 400 c.p.s., by a capacitor C3-9.

The plates of the oscillator supplying the motor are loaded by an output transformer Tp3-3. Fixed motor winding (2-4) is supplied from transformer winding 1-2 through phasing capacitors C1-13, C1-14, C1-15, while the movable motor winding (3-1) from transformer winding 3-4-5 through the control circuit.

(d) Control-Distribution Board

The control-distribution board serves to switch on the direction finder and to monitor voltages supplied from the ship mains and supply unit to the receiver-and-goniometer unit.

Voltage in the control-distribution board is monitored by means of a D.C. voltmeter (V=) and an A.C. voltmeter (V~) and a switch VOLTAGE MONITORING (КОНТРОЛЬ НАПРЯЖЕНИЙ) B2-1. This switch makes it possible to monitor the following voltages:

The D.C. ship mains.

The A.C. network and output of converter ОП-120.

Plate voltage, 210 V.

Plate voltage, 100 V.

Retardation voltage.

Voltage, 400 c.p.s.

Besides, the board is provided with an A.C. network voltage switch to adjust direction finder energizing to a real ship mains voltage magnitude. This switch supplies ship mains voltage to different taps of the power transformer primary. Thus, the direction finder can normally operate at ship mains voltages of 100 to 140 V instead of rated 127 V. The D.C. ship mains is connected to the converter ОП-120 or the network, A.C. 220 V, to the autotransformer 220/127 V by means of a tumbler switch SHIP MAINS D.C. 110, 220, A.C. 220 (БОРТСЕТЬ=110, 220 ∾ 220).

Resistor R2-1, shown in the diagram, serves to broaden D.C. voltmeter measurement range. Capacitors C2-1 and C2-2 serve for blocking the ship mains. A resistor R2-2 serves to align the instrument readings.

2. Circuit Operation at Antenna Reception (with the function switch in "Д" position)

As it was noted above, at antenna reception the direction finder operates as a conventional superheterodyne receiver. At the reception of an unmodulated signal the second heterodyne is switched on in the receiver.

3. Circuit Operation at Aural Direction Finding (with the function switch in "C" position)

At loop antenna reception which takes place with the function switch in "C" position, R.D.F. АРП-50 operates as an aural direction finder. In this case, the switch disconnects the antenna from the antenna tank circuit and connects it to the manual antenna effect compensation variometer (zero cleaning) and a capacitor C1-25, equivalent to the antenna and antenna lead-in capacitance, is connected to the antenna circuit. Simultaneously, the switch cuts in the plate supply circuit of the phasing commutator valves and loop amplifier. One of the phasing commutator valves is cut off by large bias voltage applied to the control grid. In this case, the phasing commutator operates as a conventional high-frequency amplifier and serves to amplify signals received by the loop antenna unit. A signal received by the loop antenna unit, amplified by the phasing commutator and loop amplifier is fed to the receiver input. In the receiver the signal is amplified again, converted, detected and fed to the telephone and dynamic loudspeaker.

Furthermore, with the function switch in "C" position the circuit which provides the manual rotation of the goniometer search coil is switched on.

To control manual rotation of the search coil, switch B1-6 SEARCH COIL ROTATION (ВРАЩЕНИЕ ИСКАТЕЛЯ) is used which connects the motor winding (3-1) to one of the Tp3-3 transformer legs (5-4 or 3-4 of winding 5-4-3). As voltage phases in the Tp3-3 transformer legs 5-4 and 3-4 differ by 180°, current phases in the motor winding (3-1) will differ by 180° as well and, consequently, the motor rotor will assume right-hand or left-hand rotation. In this way the search coil rotation is controlled manually. When turning the switch knob to the right or to the left as far as it will go, contacts 3 and 4 or 2 and 3 (See Fig.8) are operates as an aural direction finder. In this case, the switch disconnects the antenna from the antenna tank circuit and connects it to the manual antenna effect compensation variometer (zero cleaning) and a capacitor C1-25, equivalent to the antenna and antenna lead-in capacitance, is connected to the antenna circuit. Simultaneously, the switch cuts in the plate supply circuit of the phasing commutator valves and loop amplifier. One of the phasing commutator valves is cut off by large bias voltage applied to the control grid. In this case, the phasing commutator operates as a conventional high-frequency amplifier and serves to amplify signals received by the loop antenna unit. A signal received by the loop antenna unit, amplified by the phasing commutator and loop amplifier is fed to the receiver input. In the receiver the signal is amplified again, converted, detected and fed to the telephone and dynamic loudspeaker.

Furthermore, with the function switch in "C" position the circuit which provides the manual rotation of the goniometer search coil is switched on.

To control manual rotation of the search coil, switch B1-6 SEARCH COIL ROTATION (ВРАЩЕНИЕ ИСКАТЕЛЯ) is used which connects the motor winding (3-1) to one of the Tp3-3 transformer legs (5-4 or 3-4 of winding 5-4-3). As voltage phases in the Tp3-3 transformer legs 5-4 and 3-4 differ by 180^0, current phases in the motor winding (3-1) will differ by 180^0 as well and, consequently, the motor rotor will assume right-hand or left-hand rotation. In this way the search coil rotation is controlled manually. When turning the switch knob to the right or to the left as far as it will go, contacts 3 and 4 or 2 and 3 (See Fig.8) are closed. This connects two resistors R1-80 and R1-81 in series with the motor winding circuit reducing the current in the winding to a low value and causing the motor rotor and, consequently, the search coil to rotate slowly. If the switch B1-6 is turned to the right or to the left, as far as it will go, contacts 2 and 3 close with 1 or 3 and 4 with 5, thus short-circuiting the resistor R1-80 and increasing current in motor circuit 1-3 which causes the rotor and, consequently, the search coil to rotate to the right or to the left at greater speed than in the first case.

4. Circuit Operation at Automatic Direction Finding (with the function switch in "A" position)

In automatic direction finding simultaneous reception by the loop and non-directiona antennas takes place. In this case the switch cuts in the circuit supplying the phasing commutator, loop amplifier, audio oscillator and control valves.

Furthermore, the switch connects a leak resistance R1-13 in the control grid circuit of one phasing commutator valve to the unit body with the result that bias resistance values in both valves become equal and sufficient to facilitate cutting off and opening of the phasing commutator valves by A.C. audio oscillator voltage fed to the phasing commutator grids. Simultaneously, the switch connects the non-directional antenna to the antenna tank circuit and shunts the loop circuit by a resistor R1-18 to make the direction finder less sensitive to some detunings in the loop circuit which cannot be excluded during operation.

In this mode of operation the control grids of the phasing commutator valves are supplied with a signal from the loop input and A.C. voltage from the audio oscillator, the latter ensures periodic 180^{0}-phase shift of the signal voltage across the loop amplifier grid every half-period of low frequency.

This voltage, amplified by the loop amplifier, is fed to the antenna tank circuit where it is added to a non-directional antenna signal. Thus, the resulting voltage, across the high-frequency amplifier grid appears modulated by audio oscillator commutating frequency. An envelope phase of this amplitude-modulated oscillation at the receiver input shifts by 180^{0} depending on the side the ship deflects to with relation to the transmitter direction. Modulation depth depends upon an angle of rotation of the ship from the transmitter direction. The amplified signal passes the receiver where it is detected and is fed to the direction finder output amplifier grid. The transformer Tpl-1 tuned to audio oscillator frequency is connected to the valve plate circuit of this stage. It discriminates the voltage of local modulation frequency from the signal. This voltage is supplied in phase to the control valve grids. Magnetic amplifiers are connected into the control valve plate circuits. These amplifiers are the balance bridge legs in the diagonal of which control winding 3-1 of the motor driving the search coil is connected. The control circuit has been discussed above.

Automatic compensation of the antenna effect is provided by capacitive coupling of the compensating wire of the two-wire non-directional antenna with the field coils.

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5. Operation of the Tuning Indicator Circuit at Signal Reception

Direction finder is tuned according to the tuning indicator. The tuning indicator is connected into the cathode circuit of the Л1-12 valve. Bias is applied to the control valve grid from the detector load. With the direction finder tuned finely, maximum voltage is developed across the load which corresponds to the maximum negative bias applied to the tuning indicator valve which in its turn is related to minimum plate current in the right-hand triode of the Л1-12 valve.

The indicator pointer is at the extreme right-hand position when the apparatus is off. The maximum current position corresponds to the extreme left-hand deflection of the pointer.

Thus, rotating the tuning knob until the tuning indicator pointer deflection is maximal (right-hand deflection) the position corresponding to the minimum current flowing in the tuning indicator valve cathode circuit is found, i.e. exact tuning of the direction finder to the transmitter frequency is achieved.

The more the indicator pointer deflection to the right is, the larger is the signal value.

6. Circuit Operation at Modulated and Unmodulated Oscillation Reception

The direction finder makes it possible to receive modulated and unmodulated signals. To listen to unmodulated signals a switch TELEPHONE-TELEGRAPH (ТЛФ-ТЛГ) is set in a TELEGRAPH ТЛГ position. In this case the second heterodyne cathode circuit is grounded and it starts generating. Due to the second heterodyne, the frequency of the unmodulated signal is converted in the detector into audio frequency which is heard at the output. When TЛГ is switched on, automatic gain control is made inoperative. To align a beat note the second heterodyne trimmer shaft is brought out to the direction finder front panel.

In "A" mode of operation the second heterodyne does not operate and only modulated signals are audible.

VI. BRIEF DESCRIPTION OF PARTS AND INDIVIDUAL UNITS OF DIRECTION FINDER

The direction finder resolves itself into parts enumerated in Section IV of this Description.

1. Receiver-And-Goniometer Unit

The receiver-and-goniometer unit is made splash-proof. All cables led to the unit are received through glands and the control knobs brought out to the front panel are provided with gaskets. The cable leads are fanned out in respective casing compartments on special distribution terminal blocks. By means of the cable plug connectors the casing is coupled to the chassis. The chassis includes separate screened compartments for wiring different high-frequency stages of the direction finder. This is found necessary in order to decrease random couplings between the stages to which the receiver self-excitation and direction finding errors may be attributable. Provision of both sections of the variable capacitor assembly of the loop circuit with isolated axles serves the same purpose. The upper part of the chassis houses all the high-frequency circuits, intermediate-frequency circuits, transformer units, variable capacitor assembly, goniometer valves, etc. The under side of the chassis houses the wiring and, in the main, all the blocking capacitors. All controls are brought out to the direction finder front panel with the exception of the automatic antenna effect compensation trimmer, coupling capacitance switch of the compensating wire (arranged in the antenna compartment of the casing), regulator (screw-driver operated) of control circuit sensitivity (located in the casing power compartment), radio deviation compensation chokes, which are located in the loop compartment of the casing and balance regulator (screw-driver operated) of the control circuit located on the left side wall of the chassis. The direction finder front panel bears:

1. Two pairs of telephone jacks marked "ТЛФ" PHONE and DYNAMIC LOUDSPEAKER (ДИНАМИК) (Г1-1 and Г1-2).

2. Tumbler switch ТЛФ-ТЛГ (PHONE-TELEGRAPH) (В1-5).

3. Volume control marked VOLUME (ГРОМКОСТЬ) (R1-30a and R1-30б).

4. Adjusting screw RECEIVER GAIN (УСИЛ.ПРИЕМ.) for adjusting the receiver gain (screw-driver operated, R1-29).

5. Adjusting screw MODULATION DEPTH (ГЛУБ.МОДУЛ.) for adjusting modulation factor (screw-driver operated) - R1-24.

6. Tuning knob.

7. Band selector switch (В1-2).

8. Function switch "Д", "А", "С" (В1-3).

9. Zero sharpening control marked ZERO SHARPENING (КОМПЕНСАТОР РАЗМЫТОСТИ).

10. Knob BEAT NOTE (ТОН БИЕНИЙ).

11. Knob SEARCH COIL ROTATION (ВРАЩЕНИЕ ИСКАТЕЛЯ) (В1-6).

12. On-off switch CRYSTAL (КВАРЦ) (В1-4).

13. Knob COURSE SETTING (УСТАНОВКА КУРСА) for rotating the movable goniometer scale (В1-1).

14. Terminal GROUND (ЗЕМЛЯ).

15. Knob SHUTTER (ЗАТВОР) - 2 pieces.

Fig. 10 (a, b, c and d) shows a general view of the receiver-and-goniometer unit.

(a) Front panel view.

(b) Top view in the casing with the lid open.

(c) Top view with casing removed.

(d) Under side view with the casing removed.

The receiver-and-goniometer unit uses the following valves:

Type	6П6С	6К3	6Ж4	6Н8С	6Х6С
Quantity	3	5	5	2	1

Let us analyse the design and principle of operation of the basic parts of the receiver-and-goniometer unit.

(a) Goniometer.

The goniometer is a principal part of the receiver-and-goniometer unit. It consists of two field coils fixed at right angles to each other and of a search coil which rotates inside them. The goniometer is provided with movable and fixed scales. Radio relative bearing is read on the fixed scale and true bearing - on the movable scale. Gyro-compass angular readings are transmitted to the movable goniometer scale employing the selsyn system through a step-down reducing gear. To match gyro-compass and movable goniometer scale readings a knob COURSE SETTING is provided.

An indicator is mounted on the search coil axle to read radio bearing and radio relative bearing.

The goniometer is made small-sized and uses a carbonyl iron core. Its scales are made of plexiglass. To rotate the search coil a motor is provided, type ДРК-627. The goniometer indicator is coupled to one end of the spiral spring of the mechanical radio deviation compensator, whereas the compensator rotating disk is secured to the goniometer axle. (See description of the mechanical compensator in VI.1e). The goniometer scale assembly is illuminated by means of five lamps, type CM-36, arranged circumferentially in five points.

(b) ДРК-627 motor is a motor rotating the goniometer search coil.

This motor is two-phase induction motor with a short-circuited rotor. Motor engagement with the search coil is made through a step-down reducting gear.

(c) Tuning and band switching system.

The tuning system consists of a scale assembly with a gear and a band switching system in the high-frequency circuits combined in a common unit. The tuning scale is coupled to the rotor axle of the variable capacitor assembly. A cursor is fixed in front of the tuning scale. The scale and the cursor are covered with a blind having three observation windows according to the number of bands. The blind is connected with the axle passing through the high-frequency circuit unit and is fixed to a special bracket on the receiver chassis. The blind drive axle is brought out to the front panel of the receiver-and-goniometer unit. When switching from one band to another the drive axle turns simultaneously the blind and axle which passes through band switching plates in the circuits, thus providing switching on of any band.

The variable capacitor assembly rotor is rotated by means of a toothed gear. On rotating the tuning knob the tuning scale disk and assembly rotor begin rotating.

The direction finder tuning scale is divided into three bands. The first band (lower) covers frequencies of 187.5 Kc/s to 375 Kc/s. This band is calibrated every 20 Kc/s. The second band (middle) covers frequencies of 375 Kc/s to 750 Kc/s. This band is calibrated every 50 Kc/s. The third band (upper) covers frequencies of 270 Kc/s to 320 Kc/s calibrated every 5 Kc/s. Besides, ten index lines are plotted on the scale of the third band marked by first ten letters of the Latin alphabet. Each of these index lines corresponds to a frequency at which, according to the Intenational Standard, one of the beacon groups operates. Altogether, there are ten such beacon groups. The index lines on the scale correspond to the following frequencies:

A - f = 291.5 Kc/s
B - f = 294.5 Kc/s
C - f = 297.5 Kc/s
D - f = 300.5 Kc/s
E - f = 303.5 Kc/s
F - f = 306.5 Kc/s
G - f = 309.5 Kc/s
H - f = 312.5 Kc/s
J - f = 315.5 Kc/s
K - f = 318.5 Kc/s

Electrical compensation of quadrantal radio deviation and mechanical compensation of residual radio deviation are provided in the direction finder.

(d) Electric compensation of radio deviation.

Three chokes are used for electric compensation of quadrantal radio deviation. One choke is connected in parallel with one of the field coils (according to sign of radio deviation), the other two are connected in series with the search coil to compensate for detuning introduced by the first choke. These compensating chokes are calibrated in degrees of radio deviation compensation. Sign of radio deviation compensated for by the chokes changes with the field coil the chokes are connected to. While connecting them to the field coil coupled with the fore-and-aft loop, radio deviation of one sign is compensated for while connecting them to the field coil coupled with the athwartships loop, radio deviation of the other sign is.

Section VIII 3 describes how to connect the compensating chokes to different loop antennas.

To reduce direction finder errors, caused by radio deviation, to zero, mechanical compensation of residual radio deviation is provided.

(e) Mechanical radio deviation compensator.

The purpose of the mechanical radio deviation compensator is to change the goniometer indicator position by an angle the value of which is equal to residual (after electric compensation) radio deviation for the given direction of the goniometer indicator.

The mechanical compensator (Fig.11) is a mechanism consisting of a rotating disk with a slide inside. The slide can travel radially on the guide rollers along the disk. A roller is coupled rigidly to the slide; this roller moves along a template body positioned on the lateral surface inside the compensator. The template body shape can be adjusted with 36 screws. A correction scale is plotted on the disk. The compensator mechanism functions in the following way: rotating the goniometer search coil turns the disk fixed on its axle. When the search coil turns through some angle, the compensator disk and the indicator, provided the template shape is round, turn through the same angle. If the template is not round, the slide roller rolling along the template body will have simultaneously linear movement. Due to this movement the slide will cause a spiral spring to rotate the indicator through some additional angle. A value and sign of this additional angle of rotation will depend upon the template body shape. Employing 36 screws the template shape can be adjusted in such a way that additional change of the indicator angle will correspond to the law of the residual radio deviation change for the given ship. The adjusting screws are spaced 10^0 apart against the divisions corresponding to 0, 10, 20, etc. degrees of the relative bearing scale. The correction scale from 0^0 to $\pm 5^0$ is graduated on the disk. A correction, while adjusting the template body shape, is read on the correction scale with the help of the indicator. (Signs $\pm$ on the correction scale show the direction the indicator must rotate in, when the template body shape is being adjusted). To adjust the template body shape it is necessary to plot a residual radio deviation curve for the given ship and to check the radio deviation compensator against it.

(f) The zero sharpening control.

The direction finder employs automatic zero cleaning. For this purpose a compensating antenna is provided in the direction finder assembly which is one of the wires of the two-wire non-directional antenna. The compensating antenna is coupled to one of the goniometer field coil through a coupling capacitor. The current flowing in the circuit formed by the compensating antenna, capacitor and field coil is opposite to the current to which blurred or displaced minimum is attributable. The value of the current applied in this way is controlled by adjusting a value of the coupling capacitor and by the final tuning of the trimmer C1-137.

The compensating antenna has the same dimensions as the principal one and is connected to the receiver-and-goniometer unit likewise with the help of the lead-in. In the antenna compartment of the casing the compensating antenna is connected to the contact 3. The compensating antenna is coupled to the automatic zero sharpening control and trimmer C1-137 through a high-frequency choke connected between contacts 3 - 2 of the terminal strip. Either of capacitors C1-138, C1-139, C1-140, C1-141 can be connected in parallel with the trimmer by means of a switch B1-7. These capacitors are interconnected with the help of their second ends and are connected to contact 15 in the loop compartment of the casing which can be connected to contacts 14, 12, 10 or 8 by means of a flexible conductor in the same compartment, i.e. to one the goniometer field coils. (The contact to which the jumper of contact 15 is coupled is determined during compensation).

With the function switch in C position, in addition to automatic antenna effect compensation, manual antenna effect compensation is provided by employing the principal antenna and variometer. During direction finding the principal antenna is disconnected from the receiver antenna circuit and is connected to the stator of manual zero sharpening variometer. The rotor of this variometer is constantly connected to the loop circuit in series with the goniometer search coil. Thus, the compensating voltage, which is in antiphase with the voltage, which affects the sharp minimum, is fed into the search coil. By rotating the variometer rotor, it is possible to adjust the zero sharpening so that the minimum is sharp.

(g) Matching devices.

The matching devices serve to compensate for detuning of the direction finder loop input caused by reduced loop feeder length as compared with the length, to which the apparatus was adjusted.

A matching device is a mounting strip with capacitors and chokes fixed on it.

Conductors with tips numbered according to the figures of the loop compartment mounting strip contacts of the receiver-and-goinometer unit to which they should be connected, are soldered to the strip contacts. The tips are secured on respective contacts with the help of nuts. Seven matching devices numbered No.1, No.2, No.3, No.4, No.5, No.6 and No.7 are included into the direction finder set. The matching devices are included into the shipboard set of spare parts, tools and accessories. Matching device No.1 is installed in the casing by the Manufacturer. The matching devices are chosen during wiring according to the notes given in Section VIII-3 of this instruction.

(h) Selsyn

The selsyn serves to rotate the movable goniometer scale in step with the gyro-compass follow-up system. With the gyro-compass follow-up system turned through 1° the rotor of the gyro-compass transmitting selsyn turns through 360° employing a step-up gear. To rotate the gyro-compass follow-up system in synchronism with the movable goniometer scale a step-down gear is used with a gear ratio 1:360. Fig.12 shown the electrical connection diagram of the selsyns: СД is a transmitting selsyn, СП is a receiving selsyn. The selsyn excitation windings are connected into the A.C. network. They set up magnetic fluxes fixed in space and pulsating in time. These fluxes induce alternating electromotive forces in the three-phase selsyn stator windings, the values of the induced voltages depend upon selsyn rotor positions. When the rotors of the transmitting and receiving selsyns are in the same positions, electromotive forces induced in the stator windings will (in the respective phase windings) be equal in value for the stators of both the selsyns and opposite in direction, thus the resulting electromotive forces will be at zero in each pair of the coupled phase windings. With the rotor in this position there is no current in the stator circuit. If the transmitting selsyn rotor rotates through some angle with respect to the receiving selsyn rotor, electromotive forces different in value will appear in the respective phase windings and the resulting electromotive force will not be at zero; therefore, equalizing current establishes in the stator circuit and a torque is developed which tends to bring the receiving selsyn rotor in the position identical to that of the transmitting selsyn rotor. Thus, with the forced shift of the transmitting selsyn rotor the receiving selsyn rotor will rotate in step with the first one.

The movable goniometer scale is rotated by a receiving selsyn.

2. Loop Antenna Unit

The loop antenna unit includes two screened loops fixed at right angles to each other with diameter either 1.2 m or 0.6 m. The loop antenna unit may be installed either on a special support 1.6 m. in height, or without it. The support is a duralumin tube 84/76 mm in diameter. The connection of the support upper flange with the loop lower flange is provided with bolts. For mounting on the deck, the corner plates of the upper support flange have two holes to receive guys. To adjust tension the guys are provided with turnbuckles. The support lower base terminates in a connector with a gland. When the loop is installed on the support the connector with the gland located under the loop lower flange is removed. The loop winding (1.2 m. in diameter) has 4 turns; the loop winding (0.6 m. in diameter) has 6 turns.

The loop winding is wound on distance pieces inside the duralumin tubes (30/27 mm in diameter) which serve as a screen. The upper assembly is insulated.

The loop antenna (1.2 m. in diameter) uses a metal rod arranged in the centre for rigidity. The loop winding ends are connected to the terminal panel. The winding mid-points are coupled to the chassis through two 0.25 μF capacitors, which makes it possible to check insulation resistance of the loop and loop circuit without disconnecting the loop winding mid-point.

The external connection of the loop antenna unit with the receiver-and-goniometer unit is made by a feeder. The feeder ends are soldered inside the feeder head to the wiring conductors running to the terminal panel (See Fig.24).

For the general view of the loop antenna unit, see Fig. 13.

3.Non-Directional Two-Wire Antenna

The direction finder uses the two-wire non-directional antenna made of an antenna stranded conductor. One of the wires serves as a principal antenna, the second wire is used for compensation. The length of each antenna wire is 7 m. for direction finders with loop antennas of 1.2 m. in diameter, and for direction finders with loop antennas of 0.6 m. in diameter the length of each wire is 3.5 m. Minimal distance between the wires is 300 mm.

The length of taps leading from the antenna wires to the antenna box is 1 m.±100 mm.

The antenna wires are not necessarily parallel and in this case the length of the vertical section of the wire is taken for the antenna wire length. The wires can differ in length from nominal stipulated dimensions by 10 per cent.

Fig. 14 (versions 2 and 3) shows possible alterations of non-directional antenna realization.

With any antenna design minimum space between the wires should not be less than 300 mm.

The ends of the non-directional two-wire antenna are connected to the antenna box. The latter is coupled to the receiver-and-goniometer unit by means of an antenna lead-in using the feeder 3.5 m. in length. If necessary, the length of the feeder connecting the receiver-and-goniometer unit with the antenna box may be increased up to 5 m. In this case, the length of the non-directional antenna wire should be increased in accordance with the instructions given in Para VII 4 of this Manual.

4. Supply Unit

The supply unit is designed as a combination of units and components positioned on two separate chassis horizontally located; the chassis being arranged in one casing which is installed on a mounting frame with the help of dampers.

The principal elements included into the supply unit are as follows:

1. Valves .... 3 pieces.
2. Transformers .... 5 pieces.
3. Selenium piles for rectifiers... 5 pieces.
4. Capacitors of various types ....14 pieces.
5. Fuses .... 3 pieces and other elements.

The two chassis are located horizontally one beneath the other. The upper chassis mounts transformers and valves. The lower chassis mounts a power transformer, selenium rectifiers, capacitors. The wiring of the supply unit is made of the mounting strips and is coupled by a distributing frame, which is connected to the two mounting strips that serve to fan out the cable ends leading from the control-distribution board. The compartment in which the cable is fanned out has a gland to receive this cable. For convenience during repairs the frame securing the chassis and wiring is thrown on hinges forward providing an access to the wiring.

In the operating position the frame is secured by two screws and is sealed, only the valves being left accessible.

The upper casing lid covers the entire supply unit and is secured by four locking screws.

The supply unit casing is made of hard aluminum and is a riveted-welded box with a steel frame. For rigidity the box walls are provided with ribs.

The supply unit casing is installed on the mounting frame using four dampers.

The mounting frame is made of angle section rolled stock and designed for attachment of the supply unit to the bulkhead Fig.15 (a and b) shows the external view of the supply unit (opened and closed).

5. Converter ОП-120

The converter ОП-120 is a single-armature converter which converts ship mains direct current into single-phase alternating current of 50 c.p.s. The D.C. ship mains is applied via the control-distribution board to the motor of the converter, its generator being connected to the supply unit through the same board.

The converter ОП-120 is shown in Fig. 16 (a) and (b).

6. Control-Distribution Board

The control-distribution board is an aluminum box. The front wall of the box is provided with two lids which hermetically close it; arranged on the inside of the upper lid are main elements included in the board and their wiring. Located under the lower lid are mounting strips to which the distributing frame is led. The external connecting cables are fanned out on these mounting strips.

The control-distribution board includes:

1. A.C. voltmeter, type ЭВ-46, 400 c.p.s. with a measurement limit 150 V (V∿).

2. D.C. voltmeter, type M-63, with measurement range 3 - 300 V (V=).

3. Switch VOLTAGE MONITORING (КОНТРОЛЬ НАПРЯЖЕНИЙ) (B2-1).

4. Switch A.C. MAINS (СЕТЬ ∿) for connecting to the A.C. mains (B2-2).

5. Tumbler SHIP'S D.C. MAINS 110, 220 A.C., 220 V (БОРТСЕТЬ =110, 220 ∿ 220). ON - OFF (ВКЛ.-ВЫКЛ.)

6. Two fuses - for 5 A and 2 A (Пр2-1 and Пр2-2, respectively).

The board box is divided with a partition separating the upper compartment from the lower one where the connecting cables are fanned out. An access to the wiring is provided by throwing the upper lid and removing the lower one; to receive the cables the board compartment is provided with five glands which ensure hermetic sealing.

The under side of the control-distribution board is covered by a bottom with a rubber gasket. The bottom has a hole with rubber bushes to secure the board.

For the top view of the board with the lid open see Fig.17.

7. Signalling Boards

To control and signalize switching on and off the other antennas on board the ship two signalling boards are provided - one is installed in the chart house and the other in the radio operator room. These boards differ in inscriptions: the board in the radio operator's room bears DISCONNECT ANTENNA (ИЗОЛИРОВАТЬ АНТЕННУ) whereas the board in the chart house reads ANTENNA DISCONNECTED (АНТЕННА ИЗОЛИРОВАНА). The inscriptions become visible only when the lamps located beneath the detachable board lids are switched on.

The lids of both boards are interchangeable because they are attached to the bottom in the same way.

The bottoms of both boards are assembled likewise. Tumbler switches are arranged on the board lids and their positions are marked ON and OFF (ВКЛ., ВЫКЛ.).

If the tumbler switch of the board installed in the chart house is in ON position a lamp will flash on the board mounted in the radio operator's room and vice versa, switching on the tumblor switch on the board located in the radio operator's room and vice versa, switching on the tumbler switch on the board located in the radio operator's room flashes the lamp on the board in the chart house.

For supplying one of the boards is connected to the ship's mains according to the connection diagram (See Key Diagram of the Direction Finder shown in Fig.25 and General Diagram in Fig.2). The boards are supplied with illumination lamps depending on the voltage applied from the ship's mains which are rated for not more than 25 W.

For a general view of the boards see Fig. 18(a) and (b).

8. Dynamic Loudspeakers

The dynamic loudspeakers included into the АРП-50 set are made as separate units, one is located in the chart house and the other in the vicinity of the helmsman.

Power conveyed by the direction finder telephone channel to the loudspeaker is about 0.25 W. The loudspeaker is provided with the ON-OFF tumbler switch and volume control knob. The loudspeaker is connected with the receiver-and-goniometer unit in such a way that both loudspeakers cannot operate simultaneously. One loudspeaker can operate only when the other is switched off. The general view of the loudspeaker is given in Fig.19. The loudspeaker connection diagram is given in the key diagram.

9. Antenna Box

The antenna box serves for connecting the two-wire antenna with the antenna feeder. It has a gland and two partition insulators. To ensure hermetic sealing the lid and each partition insulator use rubber gaskets. Two resistors on the mounting strip and two neon lamps are arranged inside the box. For the general view of the antenna box in the opened and closed positions see Figs 20(a) and 20 (b).

10. Autotransformer 220/127 V

The autotransformer 220/127 V serves to supply the direction finder from tho A.C. mains 220 V. The autotransformer is mounted on a bracket that is secured to a metal plate. It is covered by a lid with holes for cooling. Beneath, there are two glands. The autotransformer is attached to the bulkhead.

Fig. 21 shows the external view of the tester TT-1, Fig. 22(a), (b) and (c) illustrates the case of the shipboard spare parts, tools and accessories.

VII. INSTALLATION OF DIRECTION FINDER ON SHIPBOARD

For the direction finder wiring diagram (general diagram) see Fig.2 and for the external connection diagram, Fig.3. The direction finder components should be connected according to these diagrams.

1. Installation of Receiver-And-Goniometer Unit

The receiver-and-goniometer mounting frame is secured in the horizontal position on a table or on a special bracket with screws passing through mounting openings. The receiver-and-goniometer unit is installed on this mounting frame and secured with three locking screws. When installing it make sure that the damper travels freely and secure the receiver-and-goniometer unit on the dampers in such a way, that it should not strike against the chart house walls and other things during storm.

The ground terminal located on the front panel should be connected with the ship hull.

The receiver-and-goniometer unit is connected to the loop antenna unit by means of a feeder which enters the loop casing compartment through glands and is fanned out in the following way: the feeder ends coming from the athwartships loop are connected to mounting strip contacts 1 and 3. The feeder ends coming from the fore-and-aft loop are connected to contacts 4 and 6; connections being made according to designations provided in the loop compartment. The feeder screens are brought to contacts 2 and 5.

The receiver-and-goniometer unit is connected to the non-directional wire antenna by means of a feeder via the antenna box. The feeder running from the antenna box enters the casing antenna compartment through glands and is fanned out in the following way: the feeder end coupled to the compensating antenna is connected to contact 3; the feeder end coupled to the principal antenna, to contact 4. Connection of the receiver-and-goniometer unit with the control-distribution board should be as shown in the external connection diagram (Fig.3). The cable terminals are secured with nuts.

The receiver-and-goniometer unit is connected to the telephone directly and to the dynamic loudspeaker by means of a special cord whose ends terminate in plugs.

Fig. 23 illustrates the fanning out of cables in the receiver-and-goniometer unit casing.

To take the receiver out of the casing proceed as follows:

(a) disconnect the ground busbar;

(b) open the locks (unscrew the bolts);

(c) pull the handles on the front panel to remove the unit out of the casing.

When it is required to test the direction finder efficiency with the casing removed, connect the casing with the receiver-and-goniometer unit making use of special spare cables provided in the set (in the case of the shipboard spare parts, tools and accessories).

2. Installation of Supply Unit

The supply unit is installed on a mounting frame.

The mounting frame is secured to the bulkhead or to a bracket with four screws in the vertical position. The supply unit is placed on this mounting frame and secured with two screws with wing nuts. The supply unit is coupled to the control-distribution board by means of a cable, connections should be as shown in the external connection diagram (Fig.3). The cable terminals are secured with nuts.

To check the unit wiring proceed as follows:

(a) open the lid by removing the locking screws;

(b) remove two screws securing the unit to the casing and pull the unit out of the casing.

3. Installation of Loop Antenna Unit

The loop antenna unit may be installed with the support and without it (depending on the direction finder set used and the conditions of the unit installation on board the ship).

The exterior wiring is assembled and installed in the following way:

1. Choose the place for the loop antenna.

2. Orient the plane of the fore-and-aft loop so that it should coincide exactly with the centre line of the ship.

In this case, the marking SHIP'S HEAD (HOC) on the head of the loop assembly must be directed towards the ship's bow.

3. Mark and bore holes for attaching the lower flange of the loop or support.

4. Measure the cable run and cut off two lengths of the feeder to suit the length of the cable run with small reserve.

5. Remove the feeder head together with five jumpers from the lower assembly of the loop antenna and unsolder the feeder ends from the jumpers as shown in

Fig.24. The feeder sheaths are interconnected and soldered to the jumper marked "K".

6. The feeder head is vaseline-seated and secured in the lower part of the loop by means of three screws. The jumper tags are bent and secured with contact screws of the porcelain panel in the loop head window according to their designation.

7. The feeder ends running to the receiver-and-goniometer unit are preliminary marked which makes it possible to determine the contact of the loop terminal panel to which a feeder conductor is soldered.

8. When the loop is mounted on the support the connector is removed from the loop lower sleeve and a cable is pulled through the loop support. The loop is secured on the support, the feeder is pulled through the support glands after which the gland bush is tightened.

9. The loop flange surface is filed (in case the loop is mounted on the support the loop and support flange surfaces are filed) and so is the ship's hull surface near the holes under bolts in order to ensure reliable contact between the hull and the loop screen. Upon filing the loop is attached to the hull. The feeder is laid out and secured; the feeder ends are taken to the chart house and connected to the receiver-and-goniometer unit. The feeder is cut off to suit the cable run and its ends are fitted with tags.

10. The feeder ends running from the fore-and-aft loop are pulled into the loop casing compartment in the receiver-and-goniometer unit through the gland C7 while the ends running from the athwartships loop - through the gland C6. The tags with the feeder leads are clamped with the help of the contacts of the mounting strip of the casing compartment of the loop so that the markings

in the loop compartment should correspond to the engravement on the jumper tags running from the feeder head. The wiring is made as shown in the external connection diagram (Fig.3) and in the diagram on fanning out cable in the casing (Fig.23).

Note: While laying out and securing the feeder care should be taken to protect the external feeder sheath from mechanical damage.

4. Installation of Two-Wire Antenna and Antenna Box

The description of the two-wire antenna is given in Para. VI.3. The direction finder two-wire antenna is erected and secured as instructed in the suggested erection diagram for the given ship.

The non-directional two-wire antenna is erected as shown in Fig.14.

The antenna wires are secured through an insulating chain on the deck or a special bracket. The upper end is pulled by means of a frame through a block with a hook and fixed. Then the antenna has to be tightened. Depending on the length of the antenna, lead in i.e. on the feeder length from the antenna box gland to the receiver-and-goniometer unit casing, the antenna length can be altered. The antenna lead-in is considered normal when it equals 3.5 m. If this length is reduced below 3.5 m. the resonance of the loop amplifier plate circuit occurs in the operating range which is impermissible. It is possible to increase the lead-in length up to 5 m. Further increase of the lead-in length is not permissible as this brings the resonance of the circuit formed by the antenna lead-in and zero sharpening variometer stator into the operating range.

When changing the antenna lead-in length it is required to change the antenna height respectively (See the table).

Antenna lead-in length	Antenna height in case of a loop, Ø 1.2 m.	Antenna height in case of a loop, Ø 0.6 m.
3.5 m.	7 m.	3.5 m.
4 m.	8 m.	4 m.
5 m.	9 m.	4.5 m.

As the feeder length is restricted in some cases vertical antennas are substituted with inclined ones.

When the antenna is arranged in this way its effective height decreases. Therefore, it is expedient to increase somewhat the effective wire length using the same wire guys as with the vertical antenna. The data on antenna extension in relation to the angle of tilt is given in the table.

Angle of tilt with the horizontal plane	Extension, m.	
	With the rated length 7 m.	With the rated length 3.5 m.
90°	0	0
60°	2	1
45°	3	1.5

The antenna may be designed as two wires which can be spaced not less than 300 mm apart.

The length of each wire should correspond to the dimension given above.

The antenna must be installed as shown in Fig.14 where possible alterations of the non-directional antenna realization are given.

The antenna box is secured by four screws to the outer bulkhead wall. Upon boring holes it is necessary to file the antenna box flanges as well as the bulkhead in the place where the holes have been bored in order to ensure reliable contact between the box and the hull. Having fanned out the feeder, screw the antenna box lid all the way in to provide hermetic sealing; the lid screws having been first coated with vaseline. After the erection of the antenna the antenna leads must be connected to the antenna box terminals.

5. Installation of Control-Distribution Board

The control-distribution board is screwed to the bulkhead or a special bracket in a vertical position, the screws being provided with spacers.

Depending on the ship's mains voltage, control-distribution board is supplied in the following way:

(a) When supplied from the D.C. ship's mains, voltage is fed to terminals 22 and 23 of the mounting strip on the control-distribution board. From terminals 23 and 24 voltage is taken to the converter OП-120. The converter feeds A.C. voltage to terminals 25 and 26 of the board mounting strip.

(b) When supplied from the A.C. mains 220 V, terminals 22 and 23 of the control-distribution board mounting strip are connected to the mains. The autotransformer primary winding (contacts 1 - 2) is connected to terminals 23 and 24; the autotransformer secondary (contacts 5 - 6) is coupled to terminals 25 and 26 of the mounting strip.

(c) When supplied from the A.C. mains 127 V, the voltage is connected to terminals 25 and 26 of the mounting strip.

Cables are used to connect the control-distribution board to the receiver-and-goniometer unit and to the supply unit. Wiring is made as shown in the general diagram (Fig.2) and in the external connection diagram (Fig.3).

6. Installation of Dynamic Loudspeaker

The loudspeakers are mounted on the bulkhead or a bracket attached to the bulkhead one being installed in the chart house and the other in the wheel-house. Connection of the loudspeaker with the receiver-and-goniometer unit and interconnection of the loudspeakers is given in the external connection diagram.

7. Installation of Converter ОП-120

The converter ОП-120 is screwed to the floor through the mounting holes in the converter bottom. The converter ОП-120 is connected to the control-distribution board with the cable as shown in the external connection diagram. The cable terminals are secured with nuts.

8. Installation of Autotransformer, 220/127 V

The autotransormer, 220/127 V, is mounted on the bulkhead or secured to the bracket fixed on the bulkhead with four screws. A cable is used to connect the autotransformer to the control-distribution board.

VIII. TESTING AND ADJUSTING DIRECTION FINDER AFTER ITS INSTALLATION ON BOARD THE SHIP

After shipboard installation of the direction finder it is necessary to test its serviceability and to adjust zero sharpening and compensating for radio deviation.

1. Testing the Loop Antenna and Exterior Wiring for Proper Insulation and Hermetic Sealing

(a) Test the loop and antenna feeders as well as the loop antenna unit for proper insulation using a megohm-meter with the test voltage of 500 V.

(b) To test the loop antenna unit and loop feeder for proper insulation disconnect the feeder terminals from mounting strip contacts 1,3,4 and 6 (in the loop compartment of the receiver-and-goniometer unit casing) and connect the megohm-meter contacts between the feeder terminals and the receiver-and-goniometer unit body. Insulation resistance between any terminals and the body must be not less than 50 megohms.

(c) To test the antenna feeder insulation unscrew the antenna box lid and remove the neon lamps; in the antenna compartment of the receiver-and-goniometer unit casing disconnect the feeder terminals from contacts 3 and 4 and connect the megohm-meter contacts between the feeder terminals and the hull. Resistance between any feeder terminal and the hull should be not less than 800 kilohms.

2. Testing the Direction Finder Serviceability

(a) Switching on direction finder

When supplied from the D.C. ship's mains, set the switch MAINS, A.C. (СЕТЬ ~) on the control-distribution board to OFF (ВЫКЛ.) position. Set the switch VOLTAGE MONITORING (КОНТРОЛЬ НАПРЯЖЕНИЯ) in the position SHIP'S MAINS, D.C. (БОРТ-СЕТЬ =). After that operate the tumbler switch SHIP'S MAINS D.C. 110, 220; A.C. 220 V

(БОРТ-СЕТЬ = 110, 220; ∼ 220 V). When the D.C. voltemeter reads necessary mains voltage, set the switch VOLTAGE MONITORING to MAINS, A.C. ОП-120 position. Depending on the A.C. voltage applied (readings are taken with the A.C. voltmeter) turn the switch A.C. MAINS to the respective position.

(1) When supplied from the A.C. mains, 220 V, set the switch VOLTAGE MONITORING on the control-distribution board to MAINS, A.C. ОП-120 position, whereas the switch A.C. MAINS to OFF position. Then, operate the tumbler switch SHIP'S MAINS, D.C. 110, 220; A.C. 220 V and according to the A.C. voltage applied, using the A.C. voltmeter, set the switch A.C. MAINS in the respective position.

(2) When supplied from the A.C. mains, 127 V, put the switch VOLTAGE MONITORING on the control-distribution board to MAINS, A.C., ОП-120 position, the switch A.C. MAINS to OFF position. Depending on the A.C. voltage applied (readings being taken with the A.C. voltmeter), set the switch A.C. MAINS to the respective position. The position of the tumbler switch SHIP'S MAINS D.C. 110, 220, A.C. 220 V is arbitrary. 1 - 2 minutes after the direction finder has been switched on and the valves heated, check voltage values taking readings with the help of the instruments arranged on the control-distribution board. For this purpose set the switch VOLTAGE MONITORING to the following positions subsequently:

1. SHIP'S MAINS D.C.
2. MAINS, A.C. ОП-120.
3. PLATE, 210 V.
4. PLATE, 110 V.
5. RETARDATION.
6. 400 c.p.s.

(Set the function switch B1-3 in the receiver-and-goniometer unit in "A" position).

In the first position SHIP MAINS D.C. the D.C. voltmeter on the board should indicate the D.C. mains voltage. With the A.C. mains voltage applied the instruments should remain inoperative.

In the second position MAINS, A.C. ОП-120 the A.C. voltmeter should indicate the ship's A.C. mains voltage or A.C. voltage, 127 V, applied from the converter ОП-120 or autotransformer. In the third position PLATE, 210 V (АНОДН. 210В) the D.C. voltemter should indicate voltage from 230 to 190 V; in the fourth position PLATE, 100 V (АНОДН. 100В) from 110 to 90 V. In the fifth position RETARDATION (ТОРМ.) the D.C. voltmeter should indicate D.C. voltage from 20 to 10 V. In the sixth position 400 c.p.s. the A.C. voltmeter should indicate 90 V (fluctuations of the instrument pointer are permissible within 135 to 65 V).

If measured voltages correspond to the values given above the apparatus is considered to be switched on correctly.

Note: The possible error of the instrument ЭВ-46 (the A.C. voltmeter) is ±2.5 per cent at the temperature of ±20°C±5°C. With temperature changes from -50° to +50°C the accuracy falls by 1 per cent of the maximum scale value for each 10° of temperature change.

The possible error of the M-63 instrument (the D.C. voltmeter) is ±4 per cent at the temperature of +20°C±5°C.

At ambient temperature fluctuations from -40°C to +60°C the instrument accuracy decreases by 2 per cent of the maximum scale value for each 10° of temperature change.

(b) Tuning direction finder

To tune the direction finder proceed as follows:

1. Set the band selector switch in such a position that the transmitter frequency is within this band.

2. Turn the function switch in "Д" position.

3. Operate the tuning knob to set the required frequency by bringing the corresponding index line of the tuning scale in line with the cursor line arranged in front of the scale.

4. By rotating the turning knob within narrow limits obtain maximum deflection of the tuning indicator pointer. (In this case the highest tuning accuracy is achieved when the maximum deflection of the tuning indicator pointer occurs in the middle of the scale. To achieve this operate the knob VOLUME (ГРОМКОСТЬ).

5. Make sure the direction finder is tuned correctly to the required radio station by listening to its call signals. During reception of unmodulated oscillation put the tumbler switch ТЛФ-ТЛГ in ТЛГ position.

Note: It is not advisable to operate at frequencies of 260 Kc/s, 390 Kc/s, 520 Kc/s and 650 Kc/s with the tumbler switch in ТЛГ position.

(c) Testing telegraph operation

Put the tumbler switch ТЛФ-ТЛГ in ТЛГ position during "Д" or "C" mode of operation (in "A" mode of operation the second heterodyne does not operate); in this case beat note should be heard in the telephones which changes as the knob BEAT NOTE (ТОН БИЕНИЙ) is turned to the right or left to attain the frequency of 2,000 c.p.s.

Having been sure that the direction finder is fully serviceable in "Д" mode of operation, proceed to test its serviceability in "A" and "C" modes of operation.

(d) Testing operation in "A" and "C" modes of operation.

Without disturbing the tuning, turn the function switch in "A" position. The goniometer indicator should read the transmitter bearing. Turning further the function switch in "C" position and operating the knob of the ZERO SHARPENING CONTROL, make sure that the manual zero sharpening control is operative. If the zero sharpening control is effective the sound during the rotation of this control should rise and fall (in this case the manual volume control should be adjusted to obtain the sound level convenient for the operation). Then, manipulate the SEARCH COIL ROTATION (ВРАЩЕНИЕ ИСКАТЕЛЯ) knob (B1-6) to deflect the goniometer indicator to the right and left from zero reception; in both cases the sound must rise as the indicator moves away from the bearing.

(e) Testing the direction finder operation with the crystal on.

With the function switch in "A" position, put the switch CRYSTAL in ON position and tune using the tuning knob. The goniometer indicator should indicate the same bearing as without the crystal.

(f) Testing the goniometer indicator setting

Having ascertained that the direction finder is fully serviceable in all modes of operation, check the goniometer indicator for proper setting. For this purpose short-circuit terminals 1 and 3 in the casing compartment and then take bearing from some radio station.

In this case the radio relative bearing obtained has to be about 0° or 180° (on the fixed goniometer scale). If the radio relative bearing will differ from 0° or 180°, it is necessary to remove the glass cover, to unscrew the indicator lid, to loose the nut, and to set the indicator in 0° or 180° position; then to screw up the nut and lid and to fix the glass cover. After that unshort the loop antenna ends.

(g) Testing the loop antennas for correct connection to goniometer.

Even being completely sure that all the connections during the direction finder installation have been made as instructed, it is necessary to check the direction finder for proper operation. For this purpose take bearings from two or three radio stations whose relative bearings are known. For convenience's sake choose stations located either to port or starboard. Suppose that the radio relative bearing for radio station No.1 equals 25° and that for radio station No.2, 65°. Hence, when taking bearings from radio stations No.1 and No.2 in turn, radio relative bearings obtained must increase clockwise. If radio relative bearings obtained for stations No.1 and No.2 do not vary, i.e. the relative bearing for both stations is the same, it means that the ends from both loop antennas are connected to each goniometer field coil. To eliminate this defect interchange the feeder end PI-1 with the end PII-1. If after that radio relative bearings obtained do not differ, it is necessary to return the end of the second loop antenna PII-1 in its former place and to interchange the end of the first loop antenna PI-1 with the other end of the second loop antenna PII-2 and to take test bearings once more. Now, radio relative bearings obtained for radio stations No.1 and No.2 should differ. In case radio relative bearings change not clockwise but counter-clockwise it is necessary to interchange either the end PI-1 with the end PI-2, or the end PII-1 with the end PII-2.

These readjustments completed, radio relative bearings, when taking bearings from radio stations 1 and 2 in turn, should change clockwise.

It should be noted, that if the pointer does not deflect, when one of the field coil ends is closed, it means that this end is shorted to the body. It is necessary to remove the short-circuit.

(h) Testing sense determination

The next step to be taken is to check the sense determination. It is checked by taking bearings from the radio station, whose approximate direction is already known. If the sense determination is wrong (shifted by 180°) it is necessary to interchange all the four ends from the loop, i.e. to interchange PI-1 with PI-2 and PII-1 with PII-2 or to turn the goniometer indicator through 180° using the method referred to in Section VIII,f.

These operations completed, the direction finding should be correct.

3. Adjustment of Direction Finder

Having checked the direction finder for correct installation it is required to adjust the direction finder, i.e. to match the length of the loop feeder and to adjust modulation depth.

(a) Matching loop feeder length

The length of the loop feeder to which the direction finder has been adjusted, is shown on the name plate in the loop compartment of the casing.

Depending on the index, direction finders are delivered adjusted to the following lengths of the loop feeder: 16 m. (index 4 - 16 m), 26 m. (index 16 - 26) or 30 m. (index 26 - 30 m). If during the direction finder installation on shipboard the loop feeder length occurs to be reduced as compared with that to which the given apparatus has been adjusted, it is necessary to match the direction finder with the present length of the feeder. For this purpose it is required to remove matching device No.1 installed by the Manufacturer in the loop compartment of the receiver-and-goniometer unit and to insert in its place one of the matching devices in accordance with the table below.

Difference between real loop feeder length and adjusted length	(0-1)m.	(1-3)m.	(3-5)m.	(5-7)m.	(7-9)m.	(9-11)m.	(11-13)m.
Matching device No.	No.1	No.2	No.3	No.4	No.5	No.6	No.7

Permissible deflection of the real feeder length from the adjusted length should not exceed ± 1 m.

The increase of the real feeder length as compared with that, to which the apparatus has been adjusted, can not be readily compensated for by replacing matching devices and therefore, use of feeders, having length above rated is not allowed.

Use of feeders shorter than 3 m. for index 4-16, shorter than 13 m. for index 16-26, and shorter than 17 m. for index 26-30 is not allowed.

When the matching device does not correspond to the loop feeder length, aural and automatic bearings do not coincide. It is observed during operation over the second band at frequencies 650 - 750 Kc/s.

(b) Adjustment of modulation depth

Prior to adjustment of modulation depth it is required to check the bias voltage across the valve grids of the control circuit (R1-74 screw-driver operated control). The screw-driver operated control is located in the power unit compartment of the casing. Bias value measured by the tester TT-I between the middle terminal of the regulator and the body should be within 14-15 V.

Modulation depth is adjusted in the following way:

1. Put the function switch in "A" mode of operation.

2. Tune to a sufficiently powerful station in the beacon band. To do this proceed as follows:

(a) Turn the knob VOLUME about 90° to the left from the maximum volume position.

(b) Tune to such a station that the tuning indicator pointer should deflect over the full scale.

3. Use the modulation depth regulator to obtain the following:

(a) The goniometer pointer oscillations should not exceed ±1.5°.

(b) The difference between the bearing positions when the bearing pointer approaches this position from different sides should not exceed ±0.3°.

For this purpose the direction finder is adjusted to operate in "C" mode of operation, the goniometer pointer deflects from the boaring position and the direction finder is adjusted again for "A" mode of operation.

It should be noted that the maximum output voltage in "C" mode of operation appeares to be of the same order as in "Д" mode of operation.

Note: The modulation depth control is in the lower right-hand corner of the direction finder front panel and is covered by a turnable name plate. Under the same name plate there is a screw-driver operated control of the receiver sensitivity marked RECEIVER GAIN. These controls are arranged as shown on the name plate. The control RECEIVER GAIN is mounted by the Manufacturer and it is not recommended to readjust this control during the direction finder installation on board the ship.

(c) Automatic zero sharpening and radio deviation compensation in the direction finder.

Prior to the calibration of the direction finder it is required to check the zero sharpening and radio deviation compensation controls for proper operation.

Antenna effect (zero cleaning) is automatically compensated for on shipboard at frequencies of about 300 Kc/s with the transmitters abeam and with the deviation chokes switched off.

The zero sharpening control is checked in the following way:

1. Remove the casing lid.

2. Put the jumpers in the loop compartment in OFF position. Terminals 16, 17 and 19, 20, 21 close and the compensation chokes are switched off.

3. Short-circuit terminal 5 of the antenna compartment to the chassis.

4. In "C" mode of operation set the goniometer indicator in the minimum volume position.

5. Put the zero sharpening control (B1-7) in position 2.

6. While switching the second end of the jumper from terminal 15 to terminals 8, 10, 12 and 14 be sure that an output signal changes with the jumper in different positions.

7. In one of the jumper positions make sure an output signal changes with the zero sharpening control (B1-7) set to different positions. By rotating the screw-driver operated trimmer CI-137 with the zero sharpening control in position 1 make sure that it operates properly.

8. Unshort terminal 5 of the antenna.

The radio deviation compensation elements are checked in the following way:

1. Put the jumpers П1-1, П1-2 and П1-3 in the loop compartment in ON position. Terminals 17, 18 and 20, 21, 22 close and the compensation chokes are switched on.

2. Tune to the radio station, whose radio relative bearing approximates a quadrant at the frequency of about 300 Kc/s and mark this radio relative bearing.

3. Rotating the compensation chokes with the help of a screw-driver make sure the indicator pointer deflects.

4. Having checked the compensation choke for serviceability put the jumpers to OFF position.

5. Adjust the mechanical compensator to read zero correction. To achieve this proceed as follows:

(a) Rotate the disc (by the knob SEARCH COIL ROTATION in "C" position of the function switch) and set zero division of the correction scale against zero of the fixed scale. Holding the goniometer indicator by hand remove the lid from it, unscrew the nut and remove the clamp keeping the indicator in a zero position. When removing the clamp the goniometer indicator should be $1^0 - 2^0$ to the left (- sign) from zero of the correction scale. If it is not so, set the goniometer indicator at $1^0 - 2^0$ division from correction scale zero (by rotating the adjusting screw, which corresponds to fixed scale zero and thereabouts).

(b) Make the same adjustments for 10°, 20°, 30°, etc. to see that the adjustment is correct. If, while rotating the disk, the goniometer indicator will be for all 36 points $1^{\circ} - 2^{\circ}$ to the left from correction scale zero it means that the adjustment is made correctly.

(c) After these adjustments put the clamp on the goniometer indicator so that its index line should coincide with correction scale zero, secure it with a nut and screw up the indicator lid.

6. Cover the goniometer window with the glass cover and put back the lid of the compartment where the cable is fanned out.

It should be noted that the radio deviation compensation chokes are usually connected to the fore-and-aft loop PI and compensate for the negative radio deviation error, the wires with tips being connected to terminals 11, 12, 13, 14 and the jumpers with tips closing terminals 7, 8, and 9, 10.

First adjust zero sharpening, proceeding as follows:

1. Tune to a well audible radio station operating at the frequency of about 300 Kc/s (in the beacon band).

2. Assume the radio relative bearing of 90° or 270°.

3. Put the function switch in "C" position.

4. Find the aural bearing by using the manual zero sharpening control.

5. Remove the lid from the casing.

6. Short-circuit terminal 5 of the antenna in the casing.

7. Put the zero sharpening switch (B1-7) in position 2.

8. By changing the jumper of the compensating wire from terminal 15 to terminals 8, 10, 12 or 14 find a position, in which the voltage in the telephones decreases when the jumper is connected.

9. Select such a position of the zero sharpening switch, in which the volume in the telephones is at minimum. Final tuning is performed by the trimmer CI-137.

10. Secure the jumper with the help of a nut.

11. Unshort terminal 5 of the antenna.

12. Cover the casing with the lid.

After zero sharpening adjustments determine radio deviation using one of the methods described (with the function switch in "A" position). Having calculated the value of radio deviation plot a curve of radio deviation in relation to a radio relative bearing, and find value and signs of radio deviation coefficients "A" and "Д".

To compensate for received radio deviation proceed as follows:

1. Move the goniometer indicator in accordance with the calculated value of the radio deviation coefficient "A" by the method described in Section (VIII, f).

2. Open the lid in the casing and put the jumpers П1-1, П1-2 and П1-3 in ON position.

3. Compensate for the radio deviation coefficent "Д" employing the electrical compensation chokes, for which purpose:

(a) If the quadrantal radio deviation coefficient is negative connect the leads from the terminal block where the compensation choke ends are fanned out (in the casing) in the following way:

terminal 16 with terminal 11;
terminal 17 with terminal 12;
terminal 19 with terminal 13;
terminal 20 with terminal 14.

Put jumpers between terminals 7 - 8 and 9 - 10 of the terminal block for the loop ends.

In this case the radio deviation compensation chokes will be connected to the fore-and-aft loop.

If the quadrantal radio deviation coefficient is negative the leads from the terminal block for the chokes should be changed: from terminal 11 to terminal 7, from terminal 12 to terminal 8, from terminal 13 to terminal 9, from terminal 14 to terminal 10, the jumper from terminals 7 - 8 to terminals 11 - 12, the jumper from terminals 9 - 10 to terminals 13 - 14.

In this case the radio deviation compensation chokes will be connected to the athwartships loop.

(b) Release the locking screws of the radio deviation compensation chokes.

(c) Rotate the adjusting screws of the chokes with the help of a screw-driver to set the cursor of all the chokes against a figure corresponding to the value of "Д" coefficient of radio deviation being compensated for.

4. Repeat procedures for compensation of radio deviation once more and having calculated corrections for radio deviation plot a curve of residual radio deviation. Maximum value of residual radio deviation should not exceed $\pm 5^\circ$.

5. Having opened the goniometer glass cover, remove the clamp from the indicator and adjust the mechanical compensator by means of the adjusting screws consulting the plotted curve of residual radio deviation. While adjusting the mechanical compensator the following should be borne in mind:

(a) It is not allowable to turn an adjusting screw more than through $2^\circ - 3^\circ$ of a revolution of the goniometer indicator. If this rule is not observed the template may be damaged as turning any of the adjusting screws by a value higher than required for the indicator revolution through $2^\circ - 3^\circ$, bends the template spring excessively and may break it and damage the clamps of the neighbouring screws. Therefore compensator adjustment should be made not at once but in several steps. For this purpose the residual radio deviation curve must be replaced by a series of curves approaching the principal one. Perform consecutive compensator adjustments consulting these curves.

(b) At the first adjustment step the following sequence of adjusting screw rotation should be observed: $350^0 - 10^0$, $340^0 - 20^0$, $330^0 - 30^0$, $320 - 40^0$, etc. When the compensation is carried out in this way the template body will approach the centre in one section and move away from the centre in the other, as positive correction for radio deviation is introduced in one section and negative in the other. Suggested sequence of adjustments protects the template body from excessive mechanical tension.

Taking into account all mentioned above attempt to adjust the compensator observing the following procedure:

(a) Apply corrections according to the residual radio deviation curve. To do this set correction scale zero division against 350^0 on the fixed scale and by rotating the adjusting screw corresponding to 350^0 set the goniometer indicator according to the correction scale to an angle corresponding in value and sign to the radio deviation plotted in the direction of 350^0 on the curve. By the same method determine corrections for all 36 adjusting screws keeping the sequence given above: $350^0 - 10$, $340^0 - 20^0$, etc. and setting the correction scale zero division in turn against all the divisions with figures on the fixed scale.

(b) Check mechanical compensator for proper adjustment. For this purpose set the compensator disk subsequently at the divisions 0^{o}, 10^{o}, 20^{o}, etc. and check to see the goniometer indicator readings correspond to the radio deviation curve. If necessary, perform readjustments simultaneously.

(c) Having ascertained that adjustment is performed correctly close the goniometer window with the glass cover and place the clamp removed from the indicator in special clips located on the inside of the casing lid.

(d) Setting the goniometer movable scale.

After radio deviation has been compensated for one must match a goniometer movable scale position with ship gyro-compass readings. For this purpose it is necessary to unscrew the cap, to release the knob COURSE SETTING by turning it counter-clockwise and then, rotating the movable scale by the knob, to set against zero of the goniometer fixed scale that degree on the movable scale which corresponds to a ship gyro-compass reading. Having matched in such a way, secure the knob COURSE SETTING by pressing it to the direction finder front wall and by turning it clockwise as far as it will go and then screw up the cap.

IX. APPENDIX

1. Instructions on Testing the Direction Finder Valve Characteristics

The test of the direction finder valve characteristics is performed by the tester TT-1 when the complete direction finder set is used.

Prior to testing the receiver-and-goniometer unit is removed from the casing and is connected to the tester by means of connecting cables, supplied with the set of spare parts, tools and accessories. The volume control is set at maximum, and the function switch, to position "A".

Prior to taking measurements allow 2 - 5 minutes to elapse after the direction finder has been switched on, this time being necessary for the valves to warm up. To monitor supply voltage, instruments arranged on the control-distribution board are used. Base connection of the valves, employed in the direction finder, is given in Table 1.

Table 1

Testing valve characteristics is performed by means of the tester TT-1 according to the following rules:

1. Heater voltage (A.C.) is measured between the valve heater pins according to Table No.1.

2. Plate voltage (DC) is measured between the plate pins and receiver body.

3. Screen grid voltage (D.C.) is measured between the screen grid pins and receiver body.

(There is A.C. voltage across the control valve screen grids).

4. Bias (D.C.) is measured between the cathode pin and receiver body.

In the control valves 6П6С bias is checked between valve pin 5 and the receiver body.

Rated characteristics for valves are given in Table No.2.

Table 1

Valve type	Valve pin							
	1	2	3	4	5	6	7	8
6K3	envelope	heater	suppressor grid	control grid	cathode	screen grid	heater	plate
6H6C	–	heater	plate	screen grid	control grid	–	heater	cathode
6X6C	–	heater	plate 2	cathode 2	plate 1	–	heater	cathode 1
6H8C	control grid 2	plate 2	cathode 2	control grid 1	plate 1	cat-hode 1	heater	heater
6Ж4	envelope	heater	suppress-or grid	control grid	cathode	screen grid	heater	plate

Table No.2

Characteristics of Receiver-And-Goniometer Unit Valves in "A" Mode of Operation

Stage	Heater voltage, V	Plate voltage, V	Screen grid voltage, V	Bias, V	Cathode voltage, V
1	2	3	4	5	6
Direction finder output amplifier	6.3	85	85	-	+2
Control plate detector I and II	6.3	170	70	-14	+0.6
Audio oscillator	6.3	160	160	-	+1.8
Phasing commutator I and II	6.3	180	124	-	+14
Loop amplifier	6.3	160	90	-	+1.0
High-frequency amplifier	6.3	85	55	-	+1.5
Mixer	6.3	90	36	-	+1.4
1st heterodyne	6.3	70	70	-	-
1st intermediate frequency amplifier	6.3	90	40	-	+5.5

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1	2	3	4	5	6
2nd intermediate frequency amplifier	6.3	85	55	-	+1.1
Detector	6.3	-	-	-	+14
Low-frequency amplifier	6.3	60	-	-	+14
Telephone output amplifier	6.3	90	85	-	+5.5
2nd heterodyne (mode of operation "Д")	6.3	85	15	-	-
Tuning indicator amplifier	6.3	75	-	-	+14

Note: Valve characteristics are taken with the gain control knob, modulation depth control (screw-driver operated) and receiver gain knob (screw-driver operated), set at maximum.

Table No.3

Characteristics of Power Unit Valves

Stage	Heater voltage, V	Plate voltage, V	Screen grid voltage, V	Cathode voltage, V	Bias, V
1	2	3	4	5	6
Driver	6.3	105	-	-	-18
Motor supply generator (I and II)	6.3	225	225	-	-34

2. Winding Data for Transformers and Chokes

Symbol according to key diagram	Winding No. (relative to core)	Panel contacts		Wire, dia.	Number of turns	Note
		Beginning	End			
1	2	3	4	5	5	7
Tp 1-1	1	5	2	0.07 mm	5200	In common screen
(T-79)	2	3	1	0.06 mm	11500	
Дp 1-3	1	7	6	0.06 mm	5280	
Tp 1-2 Tp 1-3 (T-76)	Winding is wound on middle rod	1	2	0.06 mm	8500	
	Winding is wound on end rods	3	4	0.25 mm	500 turn in one winding	Transformer uses two windings
Tp 1-4	1	1	3	0.1 mm	1600	
		1	2		800	
	2	4	6	0.1 mm	3200	In common screen
		4	5		1600	

1	2	3	4	5	6	7

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1	2	3	4	5	6	7
Tp 1-5	1	7	9	0.1 mm	2900	
		7	8		900	
	2	10	11	0.51 mm	84	
Tp 3-1	1	13	11	0.8 mm	280	
		13	15		254	
		13	14		220	
		13	10		200	
	2	6	2	0.31 mm	238	
	3	5	1	0.38 mm	215	
	4	8	4	2.1 mm	15	
		8	9		7.5	
	5	7	3	0.51 mm	52	
	6	12	16	1.5 mm	13	
Tp 3-2	1	1 1	3 2	0.15 mm	1500 750	In common screen

1	2	3	4	5	6	7
Тр 3-2	2	4	6	0.08 mm	3000	
		4	5		1500	
Др 3-5	1	8	7	0.2 mm	500	
Тр 3-3	1	6	8	0.38 mm	800	Wind windings 2 and 3 simultaneously 2 wire deep
		6	7		400	
	2	5	4	0.31 mm	150	
	3	4	3		150	
	4	1	2	0.64 mm	50	
Др 3-1	1	2	4	0.15 mm	4100	In common screen
Др 3-2	1	3	1	0.15 mm	1100	
Др 3-3	1	2	4	0.18 mm	2800	In common screen
Др 3-4	1	1	3	0.15 mm	1100	
Тр 7-1	1	1	3	0.8 mm	506	
		1	2		294	

3. Trouble Chart

No.	Trouble	Possible cause	Remedy
1	2	3	4
	With the function switch in "Д" position		
1	The direction finder is switched on but no voltages on the control-distribution board.	(1) Contact fault in the supply circuits. (2) The fuse in the board is blown out.	Check circuit continuity in the board. Replace the fuse.
2	In the presence of voltages on the control-distribution board the direction finder does not operate irrespective of a band switched on.	(1) No contact in the supply plug of the receiver-and-goniometer unit. (2) One or several valves are faulty. (3) No contact in the telephone and loud-speaker plugs.	Tighten up the locks on the receiver-and-goniometer unit. Replace faulty valve. Repair the plugs.
3	The direction finder does not operate	(1) No contact in the band selector plate	Replace the circuit.

1	2	3	4
		of any circuits.	
		(2) O/c in coil of one of the circuits.	Replace the coil.
4	No tone modulation in ТЛГ position.	(1) O/c. in wire running to the tumbler - ТЛФ-ТЛГ; the second heterodyne valve is faulty; failure of the tumbler or trimmer C1-98.	Restore the connection, replace the faulty valve. Change the trimmer C1-98, replace the tumbler.
5	The tuning indicator pointer deflects with difficulty.	(1) Valve 6H8-C (Л1-12) is faulty.	Replace the faulty valve.
		(2) The tuning indicator is faulty.	Replace the tuning indicator.
6	Poor sensitivity of the receiver at frequency watching.	(1) Emission loss of one or several receiver valves.	Replace old valves.
		(2) Change in capacitance of one or several capacitors of	Replace the capacitor.

1	2	3	4
		high, intermediate or low frequency stages.	
		(3) The antenna is not connected or broken.	Connect the antenna, remove the breakage.
	With the function switch in "C" position		
7	Failure of manual control for rotation of the search coil.	(1) Failure in the circuits of the switch SEARCH COIL ROTATION, breakage in the circuits of the ДРК motor windings.	Restore the connection.
		(2) Faulty valves of the driver or power amplifier in supply unit.	Replace faulty valves.
		(3) No contact in the supply plug in the receiver-and-goniometer unit.	Restore the contacts.

1	2	3	4
8	Noise is heard in telephones, but no signal reception at any position of the search coil.	(1)Failure of the circuit of voltage transmission from the loop antenna unit - in the feeder, in goniometer slip rings, faulty valves of the loop input.	Restore the connection, restore the contact in the goniometer, replace the faulty valve.
9	Strong cracklings when the goniometer search coil is rotated.	(1)Poor contact in the collector slip rings. (2)The rotor brushes come off the collectors.	Clean the groove of the slip rings. Install the brushes.
10	Minimum is blurred when taking bearing in "C" mode of operation.	(1)The antenna is disconnected or broken. (2)The antenna is short. (3)Breakage in the variometer circuit.	Connect the antenna, remove the breakage. Replace the antenna. Remove the breakage.

1	2	3	4
11	Minimum axis bend exceeds 1°.	The antenna is large.	Shorten the antenna.
	With the function switch in "A" position		
12	Search coil rotation is independent of tuning frequency.	One of the 6H6C valves of the control circuit is faulty.	Replace the valve.
13	Low-frequency tone of local modulation is not audible; the search coil is not in the bearing position. The automatic device does not operate.	Audio oscillator valve 6H8C is faulty, a loop amplifier valve or phasing commutator valves are faulty.	Replace the faulty valve, restore the connection.
14	In the presence of a signal, low-frequency tone of local modulation is heard in the telephones. The automatic device does not operate.	Valve 6M4 of the direction finder output stage is faulty.	Replace the faulty valve.

1	2	3	4
15	Excessive oscillations of the goniometer indicator at strong signals and high speed of automatic indicator rotation (more than 45°/sec.)	(1)Failure in the electrical retarding circuit. (2)No retarding current because of burnt out fuse or faulty selenium pile.	Restore the connection. Replace faulty fuse, replace the selenium rectifier.
16	Sluggish and inaccurate approach to the bearing. Tone of 40 c.p.s. is audible in the telephones in the absence of signals.	One of the phasing commutator valves (Л1-1 or Л1-2) is faulty.	Replace the faulty valve.
17	Sluggish and inaccurate approach to the bearing.	(1)Loss of emission of valves 6Ж4 (Л1-13 or Л1-14) (2)Modulation depth decreases.	Replace valve. Increase modulation depth using the MODULATION DEPTH control

1	2	3	4
		(3) The sensitivity control of the automatic circuit (R1-74) in the receiver casing is poorly adjusted.	Use the sensitivity control to set bias equal to 14 V.
		(4) Poor contact in the loop compartment plug of the receiver casing.	Check and restore the contact.
		(5) Loss of the receiver sensitivity.	See Item 6.
18	Strong oscillations of the goniometer indicator even at a strong signal.	1. Failure in the non-directional antenna circuit.	Check the circuits of the antenna lead-in and antenna box.
		2. Contact in the antenna compartment plug of the casing is not reliable.	Check and restore the contact.
		3. Modulation depth is great.	Descrease modulation depth using the screw-driver operated control (R1-74).

1	2	3	4
19	Aural and automatic bearings differ.	1. The loop circuit is detuned. 2. Disturbances in the circuit for switching on the antenna compensating wire.	Align the loop circuit. Check the connection circuits of the antenna compensating wire.
20	The movable goniometer scale does not rotate.	(1) The receiving selsyn in burnt out. (2) The contact in the switch COURSE SETTING (B1-6) is poor. (3) No contact in the supply plug in the receiver casing.	Replace the selsyn. Repair the contact in the switch or replace the switch. Press the contact.
21	The goniometer indicator rotates in one direction when the signal is absent; bearing errors are observed at low field strength.	1. One of the phasing commutator valves does not operate. 2. The control circuit valves are unbalanced.	Replace the valve Balance the control circuit valves using the screwdriver operated control (R1-75).

For convenience of trouble-shooting it is required to use the arrangement diagrams (See Figs 26 and 27) applied to the instructions as it is impossible to mark all the parts according to the key diagram.

4. List of Parts for the Key Diagram

Symbol	Description	Value	Quantity	Note
1	2	3	4	5
	The receiver-and-goniometer unit (ПРГ)			
	Capacitors			
C1-1ˣ	КТК-1-Д-91-I	91 pF	1	
C1-2	Trimmer	6-25 pF	1	
C1-3	Trimmer	6-25 pF	1	
C1-4ˣ	КТК-1-Д-24-I	24 pF	1	
C1-5	Trimmer	6-25 pF	1	
C1-6ˣ	КТК-1-Д-43-I	43 pF	1	
C1-7ˣ	КТК-1-Д-20-I	20 pF	1	
C1-8	КСО-2-500-Б-200-I	200 pF	1	
C1-9	КСО-2-500-Б-200-I	200 pF	1	
C1-10	КСО-2-500-А-1000-II	1000 pF	1	
C1-11	Variable capacitor assembly	20-420 pF	1	5 sections (a, b, c, d, e)
C1-12ˣ	КТК-3-М-120-I	120 pF	1	
C1-13ˣ	КТК-1-Д-100-I	100 pF	1	
C1-14	КСО-5-500-Б-5100-I	5100 pF	1	
C1-15	КСО-5-500-Б-5100-I	5100 pF	1	
C1-16	КБГ-МП-2В-600-0.5-II	0.5 μF	1	

1	2	3	4	5
C1-17	КБГ-М2-600-0.05-III	0.05 μF	1	
C1-18	КБГ-М2-600-0.05-III	0.05 μF	1	
C1-19	КБГ-М1-600-0.05-III	0.05 μF	1	
C1-20	КБГ-М1-600-0.05-III	0.05 μF		
C1-21	КБГ-МП-3в-600-3x0.1-III	0.1 μF	1	3 sections (a,b,c)
C1-22	КБГ-М1-400-0.1-III	0.1 μF	1	
C1-23	КБГ-МП-3в-600-3x0.1-III	0.1 μF	1	3 sections (a,b,c)
C1-24	КСО-5-250-Б-9100-III	9100 pF	1	
C1-25	КСО-2-500-Б-360-1	360 pF	1	
C1-26	КСО-5-500-Б-5100-1	5100 pF	1	
C1-27[x]	КТК-3-М-150-1	150 pF	1	
C1-28[x]	КТК-1-М-20-1	20 pF	1	
C1-29[x]	КТК-2-М-56-1	56 pF	1	
C1-30	Trimmer	6 - 25 pF	1	
C1-31[x]	КТК-1-М-5-1	5 pF	1	
C1-32[x]	КТК-1-Д-10-1	10 pF	1	
C1-33	Trimmer	6 - 25 pF	1	
C1-34[x]	КТК-1-М-5-1	5 pF	1	
C1-35[x]	КТК-1-Д-10-1	10 pF	1	
C1-36	Trimmer	6 - 25 pF	1	
C1-37	КСО-2-500-А-1000-11	1000 pF	1	
C1-38[x]	КГК-1-М-27-1	27 pF	1	
C1-39	КБГ-МП-3В-600-3x0.1-III	0.1 μF	1	3 sections (a,b,c)
C1-40	КСО-5-500-Б-5100-0	5100 pF	1	
C1-41[x]	КТК-3-М-120-1	120 pF	1	
C1-42	Trimmer	6 - 25 pF	1	
C1-43[x]	КТК-1-М-20-1	20 pF	1	
C1-44[x]	КТК-1-Д-43-1	43 pF	1	

1	2	3	4	5
Cl-45^{x}	КТК-1-М-20-1	20 pF	1	
Cl-46	Trimmer	6 - 25 pF	1	
Cl-47^{x}	КТК-1-Д-43-1	43 pF	1	
Cl-48	Trimmer	6 - 25 pF	1	
Cl-49^{x}	КТК-1-М-30-1	30 pF	1	
Cl-50^{x}	КСО-5-500-Г-1300-0	1300 pF	1	
Cl-51^{x}	КСО-2-500-Г-100-0	100 pF	1	Capacitors Cl-50 and Cl-51 may be replaced with two capacitors: КСО-2-500-Г-750-1 and КСО-2-500-Г-560-1
Cl-52^{x}	КСО-2-500-Г-820-0	820 pF	1	Interchangeable with two capacitors КСО-2-500-Г-430-1 and КСО-2-500-Г-390-1
Cl-53^{x}	КТК-1-М-10-1	10 pF	1	
Cl-54^{x}	КТК-3-М-120-1	120 pF	1	
Cl-55^{x}	КТК-1-М-33-1	33 pF	1	
Cl-56^{x}	КСО-2-500-Б-180-1	180 pF	1	
Cl-57^{x}	КСО-2-500-Б-100-1	100 pF	1	
Cl-58^{x}	КСО-2-500-Б-240-1	240 pF	1	
Cl-59	КТК-1-М-15-1	15 pF	1	
Cl-60	КСО-2-500-Б-100-1	100 pF	1	
Cl-61^{x}	КТК-2-М-62-1	62 pF	1	
Cl-62	Trimmer	6 - 25 pF	1	
Cl-63^{x}	КТК-1-М-5-1	5 pF	1	
Cl-64	Trimmer	6 - 25 pF	1	

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1	2	3	4	5
C1-65[x]	КТК-1-Д-10-1	10 pF	1	
C1-66[x]	КТК-1-Д-10-1	10 pF	1	
C1-67	Trimmer	6 - 25 pF		
C1-68[x]	КТК-1-М-5-1	5 pF	1	
C1-69[x]	КТК-3-М-150-1	150 pF	1	
C1-70[x]	КТК-1-М-20-1	20 pF	1	
C1-71	КБГ-М1-400-0.1-III	0.1 μF	1	
C1-72	КБГ-МП-3в-600-3х0.1-III	0.1 μF	1	3 sec-tions (a,b,c)
C1-73	КСО-5-250-Б-9100-III	9100 pF	1	
C1-74	КСО-2-500-Б-120-II	120 pF	1	
C1-75[x]	КГК-1-М-5-1	5 pF	1	
C1-76	КСО-2-500-Г-270-0	270 pF	1	
C1-77	КСО-2-500-Г-270-0	270 pF	1	
C1-78	КБГ-МП-3В-600-3х0.1-III	0.1 μF	1	3 sec-tions (a,b,c)
C1-79[x]	КТК-2-М-43-1	43 pF	1	
C1-80[x]	КГК-1-М-7-1	7 pF	1	
C1-81[x]	КГК-1-М-30-1	30 pF		
C1-82	Trimmer	6 - 25 pF	1	
C1-83	КБГ-МП-3в-600-3х0.1-III	1 μF	1	3 sec-tions (a,b,c)
C1-84	КСО-2-500-Г-270-0	270 pF	1	
C1-85	КСО-2-500-Г-270-0	270 pF	1	
C1-86[x]	КТК-1-М-4-1	4 pF	1	
C1-87	КБГ-МП-3б-600-3х0.1-III	0.1 μF	1	3 sec-tions (a,b,c)
C1-88	КБГ-МП-3б-600-3х0.1-III	0.1 μF	1	ditto
C1-89	КСО-2-500-Г-270-0	270 pF	1	

1	2	3	4	5
C1-90	КСО-2-500-Г-270-0	270 pF	1	
C1-91^x	КТК-1-М-3-II	3 pF	1	
C1-92	КТК-1-Д-51-I	51 pF	1	
C1-93	КТК-1-Д-51-I	51 pF	1	
C1-94	КТК-1-Д-100-I	100 pF	1	
C1-95^x	КГК-2-М-68-II	68 pF	1	
C1-96	КБГ-М-2-400-0.1-III	0.1 μF	1	
C1-97^x	КСО-2-500-Б-270-1	270 pF	1	
C1-98	Trimmer	6 - 25 pF	1	
C1-99^x	КСО-2-500-Г-100-I	100 pF	1	
C1-100	КБГ-МП-3б-600-3x0.1-III	0.1 μF	1	3 sections (a,b,c)
C1-101	КГК-1-М-5-1	5 pF	1	
C1-102	КСО-2-500-Б-560-II	560 pF	1	
C1-103	КСО-5-250-Б-9100-III	9100 pF	1	
C1-104	КБГ-МП-2В-600-0.5-II	0.5 μF	1	
C1-105^x	КСО-5-250-Б-9100-I	9100 pF	1	
C1-106	КСО-5-500-Б-6800-1	6800 pF	1	
C1-107	КБГ-МП-3б-600-3x0.1-III	0.1 μF	1	3 sections (a,b,c)
C1-108	КСО-2-500-А-1000-II	1000 pF	1	
C10-109	КЭГ-1-Н $\frac{50}{5}$ ОМ	5 μF	1	
C1-110	КСО-5-500-Б-6800-I	6800 pF	1	
C1-111	КСО-5-500-Б-6800-I	6800 pF	1	
C1-112^x	КСО-5-500-Б-6800-I	6800 pF	1	
C1-113^x	КСО-5-500-Б-6800-I	6800 pF	1	
C1-114	КЭГ-1-В $\frac{450}{20}$ М	20 μF	1	
C-115	КЭГ-1-Н- $\frac{50}{5}$ ОМ	5 μF	1	
C1-116	КБГ-МН-2-400-1-III	1 μF	1	
C1-117	КБГ-МН-2-400-1-III	1 μF	1	

1	2	3	4	5
C1-118x	КСО-5-500-Б-6800-I	6800 pF	1	
C1-119	КБГ-МН-2-400-1-III	1 μF	1	
C1-120	КЭГ-1-В $\frac{450}{20}$ М	20 μF	1	
C1-121	МБГП-4а-400-4-II	4 μF	1	
C1-123	КБГ-М-2-600-0.05-III	0.05 μF	1	
C1-124	КБГ-МН-2-400-1-III	1 μF	1	
C1-125	КСО-1-250-Б-62-I	62 pF	1	
C1-126	КСО-1-250-Б-62-I	62 pF	1	
C1-127	КСО-1-250-Б-62-I	62 pF	1	
C1-128	КСО-1-250-Б-62-I	62 pF	1	
C1-129	КСО-1-250-Б-62-I	62 pF	1	
C1-130	КСО-1-250-Б-62-I	62 pF	1	
C1-131	КСО-1-250-Б-62-I	62 pF	1	
C1-132	КСО-1-250-Б-62-I	62 pF	1	
C1-133	КСО-1-250-Б-62-I	62 pF	1	
C1-134	КСО-1-250-Б-62-I	62 pF	1	
C1-135	КСО-1-250-Б-62-I	62 pF	1	
C1-136	КСО-1-250-Б-62-I	62 pF	1	
C1-137	Trimmer	6 - 60 pF	1	
C1-138	КСО-1-250-Б-51-I	51 pF	1	
C1-139	КСО-2-500-Б-100-II	100 pF	1	
C1-140	КСО-2-500-Б-200-II	200 pF	1	
C1-141x	КСО-2-500-Б-430-II	430 pF	1	
C1-142	КСО-5-250-Б-9100-III	9100 pF	1	
C1-143	КСО-5-250-Б-9100-III	9100 pF	1	
C1-144	КСО-5-250-Б-9100-III	9100 pF	1	
C1-145	КСО-5-250-Б-9100-III	9100 pF	1	
	Resistors			
R1-1x	ВС-0.25-1-51000-I-А	51000 ohms	1	

1	2	3	4	5
R1-2[x]	BC-0.25-1-15000-I-A	15000 ohms	1	
R1-3[x]	BC-0.25-1-51000-I-A	51000 ohms	1	
R1-4	BC-0.25-1-240000-I	240000 ohms	1	
R1-5	BC-0.25-1-240000-I	240000 ohms	1	
R1-6	BC-0.5-1-2000-I	2000 ohms	1	
R1-7[x]	BC-0.5-1-2000-I	2000 ohms	1	
R1-8	BC-0.25-1-39000-I	39000 ohms	1	
R1-9	BC-0.25-1-39000-I	39000 ohms	1	
R1-10	BC-0.25-1-47000-I	47000 ohms	1	
R1-11	BC-0.25-1-47000-I	47000 ohms	1	
R1-12	Wire-wound resistor	100 ohms	1	
R1-13	BC-0.25-1-470000-IA	470000 ohms	1	
R1-14	BC-0.25-1-100000-I	100000 ohms	1	
R1-15	BC-0.25-1-470000-IA	470000 ohms	1	
R1-16	BC-0.25-1-4700-I	4700 ohms	1	
R1-17[x]	BC-0.25-1-10000-I	10000 ohms	1	
R1-18[x]	BC-0.25-1-15000-I	15000 ohms	1	
R1-19	BC-0.5-1-20000-I	20000 ohms	1	
R1-20[x]	BC-0.5-1-68000-I	68000 ohms	1	
R1-21	BC-0.5-1-5100-I	5100 ohms	1	
R1-22[x]	BC-0.5-1-100000-I	100000 ohms	1	
R1-23[x]	BC-0.25-1-36000-I	36000 ohms	1	
R1-24	СП-1-16-2.2-A-4	2200 ohms	1	
R1-25[x]	BC-0.25-1-68-I	68 ohms	1	
R1-26	BC-0.5-1-5100-I	5100 ohms	1	
R1-27	BC-0.25-1-100000-I	100000 ohms	1	
R1-28[x]	BC-0.25-1-1000-I	330 ohms	1	
R1-29	СП-1-16-2.2-A-4	2200 ohms	1	
R1-30	СП-III- $\frac{1}{1}$б - $\frac{10А}{22Б}$.18	10000 ohms / 22000 ohms	1	Ganged (a,b)

1	2	3	4	5
R1-31[x]	BC-0.25-1-33000-I	33000 ohms	1	
R1-32	BC-0.25-1-1500-I	1500 ohms	1	
R1-33	BC-0.25-1-510000-I	510000 ohms	1	
R1-34	BC-0.25-1-51000-IA	51000 ohms	1	
R1-35[x]	BC-0.25-1-18000-I	18000 ohms	1	
R1-36[x]	BC-0.25-1-33000-I	33000 ohms	1	
R1-37[x]	BC-0.25-1-24000-I	24000 ohms	1	
R1-38[x]	BC-0.25-1-5600-I	5600 ohms	1	
R1-39	BC-0.25-1-1500-I	1500 ohms	1	
R1-40	BC-0.25-1-100000-I	100000 ohms	1	
R1-41[x]	BC-0.25-1-36000-I	36000 ohms	1	
R1-42[x]	BC-0.25-1-3300-I	4700 ohms	1	
R1-43[x]	BC-0.25-1-47000-I	47000 ohms	1	
R1-44	BC-0.25-1-1500-I	1500 ohms	1	
R1-45	BC-0.25-1-100000-I	100000 ohms	1	
R1-46[x]	BC-0.25-1-180 -I	180 ohms	1	
R1-47[x]	BC-0.25-1-24000-I	24000 ohms	1	
R1-48[x]	BC-0.25-1-1500-I	1500 ohms	1	
R1-49	BC-0.25-1-100000-I	100000 ohms	1	
R1-50	BC-0.25-1-100000-I	100000 ohms	1	
R1-51	BC-0.25-1-510000-I	510000 ohms	1	
R1-52[x]	BC-0.25-1-270000-I	270000 ohms	1	
R1-53[x]	BC-0.25-1-10000-I	10000 ohms	1	
R1-54[x]	BC-0.25-1-18000-IA	18000 ohms	1	
R1-55[x]	BC-0.5-1-20000-I	20000 ohms	1	
R1-56[x]	BC-0.25-1-10000-I	10000 ohms		
R1-57[x]	BC-0.25-1-820-I	820 ohms		
R1-58[x]	BC-0.25-1-2200-I	2200 ohms	1	
R1-59	BC-0.25-1-510000-I	510000 ohms	1	
R1-60	BC-0.25-1-510000-I	510000 ohms	1	
R1-61	BC-0.25-1-510000-I	510000 ohms	1	

1	2	3.	4	5
R1-62^x	BC-0.25-1-4700-I	4700 ohms	1	
R1-63	BC-0.25-1-510000-I	510000 ohms	1	
R1-64	BC-0.25-1-200000-I	200000 ohms	1	
R1-65^x	BC-0.25-1-300000-I	300000 ohms	1	
R1-66^x	BC-0.25-1- 510000-I	510000 ohms	1	
R1-67^x	BC-0.25-1-4700-I	4700 ohms	1	
R1-68^x	BC-0.25-1-10000-I	10000 ohms	1	
R1-69^x	BC-0.25-1-10000-I	10000 ohms	1	
R1-70	BC-0.25-1-470000-I	470000 ohms	1	
R1-71	BC-0.25-100000-I	100000 ohms	1	
R1-72	BC-0.25-10000-I	10000 ohms	1	
R1-73^x	BC-0.25-1-18200-I	8200 ohms	1	
R1-74^x	СП-1-6-3.3-A-4	3300 ohms	1	
R1-75	СП-16-470 ohms-A-4	470 ohms	1	
R1-76^x	BC-0.25-1-510-I	510 ohms	1	
R1-77^x	BC-0.25-1-510-I	510 ohms	1	
R1-78	BC-0.25-1-560-I	560 ohms	1	
R1-79^x	BC-1-1-2000-I	2000 ohms	1	
R1-80^x	Wire-wound resistor	1200 ohms	1	
R1-81^x	Wire-wound with holder	100 ohms	1	
R1-82^x	BC-0.25-1-820000-I	820.000 ohms	1	
R1-83^x	BC-0.25-1-820000-I	820.000 ohms	1	
	Inductances			
L1-1	Goniometer field coil		1	Mid-points are earthed
L1-2	Goniometer field coil		1	
L1-3	Goniometer search coil		1	
L1-4	Loop circuit coil (band III)		1	

1	2	3	4	5
L1-5	(Band II)		1	
L1-6	(Band 1)		1	
L1-7	Phasing commutator circuit plate coil		1	
L1-8	Phasing commutator circuit plate coil		1	
L1-9	Phasing commutator circuit grid coil		1	
L1-10	Antenna variometer rotor		1	
L1-11	Antenna variometer stator		1	
L1-12	High-frequency choke		1	
L1-13	The plate supply choke of the loop compartment		1	
L1-14	Antenna circuit coupling coil (band III)		1	
L1-15	(Band II)		1	
L1-16	(Band I)		1	
L1-17	Antenna circuit coils (band III)		1	
L1-18	(Band 11)		1	
L1-19	(Band I)		1	
L1-20	Rejector coil		1	
L1-21	Coupling coils of the 1st heterodyne circuit		1	
	(Band III)		1	
L1-22	(Band II)		1	
L1-23	(Band I)		1	
L1-24	Circuit coils of Ist heterodyne (band III)		1	
L1-25	(Band II)		1	
L1-26	(Band I)		1	
L1-27	Coupling coils, H.F. amplifier circuit (band III)		1	
L1-28	(Band II)		1	

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1	2	3	4	5
L1-29	(Band I)		1	
L1-30	Coil, H.F. amplifier circuit (band III)		1	
L1-31	(Band II)		1	
L1-32	(Band I)		1	
L1-33	High-frequency choke of plate load of 1st heterodyne		1	
L1-34	Plate supply choke of the first heterodyne compartment		1	
L1-35	Plate coil of the first intermediate frequency filter circuit		1	
L1-36	Grid coil of the first intermediate frequency filter circuit		1	
L1-37	Plate coil of the second intermediate frequency filter circuit		1	
L1-38	Grid coil of the second intermediate frequency filter circuit		1	
L1-39	Plate coil of the third intermediate frequency filter circuit		1	
L1-40	Grid coil of the third intermediate frequency filter circuit		1	
L1-41	Coupling coil of the 2nd heterodyne circuit		1	
L1-42	Coil of the 2nd heterodyne		1	
L1-43	High-frequency choke, filter		1	

1	2	3	4	5
L1-44	High-frequency choke, filter		1	
L1-45	High-frequency choke, filter		1	
L1-46	High-frequency choke, filter		1	
L1-47	High-frequency choke, filter		1	
L1-48	High-frequency choke, filter		1	
L1-49	Heater choke of the loop channel section		1	
L1-50	Heater choke of the loop channel compartment		1	
L1-51	Heater choke of the 1st heterodyne compartment		1	
L1-52	Heater choke of the 1st heterodyne compartment		1	
L1-53	Series choke (band 1)		1	
Др1-1	Radio deviation compensation choke		1	
Др1-2	Radio deviation compensation choke		2	
Др1-3	Supply choke of control circuit		1	
Tp1-1 (T-79)	Direction finder output transformer		1	In one screen
Tp1-2 (T-76)	Magnetic amplifier		1	
Tp1-3 (T-76)	Magnetic amplifier		1	
Tp1-4	Audio oscillator transformer		1	In one screen
Tp1-5	Output transformer of the telephone output		1	In one screen

1	2	3	4	5
Л1-1	Phasing commutator valve, 6Ж4		1	
Л1-2	Phasing commutator valve, 6Ж4		1	
Л1-3	Audio oscillator valve, 6H8-C		1	
Л1-4	Loop channel amplifier valve, 6Ж4		1	
Л1-5	H.F. amplifier valve, 6K3		1	
Л1-6	Valve 6K3, 1st heterodyne		1	
Л1-7	Mixer valve, 6Ж4		1	
Л1-8	Valve of the first intermediate frequency amplifier, 6K3		1	
Л1-9	Valve of the second intermediate frequency amplifier, 6K3		1	
Л1-10	Valve of the 2nd detector and automatic gain control, 6X6-C		1	
Л1-11	Second heterdoyne valve, 6K3		1	
Л1-12	Valve of the low-frequency amplifier and tuning indicator amplifier, 6H8-C		1	
Л1-13	Direction finder output amplifier valve, 6Ж4		1	
Л1-14	Control plate detector, 6П6-C		1	
Л1-15	Control plate detector, 6П6-C		1	
Л1-16	Telephone output amplifier, 6П6-C		1	
ЛН1-1	Brightening lamp CM-36		1	
ЛН1-2	Brightening lamp CM-36		1	
ЛН1-3	Brightening lamp CM-36		1	
ЛН1-4	Brightening lamp CM-36		1	
ЛН1-5	Brightening lamp CM-36		1	
ЛН1-6	Brightening lamp CM-36		1	
ЛН1-7	Brightening lamp CM-36		1	
ЛН1-8	Brightening lamp CM-36		1	

1	2	3	4	5
НЛ1-1	Neon lamp МН-6		1	
В1-1	Knob for switching on manual rotation of the movable goniometer scale		1	
В1-2	Band selector switch		1	
В1-3	Function switch		1	
В1-4	Crystal filter switch		1	
В1-5	Switch ТЛФ-ТЛГ (tumbler ТП-1-2)		1	
В1-6	Search coil manual rotation switch		1	
В1-7	Zero sharpening switch		1	
КВ1-1	Filter crystal		1	
М1-1	Selsyn		1	
М1-2	Motor ДРК-627		1	
ИП1-1	Tuning indicator М-596		1	
Г1-1	Jack for switching on the telephones		1	
Г1-2	Jack for switching on the loudspeaker		1	
П1-1	Rigid jumper of circuit for switching on radio deviation compensation		1	
П1-2	Rigid jumper of circuit for switching on the radio deviation compensation		1	
П1-3	Rigid jumper of circuit for switching on the radio deviation compensation		1	

1	2	3	4	5
П1-4	Flexible jumpers of the radio deviation compensation circuit		6	
П1-5				
П1-6				
П1-7				
П1-8				
П1-9				
П1-10	Flexible jumper of zero sharpening circuit		1	
C-6	Gland inlets for connection:		1	
C-7	With the athwartship loop, with the fore-and-aft loop		1	
C-8	With the non-directional antenna		1	
C-3	With the control-distribution board		1	

Control-Distribution Board (ШКР)

C2-1	Capacitor KCO-5-500-Б-6800-II	6800 pF	1	
C2-2	Capacitor KCO-5-500-Б-6800-II	6800 pF	1	
R2-1	Wire-wound resistor	30000 ohms	1	
R2-2[x]	Resistor BC-0.25-330-1	330 ohms	1	
B2-1	Switch VOLTAGE MONITORING			
B2-2	A.C.Mains 127 V switch		1	
B2-3	Tumbler switch			

1	2	3	4	5
	SHIP'S MAINS D.C. 110, 220, A.C. 220 V (ТП1-2)		1	
ИП2-1	D.C. voltmeter M-63	300 V	1	
ИП2-2	A.C. voltmeter ЭВ-46	150 V	1	
Пр2-1	Fuse ПЦ-30-5	5 A	1	
Пр2-2	Fuse ПЦ-30-2	2 A	1	
C-1	Gland inlet for connection with the supply unit		1	
C-2	Gland inlet for connection with the gyro-compass		1	
C-3	Gland inlet for connection with the receiver-and-goniometer unit		1	
C-4	Gland inlet for connection with the D.C. ship's mains		1	
C-5	Gland inlet for connection with the A.C. ship's mains, ОП-120 converter autotransformer		1	

Supply Unit (БП) Capacitors

	Capacitors			
C3-1	КБГ-3м-600-3x0.1-III	0.1 μF	1	3 sections (a, b, c)
C3-2	КБГ-М1-400-0.1-III	0.1 μF	1	
C3-3	КЭГ-1в $\frac{450}{20}$ М	20 μF	1	
C3-4	КЭГ-1в $\frac{450}{20}$ М	20 μF	1	
C3-5	КЭГ-1в - $\frac{450}{20}$ М	20 μF	1	
C3-6	КЭГ-16 $\frac{450}{20}$ М	20 μF	1	

1	2	3	4	5
C3-7	КЭГ-1в $\frac{450}{20}$ М	20 μF	1	
C3-8	КЭГ-1в $\frac{450}{20}$ М	20 μF	1	
C3-9[x]	КБГ-М2-600-0.02-1	0.02 μF	1	
C3-10[x]	КСО-5-500-Б-4700-II	4700 pF	1	
C3-11[x]	КСО-5-500-Б-4700-II	4700 pF	1	
C3-12	КБГ-МП-2в-1500-2x0.1-II	0.1 μF	1	Two sections (a,b)
C3-13	КБГ-МН-2-400-2-II	2 μF	1	
C3-14	КБГ-МН-2-400-2-II	2 μF	1	
-15	КБГ-МН-2-400-2-II	2 μF	1	
L3-1	Filter choke, 100 V		1	
L3-2	Filter choke, 100 V		1	
	Resistors			
R3-1[x]	ВС-0.25-1-180-1	180 ohms	1	
R3-2[x]	ВС-0.25-1-180-1	180 ohms	1	
R3-3	Вс-0.25-1-240000-1	240000 ohms	1	
R3-4	ВС-0.25-1-240000-1	240000 ohms	1	
R3-5[x]	ВС-0.25-1-2200-1	2200 ohms	1	
R3-6[x]	ВС-0.25-1-20000-1	20000 ohms	1	
R3-7[x]	ВС-0.25-1-20000-1	20000 ohms	1	
Тр3-1	Power transformer		1	
Тр3-2	Oscillator transformer, 400 c.p.s.		1	
Тр3-3	Output transformer, 400 c.p.s.		1	
Др3-1	Filter choke, 210 V		1	
Др3-2	Filter choke, 100 V		1	
Др3-3	Filter choke, 100 V		1	
Др3-4	Filter choke, 100 V		1	
Др3-5	Filter choke, 20 V		1	
Л3-1	Driver, 400 c.p.s., 6H8-C		1	

1	2	3	4	5
Л3-2	Power amplifier, 6П6-С		1	
Л3-3	Power amplifier, 6П6-С		1	
Пр3-1	Fuse ПЦ-30-1	1 A	1	
Пр3-2	Fuse ПЦ-30-1	1 A	1	
Пр3-3	Fuse ПЦ-30-1	1 A	1	
Д3-1	Selenium rectifiers of type АВС-35-17	Pile of 12 elements	1	Bridge-type circuit
Д3-2	Selenium rectifiers of type АВС-35-16	Pile of 20 elements	2	Bridge-type circuit
Д3-3	Selenium receifiers of type АВС-35-16	Pile of 20 elements	2	Bridge-type circuit
С-1	Gland inlet for connection with the control-distribution board		1	

Signalling Board ЩС-2

(to disconnect the antenna)

1	2	3	4	5
ЛН4-1	Brightening lamp		1	Mounted according to the ship's mains voltage
ВЧ-1	Tumbler switch, ТВ2-1		1	

1	2	3	4	5
C-9	Gland inlet for connection with the ship's mains		1	
C-10	Gland inlet for connection with the second signalling board		1	

Signalling Board ШС-1

(the antenna is disconnected)

1	2	3	4	5
ЛН-5-1	Brightening lamp		1	Mounted according to ship's mains voltage
В5-1	Tumbler switch, ТВ2-1		1	
C-9	Gland inlet for connection with the ship's mains		1	
C-10	Gland inlet for connection with the first signalling board		1	

Antenna Box (AK)

1	2	3	4	5
R6-1	Resistor ВС-0.25-1-1000000-III	1000000	1	
R6-2	Resistor ВС-0.25-1000000-111	1000000 ohms	1	
НЛ6-1	Neon lamp МН-7		1	
НЛ6-2	Neon lamp МН-7		1	
И6-1	Antenna partition insulator		1	
И6-2	Antenna partition insulator		1	

1	2	3	4	5
C-8	Gland inlet for connection with the receiver-and-goniometer unit		1	

7 Autotransformer, 220/127 V

Tp 7-1	Autotransformer		1	
C-5	Gland inlet for connection with the control-distribution board		1	

8 Loudspeaker Д-1

PП8-1	Loudspeaker	1 W	1	
R8-1	Variable wire-wound resistor	100 ohms	1	
B8-1	Tumbler switch, TB2-1		1	
Г8-1	Socket for connection with the receiver-and-goniometer unit		1	
Г8-2	Jack for connecting the second loud-speaker		1	

9 Loudspeaker Д-2

PП9-1	Loudspeaker	1 W	1	
R9-1	Variable wire-wound resistor	100 ohms	1	

1	2	3	4	5
B9-1	Tumbler switch TB2-1		1	
Г9-1	Jack for connecting the receiver-and-goniometer unit		1	
Г9-2	Jack for connecting the first loudspeaker		1	

C O N T E N T S

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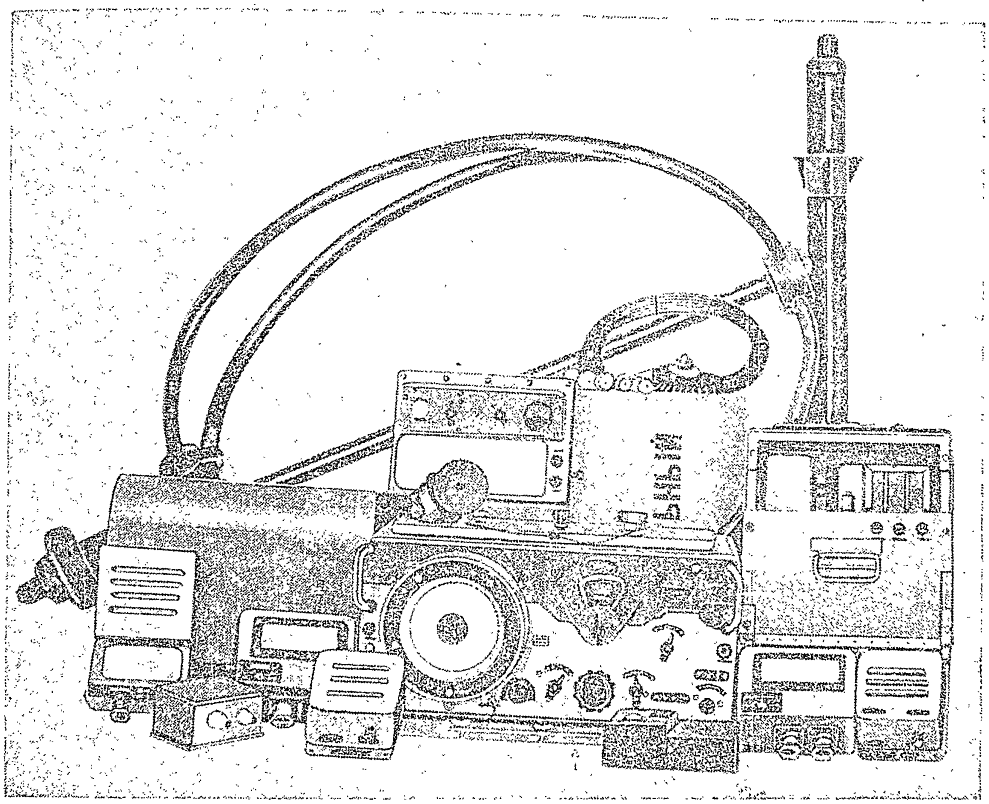

Fig. 1

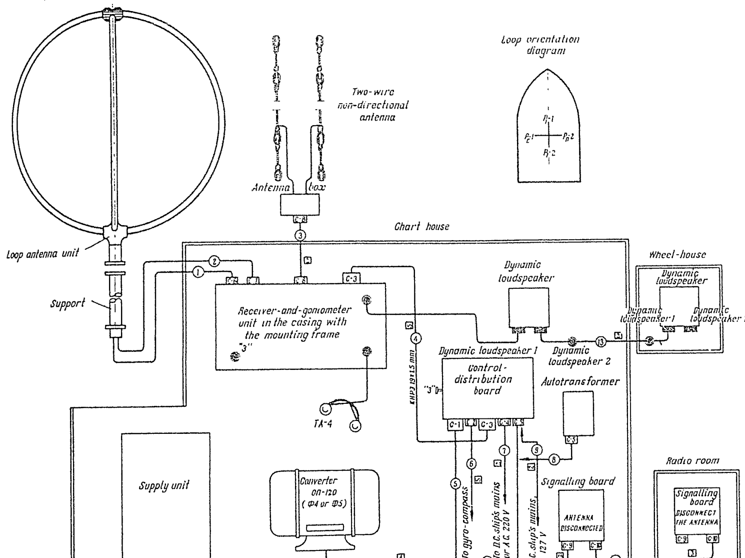

Fig 2 General Diagram

Nos		Description	Quantity	Note
		Chart house		
1	UE2.0[illegible] 001	Supply unit with mounting frame	1	
2	UE2.422 001	Signalling board	1	
3	UE2 527 003	Receiver-and-goniometer unit in casing with the mounting frame	1	
4	UE3.104 000	Converter ОП-12 Ф4	1	Supplied according to delivery set
	UE3 104 001	Converter ОП-120 Ф5	1	
5	UE3 620.005	Control-distribution board	1	
6	UE3.843 001	Dynamic loudspeaker	1	
7	UE4 723 002	Autotransformer	1	Supplied according to delivery set
8	UE4 860.000	Cord to the telephone	2	
9	UE5 277 002	Telephone with headband, TA-4	1	
		Wheel-house		
1	UE3.843.001	Dynamic loudspeaker	1	
2	UE4 860.000	Cord to the telephone	1	
		Radio room		
1	UE2.422 000	Signalling board	1	
		Remote controls		
1	UE2.090.002	Loop antenna unit		
2		Two-wire non-directional antenna	1	
3	UE2.393.000	Antenna box	1	
4	UE4 115.000	Loop-antenna unit support	1	Supplied according to delivery set

Notes: 1. The ship's D.C. mains is wired to the control-distribution board through the gland C-4. The converter ОП-120 is connected to the control-distribution board by means of a cable which is pulled through the gland C-5.

2. The ship's A.C. mains, 220 V, is wired to the control-distribution board through the gland C-4. The auto-transformer is connected with the control-distribution board by means of a cable which is pulled through the gland C-5.

3. The ship's A.C. mains, 127 V, is wired to the control-distribution board through the gland C-5. The gland C-4 is provided with a plug.

4. Resultant length of cables 4 and 5 must be equal to 3 $\pm$0.3 m.; if necessary, this length may be increased up to 6 m. $\pm$0.6 m. by connecting two cable conductors to contacts 1 and 2 of the receiver-and-goniometer unit, to contacts 15 - 16 of the control-distribution board, and to contacts 1 - 2 of the supply unit (using for this purpose free conductors).

5. Length of cable No.2 is determined by the index and according to it the length has to be within 4 to 16 m., 16 to 26 m. or 26 to 30 m.

6. Length of cable No.3 is equal to 3.5 $\pm$0.1 m. Cable No.3 may be increased up to 5 m. provided the length of the non-directional antenna increases accordingly.

7. Connection of the ship's mains to the signalling board may be performed through the gland C-9 of any board.

Notes: 1. The ship's D.C. mains is wired to the control-distribution board through the gland C-4. The converter ОП-120 is connected to the control-distribution board by means of a cable which is pulled through the gland C-5.

2. The ship's A.C. mains, 220 V, is wired to the control-distribution board through the gland C-4. The auto-transformer is connected with the control-distribution board by means of a cable which is pulled through the gland C-5.

3. The ship's A.C. mains, 127 V, is wired to the control-distribution board through the gland C-5. The gland C-4 is provided with a plug.

4. Resultant length of cables 4 and 5 must be equal to 3 ±0.3 m.; if necessary, this length may be increased up to 6 m. ±0.6 m. by connecting two cable conductors to contacts 1 and 2 of the receiver-and-goniometer unit, to contacts 15 – 16 of the control-distribution board, and to contacts 1 – 2 of the supply unit (using for this purpose free conductors).

5. Length of cable No.2 is determined by the index and according to it the length has to be within 4 to 16 m., 16 to 26 m. or 26 to 30 m.

6. Length of cable No.3 is equal to 3.5 ±0.1 m. Cable No.3 may be increased up to 5 m. provided the length of the non-directional antenna increases accordingly.

7. Connection of the ship's mains to the signalling board may be performed through the gland C-9 of any board.

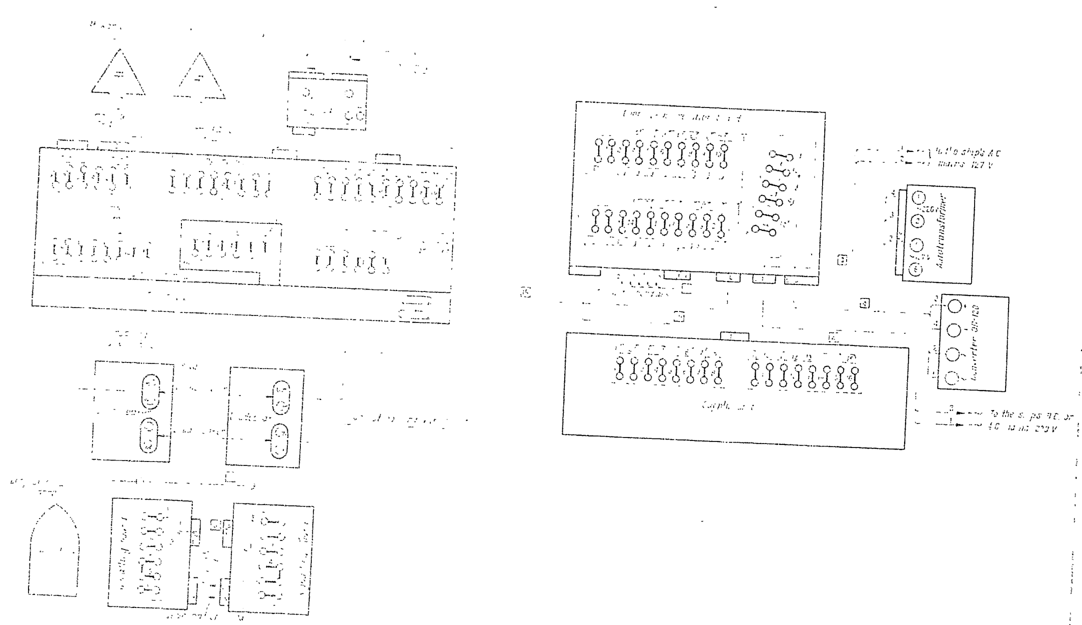

Fig.3 Diagram showing External Connection of the Set Units

1. Matching device No.1 is mounted on contacts 1, 3, 4, 6, 8, 10, 12 and 14 provided on the mounting strips of the loop compartment of the receiver-and-goniometer unit casing. Depending on the actual feeder length between the loop and receiver-and-goniometer unit the matching device should be replaced with the appropriate one from the set of spare parts, accessories and tools.
2. The external metal feeder braiding is used as the third feeder conductor (grounding end).
3. (a) The ship's D.C. mains, 110 or 220 V, is connected through the gland C-4 to terminals 22 and 23 of the control-distribution board, whereas the converter ОП-120 is connected through the gland C-5 of the same board to terminals 23, 24, 25 and 26.
   (b) The ship's A.C. mains, 220 V, is connected to control-distribution board terminals 22 and 23 through the gland C-4 and the autotransformer is connected to terminals 23, 24, 25 and 26 through the gland C-5.
   (c) The ship's A.C. mains, 127 V, is connected to control-distribution board terminals 25 and 26 through the gland C-5. The gland C-4 is provided with the plug.
4. Resultant length of two cables (between the gland C-3 of the receiver-and-goniometer unit and the control-distribution board and between the gland C-1 of the supply unit and the control-distribution board) has

to be equal to 3 m. ±0.3 m. If necessary, this length may be increased up to 6 m.±0.6 m. by connecting two conductors of the connecting cable to contacts 1 and 2 of the supply unit, to contacts 15 and 16 of the control-distribution board and to contacts of the receiver-and-goniometer unit (using for this purpose free conductors).

5. The length of the feeder running from the loops to the loop compartment of the receiver-and-goniometer unit is determined by the delivery set.

6. The feeder length between the antenna box and receiver-and-goniometer unit casing is equal to 3.5 m. + 0.25 m.

   It is allowed to increase the feeder length up to 5 m. provided the non-directional antenna length has been increased accordingly.

7. A figure near a contact designates a contact number. A figure near a conductor designates a conductor number. Both ends of each conductor are designated with the same figures.

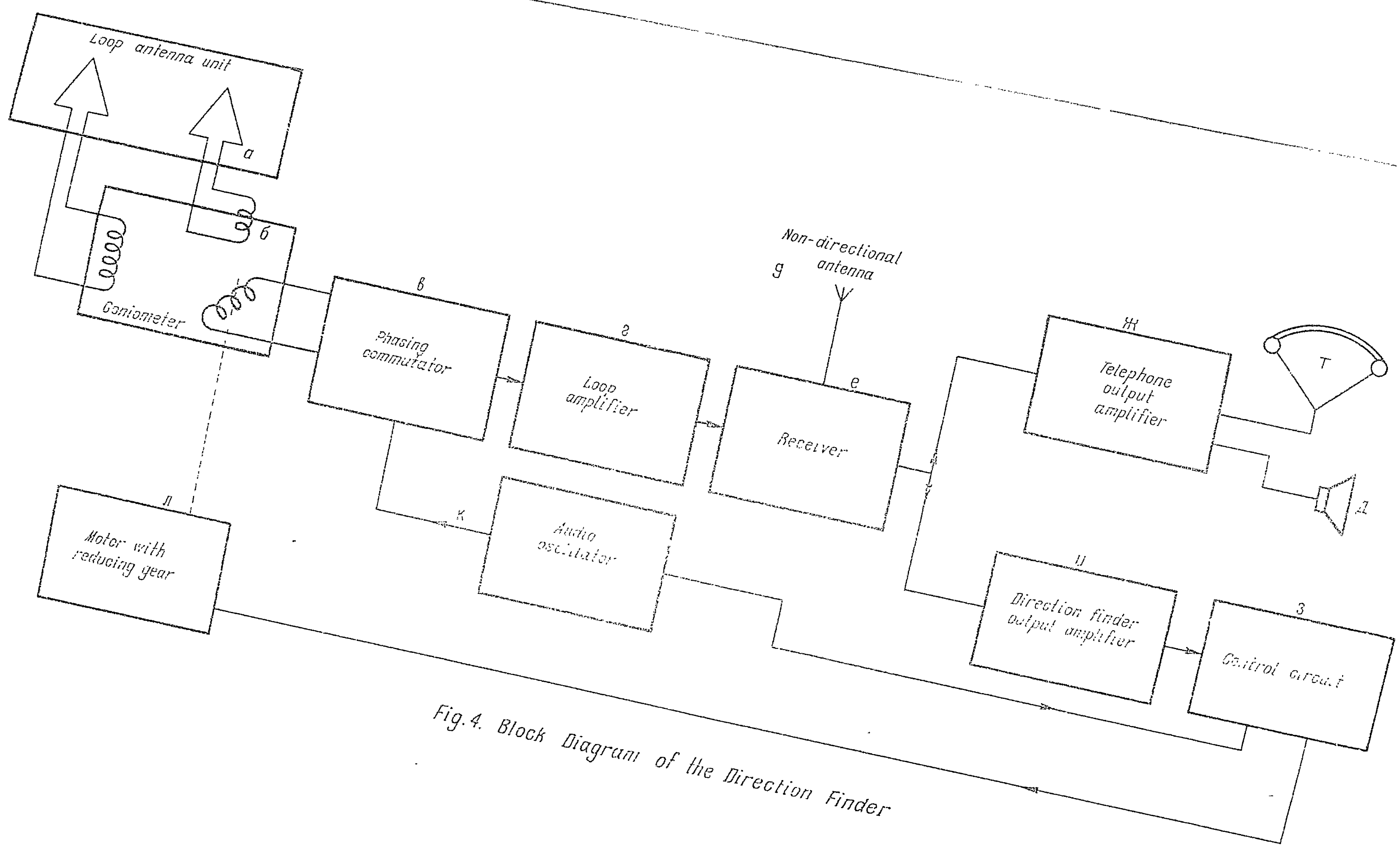

Fig. 4. Block Diagram of the Direction Finder

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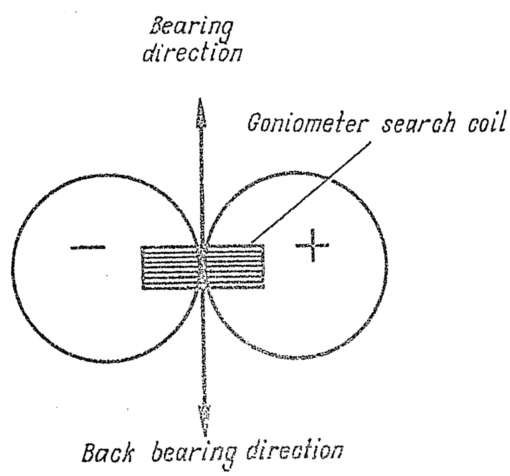
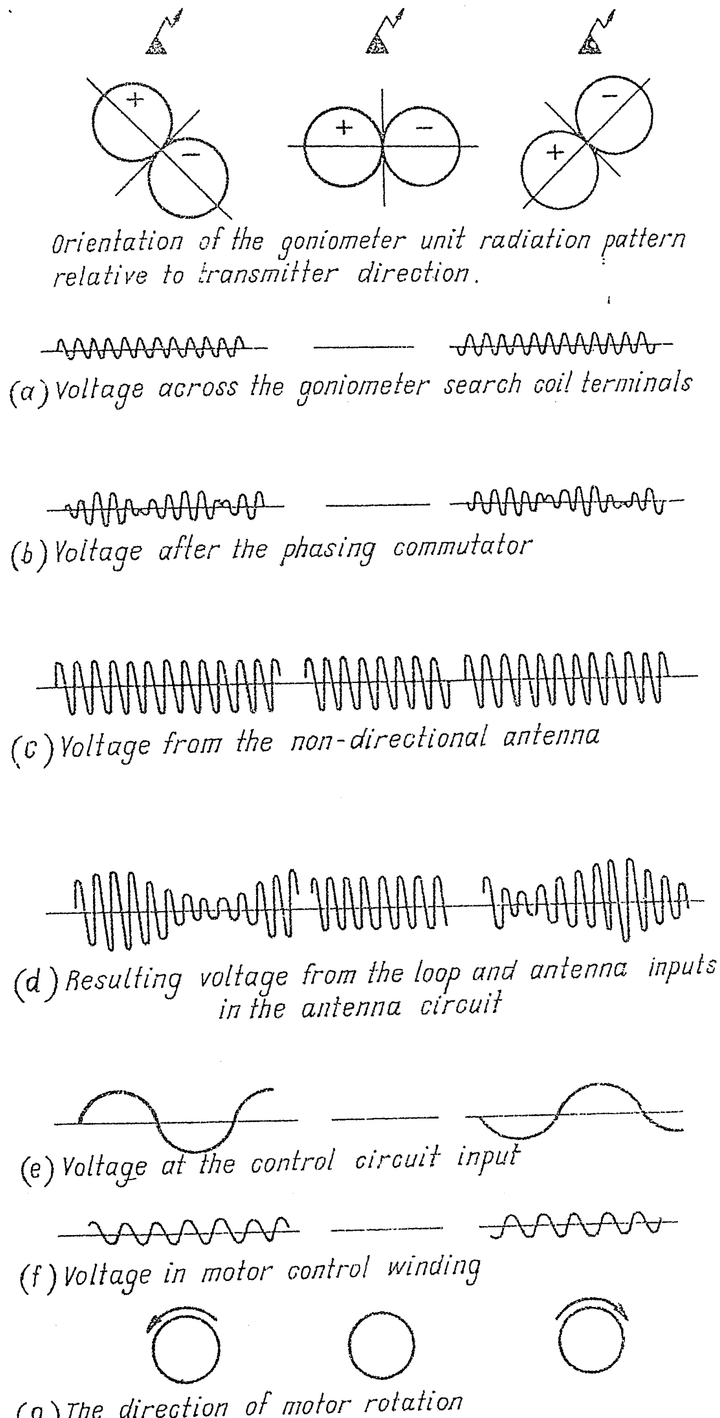


Relationship between goniometer search coil voltage and search coil angle of rotation

Fig. 5



(h) Voltage waveforms in different direction finder elements

Fig. 6

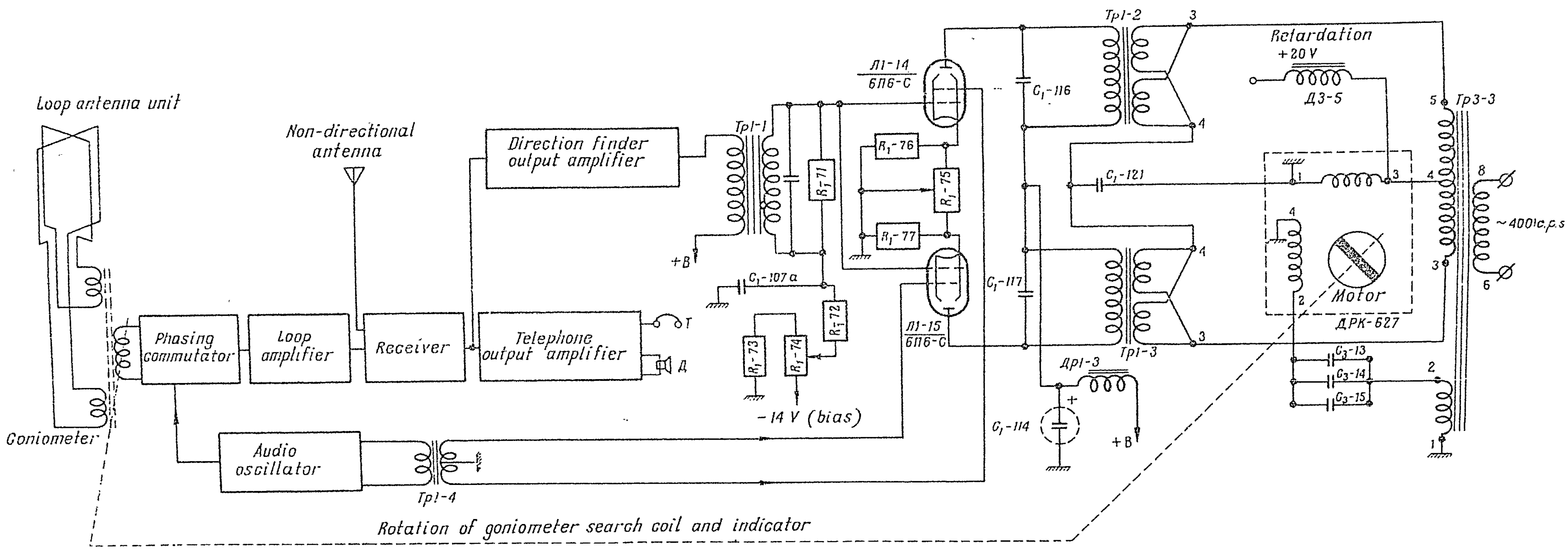


Fig. 7. Diagram of Goniometer Automatic Rotation (in "A" mode of operation)

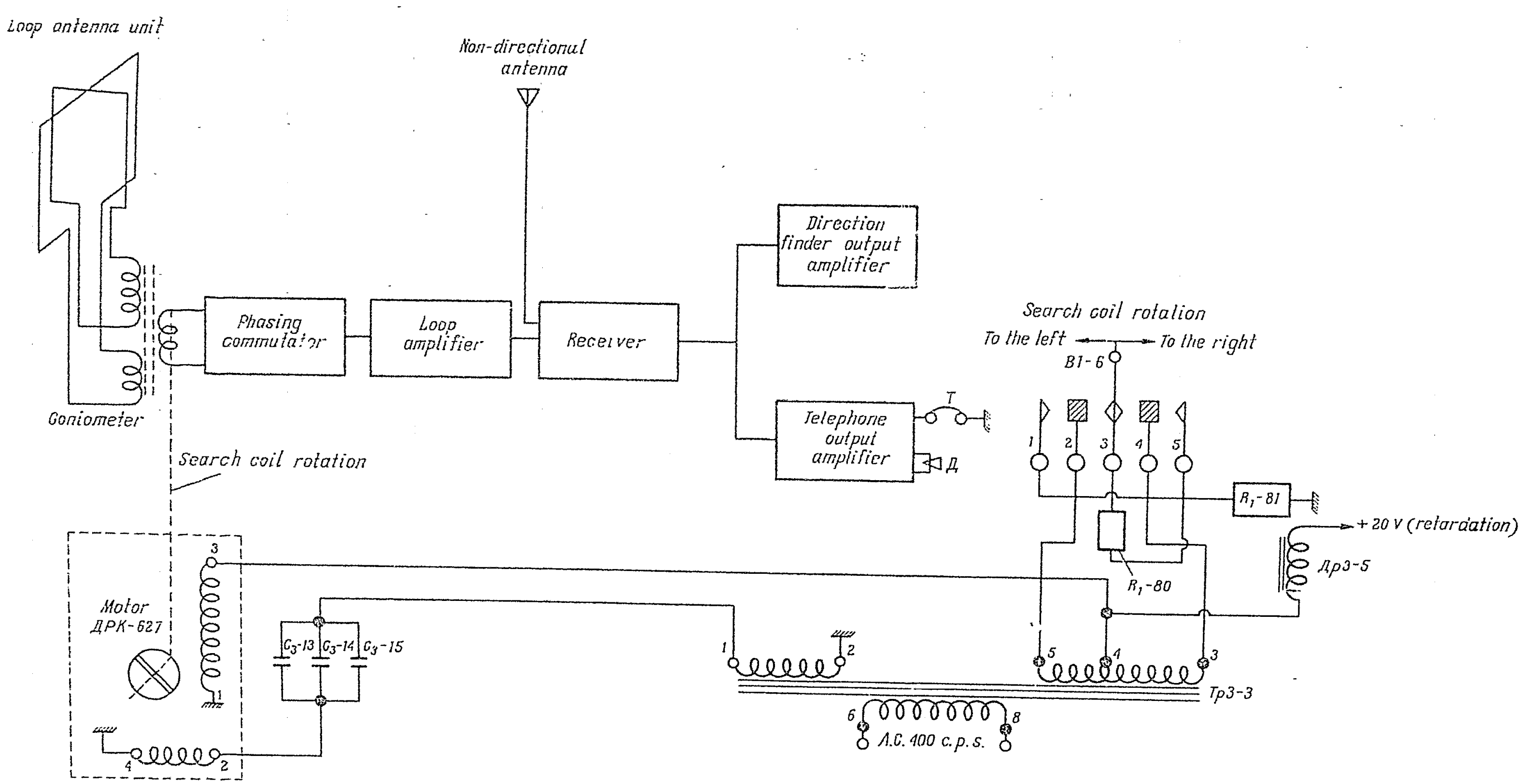


Fig. 8. Circuit Operation during Aural Mode of Operation ("C")

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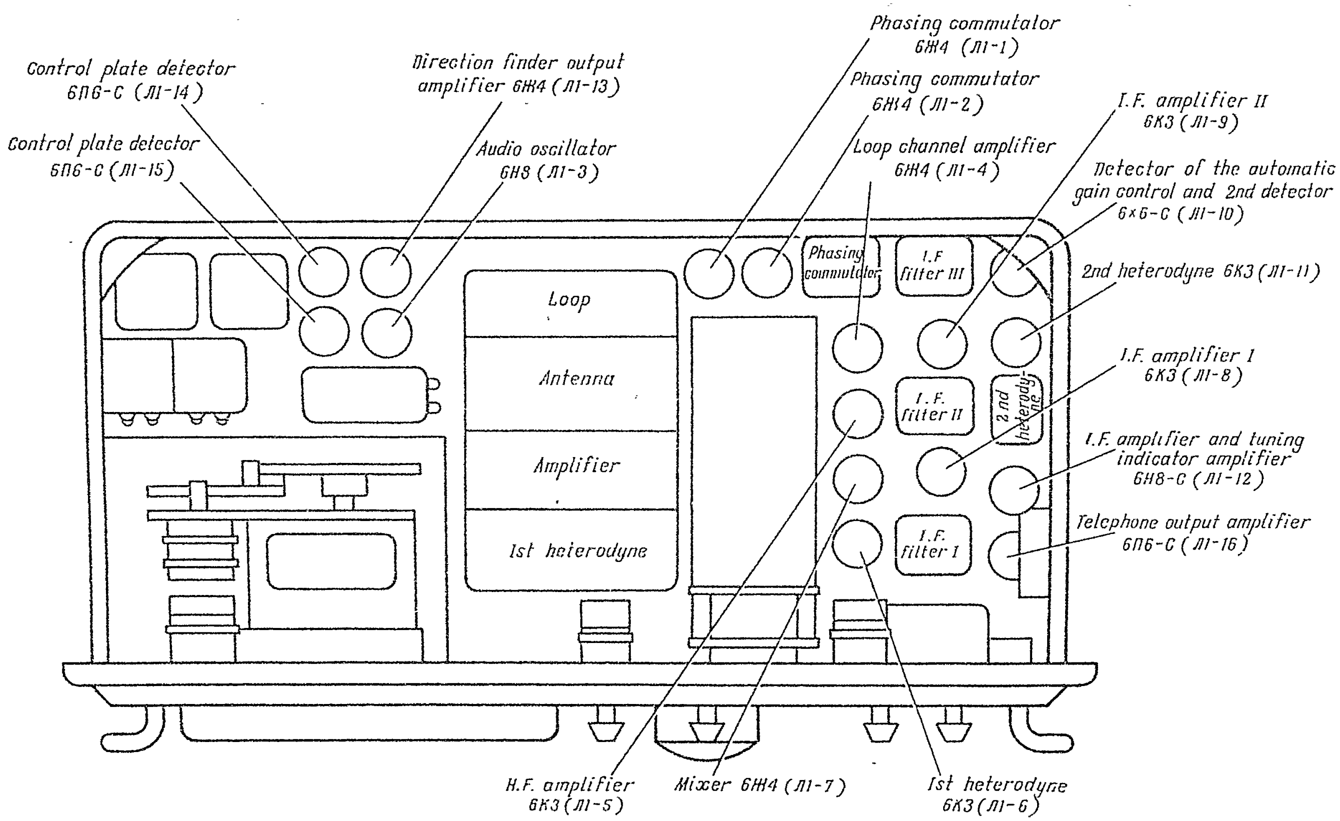

Fig.9. The Valve Arrangement in the Receiver-And-Goniometer Unit

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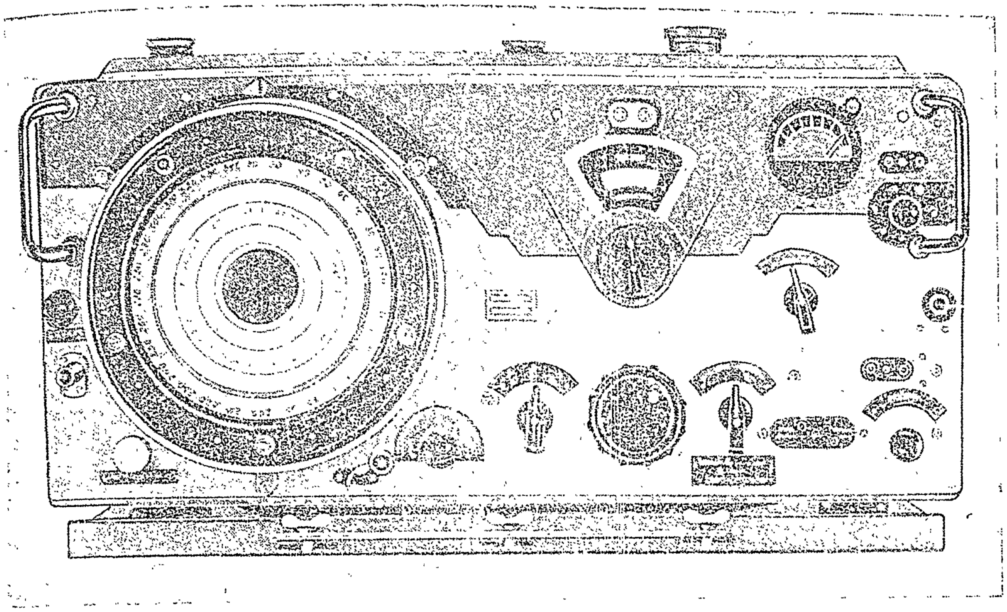

Fig. 10a

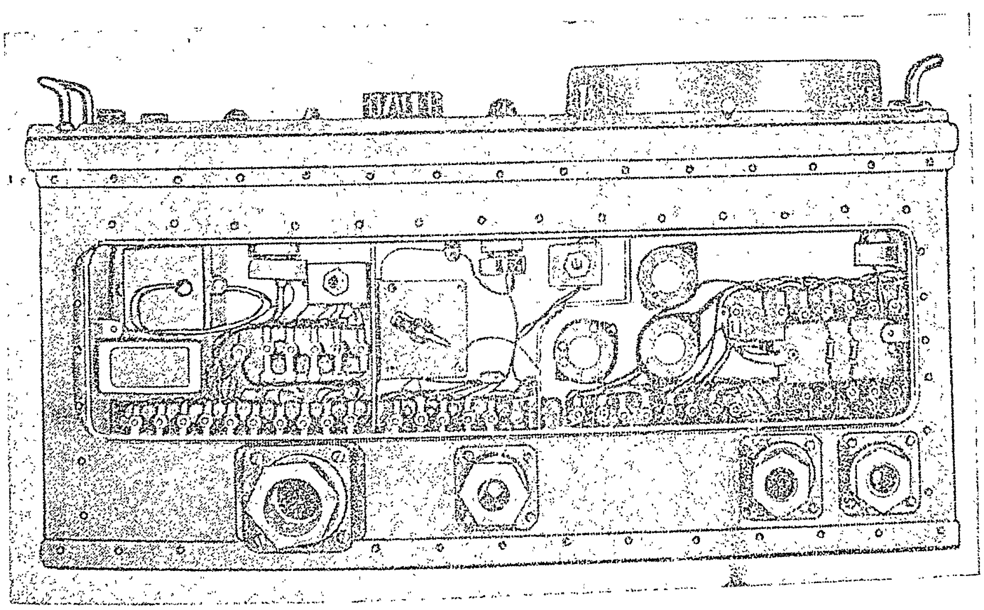

Fig. 10b

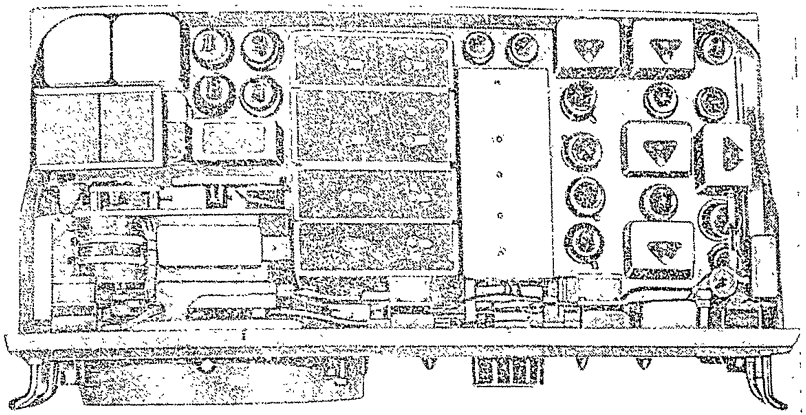

Fig. 10c

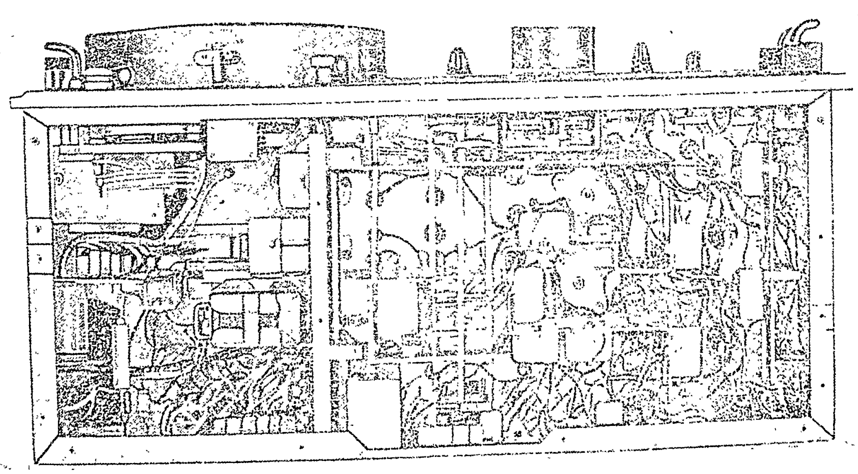

Fig. 10d

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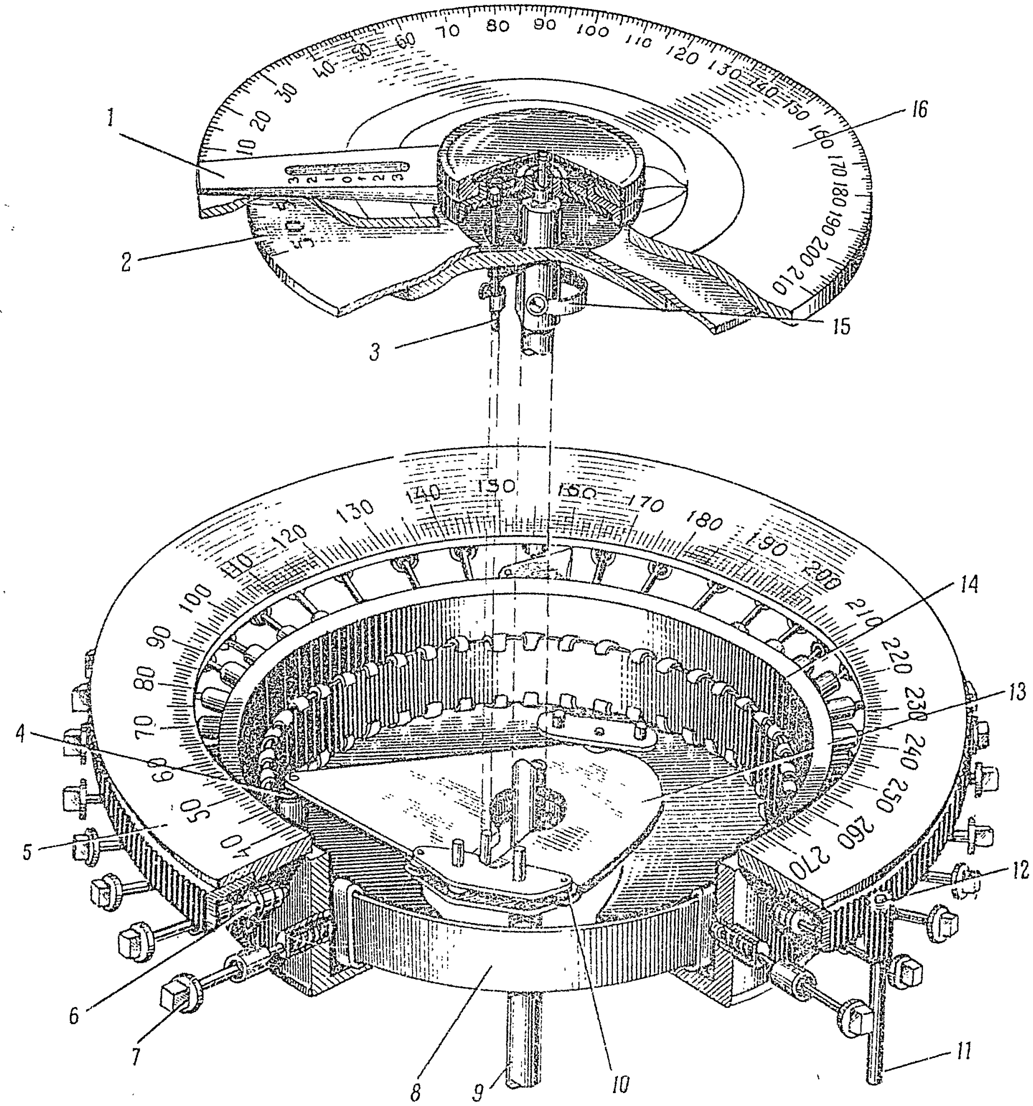

Fig. 11. Mechanical Radio Deviation Compensator
1–bearing indicator; 2–residual radio deviation scale; 3–guide; 4–roller; 5–bearing scale; 6–lock spring; 7–compensating screw for setting desired curve; 8–template; 9–goniometer axle; 10–guide roller; 11–gyro-compass repeater selsyn axle; 12–pinion; 13–slide; 14–compensator body; 15–return spring of the guide; 16–relative bearing scale.

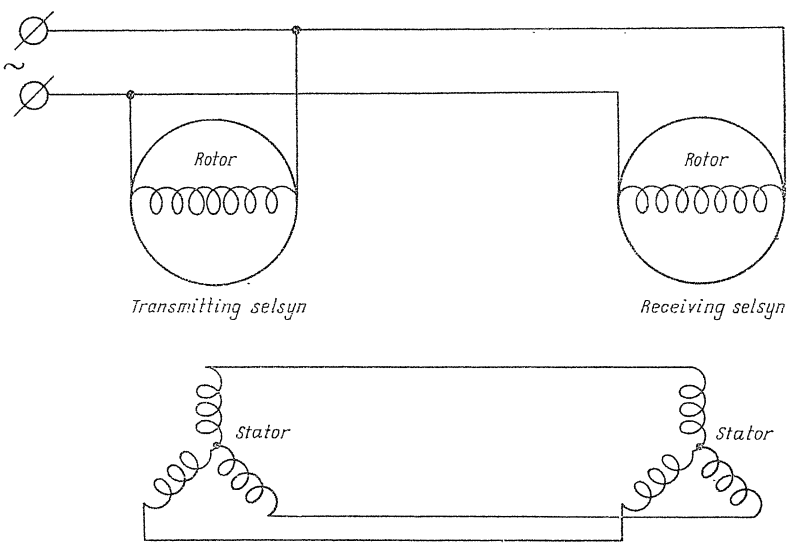

Fig.12. The Selsyn Connection Diagram

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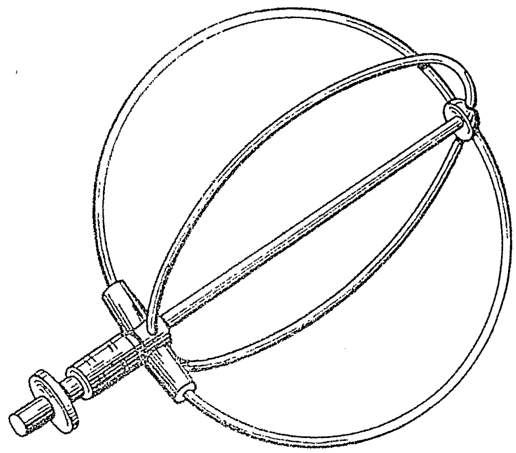

Fig. 13

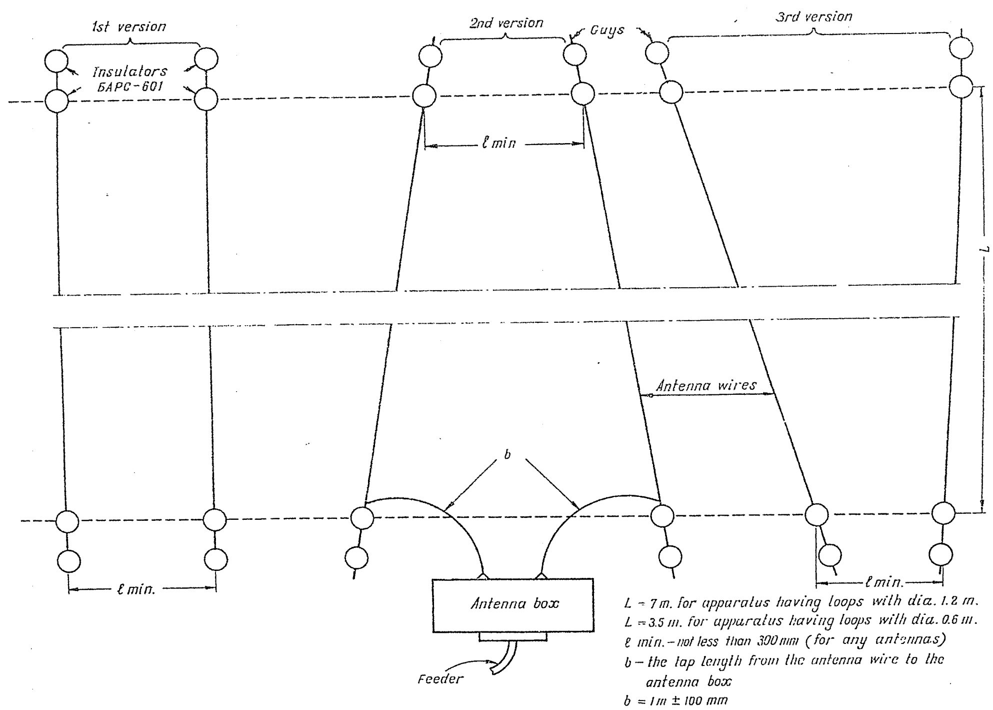

Fig.14. Possible Alterations of the Two-Wire Non-Directional Antenna Mounting

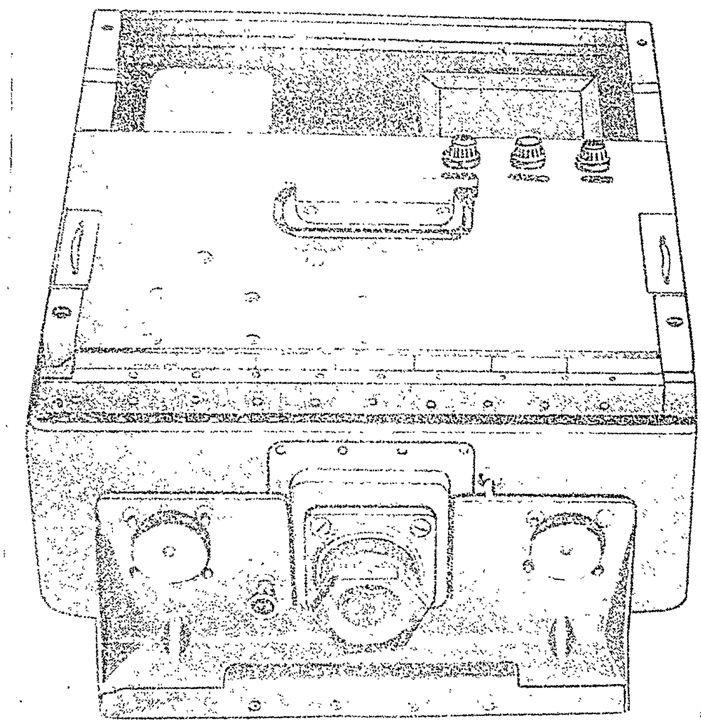

Fig. 15a

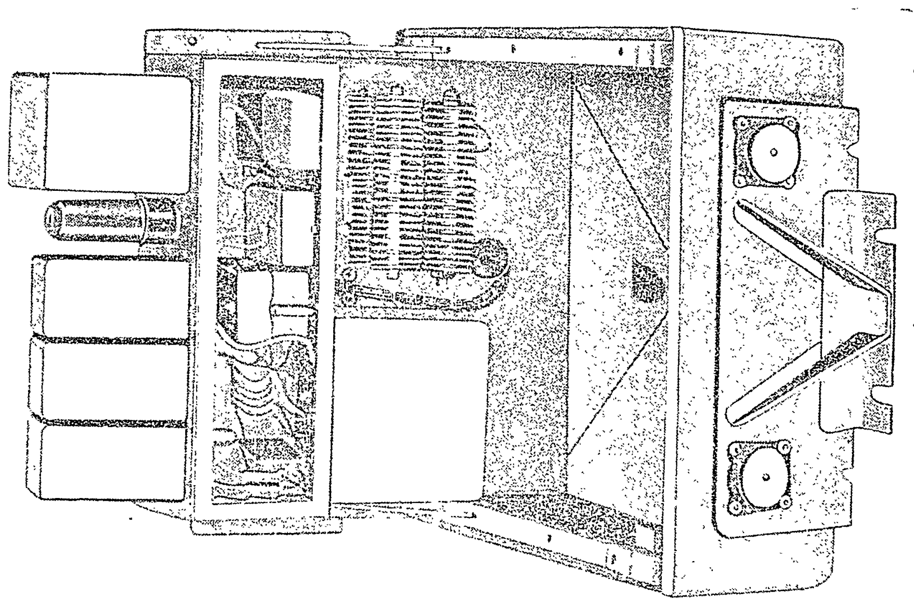

Fig. 15b

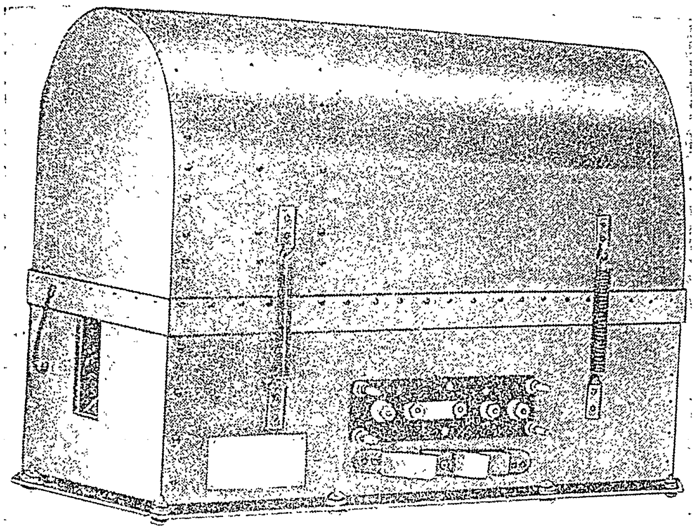

Fig. 16a

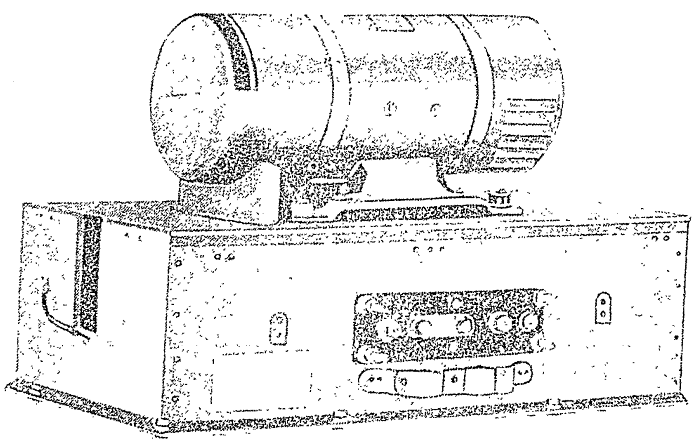

Fig. 16b

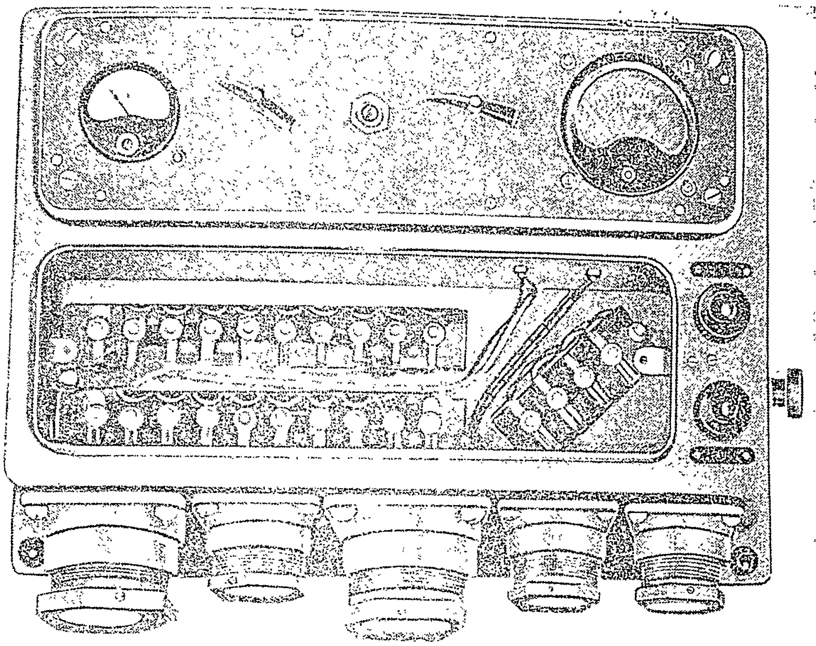

Fig 17

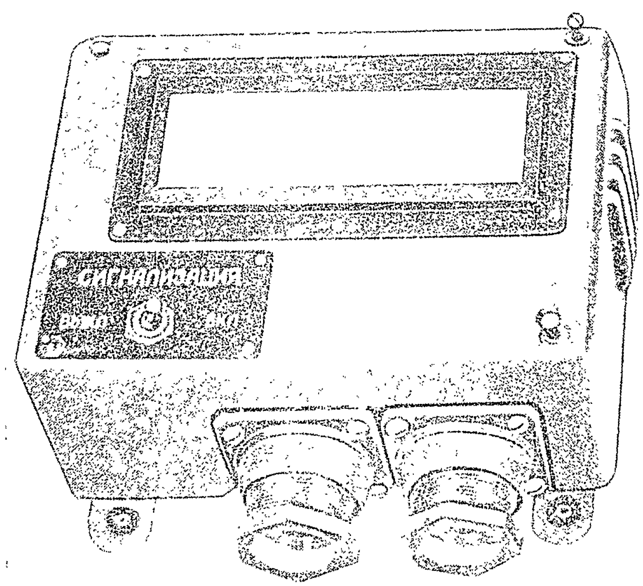

Fig. 18a

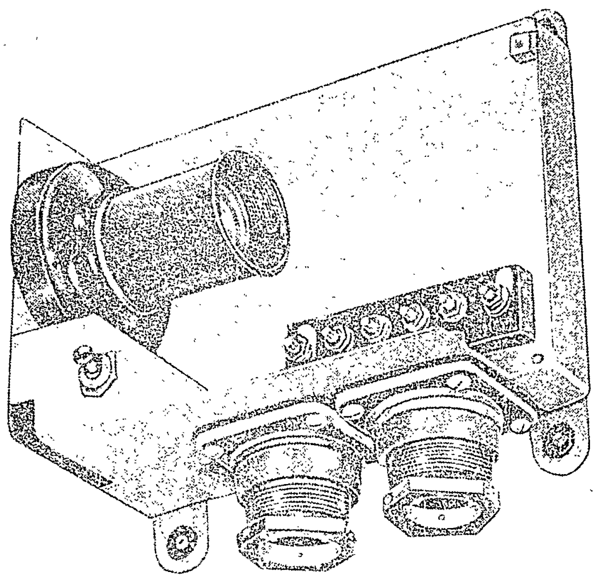

Fig. 18b

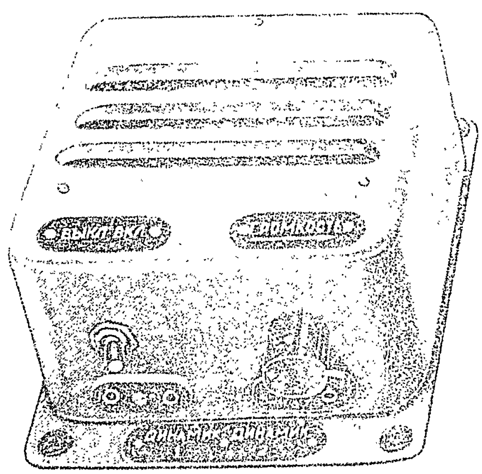

Fig. 19

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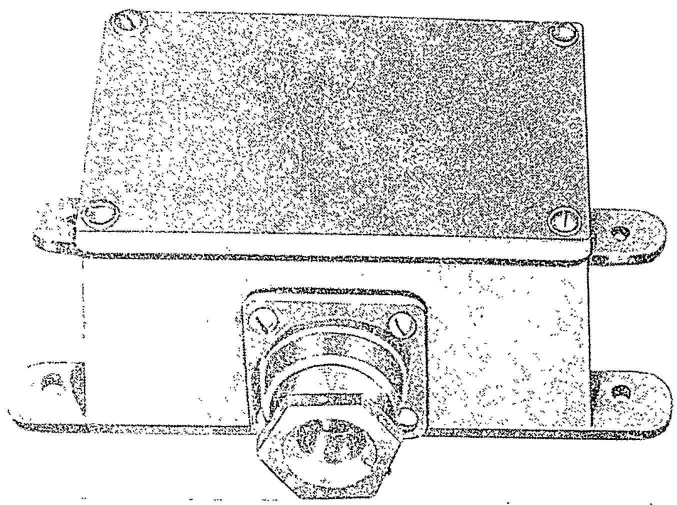

Fig. 20a

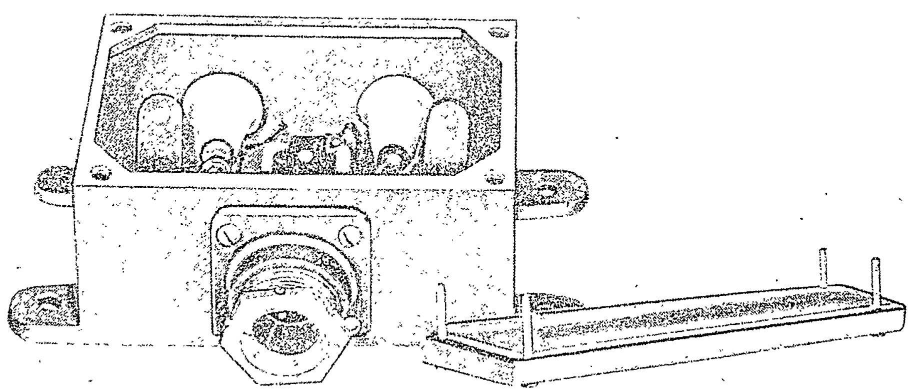

Fig. 20b

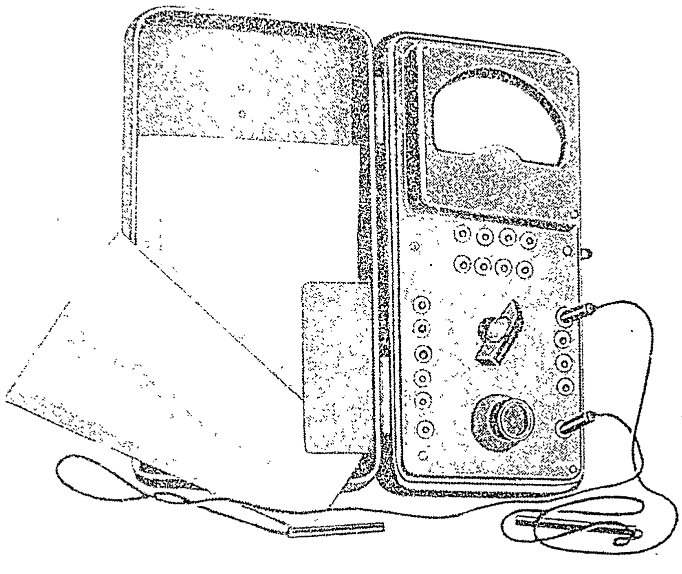

Fig. 21

Fig. 22a

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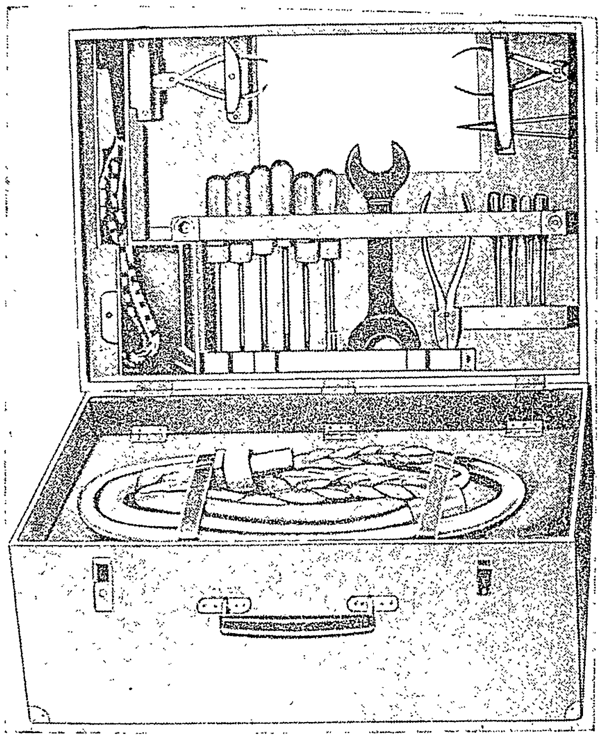

Fig. 22b

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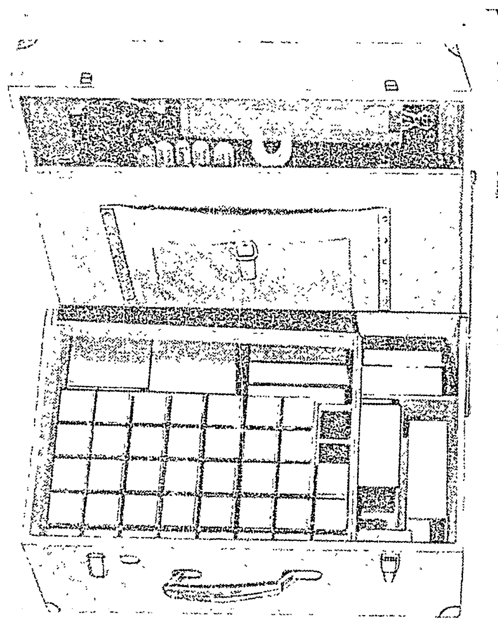

Fig. 22c

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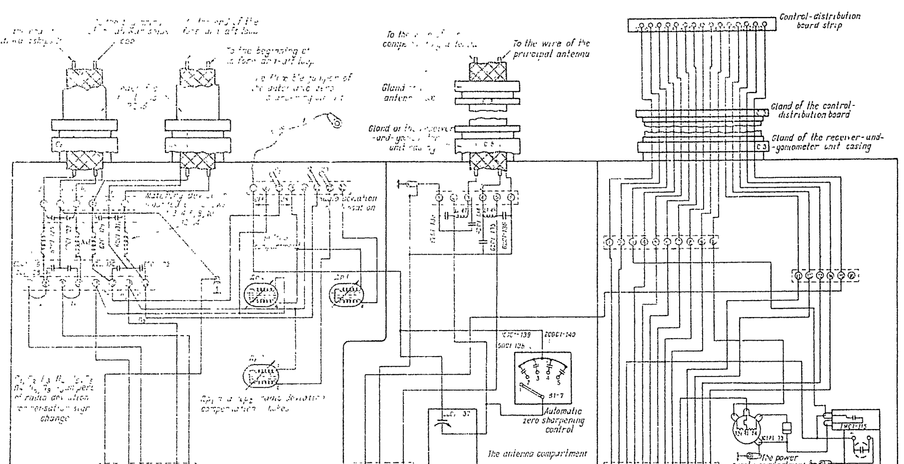
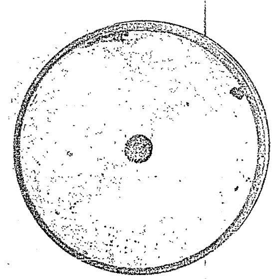
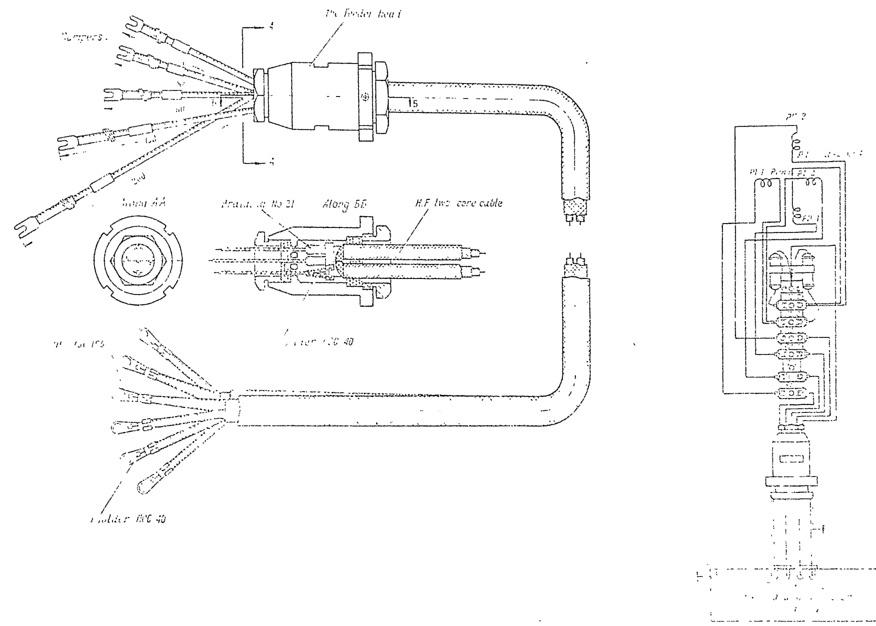


Fig 23 The Key and Wiring Diagram of Receiver-And-Goniometer Unit Casing





... Diagram of Fanning Out the Loop ...

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Notes: 1. The feeder head is supplied with the loop antenna unit.

2. Jumper lengths are finally specified on site.

3. The tags are mounted in the compartment of the receiver-and-goniometer unit casing. When laying out the feeder observe the following procedure:

4. Unscrew the nut off the feeder head, take out washers, gaskets and a disk with contacts.

5. According to the drawing, prepare the cable for mounting with the feeder head terminals.

6. Screw on the nut, a washer with a projection, three gaskets and the second washer on the cable terminals.

7. Put on insulating tubes on the terminals of the feeder head.

8. Solder the terminals of the feeder head to the cable terminals through the disk with contacts according to the drawing.

9. Solder the terminal of the head marked "K" to the cable screen.

10. Place insulating tubes on the place of soldering and braid it.

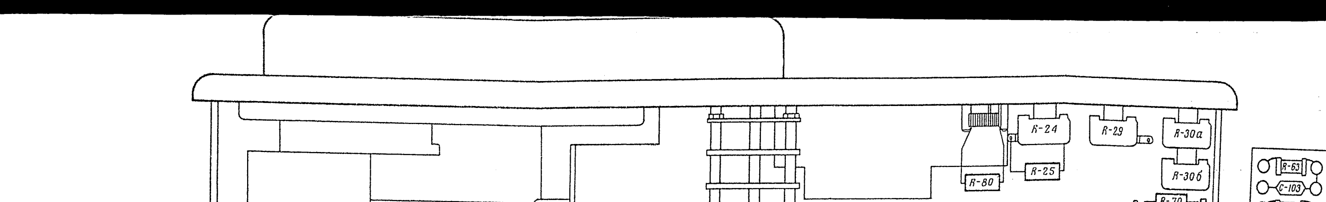
11. Put the mounted cable part together with washers and gaskets into the feeder head and clamp with the nut.

12. Unscrew the nut off the side of the leads with tags, find a lead slack and then clamp them with the help of a nut.

13. Fix the feeder head in the lower part of the loop.

14. Fan out the feeder leads on site and unsolder tags having first mounted the loop and laid out the feeder.

15. Pull the feeder running from the loop through the gland C-6 of the receiver-and-goniometer unit casing and the feeder running from the loop through the gland C-7 of the casing.



This layout is supplied to simplify the repairing of the apparatus as it is not possible to mark all the elements according to the key diagram

Fig.26. The Layout of the Mounting Strips of Individual Resistors and Capacitors on the Receiver-and-Goniometer Unit Chassis

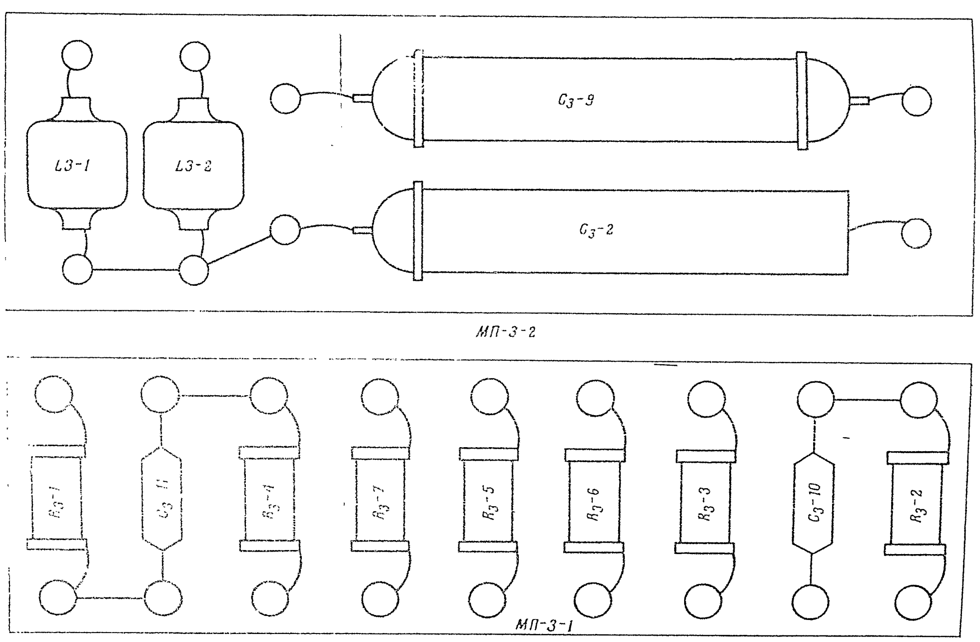


Fig. 27. The Layout of Resistors and Capacitors on the Mounting Strips of the Supply Unit