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DESCRIPTION OF THE ZVENO COMBAT INFORMATION CENTER (OPISANIE BO--ETC(U)
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DESCRIPTION OF THE COMBAT INFORMATION CENTER "ZVENO"

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CHAPTER I

Mission of the Combat Information Center [3

The mission of the Combat Information Center (CIC) is to collect data on the surface and air situation from all ship electronic observation systems, record the data obtained, evaluate its reliability, and transmit the data in processed form to the ship's command points.

The sources of information of the Combat Information Center are as follows:

a) ship surface and air target search radar, identification radar, scanning radar, radar sweep, and navigational radar;

b) sonar;

c) infrared radar;

d) radio communication facilities;

e) lookout posts for the visual observation of the horizon and air space;

f) target-sighting devices.

The work of the Combat Information Center is performed using the following forms of communication:

a) operational telephone communication;

b) autonomous telephone switchboard communication;

c) loudspeakers;

d) radio communication;

e) ordinary telephone communication service;

f) voice pipes;

g) ship's internal broadcast system.

Note. In order to simplify communication circuits subscribers to the autonomous switchboard communication system can be included in KATS [Ship Automatic Telephone Exchange].

The Combat Information Center may undertake the following assigments:

1. Supervise operation of ship electronic observation systems and operation of radar identification, scanning, and jamming stations.

2. Collect reports from all electronic and visual observation facilities as well as reconnaisance data.

3. Plot data of the surface and air situation on plotting boards and charts; process and evaluate the reliability of the data obtained. [4

4. Determine motion parameters of targets.

5. Establish identity of targets.

6. Transmit processed data on conditions to the ship's command points.

7. Direct fighter planes against enemy aircraft.

8. Direct air strikes against enemy surface targets.

9. Direct torpedo boats and other vessels against surface targets.

CHAPTER II [5

EQUIPMENT OF THE COMBAT INFORMATION CENTER

List of Basic Specially Designed Apparatus

The Combat Information Center is outfitted with basic and auxiliary equipment. The composition of the basic equipment is determined by the type of ship on which it is installed, with allowance for the regular electronic equipment of the ship and for the tasks assigned to the Combat Information Center.

Composition of Basic Equipment for Battleships, Heavy Cruisers and Light Cruisers

1. Plotting table (Ps) with Apparatus P-3, operating from the automatic plotter of the "PUT'" System.

2. Plotting table (Pn) for the surface situation with maneuvering board (Pm).

3. Plotting board (Pa) for the air situation.

4. Guidance board (Pv, 1 - 2 assemblies).

5. Five circular repeater radar scope displays (VIKO).

6. Three simplified circular repeater radar scope displays (UVIKO).

7. Optical system.

Composition of Basic Equipment for Destroyers

1. Plotting table (Ps) with Apparatus P-3, operating from the automatic plotter of the "PUT'" System.

2. Plotting table (Pnv) for the surface and air situation with maneuvering board (Pm).

3. Two circular repeater radar scope displays (VIKO).

4. One simplified circular repeater radar scope display (UVIKO).

5. Repeater of the recorder of underwater acoustics.

Note. Sometimes a limited CIC version is installed aboard ships due to difficulties in placing a complete CIC assembly.

Auxiliary equipment of the Combat Information Center includes: equipment [6
for operational telephone communication, autonomous telephone communication, loudspeaker communication and ordinary telephone service; apparatus for target indication output (equipment Du), monitoring and receiving apparatus, power supply and signal apparatus.

In addition to basic and auxiliary equipment the Combat Information Center is equipped with auxiliary apparatus and devices: special electric clocks, recording boards, working instruments and accessories.

Rules for Arranging Apparatus in the CIC

The equipment in the CIC is arranged on the basis of the following regulations (Fig. 1):

1. The plotting table for the surface condition and its plotting board are arranged together.

2. The vertical plotting board for the over-all air situation and the guidance boards are located near one another.

Moreover, the guidance boards are positioned so that when working on them the situation being plotted on the vertical board will be visible.

3. The VIKO's are positioned near those plotting boards which they service.

4. The UVIKO's are positioned near the CIC Commander's desk and near certain plotting boards for the purpose of a preliminary evaluation of data on the situation surrounding the ship.

5. The CIC Commander is centrally located. From his location the CIC Commander must be able to view the entire CIC operation and have ready access to any plotting station.

6. The Commander of the radar jamming equipment is located near the CIC Commander.

7. Auxiliary radiocommunication stations are located near corresponding plotting boards.

Fig. 1. Typical scheme for positioning equipment of the Combat Information Center on heavy cruisers

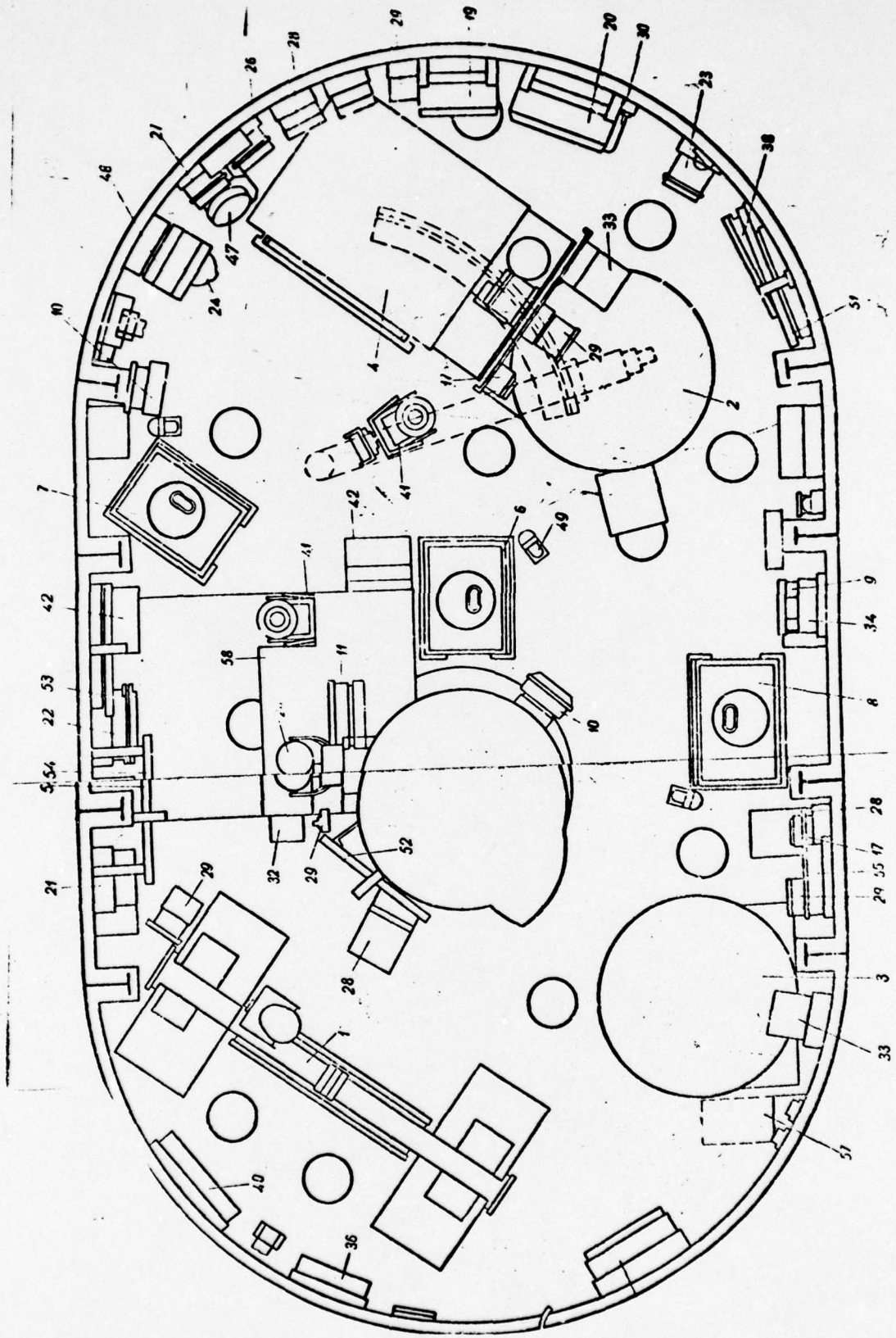


Fig. 1. Typical scheme for positioning equipment of the Combat Information Center on heavy cruisers (Continued).

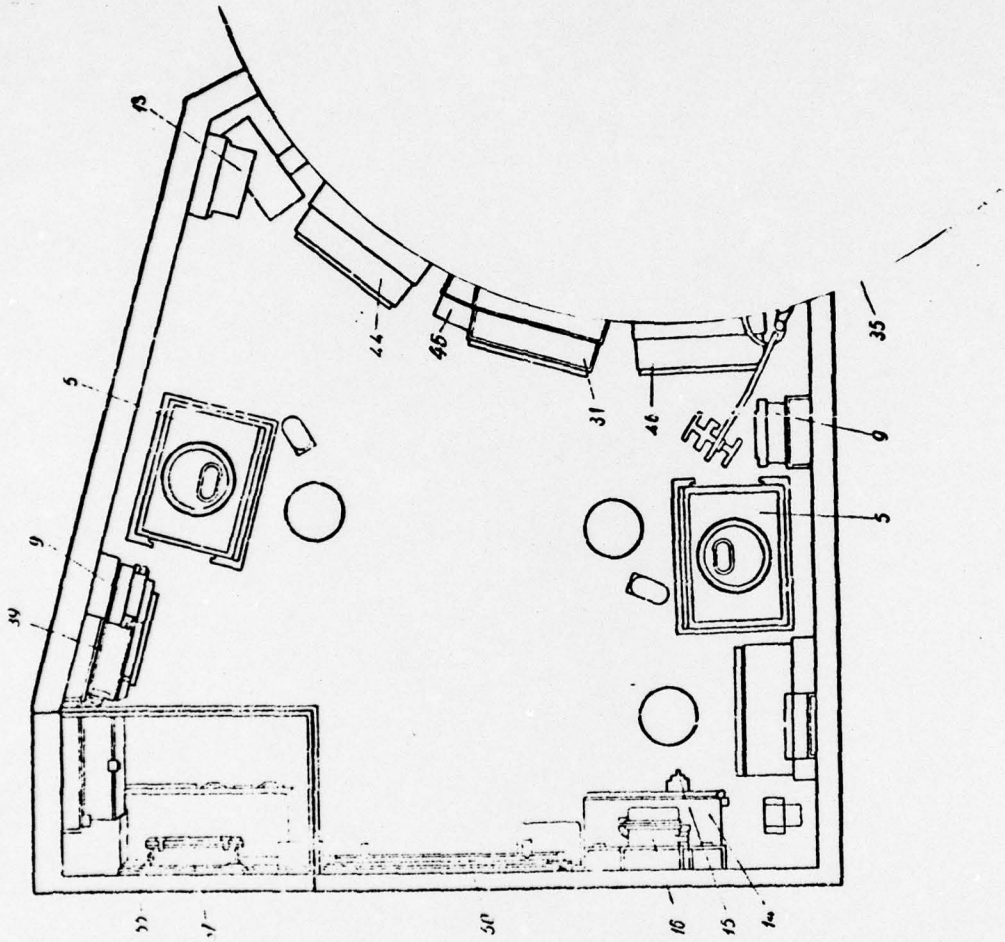


Fig. 1. Typical scheme for positioning equipment of the Combat Information Center on heavy cruisers

1 -- Pa plotting board for the air situation;
2 -- Pn guidance board;
3 -- Pv plotting board for the air situation;
4 -- Ps plotting table;
5 -- VIKO for Apparatus Pa;
6 -- VIKO for Apparatus Pn;
7 -- VIKO for Apparatus Ps;
8 -- VIKO for Apparatus Pv;
9 -- telephone panel for 6 subscribers;
10 -- telephone panel for 6 subscribers;
11 -- telephone panel for 10 subscribers;
13 -- valve oscillator;
14 -- main exchange switchboard;
15 and 16 -- calling devices of main exchange switchboard;
17 -- telephone of autonomous communication system;
19 -- signalling unit S-10;
20 -- signalling unit S-20;
21 -- box of extra DS-10 resistors;
22 -- box of extra DS-20 resistors;
23 -- log repeater (Apparatus 5A);
24 -- course repeater;
26 -- receptor of distance run;
27 -- receptor of course angle;
28 -- transmitter of position angle;
29 -- auxiliary radio communication post;
30 -- scaling Apparatus P-3;
31 -- distributing switchboard;
32 -- telephone for ordinary telephone communication;
33 -- case with secondary electric clock;
34 -- marine clock;
35 -- control panel for electric clock;
36 -- connection box;
37 -- connection box;
38 -- connection box;
39 -- connection box;
40 -- connection box;
41 -- UVIKO tube unit;
42 -- UVIKO control panel;
44 -- relay unit (Apparatus No 7);
45 -- relay unit (Apparatus No 7a);
46 -- relay unit (Apparatus no 76); 47 -- bearing repeater; 48 -- recorder repeater; 49 -- single-pedal switch; 50 -- collapsible table for pantograph; 51, 52, 53, and 54 -- board for orders, situation, and recording of interference; 55 -- connection box; 57 -- adjustable seat;
58 -- CIC Commander's desk

CHAPTER III

APPARATUS FOR THE GRAPHIC PLOTTING OF THE SURFACE AND AIR SITUATION [7

The Plotting Table (Apparatus Ps)

Design of the Plotting Table

The plotting table shown in Fig. 2 is designed for plotting the course of surface targets, for the automatic plotting of the course of one's own ship, and for guiding torpedo boats toward a target.

The plotting table consists of two basic demountable parts: the base-cabinet of the table and the plotting board.

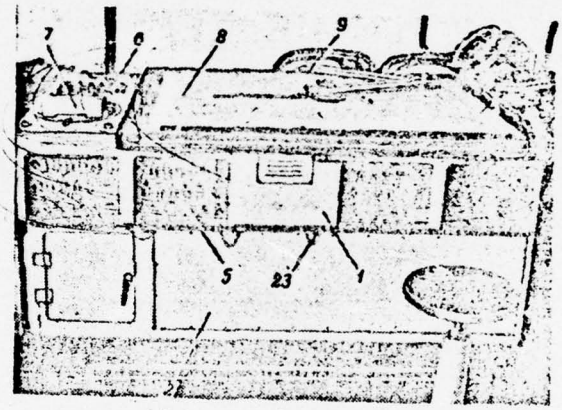


Fig. 2. Over-all view of a plotting table:

1 -- plotting board; 2 -- base cabinet; 5 -- telephone panel for 8 subscribers; 6 -- telephone panel for 6 subscribers; 7 -- special electric clock; 8 -- organic glass; 9 -- mechanical ruler; 23 -- fastening

The base of the plotting table (Fig. 3) consists of 1585 x 850 x 440 mm cabinet 2 cast of Silumin and designed for mounting the plotting board.

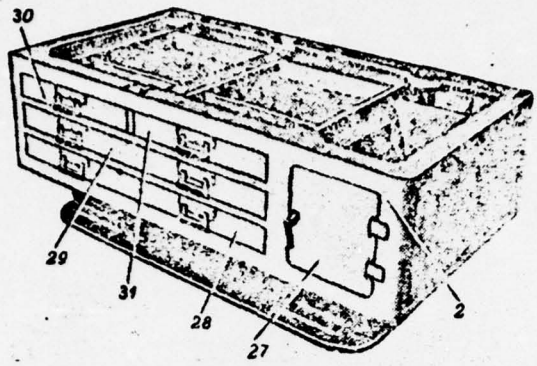


Fig. 3. Base cabinet of a plotting table:

27 -- compartment; 28 -- drawer for navigational charts; 29 -- drawer for tracing paper; 30 -- drawer for colored pencils; 31 -- drawer for detachable rulers

The base cabinet has four drawers for storing navigational plotting charts, tracing paper, working instruments and accessories as well as a compartment 27 closed by a door for storing telephone sets. There is a similar compartment on the reverse side of the plotting table cabinet. [8

Drawer 28 is used for storing navigational charts while center drawer 29 is used for storing rolls of tracing paper. Upper left drawer 30 has 14 small compartments for keeping colored pencils. Each compartment is of a corresponding color. In this same drawer there are erasers, a bearing converter, a slide rule, penknife, rulers for a protractor, dividers, and a measuring device.

In drawer 31 there are detachable rulers for the ruler with parallel movement, speed finders, special colored pencils, and colored pencils for use on paper. The base cabinet has four legs which are bolted down on the deck. Each leg is fitted with a shock absorber.

The plotting board of the plotting table (Fig. 4) is of Silumin, having dimensions 1585 x 990 x 235 mm. Its casing is divided by a partition into two sections -- a large and small section. Each section has a cover. Installed on the cover of the large section is a 1086 x 886 x 20 mm sheet 8 of organic glass with a dull finish on the surface. This is the working surface of the plotting board. For convenience in determining the course of a target by means of a protractor and ruler a rectangular coordinate grid has been drawn on the working surface of the plotting board.

2

The "North" edge of the plotting board cover is used to secure mechanical ruler 9 with parallel movement. The ruler is used to plot the course of a target manually.

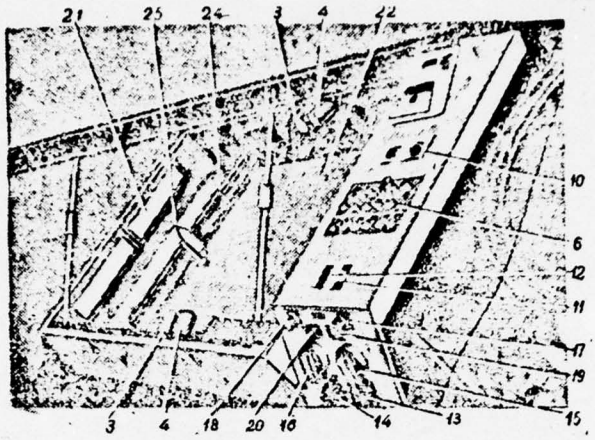


Fig. 4. Plotting table with view of the automatic plotter, auxiliary devices and control panel:

3 and 4 -- signal devices; 6 -- telephone panel for 6 subscribers; 10 -- signal panel; 11 and 12 -- viewing windows; 13 and 14 -- rotary switches; 15 and 16 -- knobs for adjusting pencil; 17 and 18 -- levers for matching the longitude and latitude of Apparatus P-4; 19 and 20 -- switches; 22 -- wooden panel; 24 and 25 -- device for the automatic recording of the course of one's own ship; 21 -- finger-shaped lamps

Mounted on the cover of the small section is special electric clock 7, [9 telephone panel 6 for six subscribers of the operational telephone communication system, signal panel 10 and two viewing windows 11 and 12 for reading the instantaneous values of the latitude and longitude from the scales of Apparatus P-4 (repeater).

The following are mounted in the casing of the small section: Apparatus P-4 -- repeater of the latitude and longitude of the position of one's own ship; electric motors SCh-274; two signal lamps, one of which is installed under green glass and the other under red glass; signal panel 10; terminal plates and receptacles for inserting feeder cables.

Located on the panel of the wall of the outer side (Fig. 4), to the rear of the small section, on the casing of the plotting board are: control organs consisting of two rotary switches 13 and 14 which are used to switch on the plotting board and to change the operational regimes of the automatic position plotter installed in the large section of the plotting board; two levers 17 and 18 for matching the latitude and longitude of Apparatus P-4; two tumbler

switches 19 and 20 for turning on the lamps of the internal preliminary illumination system and the luminous marker of the recording device of the automatic position plotter and of the two knobs 15 and 16 for adjusting the pencil along O - W and N - S.

On the large section of the casing of the plotting board are: the elements 24 and 25 of the device for the automatic recording of the course of one's own ship; signal devices 3 and 4 of the operational communication system and of the optical system; eight finger-shaped lamps 21, 110 volts (15 watts), for illuminating the working surface of the plotting board; and wooden panel 22 to which the navigation chart is attached.

The illumination finger-shaped lamps are turned on by means of the switch with the inscription "Light" that is installed on the control panel located on the wall panel of the front side of the casing of the plotting board.

Four telephone panels 5 for eight subscribers each are located along the facing side of the casing of a plotting board of horizontal design.

Note. Shown in Figs. 2 and 4 is Apparatus Ps, the old model, with telephone panels for 10 subscribers instead of 8.

Apparatus for the Automatic Plotting of the Course of One's Own Ship

The apparatus for the automatic plotting of the course of one's own ship is the basic equipment of the plotting table. This apparatus automatically records on a navigational plotting chart the path of one's own ship. The direction and velocity of movement of the pencil of the recording device of the apparatus depends on the ship's course, speed, on the latitude and longitude of the ship's position as well as on the scale of the chart selected.

The apparatus for the automatic plotting of the path of one's own ship is included in the ship's automatic position plotting system "PUT'" through an additional scaling device P-3 installed in the Combat Information Center. A diagram of the operation of the system for the automatic plotting of the course of one's own ship is shown in Fig. 5.

In this diagram:

1. Apparatus P-1a introduces the gyrocompass and log corrections.

2. Apparatus P-1 is a computing mechanism that determines the meridional and equatorial components of the ship's path from the course data and distance run per unit time which are automatically obtained from the gyrocompass and log, respectively.

3. Apparatus P-3 is a scaling device that works out a scale with respect to the chart selected for the plotting table; it automatically calculates and introduces a correction into the record of the ship's movement because of the nonlinearity of the scale of the Mercator projection of the navigation chart.

4. Apparatus P-3a is a converter of the components of the ship's path into geographic coordinates -- latitude and longitude of position.

As seen from the diagram, the control organs of the recording device on the plotting board of the plotting table are the gyrocompass and log.

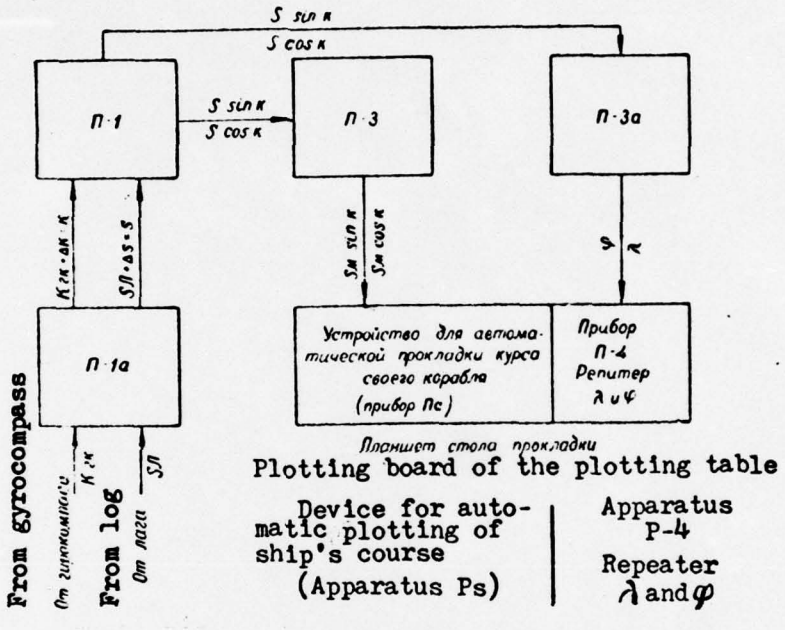


Fig. 5. Functional diagram of the automatic position plotting system

The course data from the gyrocompass and the distance run from the log enter Apparatus P-1a where they are adjusted, respectively, by way of the algebraic addition of the gyrocompass course K_{gc} and the quantity ΔK [11 introduced into Apparatus P-1a as the course correction and by way of the algebraic addition of the distance run according to the log and the quantity ΔS introduced as the log correction. The correction for the distance run is introduced into Apparatus P-1a either in knots or in percentage with respect to the distance run.

5

The adjusted course $K_{gc} + \Delta K = K$ and the adjusted path $S\int + \Delta S = S$, characterizing the position of the ship in polar coordinates

$$A = f(K;S),$$

where A -- ship's path at a given moment;

K -- ship's course;

S -- distance run,

enter into Apparatus P-1 where, by means of sine integrating mechanisms, the polar system of coordinates of the ship's position is converted into the rectangular system of coordinates

$$A = f(S_{N-S}; S_{O-W});$$

$$S_{N-S} = S\sin K \text{ and } S_{O-W} = S\cos K,$$

where S_{N-S} -- projection of the path on line N - S;

S_{O-W} -- projection of the path on line O - W.

In Apparatus P-3 the data S_{N-S} and S_{O-W} undergo a scale change with respect to the scale of the chart selected for the plotting, taking into account corrections for the change in the scale of the Mercator chart as a function of the change in latitude. A functional diagram of Apparatus P-3 and its operation is presented in the Section "Auxiliary Apparatus and Devices." [12

From Apparatus P-3 the quantities S^M_{N-S} and S^M_{O-W} (comprising the ship's path along the lines N - S and O - W in the scale selected for the work on the chart) enter in the form of electrical impulses into electric motors SCh-274 for the automatic plotting of the ship's course. The SCh-274 motors rotate the motion screws of the device for the automatic plotting of the course (Fig. 7), as a consequence of which, in the result of the geometric addition of the components of the distance run by the ship along the lines N - S and O - W, there occurs a shift in the carriage with the recording device and the projector which plots the line of the ship's movement, i.e., the course.

The components S_{N-S} and S_{O-W} of the distance run which enter Apparatus P-3a from Apparatus P-1 are converted in the said apparatus into the geographical coordinates of the ship's position (latitude and longitude), following which this data proceeds along sychronous transmission lines to the latitude and longitude repeater of Apparatus P-4 of the plotting table.

Operation of the Functional Diagram of the Automatic Position Plotter and Apparatus P-4

The apparatus for the automatic plotting of the course of one's own ship consists of: two carriages 9 and 28 (Fig. 6); two motion screws 2 and 3 for the movement of the carriage along N - S and O - W; recording device 8; projector 7 -- an optical device; time recorder 10 consisting of synchronous motor SD-2 with three special contact disks 11, 12, and 13 and with electromagnet 6 for time recording; a gear and bevel transmission system; and two receiving electric motors 4 and 5 (four-wire synchronous communication of the SCh-274 type) for the N - S and O - W components.

The SCh-274 four-wire synchronous electric motors are located in the small section of the plotting board of the plotting table. The rest of the elements of the equipment, with the exception of the adjusting knobs, are brought out on the front side of the plotting board, in the large section of the plotting board.

The carriage for the movement of the recording device along line O - W carries nut 29, motion screw 3 and the carriage for movement along N - S, on which the pencil and projector are mounted. With the rotation of receiving electric motor SCh-274 by the component of the distance run along O - W motion screw 3 for the movement of carriage 28 along O - W, while rotating, moves nut 29 which, being secured to the carriage, moves the carriage and, along with it, motion screw 2 and carriage 9.

With the rotation of receiving electric motor SCh-274 by the component of the distance run along N-S, motion screw 2 moves carriage 9 along line N - S and, along with it, the recording device and projector. [14

Recording device 8 consists of a pencil, Mark 4N inserted into a clamp, and an electromagnet 6 of type EM-5.

Under the action of a spring the pencil presses against the lower working surface and, with the movement of the carriage, leaves a trace on the working surface of the Mercator chart which is attached by means of tacks to the wooden panel of the plotting board.

When the electromagnet is activated the clamp connected with the armature of the electromagnet rises and a space of approximately 1 mm is formed between the pencil and the lower working surface of the chart.

Projector 7 -- a device consisting of a cylinder, in the upper part of which there is a clouded glass and a diaphragm with an opening in the form of a cross, and which has a lens and a signal lamp of 110 volts (8 watts) -- projects a luminous mark on the surface of the plotting board in the form of a cross indicating at each moment of time the location of the pencil and hence the position of one's own ship on the chart.

Fig. 6. Functional diagram of the automatic position plotter and Apparatus P-4

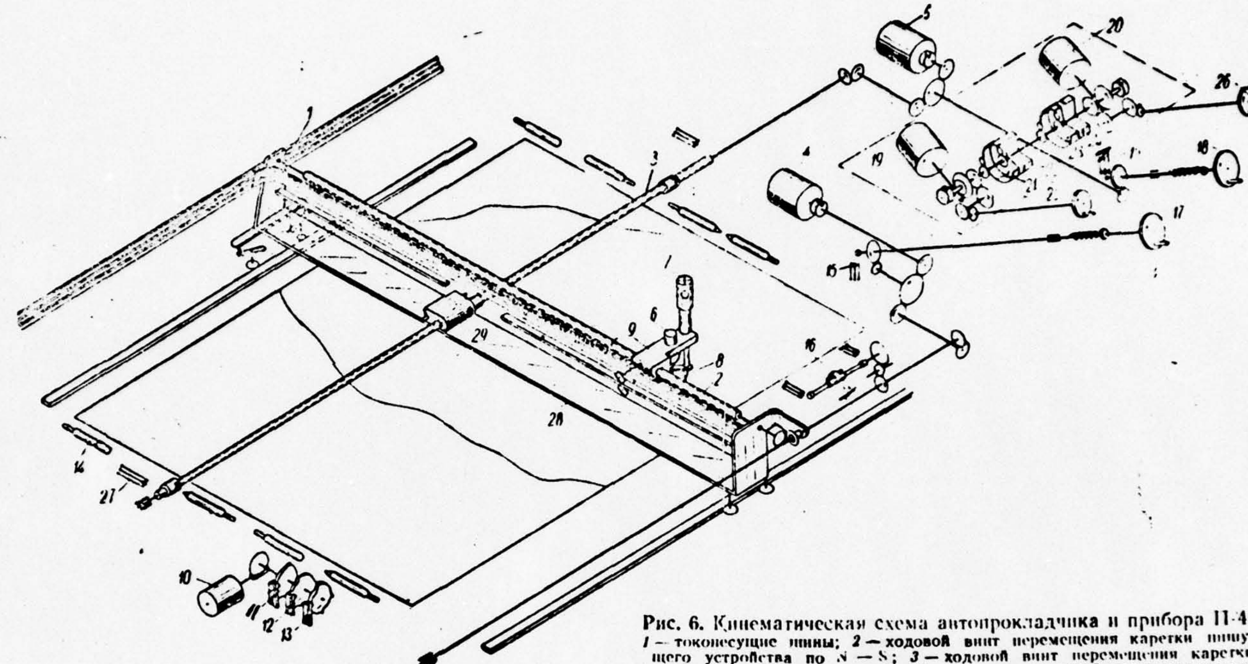


Рис. 6. Кинематическая схема автопрокладчика и прибора П-4: *1* — токонесущие шины; *2* — ходовой винт перемещения каретки пишущего устройства по N — S; *3* — ходовой винт перемещения каретки пишущего устройства по O — W; *4* — принимающий электродвигатель СЧ-274 составляющей пройденного расстояния по N — S; *5* — принимающий электродвигатель СЧ-274 составляющей пройденного расстояния по O — W; *6* — электромагнит временной отметки ЭМ-5; *7* — проектор; *8* — карандаш пишущего устройства; *9* — каретка пишущего устройства; *10* — синхронный электродвигатель; *11* — контактный диск отметки времени через 10 минут; *12* — контактный диск отметки времени через 2 минуты; *13* — задающий временный контактный диск; *14* — пальцеобразная лампочка освещения рабочей поверхности; *15* — контакты согласования карандаша; *16* — валик с контактами ограничения крайних положений каретки пишущего устройства по линии N — S; *17* — маховик установки карандаша на карте по направлению N — S; *18* — маховик установки карандаша на карте по направлению O — W. *19* — сельсин СС-404, принимающий широты; *20* — сельсин СС-401, принимающий долготы; *21* — шкала грубого отсчета широты; *22* — шкала точного отсчета широты; *23* — шкала грубого отсчета долготы; *24* — шкала точного отсчета долготы; *25* — рукоятка первоначальной установки широты; *26* — рукоятки первоначальной установки долготы; *27* — контакты ограничения крайних положений каретки пишущего устройства по линии O — W. *28* — каретка перемещения пишущего устройства по линии O — W; *29* — гайка

Fig. 6. Functional diagram of the automatic position plotter and Apparatus P-4

1 -- current-carrying bus bars;
2 -- motion screw for the N - S movement of the carriage of the recording device;
3 -- motion screw for the O - W movement of the carriage of the recording device;
4 -- receiving electric motor SCh-274 for the component of the distance run along N - S;
5 -- receiving electric motor SCh-274 for the component of the distance run along O - W;
6 -- electromagnet EM-5 for time recording;
7 -- projector;
8 -- pencil of the recording device;
9 -- carriage of the recording device;
10 -- synchronous electric motor;
11 -- contact disk for recording time every 10 minutes;
12 -- contact disk for recording time every 2 minutes;
13 -- time-selecting contact disk;
14 -- finger-shaped lamp for illuminating the working surface;
15 -- contacts for adjusting pencil;
16 -- cylinder with contacts for limiting the extreme positions of the carriage of the recording device along line N - S;
17 -- knob for setting the pencil on the chart for the N - S direction;
18 -- knob for setting the pencil on the chart for the O - W direction;
19 -- selsyn SS-404, latitude receptor;
20 -- selsyn SS-404, longitude receptor;
21 -- scale for approximate latitude reading;
22 -- scale for precise latitude reading;
23 -- scale for approximate longitude reading;
24 -- scale for precise longitude reading
25 -- lever for initial setting of latitude;
26 -- lever for initial setting of longitude;
27 -- contacts for limiting the extreme positions of the carriage of the recording device along the line O - W;
28 -- carriage for moving the recording device along the O - W line;
29 -- nut

The time recorder consists of: synchronous motor 10 of the SD-2 type which is connected by means of mechanical drive with disks 11, 12, and 13; and electromagnet 6 with the armature of which the clamp of the recording device is connected. With the rotation of the three contact disks a periodic closing of the circuit of the armature of the electromagnet occurs, as a result of which the pencil of the recording device, by rising and falling, leaves a mark in the form of a point on the lower surface of the apparatus.

The apparatus for automatic position plotting is equipped with devices limiting the movement of the carriage, of which two devices 16 are for limiting the motion of the carriage in the N - S direction and two devices 27 are for limiting the motion of the carriage in the O - W direction. The limiting devices are triggered when the carriage of the recording device approaches the extreme positions, whereupon the power supply of the corresponding SCh-274 electric motor is cut off and the carriage stops.

The operation of the limiting devices is signalled by the lighting of a lamp installed under the glass of the signal panel (cover of the small section of the plotting board).

Apparatus P-4 is installed under the cover of the small section of the plotting table and is a repeater of Apparatus P-3a of the "PUT" system which gives the value of the ship's instantaneous geographic coordinates (latitude and longitude). In Apparatus P-4 two selsyns 19 and 20 of the SS-404 type serve as receivers of the longitude and latitude of position. The rotor of each selsyn is mechanically connected with two cylindrical scales: one is an approximate scale (in degrees) and the other is a precise scale (in minutes).

When the ship's position changes only in latitude selsyn SS-404 (19) will rotate and via the friction clutch for slippage scale 22 -- connected by planetary gear with scale 21 for an approximate latitude reading -- will rotate giving a precise reading of the latitude. With a change in the ship's longitude selsyn SS-404 (20) rotates and via the friction clutch for slippage, the cylinder and scale 24 rotate giving a precise reading of the longitude. The scale for precision longitude reading is connected by planetary gear with scale 23 which gives an approximate reading of the longitude. The scales of Apparatus P-4 are illuminated by a small electric lamp of 110 volts (8 watts). The scales are read through viewing windows located on the cover of the small section of the plotting board of the plotting table.

Description and Principle of Operation of the Electric Circuit of the Equipment for the Automatic Plotting of the Course of One's Own Ship. The Joint Operation of Apparatus P-4 and P-3.

From the transmitters the components of the distance run of Apparatus P-1, given in the form of direct current impulses, enter through a special connection box into the receiving motors for the distance run along lines N-S and O-W, in Apparatus P-3 (Fig. 7).

Fig. 7 Principal electric circuit of the equipment for the automatic recording of the path of one's own ship together with Apparatus P-4 and scaling Apparatus P-3

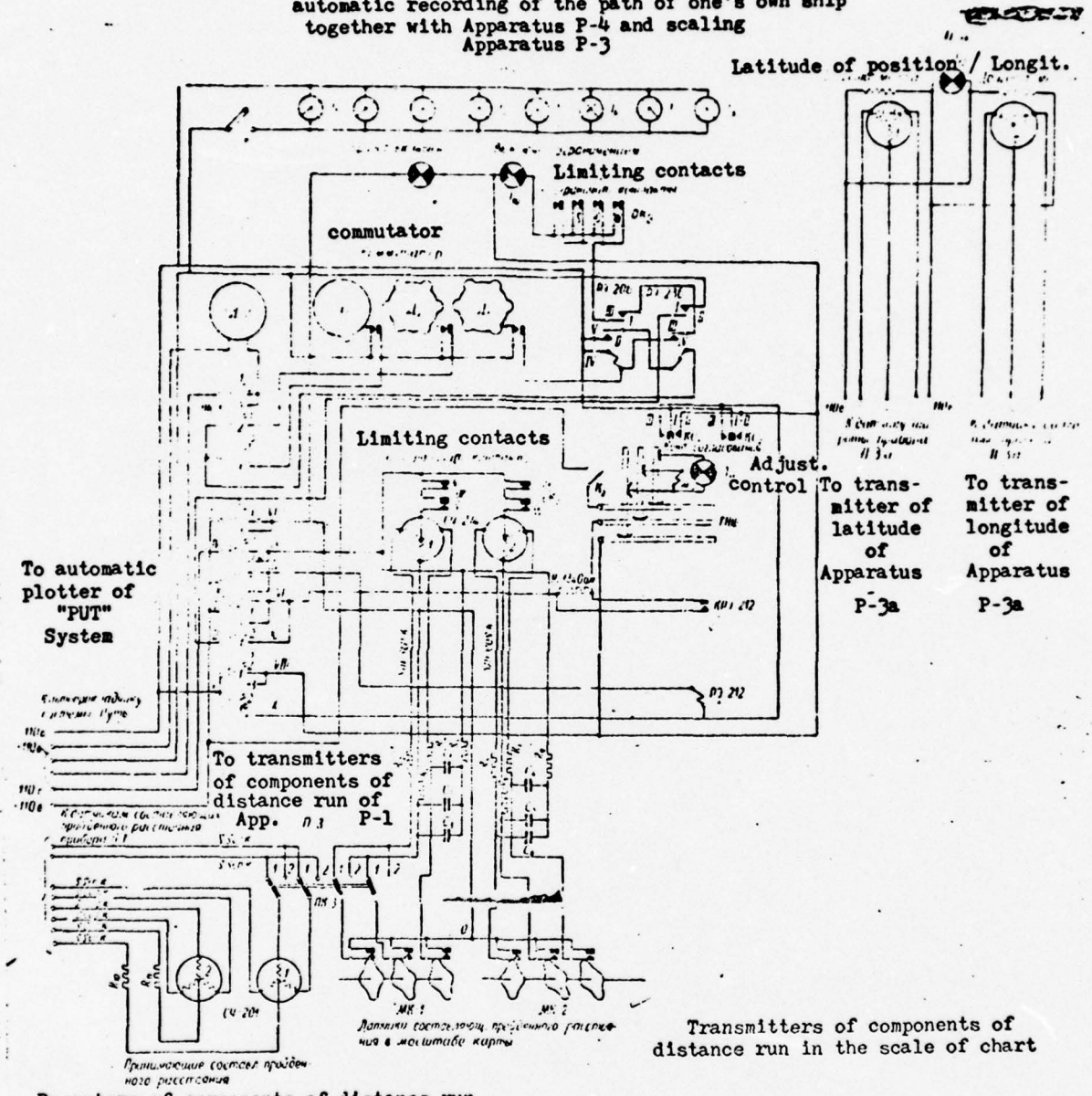


Fig. 7 Principal electric circuit of the equipment for the automatic recording of the path of one's own ship together with Apparatus P-4 and scaling Apparatus P-3:

$Л_1 - Л_8$ -- finger-shaped electric lamps, 110 volts (8 watts);

$Л_9$ -- finger-shaped signal lamp, 110 volts (8 watts);

$Л_{10}$ -- finger-shaped signal lamp, 110 volts (8 watts), signalling that apparatus is turned off when carriages of the recording device are at extreme positions;

$Л_{11}$ -- finger-shaped lamp, 110 volts (8 watts), for illuminating cross of projector;

$Л_{12}$ -- finger-shaped lamp, 110 volts (8 watts); (lamp for illuminating scale of Apparatus P-4;

ПК-1 -- three-position rotary switch for turning on time recorder on recording device;

ПК-2 -- three-position rotary switch for various regimes of apparatus;

ПК-3 -- two-position rotary switch (latitude switch);

СЧ-274(1) -- electric motor, receptor of distance run along N - S;

СЧ-274(2) -- electric motor, receptor of distance run along O - w;

СЧ-201(2) -- electric motor, receptor of distance run along O - W;

СЧ-201(1) -- electric motor, receptor of distance run along N - S;

СД-2 -- synchronous motor of time recorder;

СС-404(1) -- selsyn -- (receptor of latitude of position);

СС-404(2) -- selsyn -- (receptor of longitude of position);

$П_1, П_2, П_3$ -- time recorder contact disks;

МК-1 -- scaling keys of the transmitter of distance run along line N - S;

МК-2 -- scaling keys of the transmitter of distance run along line O - W;

КС-1 -- contacts for adjusting carriage of recording device;

ЭМ-5 -- electromagnet for lifting pencil of recording device;

ОК-1 -- contacts for limiting movement of carriage of the recording device along line N - S;

ОК-2 -- contacts for limiting movement of carriage of the recording device along line O - W;

К-1 -- key for turning on illumination of working surface;

К-2 -- key for turning on projector lamp;

Fig. 7 (continued)

РЭ-206 and
РЭ -236 -- auxiliary relays of time recorder of recording device;

РЭ -212 -- relay for switching on resistor R_1;

R_1 -- resistance = 1340 ohms for dampening current in circuit of electromagnet EM-5;

R_2 - R_9 -- resistances of 200 ohms each;

R_{10} and R_{11} -- resistances of 140 ohms each;

C_1 to C_6 -- filter capacitors, 1 μF each;

ТНШ -- current-carrying bus bars

Data for distance run along the line N - S (S sin K) enters electric motor SCh-201 (1); data for distance run along the line O - W (S cos K) enters electric motor SCh-201 (2). The shaft of electric motor SCh-201 (1) is connected with the scaling transmitter-keys (keys MK-2) for the distance run along the line N - S.

The scaling transmitter-keys MK-1 and MK-2 convert the components S sin K and S cos K in accordance with the scale of the Mercator chart selected for the work; scaling key MK-1 is designed so that it takes into account the nonlinearity of the Mercator chart scale with a change in the ship's position with respect to latitude.

With allowance for the scale the components of the distance run, i.e., S_M sin K and S_M cos K, in the form of direct current impulses from the scaling transmitter-keys MK-1 and MK-2, enter through heavy-duty filters of capacitors and resistors into receiving electric motors SCh-274 (1 and 2) of the apparatus for automatic plotting of the course of one's own ship (Apparatus Ps).

Receiving electric motors SCh-274 (1 and 2) rotate the corresponding motion screws (See Functional diagram) which move the carriages of the recording device.

The circuit for automatic operation is switched on through rotary switch PK-2 located on the right side of the panel of the small section of the plotting table. Switch PK-2 has three positions:

Position 1 -- Normal regime;

Position 2 -- Off;

Position 3 -- Without lower chart.

In the "Off" position all contacts of the rotary switch are open with the exception of contacts I - III and I - VI which by remaining closed prepare the supply circuit of electromagnet EM-5 and relay RE-212 for operation at the moment the pencil is adjusted on the chart. [16

A power supply of a 110 volt direct current is delivered to the elements of the recording device by metal bus bars TNSh through sliding contacts. During adjustment the pencil must not touch the working surface of the chart. The lifting of the pencil and its maintenance in an elevated position is accomplished by means of electromagnet EM-5. To adjust the pencil on the chart (to set the pencil at the latitude and longitude of the ship's position at the moment Apparatus Ps is started up) the adjustment levers are shifted from the horizontal to the vertical position. In shifting the levers there occurs, by means of the lever rods, a mechanical closing of the adjusting contacts KC_1 and KC_2 -- first, contacts I - II; then contacts I - III. Through contacts I - II a power supply of 110 volt direct current is delivered to electromagnet EM-5 which responds and lifts the pencil. Two to three seconds after electromagnet EM-2 is activated, a resistor R_1 = 1340 ohms is automatically introduced in the circuit, whereby the excess heat of the electromagnet's winding is cancelled. The resistor is automatically introduced through relay RE-212 by way of opening contacts KRE-212 which otherwise shunt resistance R_1.

A power supply of a 110 volt direct current is delivered to the relay through adjusting contacts KC_1 and KC_2 by way of closing contact I - III. The position of the carriage of the recording device at the time of adjustment is recorded on the working surface of the plotting table in the form of an illuminated cross from the projector.

The projector is turned on by switch K_2 with the designation "Projector light."

For the automatic plotting of the course without a recording on the lower chart the rotary switch PK-2 is shifted into Position 3, "Without the lower chart". Further, through the contacts of rotary switch PK-2 (contacts I - VII and V - VIII) electric lamp L_9 under the green glass lights up signalling that the equipment is in operation.

By closing contacts I and VII a 110 volt direct current is delivered to the common line of scaling keys MK-1 and MK-2 of Apparatus P-3. By closing contacts IV - IX of rotary switch PK-2 direct current impulses are transmitted from scaling transmitter-keys MK-1 and MK-2 of Apparatus P-3 to receiving electric motors SCh-274 (1) and SCh-274 (2). As a result, electric motors SCh-274 rotate the motion screws and move the carriage with the projector and recording device; along with them, on the upper working surface of the plotting board the illuminated cross (light spot) moves, indicating the position of the ship.

Depending on the velocity of rotation of electric motor SCh-274 (1) for the component of distance run along line N - S and on electric [17

motor SCh-274 (2) for the component of distance run along line O - W the light spot will move at a velocity corresponding to the ship's speed and in a direction corresponding to the ship's course.

The plotting of the ship's course in the indicated operational regime takes place without a recording by the pencil on the lower chart. The lifting of the pencil and its maintenance in an elevated position is accomplished, just as during adjustment, by electromagnet EM-5 which in this operational regime obtains a power supply of 110 volts direct current through the contacts of rotary switch PK-2 (contacts I - VI and V - VIII).

Following the elevation of the pencil, just as during adjustment, an additional resistance R_1 = 1340 ohms in series is introduced into the circuit of the winding of electromagnet EM-5 by breaking contacts KRE-212 of relay RE-212.

A power supply of 110 volts direct current is delivered to relay RE-212 in this regime through contacts V - X and I - III of rotary switch PK-2 and not through the contacts for adjustment KS_1 and KS_2.

For the automatic plotting of the course with a recording on the chart, switch PK-2 is set at Position 1, "Normal regime." At the same time signal lamp L_9 under the green glass also lights up signalling that the equipment is switched on.

The switching on of the elements of the circuit for automatic operation with recording on a chart is similar to the switching on for the operational regime "Without lower chart." The difference is only that in the operation of the "Normal regime" circuit electromagnet EM-5 is de-energized by the breaking of contact I - VI; the pencil of the recording device drops down under the action of a spring and draws a line on the chart, i.e., the course of one's own ship.

Limiting the extreme positions of the carriage of the recording device is accomplished by the contacts for limitation. When the carriage of the recording device approaches the northern edge of the chart there occurs a mechanical breaking of the north contact, the contacts OK_1 for limitation, and the closing of the north contact of the group of contacts OK_3, whereby electric motor SCh-274 (1) is deprived of current and electric lamp L_{10} under the red glass lights up signalling that the apparatus has been turned off by the limitation.

When the carriage of the recording device approaches the southern edge of the chart electric motor SCh-274 (1) shuts off and electric lamp L_{10} likewise lights up. In this case the shutting off of electric motor SCh-274 (1) and the lighting of signal lamp L_{10} occur through the south contact of the group of contacts OK_1 for limitation and through the closing of the south contact of the group of contacts OK_3. Limiting the motion of the carriage of the recording device in the O - W direction is analogous to the above, the

difference being only that the safety factor of electric motor SCh-274 (2) is due to the breaking of contact O or W (of group OK_2) and the closing of contacts for turning on lamp L_{10} (OK_3 group). [18

The recording device plots marks on the lines of the ship's course after a fixed interval of time. A mark in the form of a point is obtained as a result of the action of electromagnet EM-5. Intervals of either two or ten minutes between markings may be selected at will. The timing is turned on by means of timing switch PK-1.

Position 1 of rotary switch PK-1 corresponds to the "Off" position, i.e., without markings.

Position 2 of switch PK-1 corresponds to markings at 2 minute intervals.

Position 3 -- to markings at 10 minute intervals.

Synchronous electric motor SD-2, the intermittent contact disks (D_1 is a selector or preparatory disk; D_2 is the disk for the 2-minute interval marking and D_3 is the disk for the 10-minute interval marking), and two auxiliary relays RE-206 and RE-236 are used for obtaining marks.

Selecting disk D_1 is slightly shifted in its projections with respect to the projections of the two-minute and ten-minute contact disks, as a result of which, in rotating, the contacts of the selecting disk are closed first and then the contacts of the two-minute or ten-minute disk. The breaking of contacts occurs in that same sequence.

Electric motor SD-2 rotates the three contact disks by means of a mechanical drive. When the contacts of selecting disk D_1 are closed the first relay RE-206 operates and through its contacts III - I creates an interlocking circuit; through contacts IV - II it readies the supply circuit of relay RE-236. Relay RE-236 operates with the closing of the contact of any one of the working disks -- D_2 or D_3.

With the closing of the contacts of one of the working disks relay RE-236, after closing its contacts I - II, sends, through contacts II - XI of rotary switch PK-2, direct current impulses to electromagnet EM-5. At the same time relay RE-236 breaks, through its contacts III - IV, the interlocking circuit of relay RE-206 and it drops its own armature and breaks its own contacts. In view of the fact that the contacts of the preparatory disk are already broken (owing to the displacement of its projections with respect to the projections of the working disk), relay RE-236 will not operate again and the entire system will be at rest.

Upon receipt of a current impulse electromagnet EM-5 operates and lifts the pencil; when the current of the electromagnet is cut off, the pencil, under the action of a spring, drops and makes a time mark in the form of a point. The length of time the pencil remains in an elevated position depends on the

position of the projections on the working disks with respect to the projections of selecting disk D_1.

The apparatus for the automatic plotting of the course of one's own ship is designed for the automatic recording of latitudes within geographical limits ranging from Lat = 0° to Lat = 75° for the northern latitude and from Lat = 0° to Lat = 75° for the southern latitude.

The operational range of the apparatus along the geographical longitude [19
extends from Long = 0° to Long = 180° for the eastern hemisphere and from Long = 0° to Long = 180° for the western hemisphere.

The apparatus can operate on charts in scales 1:50 000 - 1:800 000.

Charts of only three scales -- 1:50 000, 1:100 000, and 1:150 000 -- are used on the plotting table of the Combat Information Center.

The maximum speed of the ship for which the apparatus is designed is 45 knots, which corresponds to a velocity of rotation of the receiving motors for distance run as follows: 22 revs/min for electric motor SCh-274 (1) for the component of distance run along line N - S; and 30 revs/min for electric motor SCh-274 (2) for the component of distance run along line O - W.

If a ship is sailing in the northern hemisphere the latitude switch PK-3 is set at Position 1 -- "North latitude;" in this case the receiving motors for the component of distance run along line N - S, in apparatus P-3 and Ps, rotate in the same direction. When the ship crosses the equator, i.e., from the northern to the southern hemisphere, switch PK-3 is set at Position 2 -- "South latitude" -- which corresponds to a reverse rotation of the receiving electric motors for the component of distance run along line N-S. A description of the special electric clock mounted on the cover of the small section of the plotting board is presented in Chapter VIII (Auxiliary Apparatus and Devices).

List of Work Instruments and Accessories for the Plotting Table

The following work instruments and accessories are used in performing taks on the plotting board pertaining to the plotting of targets and the course of one's own ship.

1.	Ruler with parallel movement	1 item
2.	Detachable rulers for the ruler with parallel movement, for scales 1:50 000, 1:100 000 and 1:150 000	3 "
3.	Speed finder, by the method of comparing distances run	1 "
4.	Speed finder, by the method of comparing distances run, for the large scale chart	1 "

5.	Speed finder for scales 1:50 000, 1:100 000 and 1:150 000	3 items
6.	Slide rule	1 "
7.	Bearing converter	1 "
8.	Protractor	1 "
9.	Detachable rulers for the protractor, for scales 1:50 000 1:100 000, and 1:150 000	3 "
10.	Dividers	1 "
11.	Drawing compass	1 "
12.	Special colored pencils for glass (the set consists of six pencils: black, brown, red, green, blue and yellow)	2 sets [20
13.	Ordinary colored pencils (the set consists of six pencils: black, brown, red, green, blue and yellow)	2 sets
14.	Graphite pencils, Mark V	2 items
15.	Penknife	1 item
16.	Soft eraser for erasing pencil tracings	1 "
17.	Bottle of fluid for wiping away pencil tracings on th Plexiglas of the plotting board, 100 g	1 bottle
18.	Clean cloth	50 grams
19.	Tracing paper	1 roll

All these instruments and accessories, with the exception of the fluid for erasing pencil tracings, are arranged in wooden storage trays installed in the upper metal drawers of the plotting table cabinet.

Stored in the lower drawers of the plotting table cabinet are the navigational charts and three rolls of tracing paper, one roll of which is for the plotting board of the plotting table and the other two are for Apparatus Pn and Pv (plotting board of the surface situation and guidance board, respectively).

Plotting Table for the Surface Situation (Apparatus Pn)

Purpose and Design

The plotting table for the surface situation, an over-all view of which is presented in Fig. 8, is used for the graphic recording of the position, characterists, and motion parameters of surface targets in the vicinity of one's own ship. The plotting table for the surface situation consists of two basic parts: the plotting board and the base cabinet of the plotting board. The plotting board for the surface situation is mounted on the base in a horizontal position. [21

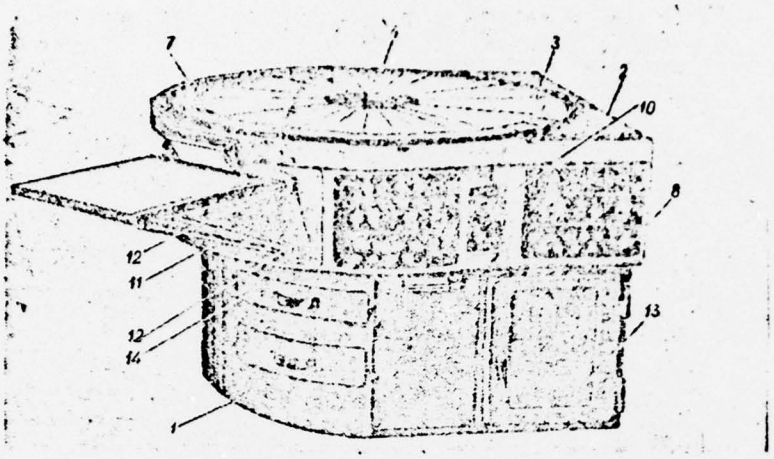


Fig. 8 Over-all view of the plotting table for the surface situation (Apparatus Pn):

1 -- base cabinet of the plotting board; 2 -- casing; 3 working surface; 4 -- gyrocompass course repeater scale; 7 -- fastener; 8 -- telephone panel; 10 -- light panel; 11 -- cover; 12 flange; 13 -- door; 14 -- drawer

In Fig. 8 it is seen that base 1 of the plotting table is a cabinet cast of Silumin in which there are three doors that open (two side doors and one on the face side).

The side doors are used for access to the connection boxes with the terminal plates, whereas the door on the face side is used for access to organs for coordinating the course repeater and for access to the illumination lamps.

On the inner side of the doors there are hooks for hanging telephone gear. In the under part of the base cabinet there are three shock absorbers which protect the apparatus from vibrations and shocks. The base of the plotting table is bolted to the deck of the ship.

There are four special drawers 14 in the side walls of the base cabinet for storing work instruments and accessories.

The plotting board of Apparatus Pn shown in Fig. 9 is made in the form of a shaped casing 2 cast of Silumin, open in the upper and lower parts.

The casing serves as a mounting for working surface 3 of Plexiglas 20 mm in thickness, and for installing the elements of the circuit.

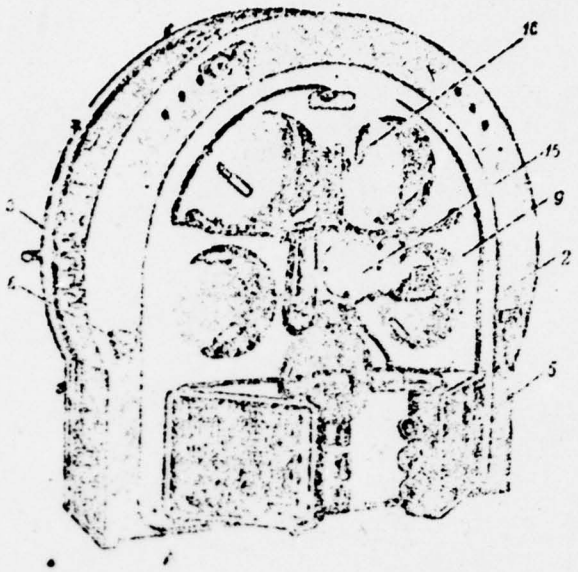


Fig. 9. View of the internal assembly of the plotting board for the surface situation (Apparatus Pn):

2 -- casing; 5 -- connection box; 6 -- plug socket; 8 -- telephone panel; 9 -- panel; 15 -- gyrocompass repeater; 16 -- illumination lamps

The bottom part of the casing of the plotting board is enclosed by Duralumin panel 9. Installed on the front of this panel are the following: a frosted disk for obtaining diffused illumination of the working surface of the plotting board, two demountable cones, three microtelephone transformers, four signal devices and extra resistors -- 800 ohms each -- for limiting the voltage to 110 volts, given a lateral source of 220 volts for supplying Apparatus Pm.

Secure[d] to the lower part of the panel are two connection boxes 5 with terminal pla[t]es; two KDS type wire-wound resistors -- 1500 ohms each -- for limiting the voltage to 110 volts, given a lateral source of 220 volts in the circuit of signal device OS; plug sockets 6 for connecting telephone gear to telephone panels; a terminal plate with six terminals for connecting the wires from the illumination lamps; and the course repeater, the axis of which is brought out through the central cone.

Located on the side walls of the casing are: four telephone panels 8 for eight subscribers each, one telephone panel for six subscribers, illumination

panel 10 and removable covers 11 for access to elements of the assembly. Covers 11 have special flanges 12 for securing the maneuvering board (Apparatus Pm) to Apparatus Pn.

Along the circumference of the ring of the plotting board's casing are twelve uniformly spaced fasteners for securing the tracing paper placed on the working surface in order to obtain the plotted situation.

The Working Surface of the Plotting Board for the Surface Situation

The working surface of the plotting board, i.e., the diagram shown in Fig. 10, is drawn on a circle consisting of a sheet of colorless organic glass 20 mm thick and 1030 mm in diameter. The upper surface of the circle is polished whereas the under surface has a dull finish, with the exception of the center section under which the scale for the repeater 4 of the gyrocompass course is located. To protect this scale from impairment the circle in the center section rests on three special supports made of colorless organic glass. These supports are secured to the bottom of the plotting board near the base of the center cone.

A polar coordinate diagram, in the form of radius vectors and concentric circles designating distances, is engraved on the polished surface of the organic glass.

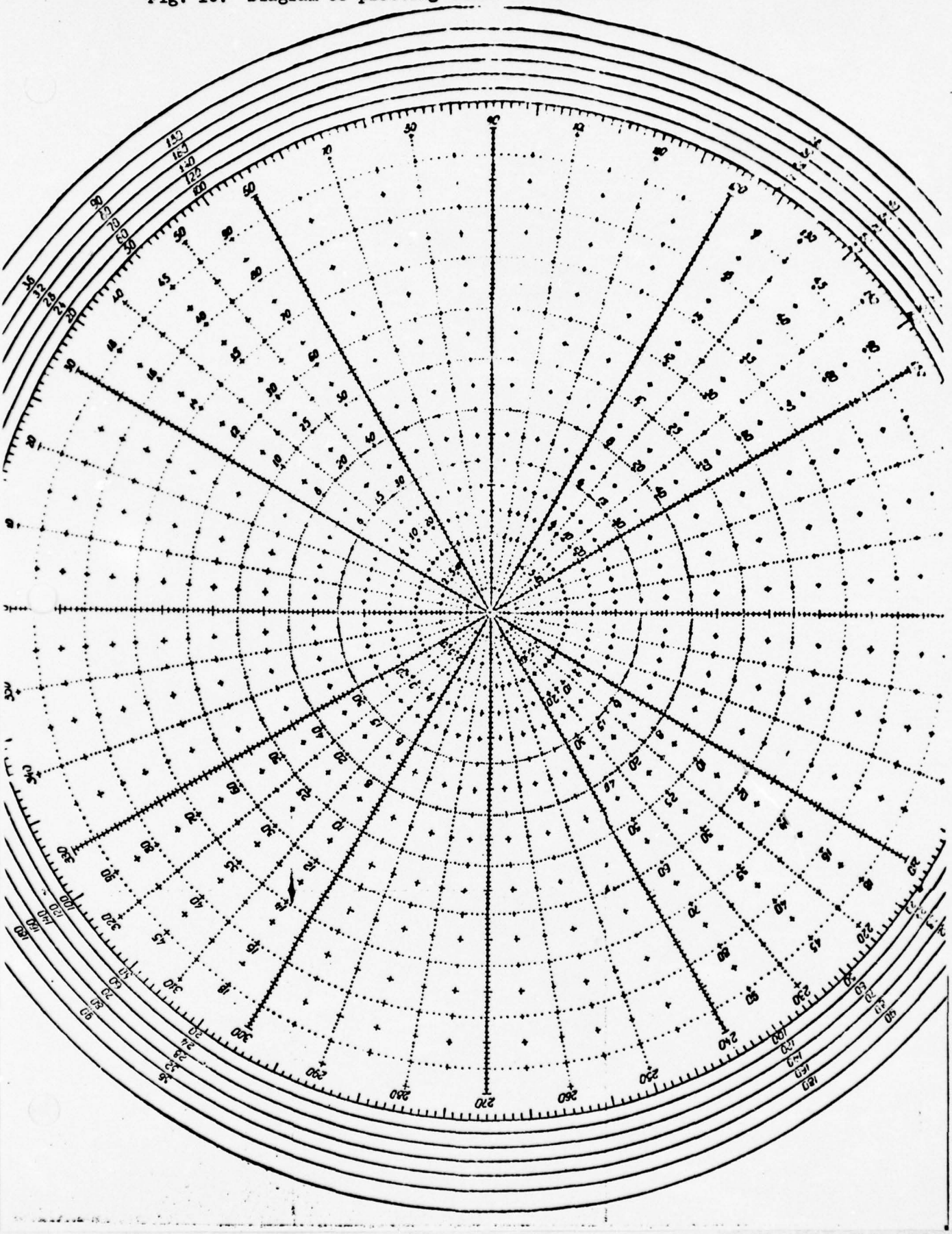
The center of the circle, maked by a cross, is the center -- pole -- of the coordinate system; the zero radius vector representing the line of true North on the diagram is taken as the polar axis. The position of any target on the diagram is determined by the length of the radius vector up to the given target and by the angle between the said radius vector and polar axis. The angles on the diagram are recorded from the north radius vector, with designation 0°, clockwise from 0° to 360°.

For greater convenience, increased accuracy and rapid plotting of the position of targets the radius vectors are plotted with solid lines every 30° along the arc of the circle beginning with 0° and, in 10° intervals between these lines, the radius vectors are plotted with points. [23

For the rapid determination of distance to any target there are 15 range circles of which the first ten, counting from the pole of the diagram, are plotted in the form of points at 44 mm intervals; while the remaining 5 circles are drawn with solid lines at 12 mm intervals.

In the four quadrants of the polar diagram, above the concentric range circles, the distances are recorded in conformity with the three scales for plotting targets: 0 - 20 and 20 - 40; 0 - 50 and 50 - 100; 0 - 100 and 100 - 200 nautical miles. The positions of surface targets on the plotting board for the surface situation are plotted in the scales 0 - 5, 0 - 20, and 0 - 50 nautical miles within the areas of the circles at a distance interval of 44 mm; and in the scales 5 - 10, 20 - 40, and 50 - 100 nautical miles within the areas of the circles drawn at 12 mm intervals.

Fig. 10. Diagram of plotting board for the surface situation



The scales 0 - 20, 0 - 50, and 0 - 100 nautical miles for the range circles plotted at 44 mm intervals and the scales 20 - 40, 50 - 100, and 100 - 200 nautical miles for range circles drawn at 12 mm intervals are used for plotting the positions of air targets and aircraft guided from the ship.

The Course Repeater

The course repeater, a functional diagram of which is shown in Fig. 11, is a device indicating the ship's course. The course repeater is connected by means of synchronous communication, type SSP, with the course transmitter of the ship's gyrocompass. A selsyn motor 4, type SS-404, is used in the repeater as a receiving motor, the rotor of which is connected by means of a gear drive system with compass card 1 of the repeater, the degree scale of which is divided into 360 divisions of 1° each. [24

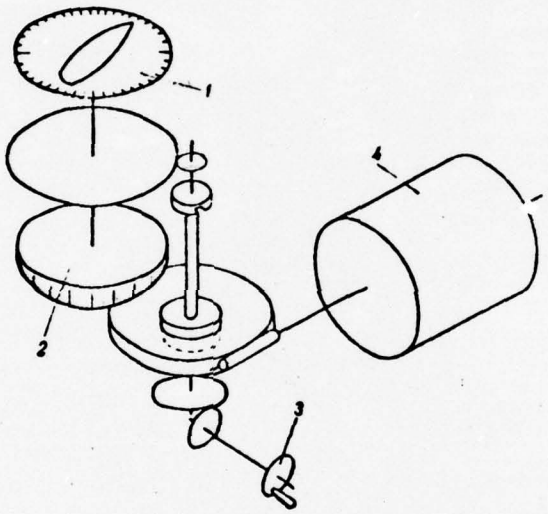


Fig. 11. Functional diagram of a course repeater:

1 -- compass card; 2 -- scale for matching; 3 -- manual control for matching; 4 -- receiving selsyn, type SS-404

The compass card is made of colorless organic glass; it is 250 mm in diameter and 2 mm in thickness. The bottom surface of the card has a dull finish while the upper surface is polished; a degree scale and an outline of the ship are drawn on the surface.

The matching of the repeater with the gyrocompass is accomplished by means of manual control 3 of dial 2 for matching, which has a degree scale ranging from 0° to 360°.

All elements of the repeater are placed in a casing cast of Silumin in which there is a window for monitoring the scale for matching.

The repeater is installed in the center of the plotting board so that the center of the compass card is opposite the center of the working surface of the plotting board.

Access to the mechanisms for matching the repeater is through the door in the base of the plotting table.

Signal Devices

There are two signal devices each of which consists of two cylinders mounted in a common casing and installed on the bottom of the plotting board in an inclined position.

Inside each cylinder there is a plug socket for a 110 v (8 w) electric signal lamp, type STs-21. The cylinders are enclosed from above by a common cover with lenses, one of which is colored red and the other green.

The signal devices with the red lenses are used as luminous call signals for the telephone panels of the apparatus.

The signal devices with the green lenses are used for the reception of a call signal from the optical system signalling that the horizontal bend of the optical system must be set over the plotting board so that the situation plotted on the board may be monitored from the Main Command Center.

The Light Panel

The light panel 10 (Fig. 8) installed on the side wall of the casing of the plotting board is used for mounting safety elements and for turning on and off the illumination of the working surface of the plotting board.

Installed on the panel are:

a) switches for turning the illumination lamps on and off;

b) two cartridge fuses in the circuit of the illumination lamps (2 amp fuses, type PT);

c) two neon signal lamps with green covers; the lamps monitor the condition of the fuses and the presence of a supply voltage to the panel;

d) two resistors, 68 000 ohms (0.5 watts), type V , in series in the supply circuit of the neon lamps; [25

e) Switch position indicator: "On" and "Off".

27

The Cones and Connection Boxes

Metallic cones installed inside the casing of the plotting board provide for a more effective utilization of the light generated by the ten frosted finger-shaped lamps that illuminate the plotting board and also reduce light shadows.

For this reason the cones are covered with an enamel aluminum paint, so that the light reflected from the surface of the cones falls on the working surface of the plotting board thus illuminating it more uniformly.

There are two connection boxes with cast Silumin casings, inside of which are located 5 plates made of Duralumin. Two terminal boards are secured to each plate: one for 10 terminals and the other for 6 terminals. Leading to the terminal boards are the wires of the internal circuit of the Apparatus and of the external cables which are plugged into the connection boxes through three receptacles located in each box.

On all the terminals to which the wires are connected there is a digital engraving of the corresponding wire numbers. In addition each terminal board is also numbered.

The Electric Circuit

There are two versions of the plotting board for the surface situation: one with a source of 110 volt D.C. and the other with a source of 220 volt D.C.

The basic electric circuit for the components of the plotting board is shown in Figs. 12 and 13.

Both versions of Apparatus Pn are absolutely identical in the composition of their electric circuit elements; they differ only in the magnitude of type VS resistors in the supply circuit of the common call-signal lamps of the telephone panels; in the presence of damping resistors of type KDS; and in the circuit connecting the lamps which illuminate the working surface of the plotting board. With a supply voltage of 110 volt D.C. the illumination lamps are turned on as shown in Fig. 12. With a supply voltage of 220 volt D.C. the lamps are turned on as shown in Fig. 13.

Work Instruments and Accessories of the Plotting Board for the Surface Situation

The set of workinstruments and accessories of the plotting board include:

1. Speed finder using the method of comparison of distances run.
2. Speed finder using the method of comparison of distances run for the large scale on the diagram.

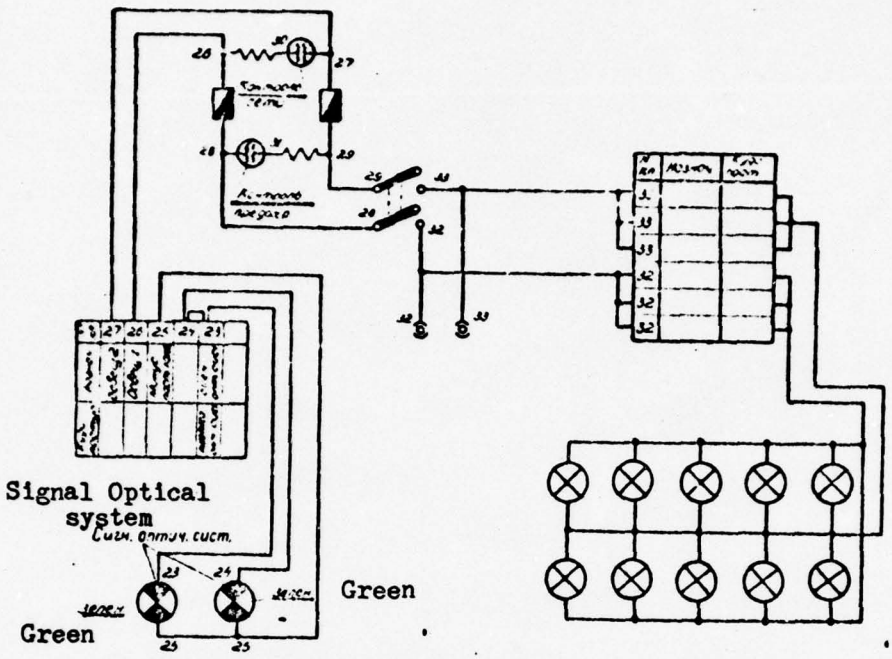


Рис. 12. Принципиальная электрическая схема включения прибора Пн (корабельная сеть 110 в)

Fig. 12. Basic electric circuit for switching on Apparatus Pn (Ship supply system, 110 v)

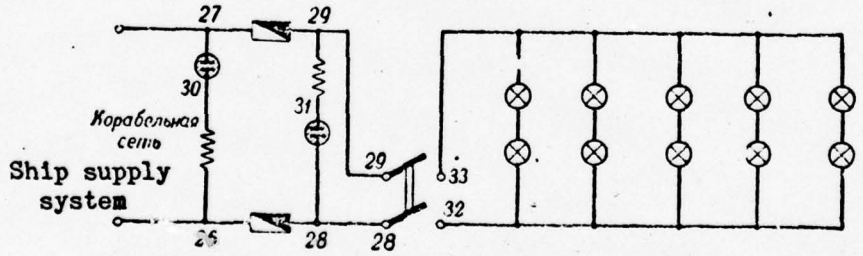


Рис. 13. Принципиальная электрическая схема включения прибора Пн (корабельная сеть 220 в)

Fig. 13. Basic electric circuit for switching on Apparatus Pn (Ship supply system, 220 v)

3. Set of speed finders for scales 0 - 5, 0 - 20, and 0 - 50 nautical miles. [27

4. Slide rule for Apparatus Pn.

5. Protractor.

6. Detachable ruler for the protractor for scales 0 - 5, 0 - 20, and 0 - 50 nautical miles.

7. Bearing converter.

8. Parallel rule 600 mm in length.

9. Dividers.

10. Drawing compass

11. Two sets of special colored pencils for recording on glass. Each set consists of pencils of 6 colors: black, brown, red, green, blue, and yellow.

12. Two sets of ordinary colored pencils. Each set consists of pencils of 6 colors: black, brown, red, green, blue, and yellow.

13. Two Mark V "Konstruktor" graphite pencils.

14. Two penknives.

15. Two soft erasers for erasing pencil recordings.

16. Fifty grams of clean cloth.

17. Roll of tracing paper.

All the above-listed instruments and accessories are located in drawers in the base cabinet of the plotting table for the surface situation.

The following items are stored in drawers located to the right of the telephone panels for 6 subscribers.

In the upper drawer:

a) bearing converter;

b) penknife;

c) one set of special colored pencils;

d) eraser for erasing pencil recordings.

In the lower drawer:

a) six cases with indicators of the effective range from Apparatus Pm;

b) one case with a speed finder using the method of comparison of distances run;

c) one set of ordinary colored pencils;

d) clean cloth.

The following items are stored in drawers located to the left of the distribution panel for 6 subscribers.

In the upper drawer:

a) protractor;

b) two detachable rulers for the protractor (one for Apparatus Pv);

c) penknife;

d) dividers;

e) drawing compass;

f) set of special colored pencils for glass;

g) soft eraser for erasing pencil recordings.

In the lower drawer: [28

a) case with speed finder;

b) slide rule;

c) parallel rule 300 mm in length for Apparatus Pm;

d) one set of ordinary colored pencils;

e) two Mark V "Konstruktor" graphite pencils;

f) clean cloth.

The parallel rule 600 mm in length is stored inside the base cabinet of the apparatus on a special rack. The tracing paper is stored in the base drawers of Apparatus Ps.

The Maneuvering Board (Apparatus Pm)

Use and Design of the Maneuvering Board

The maneuvering board is used for the graphic determination of the motion parameters of surface targets: course, speed, and distance traversed by a target as well as for the solution of tactical problems in combat maneuvering of a ship and for the determination of zones for the effective use of torpedo weapons.

The maneuvering board is auxiliary equipment of the plotting table for the surface situation and is made fast to the latter by means of special brackets and supporting braces.

The maneuvering board (Fig. 14) consists of three basic parts: working surface (board), casing, and reflector.

The casing of the board consists of metal frame 1 in which working surface 2 is secured, two brackets 3 and two supporting braces 4 by which the board is made fast to the plotting table for the surface situation.

There is a drawer 5 in the casing of the board for storing work instuments and accessories. To illuminate the working surface of the board during operation, reflector 6 is secured above the frame of the board to special bracket 7. Holder 2S-15 for the finger-shaped lamp is installed inside the reflector. The reflector can be rotated and set at a fixed position. From the reflector holder there extends a cord with a plug which, during operation, is inserted into a jack of the telephone panel for 6 subscribers on the plotting board for the surface situation, especially installed for this purpose.

A finger-shaped 110 v (15 w) type STs-3 electric lamp goes into the reflector of the maneuvering board.

The working surface of the maneuvering board is a rectangle made of organic sheet glass with dimensions 368 x 368 x 6 mm, the surface side of which has a dull finish. On the surface of the plotting board, on the area of a circle 300 mm in diameter, a working diagram is outlined in the form of a polar coordinate system consisting of radius vectors and concentric range circles. On the right and left side of the working diagram are scales which make it possible to read distances for plottings on the board in scales 0 - 5, 0 - 10, 0 - 15, 0 - 20, and 0 - 25 nautical miles.

A nomogram which enables one to determine the velocity of a target from distance and time is drawn on the lower part of the board. [29

The Working Diagram of the Maneuvering Board

The working diagram of the maneuvering board (Fig. 14) has five concentric range circles plotted at 30 mm intervals and radius vectors drawn every 10° in the form of points.

The first and fifth concentric circles, counting from the center of the coordinate system, are drawn with solid lines and the remaining circles are plotted by points spaced at 1° intervals along the circumference.

In place of each fifth point a cross is placed on the concentric circles plotted with points.

In the four quadrants of the polar diagram, over each concentric circle, circle numbers are designated which correspond to a fixed distance in the scale selected for working on the board.

Each fifth point on any radius vector between two adjacent range circles is plotted as a cross and not as a point.

Fig. 14. Maneuvering board (Apparatus Pm)

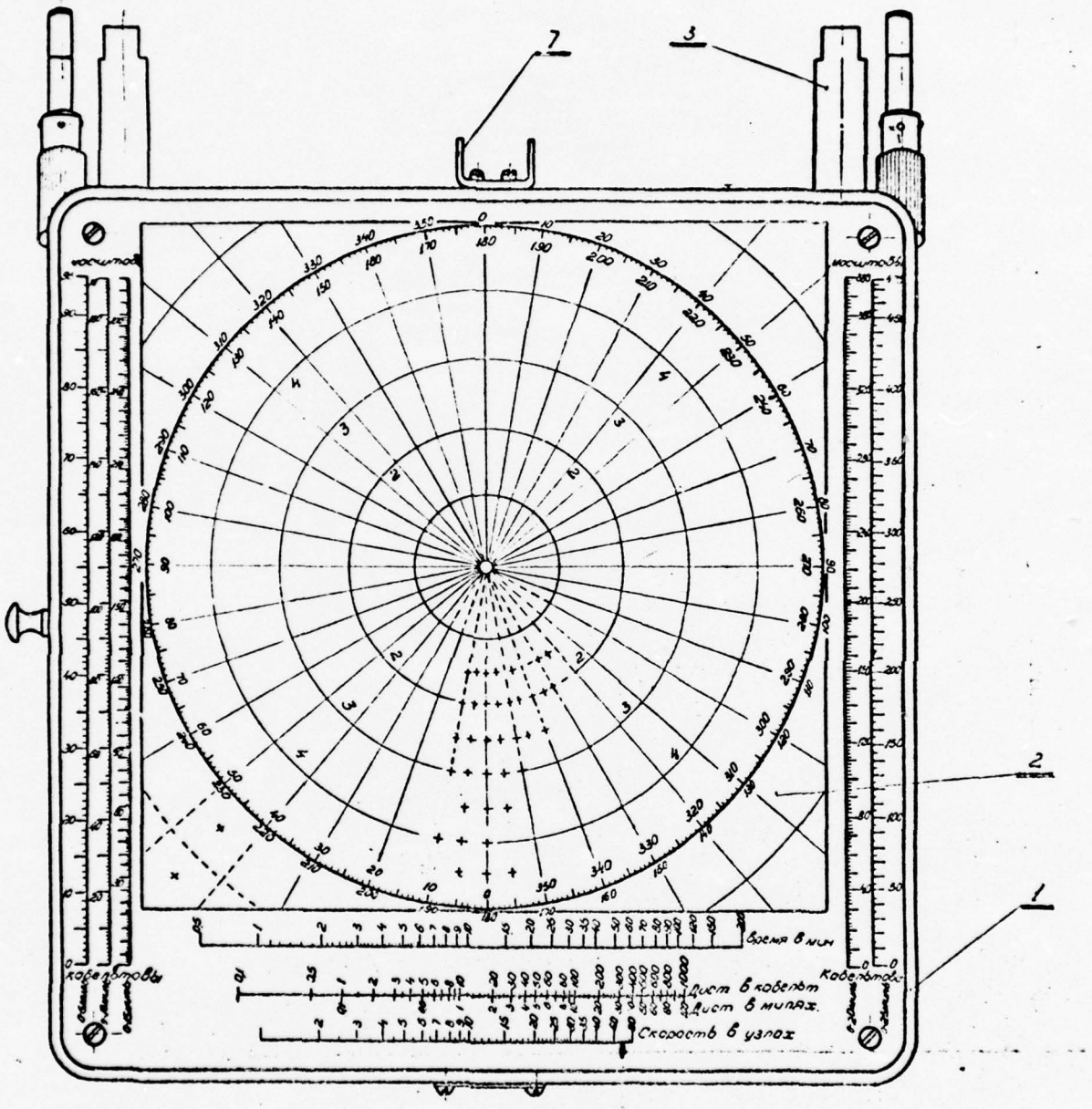


Рис. 14. Маневренный планшет (прибор П

1 — металлическая рама; *2* — рабочая поверхность; *3* — кронштейны; *4* — консоли; *5* — выдвижн

Fig. 14 Maneuvering Board (Apparatus Pm)

1 -- metal frame; 2 -- working surface; 3 -- brackets; 4 -- supporting braces; 5 -- drawer; 6 -- reflector; 7 -- bracket

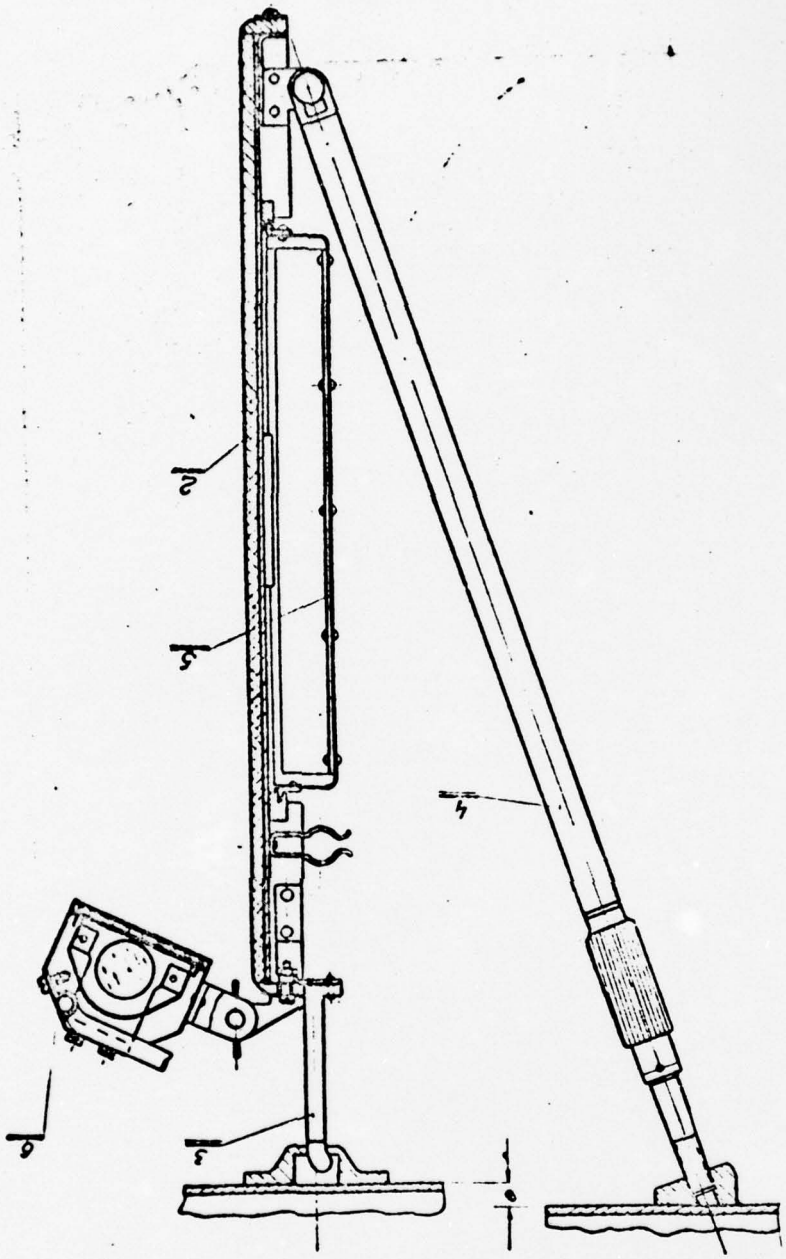


Fig. 14 Maneuvering Board (Apparatus Pm)

1 -- metal frame; 2 -- working surface; 3 -- brackets; 4 -- supporting braces; 5 -- drawer; 6 -- reflector; 7 -- bracket

The fifth circle of the diagram corresponding to distances 5, 10, 15, 20, and 25 nautical miles has a double degree scale ranging from 0 to 360°, with the value of each division equal to 1°.

For rapid determination of reciprocal bearings the scales are displaced 180° with respect to one another.

Work Instruments and Accessories of the Maneuvering Board

The following set of work instruments and accessories are available for work on the maneuvering board.

1. Six indicators of the effective range of torpedoes.
2. Parallel rule 300 mm in length.
3. Dividers.
4. Drawing compass.
5. Two Mark V "Konstruktor" graphite pencils.
6. Penknife.
7. Soft eraser for erasing pencil recordings.
8. Fifty grams of clean cloth.

All the enumerated instruments and accessories, with the exception of the indicators of the effective range of torpedoes and the parallel rule, are stored in drawers in the casing of the board.

The indicators of the effective range of torpedoes and the parallel rule are stored in drawers in the base cabinet of the plotting table for the surface situation.

The Plotting Board for the Air Situation (Apparatus Pa)

[30

The vertical plotting board for the air situation, shown in Fig. 15, is used for the graphic recording on its working surface of the position, characteristics, and motion parameters of air targets near the ship.

The plotting board for the air situation consists of the following basic parts: casing, base, working surface and auxiliary apparatus and devices.

The casing 1 of the apparatus, in assembled form, consists of two identically shaped castings of Silumin. The frames are bolted together and faced with sheet Duralumin which covers the recesses where feeder cables

appropriate for the apparatus are laid. In the center of the casing there is a circular opening in which working surface 3 of the board (diagram) is installed; this is of colorless organic glass and consists of two semicircles secured to the opening in the casing of the apparatus by special bolts with felt gaskets.

To keep the board from vibrating and to mount it more securely there [31
is shock absorber 2 in the upper part of the casing by means of which it is made fast to the deckhead.

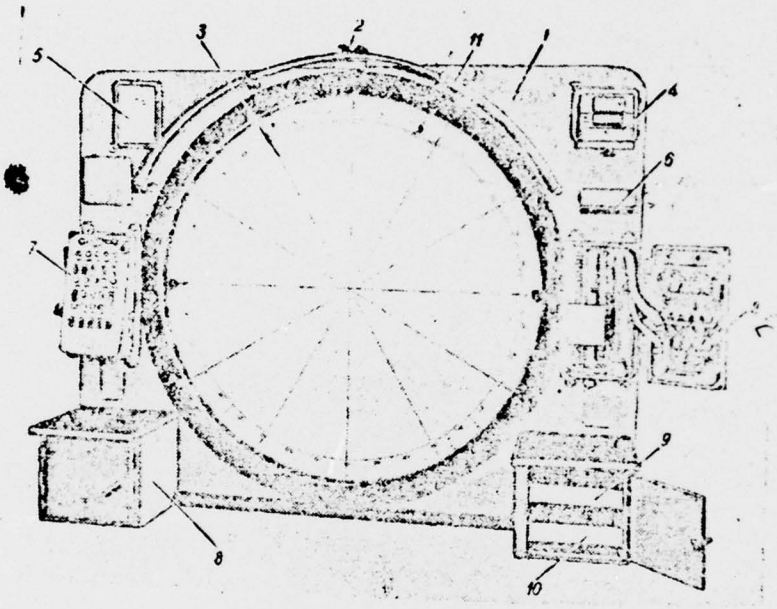


Fig. 15. Vertical plotting board for the air situation (Apparatus Pa):

1 -- casing; 2 -- shock absorber; 3 -- working surface; 4 -- electric clock; 5 -- cubicle; 6 -- hinged shelf; 7 -- telephone panel for 15 subscribers; 8 -- base cabinets; 9 and 10 -- upper and lower compartments; 11 -- framing of the working surface

Work is performed on both surfaces on the plotting board for the air situation. Auxiliary apparatus and devices used to conduct the work on the plotting board are mounted on both sides. A special electric clock 4 is located on the upper right corner of each side of the casing. On the

side opposite to the electric clock cubicles 5 are installed for storing documents during operation of the plotting board. Lower down, under the clock there are two hinged shelves 6 for placing pencils while working. The telephone panels are located under the shelves: two panels for 6 subscribers and two panel 7 for 15 subscribers on the other side. Under each telephone panel of the operational telephone communication system for 6 subscribers a fixture for illuminating the working surface of the board has been installed.

The edge of the working surface is enclosed from the outside by detachable metal ring framing 11 under which there are 18 lamp sockets -- uniformly spaced along the circumference of the working surface -- for the finger-shaped electric lamps that illuminate the diagram of the board. For convenience in changing the lamps, the lamp sockets are extensible. Access to the illumination lamps is by removing segments of the metal ring framing of the working surface.

The casing of the plotting board is secured to a special base consisting of four cabinets 8, each pair of which is connected by means of two horizontal beams at a distance from one another equal to the width of the casing of the apparatus.

The casing of the apparatus is bolted to the connecting beams between the two pairs of base cabinets. Each cabinet has two compartment-drawers: upper drawer 9 and lower drawer 10 which are closed from the outside by a common door. Each cabinet is closed from above by a wooden cover. To protect the apparatus from likely vibrations the base is set on 8 shock absorbers, two shock absorbers under each cabinet.

The Working Surface of the Plotting Board for the Air Situation

The working surface of the plotting board for the air situation consists, when assembled, of a circle -- 1500 mm in diameter -- made of colorless organic sheet glass 20 mm thick that is mounted vertically in the casing of the plotting board so as to provide for working on both sides.

One side of the working surface has a dull finish and the other side is polished. The presence of a dull surface makes it possible to see, from the polished side, all recordings plotted on the dull side and, vice versa, the recordings plotted on the polished surface are barely perceptible from the dull side. A polar coordinate diagram consisting of radius vectors and 15 concentric circles denoting distance is plotted on the dull side of the working surface.

The center of the working surface is the center or pole of the coordinate system; the radius vector with designation 0°, which represents the line of true North on the working surface is taken as the polar axis. [32

The position of any target is determined on the working surface by the length of the radius vector up to the given target and by the angle between the radius vector and the line of true North.

The angles on the diagram are recorded clockwise, from the line of true North with designation 0° up to 360°. For rapid plotting and determination of the coordinates of any target there are 15 concentric range cirsle on the working surface, of which the first ten, counting from the center, are drawn at 67.5 mm intervals, and the remaining five are drawn at 15 mm intervals. In this way the diagram is drawn as a two-scale diagram with respect to distance. The area of the circle bounded by the concentric circles drawn every 67.5 mm is used to plot positions of targets in the scales 0 - 50, 0 - 100, and 0 - 200 nautical miles. The areas of the rings bounded by the circles drawn at 15 mm intervals are used to plot the positions of targets in conformity with the scales 50 - 100, 100 - 200, and 200 - 400 nautical miles. For increased accuracy and rapidity in plotting the positions of targets the radius vectors of the diagram are drawn as solid lines every 30°, beginning with 0°; whereas in the interval between them the radius vectors are plotted, every 10°, with points, with the interval between points corresponding, respectively, to the distances 0.5, 1, and 2 miles. The points are plotted alternately in red and black.

The concentric circles from 10 to 15, counting from the center, are plotted as solid lines. The first and second circles are plotted with crosses at intervals of 5° between crosses along the arc of the circle. The rest of the concentric range circles, i.e., from 3 to 9, are plotted with at 1° intervals. On the concentric circles plotted with points a cross is plotted in place of every fifth point. In addition, the center points between the concentric circles plotted with points are marked by crosses at each 5° interval along the arc. In the four quadrants of the diagram, above the concentric range circles, the distances in nautical miles are recorded corresponding to the three scales for plotting targets: 0 - 50, 0 - 100, and 0 - 200 nautical miles.

The degree scale on the diagram is placed on the tenth range circle and extends from 0 to 360°, with 1° divisions.

The Electric Clock of the Plotting Board for the Air Situation

The electric clock of the plotting board for the air situation is used to record the time of a fix on targets. The clock is a secondary clock and is connected to the over-all electric clock system of the Combat Information Center; it operates from the over-all primary clock. The clock is secured in a special rotatable case which is connected with the casing of the plotting board by hinges. The case of the clock can be rotated 90° with respect to the casing of the board and set at any fixed positionby means of a stop screw. The clock in the over-all electric clock system of the Combat Information Center is connected through a terminal plate to three terminals [33

installed inside the casing of the plotting board behind the electric clock. For access to the terminal plate the clock must be rotated 90° with respect to the casing of the plotting board.

Under each terminal plate there is a junction box for leading in the feeder cable. A description of the circuit of the secondary clock and its operation in the over-all circuit of the electric clock system of the Combat Information Center is presented in Chapter VIII (Auxiliary Apparatus and Devices).

The Illumination Panel of the Working Surface

The illumination panels are used for switching on the illumination of the working surface of the plotting board: one panel is for turning on the illumination lamps of the right half and the other is for the left half of the working surface.

Installed on each panel are the following:

a) switch for turning the illumination lamps on and off;

b) two 2 amp cartridge fuses, type PT, in the circuit for the illumination of the lamps;

c) two special fixtures with neon lamps and red covers; the lamps are used to monitor the condition of the fuses and the presence of a voltage supply to the panel;

d) two type VS resistors -- 68 000 ohms (0.5 watts) -- in the supply circuit of the neon lamps;

e) switch position indicator ("On" and "Off").

Access to the panel assembly is through an opening on the reverse side of the plotting board's casing opposite each panel; the opening has a cover that is screwed on.

The Basic Electric Circuit for Illuminating the Working Surface of the Plotting Board

The basic electric circuit for illuminating the working surface of the plotting board for the air situation is presented in Figs. 16 and 17.

The illumination of each working half of the surface of the board is accomplished by nine finger-shaped electric lamps 1 connected in parallel or as shown in Fig. 17, depending on the supply voltage. The parallel connection of lamps is accomplished on a 10-terminal plate to which the feeder wires from each lamp are led. The plate for each half of the illumination for the working surface of the plotting board is installed inside the casing of the board. Under each terminal plate there is a junction box for leading in the feeder cable. [34

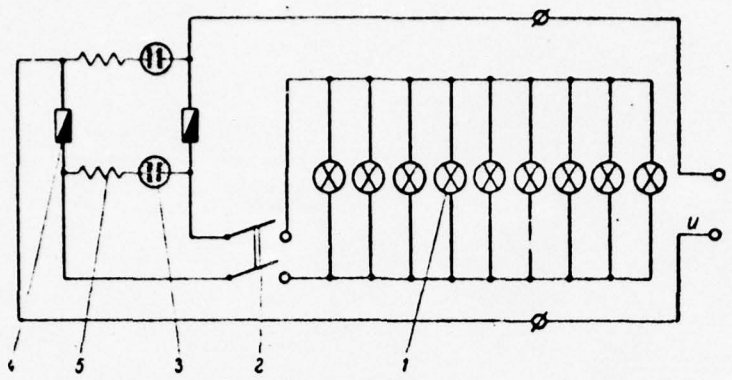


Fig. 16. Basic electric circuit for illuminating the working surface of a plotting board (voltage: 110 v):

1 -- finger-shaped electric lamps; 2 -- double-pole switch; 3 -- neon lamps; 4 -- safety fuses; 5 -- resistor

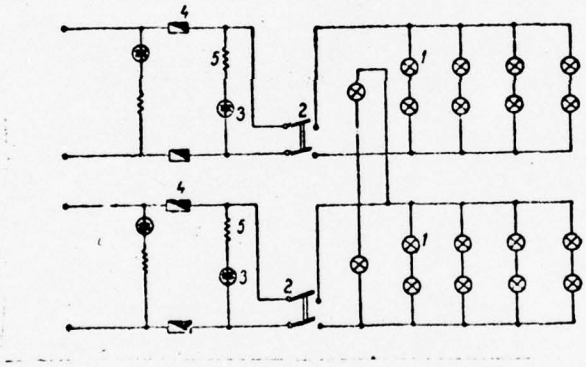


Fig. 17. Basic electric circuit for illumination the working surface of a plotting board (voltage: 220 v)

1 -- finger-shaped electric lamps; 2 -- double-pole switch; 3 -- neon lamps; 4 -- safety fuses; 5 -- resistor

Two amp safety fuses 4 are in the feeder wires for protection against short curcuit currents. Two neon lamps 3 are inserted between the feeder wires: the lamp inserted before the fuses monitors the presence of a supply voltage to the illumination panel while the lamp inserted after the fuses monitors their integrity. In the supply circuit of each neon lamp a wire wound resistor 5, type VS -- 68 000 kilohms (0.5 watts), is placed in series with the lamp and is independent of the supply voltage delivered to the panel. STs type lamps, 110 volts (15 watts), are used on the plotting boards to illuminate the working surface. [35

Work Instruments and Accessories of the Plotting Board for the Air Situation

The list of work instruments and accessories of the plotting board for the air situation include the following items:

1. Two speed-finder sets with scales 0 - 50, 0 - 100, and 0 - 200 nautical miles.
2. Special slide rule.
3. Two bearing converters.
4. Protractor with direct engraving of the scale.
5. Protractor with reverse engraving of the scale.
6. Six detachable rulers with protractor for scales 0 - 50, 0 - 100, and 0 - 200 nautical miles (there are 2 rulers for each scale).
7. Parallel rule 600 mm in length.
8. Dividers.
9. Beam compass.
10. Drawing compass.
11. Four sets of special colored pencils for glass. Each set consists of pencils of 6 colors: black, brown, red, green, blue, and yellow.
12. Four sets of ordinary colored pencils. Each set consists of pencils of 6 colors: black, brown, red, green, blue, and yellow.
13. Two Mark V "Konstrucktor" graphite pencils.
14. Three penknives.
15. Two soft erasers for erasing recordings.
16. Bottle containing 100 grams of fluid for removing pencil recordings.
17. 100 grams of clean cloth.

The above-indicated instruments and accessories are stored in the base drawers of the plotting table.

The following items are stored in the drawers located on the side of the telephone panel for 6 subscribers:

In the upper left drawer:

a) protractor with reverse engraving of the scale;

b) three detachable rulers for the protractor with scales 0 -50, 0 - 100, and 0 - 200 nautical miles;

c) penknife;

d) set of colored pencils for glass

e) soft eraser.

In the lower left drawer:

a) set of ordinary colored and conventional pencils;

b) 25 grams of clean cloth.

In the upper right drawer: [36

a) set of colored pencils for glass;

b) ordinary colored pencils;

c) penknife;

d) 25 grams of clean cloth.

In the lower right drawer:

a) bearing converter;

b) case with three speed finders for scales 0 - 50, 0 - 100, 0 - 200 nautical miles;

The following items are stored in the drawers located on the side of the telephone panels for 15 subscribers:

In the upper left drawer:

a) bearing converter;

b) case with three speed finders for scales 0 - 50, 0 - 100, and 0 - 200 nautical miles.

In the lower left drawer:

a) protractor with direct engraving of the scale;

b) three detachable rulers for the protractor with scales 0 - 50, 0 - 100, and 0 - 200 nautical miles;

c) drawing compass;

d) dividers;

e) penknife;

f) set of special colored pencils for glass;

g) eraser.

In the upper right drawer:

a) slide rule;

b) bottle of fluid;

c) 50 grams of clean cloth.

In the lower right drawer:

a) set of special colored pencils for glass;

b) two sets of ordinary colored pencils.

The beam compass and parallel rule 600 mm in length are located on the narrow side walls of the casing of the plotting board: the compass is on the right and the ruler is on the left side of the telephone panels for 15 subscribers.

The Guidance Board (Apparatus Pv)

The guidance board is used for the graphic recording on its working surface of the characteristics and motion parameters of air targets in directing one's own aircraft against surface or air targets.

In structural design, arrangement, and with respect to its working surface the guidance board is identical to the previously described board for the surface situation (Apparatus Pn).

The guidance board and the board for the surface situation are interchangeable. On certain ships one apparatus can be installed which, depending on circumstances, is used either for plotting the positions of surface targets, i.e., such as the board for the surface situation, or for plotting air targets, i.e., such as the board for the air situation.

CHAPTER IV

APPARATUS OF THE OPERATIONAL TELEPHONE COMMUNICATION SYSTEM

A Brief Description of the Operational Telephone Communication System and Its Use [37

The operational telephone communication system is the basic communication system insuring the operation of the CIC. It is designed to receive and transmit data on the situation and to link together the ship's most important stations accordingly.

A self-powered telephone communication system with separate control switchboards in the form of telephone panels with capacity for 3, 6, 8, 10, and 15 subscribers is used in the Combat Information Center as the operational telephone communication system. Each telephone panel can call-up individual subscribers connected to it as well as well as several subscribers at the same time.

The operational telephone system can quickly connect the basic observation stations with the Combat Information Center and likewise connect the CIC with the ship's command stations without recourse to a central telephone switchboard.

The call-up of subscribers is accomplished by a light and sound signal system fed from the ship's 110 or 220 volt D.C. supply system.

The operational telephone communication system consists of the following basic apparatus:

1. Telephone panels for 3, 6, 8, 10, and 15 subscribers, used as subscriber stations.

2. Valve oscillator, used as a source of low frequency oscillations for transmitting an acoustic call signal.

3. Relay box for connecting the valve oscillator to the panel being summoned at the time an acoustic call signal is transmitted.

Telephone Panels

Telephone panels with a capacity for 3, 6, 8, 10 and 15 subscribers are constructed both in the form of individual assemblies (Fig. 18) and in the

form of components mounted on apparatus Ps, Pn, and Pv. In the telephone panels of this equipment, with the exception of Pa, the acoustic call signal is replaced by a light signal. In order to call-up telephone panels installed in open combat stations, a call bell is mounted on these panels. [38

The telephone panels constructed in the form of individual assemblies consist of a casing cast of Silumin with a hinged cover. Located on the front of the cover are the organs of control, signalling, monitoring, and safety, i.e., knobs of the talk-call keys, push button for transmitting a sound call signal, signal covers over the calling neon lamps and over the lamps monitoring the integrity of fuses, and also cartridge fuses.

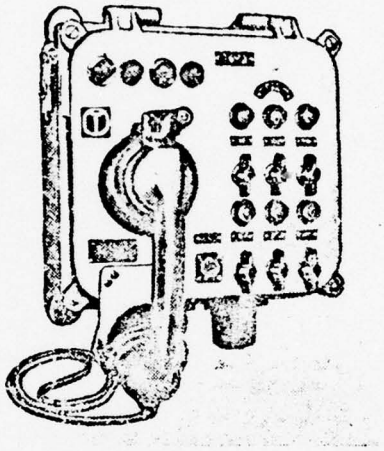


Fig. 18. Telephone panel for three subscribers

Each assembly has a junction box for leading in feeder cables as well as a plug jack for connecting the removable microtelephone receiver on the front of the cover.

The telephone panels for 6 and 8 subscribers mounted on Apparatus Ps, Apparatus Pn, and Apparatus Pv are constructed in the form of metal panels on the face side of which the same control, signalling, monitoring, and safety organs are mounted.

The Relay Box

Depending on the number of telephone panels in the circuit of the operational telephone communication system, a relay box of 20 or 35 relays is installed in the CIC.

The relay box consists of a casing cast of Silumin with a hinged cover and is bolted to the casing.

Located inside the casing of the relay box is a frame connected to the casing by hinges and secured by bolts. The frame can be turned on the hinges 120° to the left in order to gain access to the components mounted on the frame and to the terminal plates.

Mounted on the frame are 20 or 35 KDP-1 type telephone relays with two contact groups which operate when closed and also 20 or 35 1 amp knife fuses in the supply circuit of the relay windings.

Terminal plates are mounted on the bottom of the casing of the relay box. Connecting cables are brought up to the terminal plates through 5 junction boxes located on the lower side wall. [39

The Valve Oscillator (Assembly Lg)

A low frequency valve oscillator, the basic ciruit of which is shown in Fig. 19, is the source of a sound frequency current of 450 ± 100 cps which is transmitted to the panels through the relay box in order to produce an acoustic call signal.

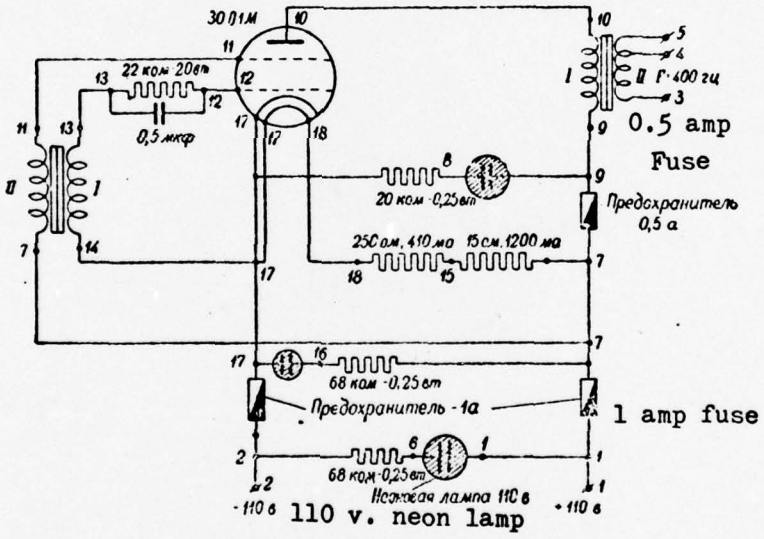


Fig. 19 Basic electric circuit of a low frequency valve oscillator (Assembly Lg)

In design the valve oscillator is constructed in the form of a casing cast of Silumin with a removable chassis. In the casing, on the rear wall, a terminal plate is mounted with four contact jaws with which are connected the knife-switch blades installed on the chassis. In the bottom of the casing there is a junction box for admitting a cable. The chassis of the valve oscillator is made of Duralumin and consists of a horizontal panel with a vertical wall which is, at the same time, a cover. The chassis is inserted into the casing on guides and the front panel is fixed to the casing by means of four screws. There are two openings in the casing for dissipating the heat generated during operation of the valve oscillator. All components of the valve oscillator circuit are located on the horizontal panel with the exception of the capacitor of constant capacity, the grid leak resistor, the fuses, and the neon control lamps which for convenience [40 in servicing are located on the front vertical panel of the chassis.

The valve oscillator does not have a control or adjustment knob; it is turned on from the over-all switchboard of the CIC. From its basic circuit the valve oscillator is an oscillator with self-triggering in type 30-P1-M tube with subsequent amplification of the low frequency oscillations in the anode circuit of this same tube. The circuit is fed from 110 volt D.C. With 220 v. D.C., a box is connected to the valve oscillator with ballast resistors which are inserted in the supply circuit of the oscillator. A voltage in excess of 110 is cancelled through the ballast resistors.

Operation of the Basic Electric Circuit of the Operational Telephone Communication System

The entire operational telephone communication system is switched into operation by setting the "Operational communication" rotary switch on the CIC switchboard at position "On." A 110 or 120 volt direct current is supplied to all equipment entering into the operational telephone communication system and the circuit as a whole is ready for operation.

Operation of the operational telephone communication system is illustrated by the basic circuit shown in Fig. 20.

The circuit makes it possible to conduct either pair communication or communication with several subscribers at the same time.

Pair communication is accomplished in the following manner. In order to call Subscriber No 1 from the panel for three subscribers the talk-call key of the given subscriber on the panel must be set in the "Call" position and the "Sound signal" push button must be pressed. In this case the key contacts 5 - 9, 2 - 8, and 1 - 10 are closed whereas contacts 1 - 9 and 1 - 1 are open. Contacts 8 - 10 of the call key are closed. Thereupon the following circuits are formed:

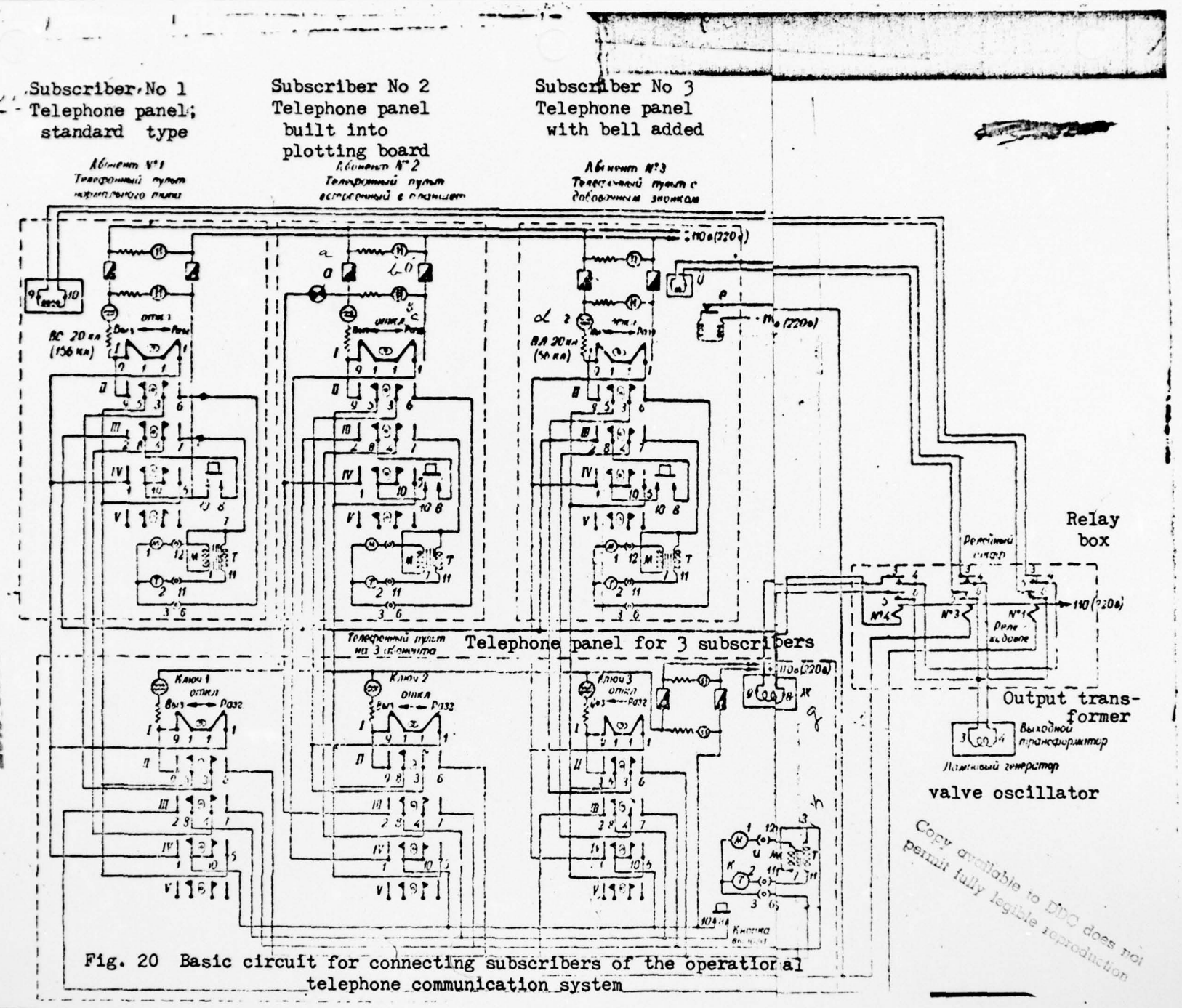


Fig. 20 Basic circuit for connecting subscribers of the operational telephone communication system

Fig. 20. Basic circuit for connecting subscribers of the operational telephone communication system:

a) light signal for call-up of panel;
b) supply system control;
c) control fuse;
d) call signal for subscriber;
f) bell;
e) and g) capsule of the BEM (electromagnet) of the sound signal;
h) microtelephone transformer;
i) plug jacks;
j) telephone receiver

First circuit: +110 volts, fuse, terminal 10, contacts 1 - 10 of key No. 1 of the the panel for 3 subscribers, line, contacts 1 - 1 and 1 - 9 of key of Subscriber No. 1, resistance of 20,000 ohms, neon lamp, fuse, - 110 volts, whereupon the neon call signal lamp of Subscriber No. 1 lights up.

Second circuit: +110 volts, fuse, terminal 10, contacts 8 - 10 of push button, contacts 2 - 8 of key No. 1 of the panel for 3 subscribers, line, terminal 2 of relay No. 1, windings of relay, terminal 1, - 110 volts. In this case relay No. 1 (of the panel summoned) in the relay box operates and its normally open contacts 3 - 4 and 5 - 6 are closed, thereby forming a third circuit.

Third circuit: terminal of output transformer of valve oscillator, relay contacts 5 - 6, line, terminal 8 of capsule BEM-2 (electromagnet), coil of capsule, terminal 9, line, relay contacts 3 - 4, terminal 4 of output transformer. In this case an acoustic call signal operates on the call panel, the action of which continues as long as the button remains in a depressed condition. [41

Upon receiving a light and call signal Subscriber No. 1 removes the microtelephone receiver on his panel and sets the "Talk-call" key under the lighted signal neon lamp at the "Talk" position, whereupon key contacts 3 - 6, 4 - 7, 5 - 10 are closed while contacts 1 - 9, 1 - 1, 5 - 9, 2 - 8, 1 - 10 are open.

The first circuit is broken by contacts 1 - 9 and 1 - 1 of the key and the neon call lamp of Subscriber No. 1 is extinguished. With the closing of contacts 3 - 6 and 4 - 7 the microtelephone set is connected to the line and the conversation circuit is readied. With the closing of contacts 5 - 10 a fourth circuit is formed.

Fourth circuit: + 110 volts, fuse of panel of Subscriber No. 1, key contacts 5 - 10, line, contacts 5 9 of key No. 1 of panel for three subscribers, resistance of 20, 000 ohms, neon lamp, fuse, - 110 volts. In this case the neon lamp on the panel of the subscriber being called lights up; this is a signal that Subcriber No. 1 is ready to speak. After receiving

a return signal that Subscriber No. 1 is ready to speak, the subscriber of the panel for three subscribers removes the microtelephone receiver and sets the "Talk-call" key in the "Talk" position. In this case contacts of Key No.1 5 - 9, 2 - 8, 1 - 10, and 1 - 9 are open while contacts 3 - 6, 4 - 7, and 5 - 10 are closed, whereby the fourth circuit is broken by contacts 5 - 9 and the neon lamp of the panel for three subscribers is extinguished. With the closing of contacts 3 - 6 and 4 - 7 a fifth circuit (conversation) is formed.

Fifth circuit: microtelephone set of the panel for three subscribers; terminals 1, 2, and 3 of the plug jack, contacts 3 - 6 and 4 - 7 of key No. 1, line, contacts 3 - 6 and 4 - 7 of the key of Subscriber No. 1, microtelephone set of Subscriber No. 1. When the fifth circuit is closed the microtelephone sets of the subscribers are connected.

In order to separate the microtelephone and telephone circuits and to reduce audibility of one's conversation in one's own telephone, microtelephone transformers are included in the conversation circuit. This system permits a simultaneous call of either panel by several subscribers and is independent of the fact that this panel is or is not busy. In this case the call circuit remains the same as described above. Upon completing a conversation the subscribers set the microtelephone sets in place and the talk-call keys are set in the "Off" position.

In order to conduct a simultaneous conversation (circular communication) with several subscribers the corresponding talk-call keys on the calling panel must be set in the "Call" position and the "Sound signal" button must be depressed. In this case the neon call lamps of the subscribers being called light up and the sound call signal operates. In other respects the operation of the circuit is the same as described above.

The call signal circuits are fed from a supply system of 110 or 220 volts D.C. through a switchboard. For protection against short circuits two fuses are installed in each panel. The monitoring of the supply voltage and integrity of the fuses is accomplished by two neon lamps with red signal covers inserted before and after the fuses. [42

In case feeding ceases both lamps on the panel go out and if the fuses burn out only the right lamp is extinguished.

Sound call signals are not present in the telephone panels built into Apparatus Ps, Pn, and Pv. So that the panels of this equipment can receive a common call signal there are special signal devices with red lenses under their working surfaces.

Autonomous Switchboard Communication

The autonomous switch board communication system is used to transmit information and to conduct official conversations between points within the sphere of activity of the CIC which, with respect to the type of functions

being performed, do not require urgent and uninterrupted prolonged communication between them. In the event the lines of the operational communication system are impaired the autonomous switchboard communication system can be used as a reserve.

Loudspeaker Communication

Loudspeaker communication is used to insure rapid, reliable, and clear communication between the basic plotting boards of the Combat Information Center and the ship's main control stations.

Ordinary Telephone Communication

Ordinary telephone communication that is used in the CIC to conduct official conversations with radar and other ship stations which are not subscribers of the operational or autonomous switchboard communication systems is accomplished by the ship's ordinary telephone exchange system. The telephone apparatus for ordinary communication is located as a rule on the majority of ships near the Commander of the Combat Information Center.

Radio Communication

Radio communication in the Combat Information Center is used to direct aircraft and torpedo boats and also to communicate with other ships.

For this purpose auxiliary radio communication stations are installed in the CIC which consist of a panel and microtelephone set. The number of auxiliary radio communication stations (VPS) installed in the CIC depends on the class of the ship. The auxiliary radio communication stations are installed near the situation plotting boards and near the CIC Commander.

By means of the auxiliary radio communication stations two-way radio telephone communication on the part of the CIC is established with aircraft and torpedo boats that are being guided as well as with other ships in a squadron. Two-way communication is accomplished through radio communication channels assigned to the Combat Information Center. The switching on of the radio lines is conducted in the ship's radio center for telephone inquiries from an auxiliary radio communication station. [43

Synchronous Communication System

The synchronous communication system used in the Combat Information Center serves for the reception and transmission of data on the relative bearing, elevation angle, course, range, speed and distance run.

Installed in the CIC are the following:

a) receptors of the course;

b) receptors of the relative bearing;

c) receptors of range;

d) receptors of distance run and speed;

e) transmitters of elevation angle.

All the indicated synchronous communication devices are component elements of the corresponding over-all ship synchronous communication systems and are connected to the said systems.

The course receptors are conventional ship gyrocompass repeaters on gimbals (Fig. 21)

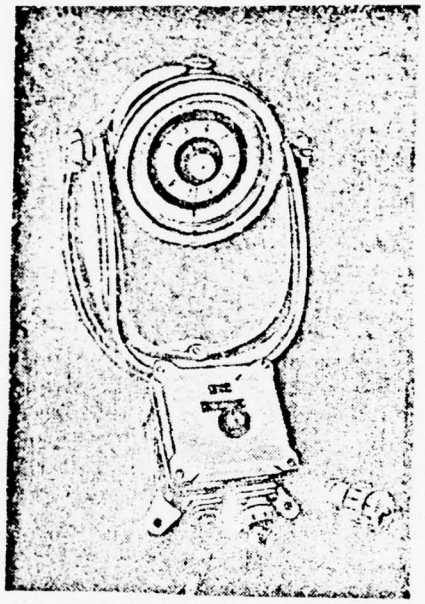


Fig. 21 Course repeater with gimbals

Each repeater is switched into the circuit of the forward or after gyrocompass through a special switch.

The course repeater on gimbals is mounted on vertical plotting board Pa, on plotting table Pc and on the desk of the Commander of the Combat Information Center.

The gyrocompass repeaters built into the Pm and Pv plotting boards are also included among the course receptors.

The relative bearing receptor shown in Fig. 22 is a standard device 24 used for the reception of one's own relative bearing on a target which is being tracked by means of electronic equipment. On some ships the "bearing indicator" of sonar station "TAMIR" is installed as a receptor of the relative bearing. The "bearing indicator" is installed alongside the Ps plotting table.

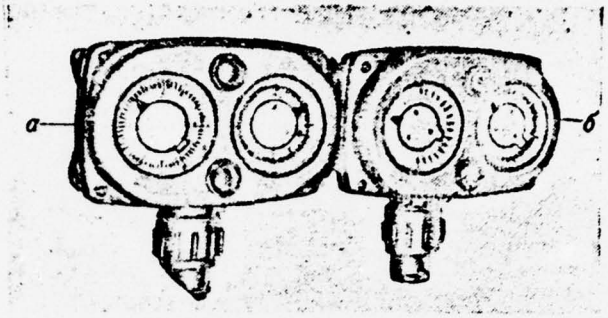


Fig. 22 Relative bearing receptor and range receptor

The range receptor, an over-all view of which is shown in Fig. 22 (on the right) is standard device 56. Also installed in the CIC on some ships is a repeater of the recorder of the TAMIR-5N Sonar Station which is used to indicate distance to underwater targets. The range receptors, just as device 56 and the recorder, are used to provide necessary data for the Ps plotting table.

The receptors from the log in the CIC are used for information on the ship's speed and distance run.

The Transmitter of the Elevation Angle (Device Du)

The transmitter of the elevation angle is a device used for an approximate determination of the altitude and angular elevation of a target from "Gyuys-2" -- aircraft detection radar -- data and for the transmission of this data from the CIC to the target-designation distribution point.

All components of Device Du are located in a cast metal casing. The casing has a hinged cover on the inside of which is mounted a nomogram.

The control organs and the scale of the device are located on the top horizontal panel under the cover. The scales of a computer device are located on the left part of the panel under glass; and above the computer is the scale of the transmitter DI-511 and the knob of the index.

Located on the right side of the panel is the knob of the switch with inscription "Receive target-designation," and above it is the cover of signal lamp STs-21 with inscription "Transmit target-designation." In the bottom part of the casing there is a junction box for leading in the feeder cable to the terminal plate mounted inside the casing. Access to the terminal plate is through a cover located on the inclined plane of the casing and secured to it by bolts. [45

Access to the signal lamp and to the contacts of the switch and transmitter is by way of removing the upper half of the device: in this case the index knob must first be removed.

The casing has lugs with openings for bolts by which the device is secured when mounted.

The Du device consists of the following basic elements:

a) nomogram for determining the altitude of a target;

b) computer device for determining the elevation angle of the target;

c) target-designation transmitter DI-511 with a scale and index for setting up a target's elevation angle that is to be transmitted;

d) light signal components.

The nomogram shown in Fig. 23 for determining the altitude of a target consists of the radiation characteristics of the radar antenna in the vertical plane, constructed in the rectangular system of coordinates. [46

The lines of minimal antenna radiation (zero lines) are used to determine the altitude of a target. The inclined range in nautical miles to a target is plotted on the nomogram along the horizontal axis, whereas the altitude of the target is plotted in meters along the vertical axis.

For clear representation not only are the zero lines plotted on the nomogram but also the lobe pattern of the radar antenna radiation.

When an air target crosses the region of the zero lines of the lobe pattern the signal reflected from the target on the screen of the radar tube either disappears or is greatly attenuated.

After determining the inclined range of a target at the moment of loss or weakening of the signal reflected from the target, the altitude of the target is determined on the nomogram from the inclined range. For a unique determination of a target's altitude it is necessary to find no less than two points of intersection of the zero lines corresponding to two different values of the inclined range and to connect them with a horizontal straight line; the intersection of this line, when extended, with the vertical axis gives the desired altitude of the target.

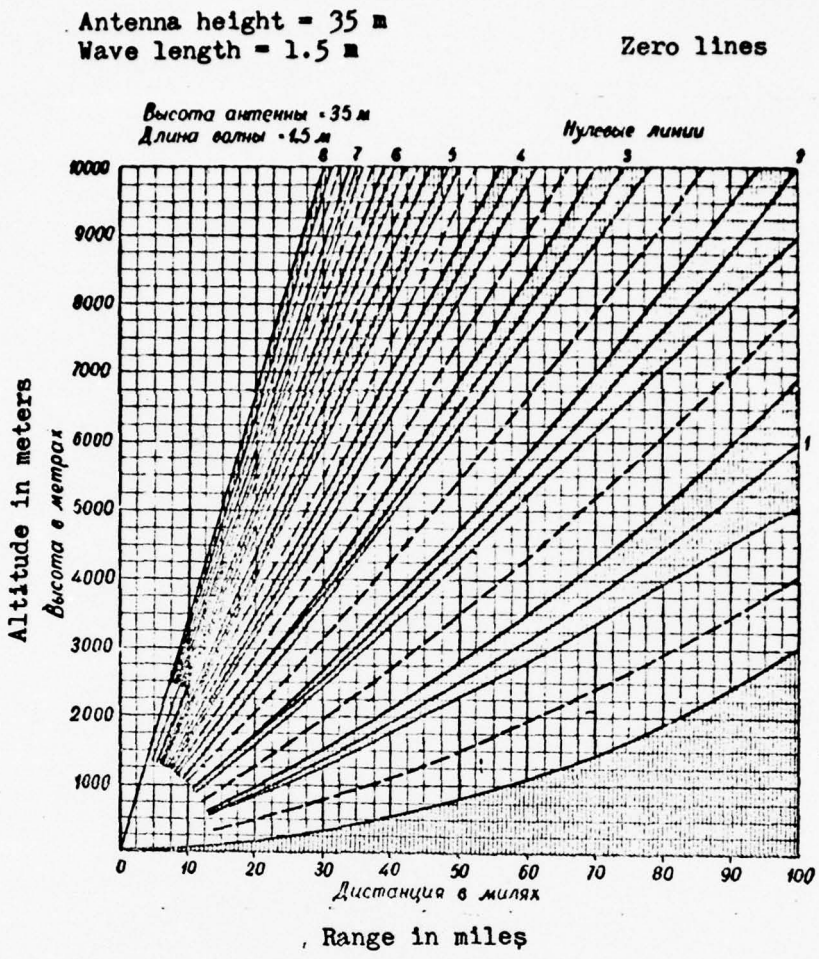


Fig. 23 Nomogram for determining the altitude of a target

The nomogram is located under colorless organic glass allowing one to make auxiliary constructions on it with special pencils and to remove these constructions after determining the altitude. Two nomograms are assigned to Device Du which differ only in the altitude scale: one extends to 20 km and the other to 10 km. The value of the inclined range of the target is 100 miles for both nomograms.

The determination of the elevation angle is performed by a computing device consisting of three concentric scales (Fig. 24).

The inclined range (distance) scale is a movable scale but the altitude and elevation angle scale is fixed.

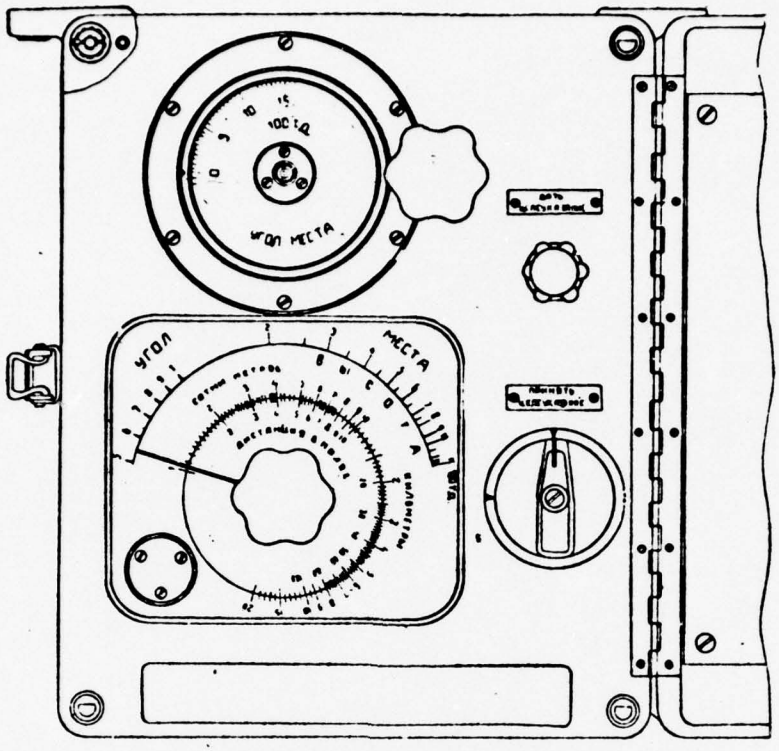


Fig. 24. View of the scales of Device Du

The relative arrangement and drawing of the graduation lines on the concentric scales is such that when the values of the range in miles and the altitude in meters coincide on the first two scales the pointer attached to the movable scale indicates on a third scale the value of the elevation angle in 100 t.d.

The elevation angle of a target determined by means of the computing device can be outputted into the ship's target-designation circuit by means of the target-designation transmitter of the elevation angle. The target-designation transmitter of the elevation angle is a modified standard device of the PUS self-synchronizing synchronous transmission system in selsynDI-511, with the value of a rotation equal to 6000 t.d. The scale situated on the shaft of the selsyn rotor of transmitter DI-511 is shown in that same drawing.

Rotation of the scale and its setting at a fixed position, resulting in the rotation of the selsyn rotor of transmitter DI-511, is produced by means of the index knob located to the right of the scale.

The light signal components of the device consist of a cam-type switch and an STs-21 110 v (15 w) lamp with inscription "Transmit target-designation."

Principle of Operation of Device Du [47

The principle of operation of Device Du is based on the fact that the altitude of the target is determined from the nomogram from the measured distance to a target at the time of the disappearance or attenuation of the reflected signal; and then, from the altitude determined and from the distance measured to the target, the elevation angle of the target is calculated by means of the computer device.

The elevation angle of the target determined in this manner is sent by the radio operator, by means of transmitter DI-511, to the point of distribution of the target designation; for this purpose the radio operator, by means of a knob with 30 fixed positions, turns the disk of the elevation angle to the required value. When the scale of the transmitter is set at the specified angle the rotor of transmitter DI-511 rotates; this causes the rotor of the receiving selsyn to turn to that same angle. Thereupon the elevation angle of the target will be recorded on the scale of the receiving selsyn at the point of distribution of the target designation. A request concerning the sending or reception of the target designation or notice of its cancellation is carried out by means of the light signal circuit shown in Fig. 25.

To transmit target designation

To receive target designation

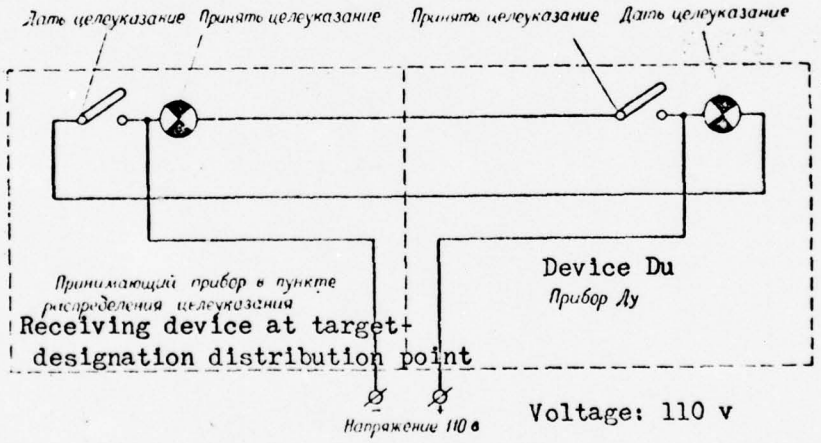


Fig. 25 Light signal circuit for the target-designation of the elevation angle

As seen from the drawing, the switching on of the signal lamp of Device Du is accomplished in a receiving device which has the same light signal components as Device Du. When the switch of Device Du is set in the "Receive target-designation" position the contacts of the switch close the supply circuit of the signal lamp in the receiving device to which the light signal of Device Du is being transmitted.

Apparatus of the Optical System

Purpose of the Optical System

The optical system is used by the Main Command Center to monitor the situation plotted on the boards in the Combat Information Center. The CIC is located, as previously indicated, under the Main Command Center of the ship or alongside.

Depending on the location of the Main Command Center with respect to the CIC and on the location of the situation plotting boards (Ps and Pn) the optical system used in the CIC is either angular or vertical.

Angular Optical System OS-U2

Angular optical system OS-U2, a diagram of which is shown in Fig. 26, consists of a horizontal and a vertical tube 85 mm in diameter.

Vertical tube 3 of the optical system is secured in column 2 which is installed in the Main Command Center and bolted to the deck.

The column has a drop table with a drawer for storing recording materials and two push buttons for transmitting light signals to the radio operators of the plotting boards: one button is for plotting board Pn and the other for Ps. [49

Horizontal tube 1 of the optical system can be rotated about its vertical axis. The end of the horizontal tube slides along supporting strip 4 secured to the deckhead. The erecting lens inserted at the end of the horizontal tube can be set over the center of one of the two plotting boards 5.

In both the horizontal and vertical tubes of angular optical system OS-U2 all the optical devices are assembled in the form of individual optical units set in individual mountings and inserted in an L - shaped tube.

Basic data of optical system OS-U2:

a) visual magnification -- 0.3^{x};

b) field of view -- 1000 mm;

c) diameter of entrance opening -- 5.95 mm;

d) diameter of exit opening -- 5 mm;

e) length of the horizontal part of the system -- 1600 - 2000 mm;

f) length of the vertical part of the system -- 1615 - 2515 mm;

g) field of view of the system -- 53°;

h) displacement of prism and eyepiece -- 150 mm.

Note. Assembly of the entire system with the given dimensions of the horizontal and vertical tubes is conducted at the factory. Dismantling of the optical system by ship personnel is prohibited.

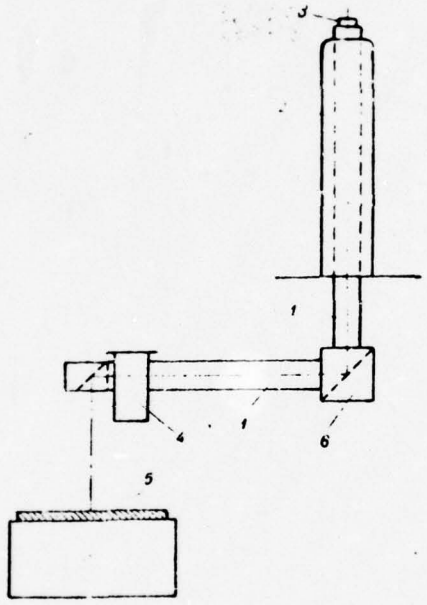


Fig. 26 Diagram of the angular optical system:

1 -- horizontal tube; 2 -- column; 3 -- vertical tube; 4 -- support strip; 5 -- plotting board; 6 -- lens

Angular Optical System OS-U1

In its external construction design angular optical system OS-U1 does not differ in any way from angular optical system OS-U2. The basic

difference between the OS-U1 and OS-U2 systems is in the optical scheme and in the limit to which the dimensions of the horizontal and vertical parts of the system may be varied. In optical system OS-U1 the length of the horizontal part can be altered (under factory conditions) within limits ranging from 1000 mm to 1600 mm; and the length of the vertical part -- from 1633 - 2515 mm. [50

Basic data of the optical system:

a) magnification -- 0.3;

b) field of view -- 1000 mm;

c) diameter of exit opening -- 5 mm;

d) diameter of entrance opening - 5.95 mm;

e) position of exit opening -- ± 16 mm.

Vertical Optical Systems and How They Differ From Angular Systems

There are two types of vertical optical systems -- No 1 (OS-P1) and No 2 (OS-P2). In contrast to angular optical systems each vertical optical system consists of only one vertical tube secured in a vertical column, as shown in Fig. 27.

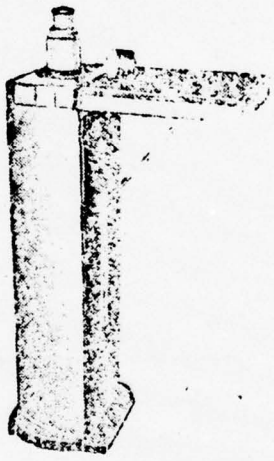


Fig. 27 Over-all view of optical system column

The column is standard for both angular and vertical optical systems. Vertical optical systems differ basically from angular systems in the fact that they enable one to monitor, from the Main Command Center, the situation on only one of the plotting boards over which this system is set. In

vertical optical systems, in contrast to angular systems, the prism and mirror are absent. Length of vertical systems : OS-P1 -- 1178 - 2086 mm; OS-P2 -- 2627 - 4509 mm.

CHAPTER V

SIGNALLING EQUIPMENT [51

Purpose

Signalling equipment is used in the Combat Information Center to receive two or three separate light signals concerning the operation status of the ship's radar stations. Signal assemblies for 10 or 20 radar stations are employed for this purpose.

Construction Design of Signal Assemblies

The signal assembly for 20 radar stations (Apparatus S-20), shown in Figs. 28 and 29, is used to receive light signals concerning the operation status of a ship's 20 radar stations. The apparatus consists of casing 1 and cover 2 cast of Silumin. The cover is joined to the casing by two hinges and secured by six bolts. The apparatus is watertight, for which [52 purpose rubber cord 3 is placed between the cover and casing.

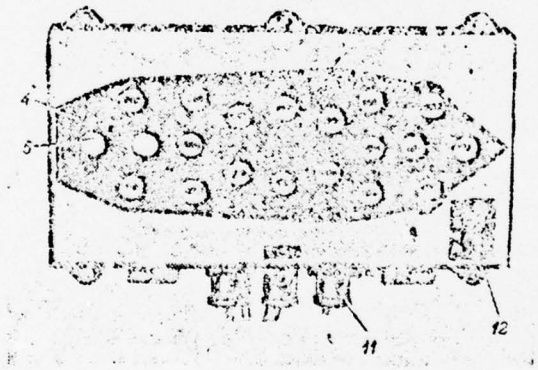


Fig. 28. Signal assembly for 20 radar stations:
4 -- outline of ship; 5 - signal windows;
11 -- junction box; 12 -- legend

On the outer surface of the cover of the apparatus is a dark colored outline 4 of the ship within which 20 signal windows 5 are arranged. Under

each signal window, inside the casing of the assembly, there is a signal device 6 which is shown separately in Figs. 30 and 31.

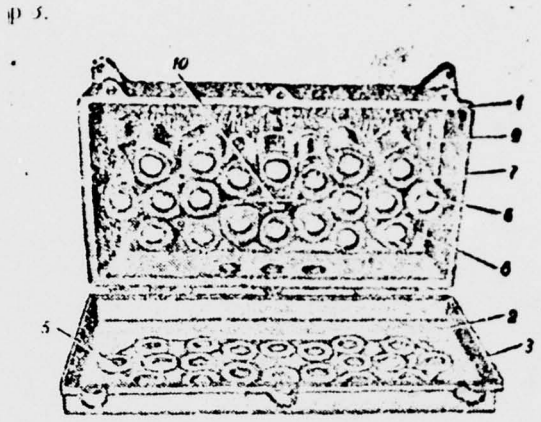


Fig. 29. Signal assembly for 20 radar stations (view with cover open)

1 -- casing; 2 -- cover; 3 -- rubber cord; 5 -- signal window; 6 -- signal device; 7 -- metal casing; 8 -- textolite plate; 9 -- terminal plate

The signal device consists of a base and casing 7. Three No 2 S-15 prongs for 8 v (110 w) signal lamps are mounted on the base.

Fig. 30. Signal device

The lamps are enclosed by metal casing 7 in which is mounted light filter 14 consisting of three panes of colored glass -- orange, white, and green -- cemented together; they correspond to the operation status of the radar station: In operation, On, and Warmup.

Clouded glass 16 is set in the upper part of the casing in mounting 15; the radar station's code name is recorded on it in black.

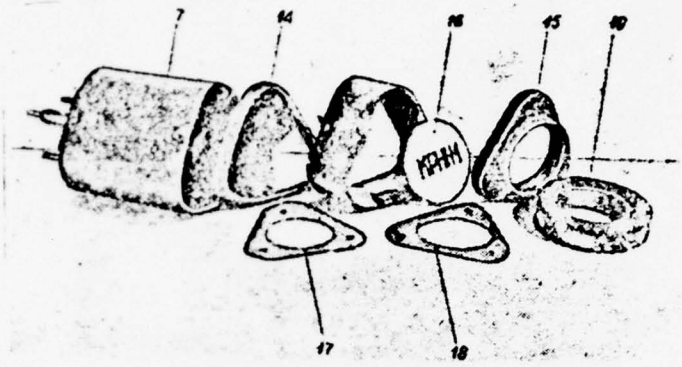


Fig. 31. Signal device in disassembled form: [53

1 -- casing; 2 -- light filter; 15 -- mounting;
16 -- clouded glass; 17 cardboard gasket;
18 - washer; 19 -- rubber ring

Under the glass there is a cardboard gasket 17 on which the scan angle of the station's antenna is engraved.

Terminal clouded glass 16 and gasket 17 are secured to the mounting by Dural washer 18 and three screws. Rubber ring 19 is placed between mounting 15 and the cover of the apparatus in order to tighten the signal device.

With the illumination of the clouded glass from below, the non-working angle of the antenna of the radar station is blacked out. The casing of the signal device is secured by three prongs in sockets in the base of the assembly.

All 20 signal devices are mounted on a common textolite plate 8 which is secured by six screws to the casing of the apparatus. Also located on the textolite plate are terminal plates 9 for connecting the internal assembly wires with the cores of the cables entering the apparatus. The wiring diagram of the assembly is located in the center part of the plate in a special holder 10. In the bottom of the apparatus there are three junction boxes 11 for leading in feeder cables. On the cover of the apparatus there is a legend 12, with an explanation of the signals, and also nameplate 13 with the code name of the apparatus.

The signal assembly for 10 radar stations, i.e., Apparatus S-10, is similar in design to the signal assembly for 20 radar stations; it differs from the latter only in its over-all dimensions, number of signal devices and signal windows, and in the number of junction boxes. The rest of the components are the same as in the signal assembly examined above for 20 radar stations.

Basic Electric Circuit

An expanded diagram of one signal unit is presented in the basic electric circuit shown in Fig. 32. Every signal unit of the signal assembly is similar in operation to that in the diagram. Each signal unit operates by [54
the closing of the contacts of special switching devices of that radar station to which the given signal unit is connected. Depending on which contacts of the switching device are closed, one of the signal lamps in the given signal assembly receives a power supply, as a consequence of which the terminal clouded glass with the code name of the radar station will be colored white, green, or red by the light filter. The white color signifies that the radar station is in the "On" position; the green signifies "Warmup", and the red -- "In operation."

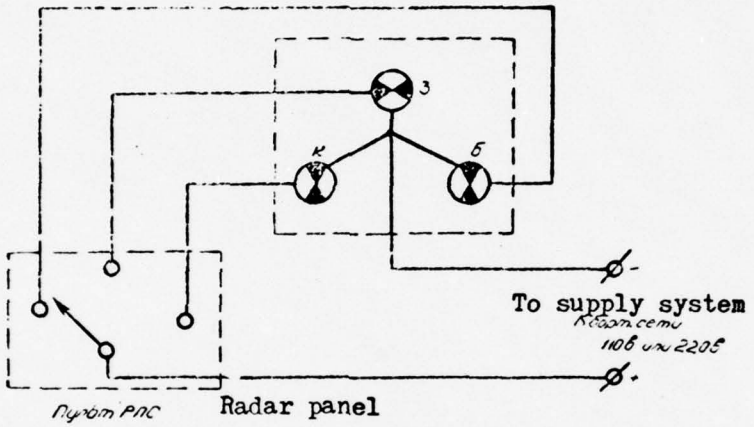


Fig. 32. Basic electric circuit of a signal unit:
3 -- green lamp; k -- red lamp; 6 -- white lamp

CHAPTER VI

POWER SUPPLY

General Information [55

The primary source of power for supplying the equipment of the Combat Information Center -- with the exception of the power supply of the automatic plotter of Apparatus Ps, the synchronous communication devices of the special electric clocks and the KRTS (Ship Wireless Telegraph Station) -- is the ship's electrical network. For various ships this is either a 110 or 220 v direct-current supply system or a 50 cps alternating-current supply system of 127, 220, or 380 v. Depending on the type of current and on the voltage of a ship's supply system, a corresponding power supply circuit is used for the equipment of the Combat Information Center.

The automatic plotter of Apparatus Ps and Apparatus P-3 are suuplied from a special unit which powers the apparatus of the ship's automatic plotting system "PUT!"

The synchronous communication devices used in the Combat Information Center are supplied from units of those ship systems in the circuit of which they are included.

The special electric clocks are supplied from two type 10-NKN-45 storage batteries with capacity 45 amp-hrs and voltage of 24.

Circuit of Power Supply From 110 or 220 v Direct- Current System

With a ship 110 or 220 v direct-current supply system all the equipment of the Combat Information Center -- with the exception of the automatic plotter of Apparatus Ps, Apparatus P-3, the synchronous communication devices and special clocks -- is powered from the supply system without conversion through the distribution board, in accordance with the circuit shown in Fig. 33.

The distribution board, shown from the control panel in Fig. 34, is installed in a compartment of the CIC and is used to distribute to CIC equipment the electric power delivered to the board from the ship's 110 or 220 v direct-current supply system of the starboard or port side.

The distribution board consists of a casing cast of Silumin and a cover. The cover of the board is hinged to the casing and is provided with a

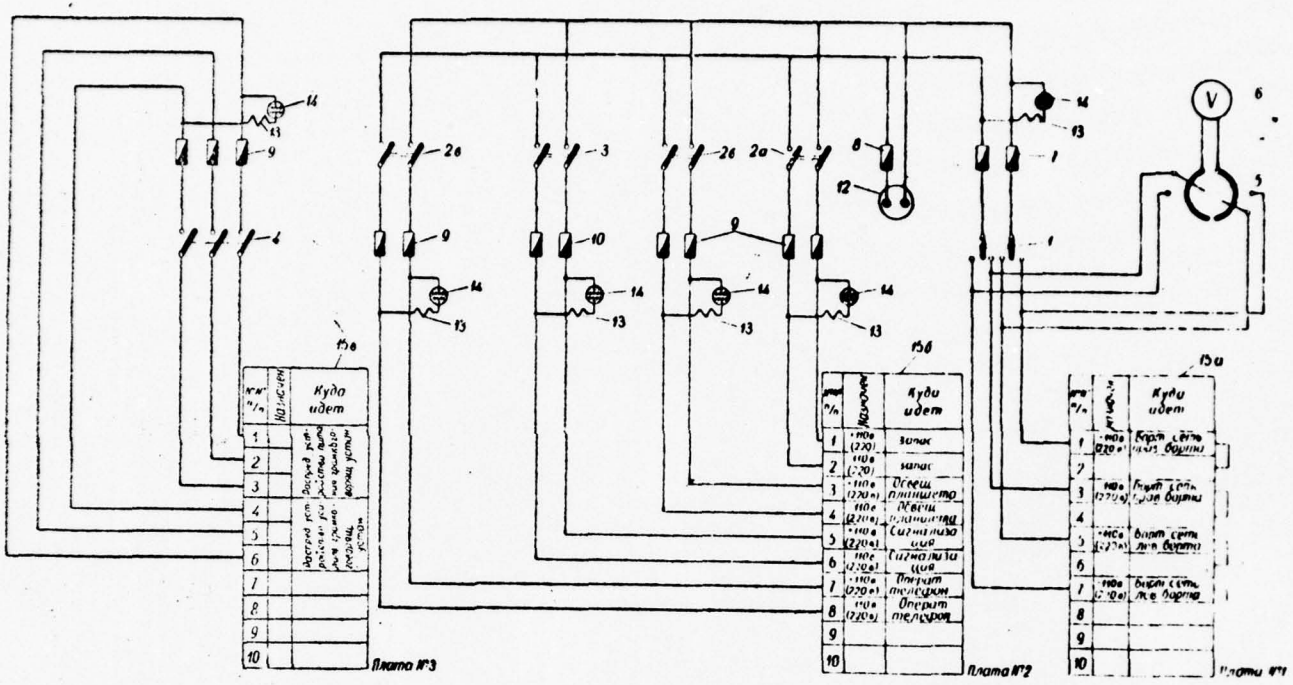


Рис. 33. Принципиальная схема распределительного щита для сети постоянного тока 110/220 *в*:

1 и *4* — пакетные переключатели; *2а*, *2б*, *2в* и *3* — пакетные выключатели; *5* — переключатель вольтметра; *6* — вольтметр; *7*, *8*, *9* и *10* — предохранители; *12* — розетка; *13* — сопротивление; *14* — лампа; *15а*, *15б*, *15в* — платы

Fig. 33. Basic circuit of the distribution board for 110/220 v direct-current supply system:

1 and 4 -- packet change-over switches; 2a, 26 , 2 , and 3 -- rotary switches;
5 -- voltmeter switch; 6 -- voltmeter; 7, 8, 9, and 10 -- fuses; 12 -- socket;
13 -- resistance; 14 -- lamp; 15a, 15 , and 15 -- plates

handle and lock. Mounted on the cover of the board are all the components of the board's circuit with the exception of the terminal plates and cartridge fuses which are installed on the back wall of the casing where a photo-diagram of the board's electric wiring is also mounted. On the front of the cover are the knobs of all rotary switches, the voltmeter scale and the signal panes of the neon control lamps. Access to the fuses is through a hinged door which is located on the front of the board's cover. In addition, on the cover of the board there are two standard plug sockets for connecting a portable electric lamp or soldering iron to the board. A holder with type PT fuses is installed under the plug sockets. In the bottom of the casing there are 10 junction boxes and a grounding terminal for leading in the feeder cables and for grounding the board. On the back wall of the board's casing are 4 lugs by which the board is secured to the bulkhead. [57 [58

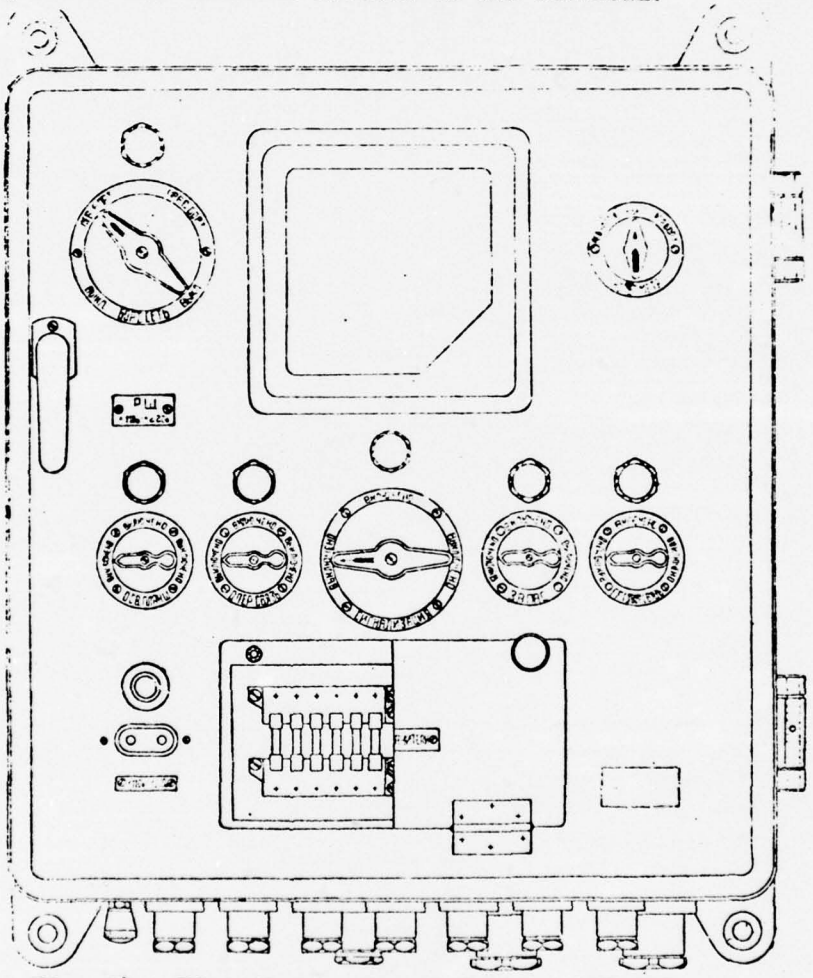


Fig. 34. Distribution board for the 110-220 v direct-current supply system (view from control panel)

The circuit of the distribution board makes it possible to connect the board to the 110 or 220 v direct-current supply system of the starboard and port sides, to monitor the presence and magnitude of the voltage, and to distribute it among individual consumers.

The voltage from the ship's supply system (Fig. 33) is led through cables to the terminal plates and then to rotary switch 1 which has three positions: Port, Starboard, and Off. From the switch the voltage is delivered through fuses 7 to the common busbars of the board. Monitoring the magnitude of the voltage supplied is by voltmeter M-110 which is connected through voltmeter switch 5 to the voltage of the ship's supply system of the starboard or port side. Individual consumers are connected to the common busbars of the board by means of corresponding rotary switches 2a, 2б, 2в, and 3, through type PNO and PN fuses 9 and 10. Monitoring the integrity of the fuses is accomplished by neon signal lamps 14. Illumination of the neon lamp attests to the integrity of the fuses and, vice versa, the neon lamp will not light up if the fuses are faulty.

Rotary switch 4 is provided for the purpose of feeding the switchboard system of the loudspeaker systems from the bus and switch distribution structure.

In view of the fact that the signal assemblies (Apparatus S-10 and S-20) and the valve oscillator (Assembly Lg) require a power supply of 110 volts when fed from the ship's 220 v supply system, an auxiliary unit with ballast resistors is introduced into the power supply circuit of each signal assembly; whereas a connection box with ballast resistors is introduced into the circuit of the valve generator. Through the ballast resistors of Apparatus S-10 and S-20, as well as through the ballast resistor of the junction box for the valve oscillator Lg, a voltage in excess of 110 v is cancelled.

Circuit of Power Supply From 127, 220, or 380 v, 50 cps Alternating-Current System

For ships supplied with A.C. power the basic equipment of the Combat Information Center (with the exception of equipment supplied from the ship's supply system or from special supply sources, i.e., the automatic plotter of Apparatus Ps, Apparatus P-3, the synchronous communication devices, and the special electric clocks) is powered from the ship's supply system by way of converting the voltage to 110 volts and rectifying it by means of a selenium rectifier. The power supply of CIC equipment in this case is accomplished through the distribution board, the basic diagram of which is shown in Fig. 35.

The basic control circuit of the distribution board for 127 - 220 volts is shown the drawing. In its external appearance, construction design, and electrical circuit the distribution board for 380 volts is completely analogous to the distribution board for 127 - 220 volts. [59

The distribution board for either A.C. voltage of 50 cps is intended to service two transformers, a rectifier, and five consumers.

In design the distribution board is constructed in the form of a cast Silumin casing and cast Silumin cover. The cover of the board is hinged to the casing and is fitted with a handle and lock. Mounted on the cover of the board are all the components of the board's circuit with the exception of terminal plates, cylindrical fuses, and capacitors which are mounted on the back wall of the casing where the electric wiring photo-diagram of the board is also mounted.

In the circuit of the board are the following:

a) double-pole rotary switch 1 for connecting to the electric system of the starboard or port side, mounted in the upper left corner of the cover;

b) neon signal lamp for monitoring the voltage supply, installed over the switch with inscription "Lateral supply system";

c) voltmeter 20 for measuring voltage reduced to 110 volts, in transformers 21;

d) four-pole rotary switch 2 for switching on the regular or reserve transformer, installed in the upper right corner of the apparatus;

e) five double-pole rotary switches 3a, 6, 8, 2, and 4 for supplying 110 v A.C. to individual consumers;

f) one three-pole rotary switch 5 for switching on the loudspeaker communication system;

g) 15 type PNO cartridge fuses under which there is a plate with an indication of their purpose and current rating;

h) 10 neon lamps 18 with red signal panes for monitoring the working condition of fuses across the rotary switches;

i) 10 type VS non-wirewound ballast resistors 13, each of which is in series with the supply circuit of the neon lamp.

On the cover of the board there is a hinged door for access to safety fuses and also two standard plug sockets for connecting a portable electric lamp or soldering iron. Above the sockets is a holder with a type PT fuse. At the bottom of the casing of the board there are 14 junction boxes for leading in cables and a terminal for grounding the board.

On the back wall of the casing there are four lugs for attaching the board to the bulkhead.

Operation of the basic electric circuit with power supplied from a 50 cps, 127 v system is as follows: Voltage is supplied along cables through junction boxes to the terminal plates of the board, then to rotary switch 1 with positions: Port, Starboard, and Off. From switch 1 the voltage proceeds

to the right contacts of rotary switch 2 which has 2 operating positions, thus making it possible to connect the regular or reserve transformer through fuses 6a and 6б . From one of these transformers, depending on the position of switch 2, a voltage of 110 v, 50 cps from the terminal plates through the two left contacts of switch 2 is supplied to the circuit of the board and is measured by voltmeter 20. Individual consumers are connected to the circuit of the board by rotary switches; they are protected by fuses.

The integrity of the fuses is monitored by neon signal lamps across the fuses. Illumination of the neon lamps confirms the integrity of the fuses. By switching on rotary switch 32 with the inscription "Operational communication system" 110 v A.C. is supplied through fuse 10 to terminals 3 and 4 of terminal plate 4 and from there it proceeds to the rectifier.

The rectified current proceeds from the rectifier to terminals 5 and 6 of plate 4 and through fuses 11 is delivered to terminals 7 and 8 of plate 4; from there it enters the circuit of the operational communication system. Capacitors 17, type KEG-2, together with choke coil 25 in the rectifier form a filter which serves to smooth out the rectified current.

Operation of the Circuit of the Selenium Rectifier

A 110 v alternating current (See Fig. 35) proceeding from the distribution board to terminal plate 23 is supplied via double-pole rotary switch 30 to the primary winding of step-up transformer 28. The primary winding of the transformer has taps brought out to terminals on the panel with the inscription "5%" and "10%"; these are intended to regulate the voltage in the secondary windings in case the voltage of the alternating current supply system drops. The transformer has two identical secondary windings, each of which is connected through fuses 7 to one of the selenium cell units. If one of the rectifying units goes out of commission the power supply of consumers is transfered by shifting switch 22 to the other rectifying unit. Choke coil 25 together with the capacitors installed on the distribution board form a filter which serves to smooth out the rectified current. Current-carrying capacity of the rectifier is equal to 1.5 amp.

Power Transformers

Power transformers in the power supply circuit of the Combat Information Center serve to step down a 50 cps, 127, 220, and 380 v alternating current to 110 v. Since the voltage of ship supply systems varies for different ships [61
three versions of the power transformer are produced by industry:

a) for a 127 v alternating-current lateral supply system;

b) for a 220 v alternating-current lateral supply system;

c) for a 380 v alternating-current lateral supply system.

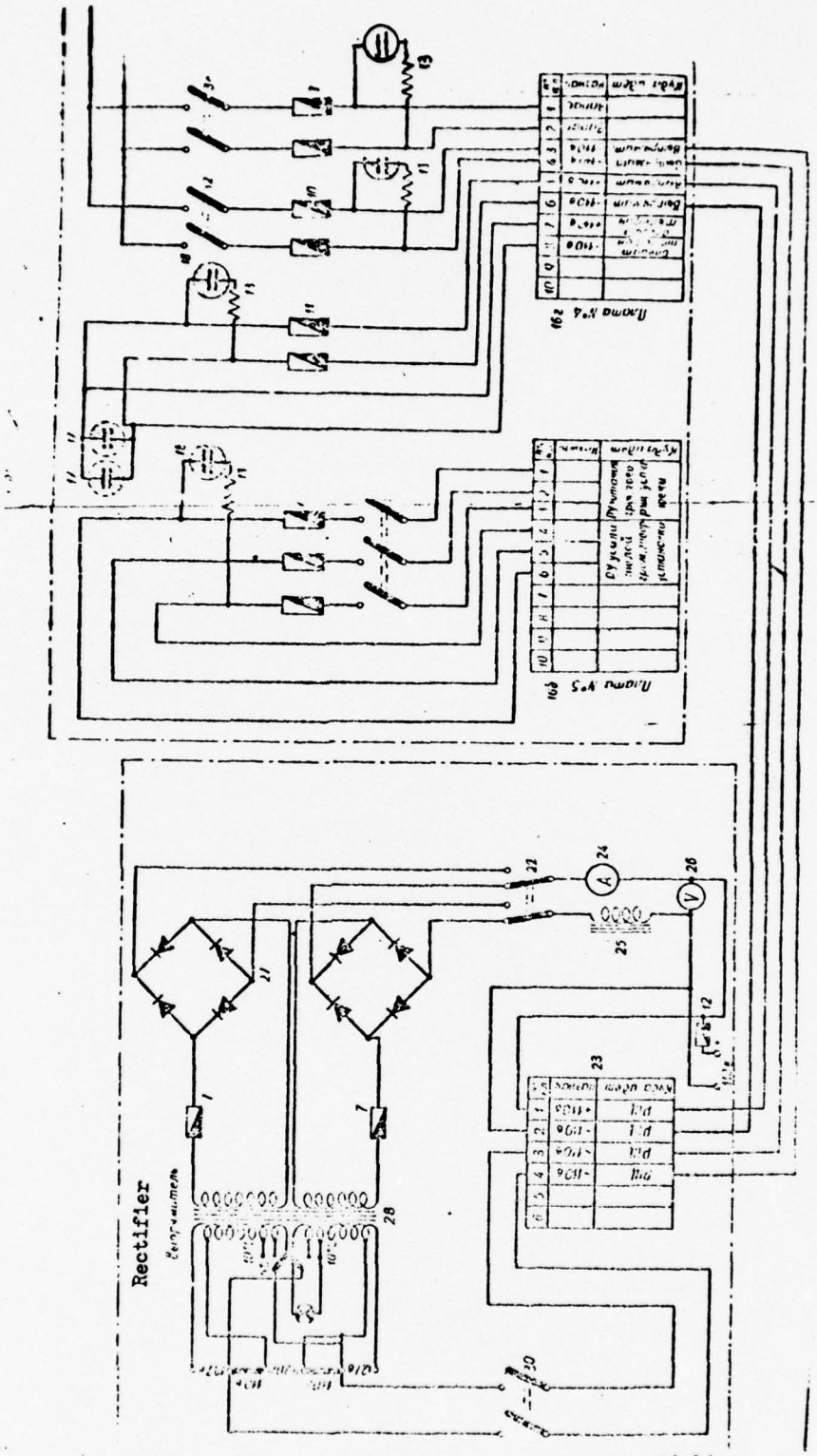


Fig. 35. Basic circuit of power supply from supply system of 127, 220, and 380 v, 50 cps

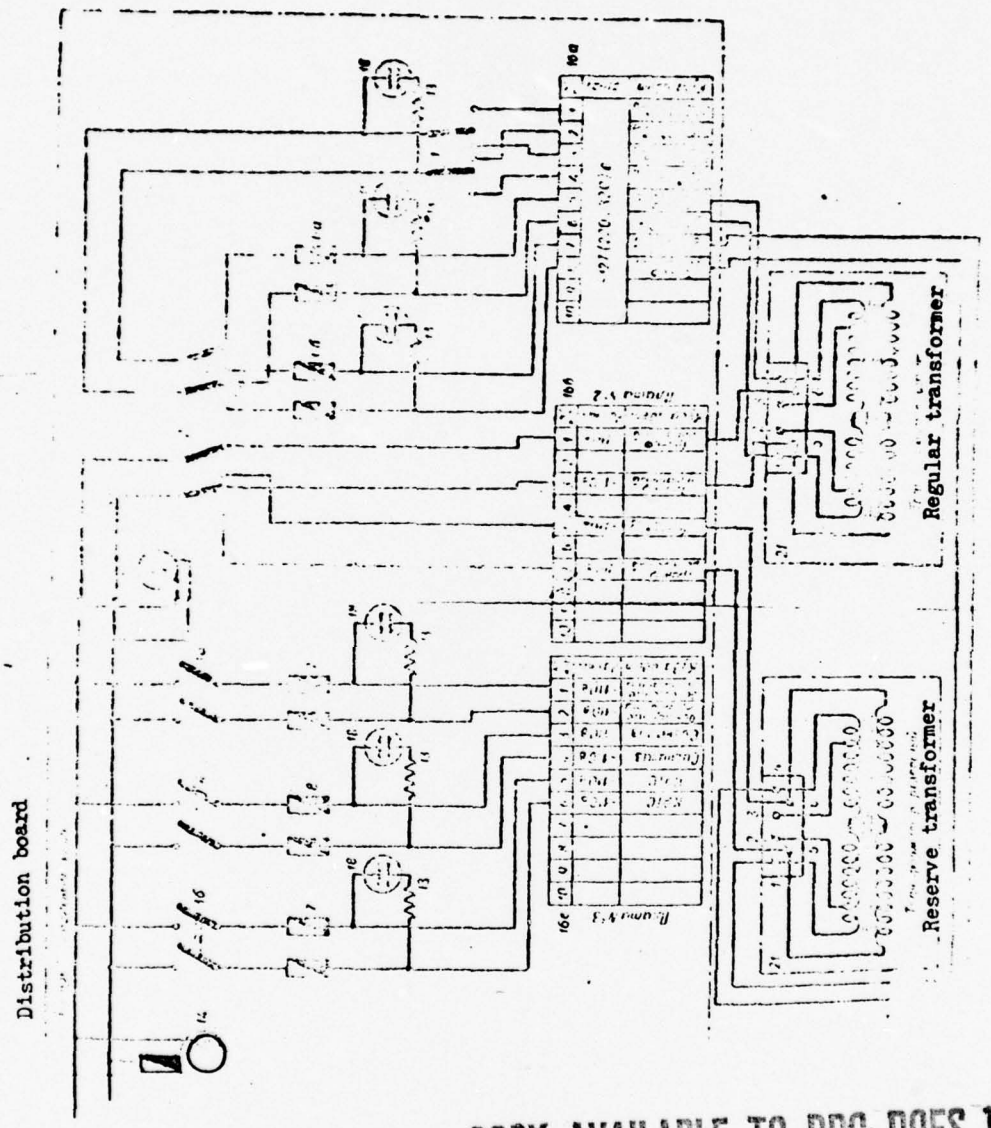


Figure 35 (Continued)

Each of the above-indicated devices consists essentially of a transformer and casing with cover.

In construction the transformer is single-phase, double-wound, dry, and air cooled. The transformer consists of a magnetic circuit with two coils. The windings of high and low voltage are coiled on two common coil forms. Mounted on the upper part of the transformer is a panel with six terminals to which are brought out the ends of the windings intended for the connection of feeder cables. In addition, voltage of the lateral supply system is supplied to terminals 1, 2, 3, and 4; whereas a voltage of 110 is obtained from terminals 5 and 6. The transformer is bolted to the casing by means of two angle bars at the bottom. The casing is a box cast of Silumin.

There are louvers in the front and back sides of the box which provide for the dissipation of heat liberated by the transformer. On the casing there are two junction boxes for leading in feeder cables, two handles for carrying it, and four legs with bolt holes for securing the device to the deck.

The circuit of the transformer makes it possible to regulate the voltage of the secondary winding in the direction of an increase of 2.5 or 5% of the nominal.

If a power supply is delivered to terminals 1 and 4, then the reduced voltage corresponds to the nominal voltage. If a power supply is delivered to terminals 1 and 3, then the voltage will be greater by 2.5%; and with the delivery of a power supply to terminals 2 and 3 the voltage will be greater by 5% of the nominal.

Fig. 35. Basic circuit of power supply from supply system of 127, 220, 380 v, 50 cps:

1 -- switch; 2 -- packet change-over switches; 3a, 3 , 3 , 4, 22, 30, 32 -- rotary switches; 8, 9, 10, and 11 -- fuses; 13 -- resistor; 14 -- socket; 16a, 16 , 16 , 16 , and 16 -- plates; 17 and 18 -- lamps; 20 -- voltmeter; 21 -- reserve and regular transformers; 24 -- ammeter; 25 -- choke coil; 26 -- voltmeter; 27 -- rectifier; 28 -- transformer

CHAPTER VII

AUXILIARY APPARATUS AND DEVICES [62

Recording Boards

The recording boards in the CIC are used to record the most important single moments in time during a given operation that are necessary for orientation in subsequent actions. There are three types of recording boards: Board No. 1 -- board for orders; Board No. 2 -- situation board; Board No. 3 -- board for recording interference.

One board for orders is installed near plotting board Pa and another is installed near plotting boards Ps and Pn. The situation board is installed near plotting board Pa and the board for recording interference is installed near the PLS table.

All three types of recording boards are identical in construction and have the same over-all dimensions; they differ only in the number and function of the columns.

Each board is a metal panel 3 mm in thickness covered with linoleum and has a metal frame which imparts great rigidity to the entire structure. The dimensions of a board are 750 x 800 mm. A metal tray for chalk and cloth is attached to the lower edge of the panel.

For mounting purposes lugs with bolt holes are fixed to the corners of [63 the board's framing. Each of the above-indicated boards has the following use:

The board for orders shown in Fig. 36 is used to record orders issued in directing fighter aircraft and in guiding torpedo boats. A brief summary of the order issued and instructions given for its execution are recorded on the board in consecutive time order. For this purpose the board has columns for recording course, speed, bearing, range, and altitude.

The situation board shown in Fig. 37 serves as an auxiliary aid in directing aircraft from a given ship. Target numbers and target characteristics and data are recorded on the board in consecutive time order. Recorded on the situation and order boards -- in addition to the indicated specific recordings for a given type of board -- are navigational and meteorological data on the situation such as: latitude and longitude of the site of the operation, weather conditions (cloud cover, wind, sunrise and sunset, phase of the moon and the time of its rising and setting. [64

Board No. 1

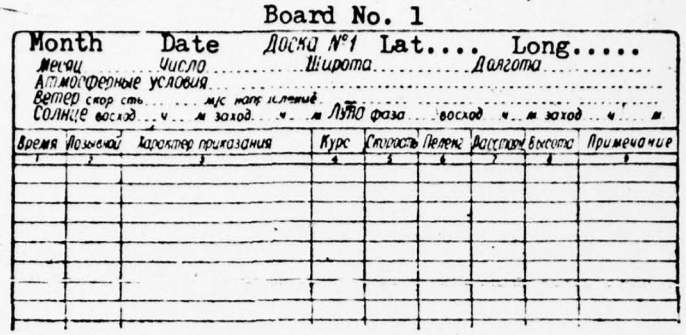


Fig. 36 Board for orders (over-all view)

Board N. 2

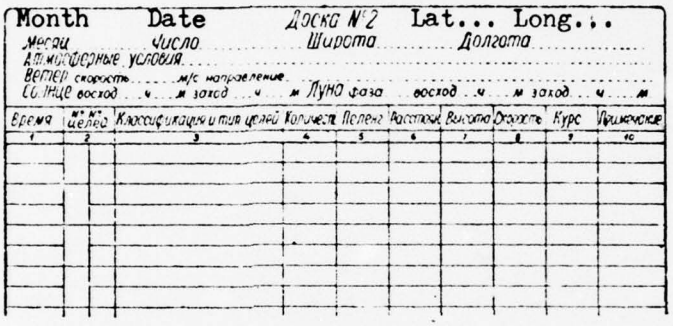


Fig. 37. Situation board (over-all view)

Board No. 3

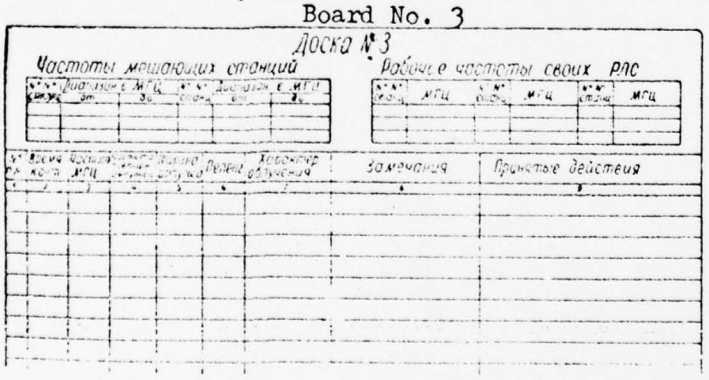


Fig. 38. Board for recording interference (over-all view)

The board for recording interference shown in Fig. 38 is used to record data obtained from radar search stations. For this purpose the board has columns for recording the most characteristic data for each operating radar station. In addition, the working frequencies of the interfering and of one's own radar stations are recorded on the board.

Scaling Apparatus P-3

Scaling Apparatus P-3, an over-all view of which is shown in Fig. 39, is used to service the automatic position plotter of the Ps plotting table.

Apparatus P-3 converts the components of the distance run by the ship along N - S and O - W to the scale of the chart selected for the work; it automatically takes into account and introduces a correction into the recording of the ship's course, since the scale of the Mercator chart varies with a change in the ship's position with respect to latitude.

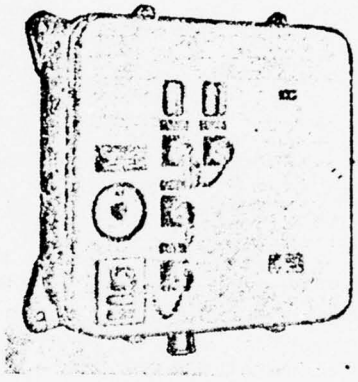


Fig. 39. Over-all view of Apparatus P-3

The functional diagram of Apparatus P-3 shown in Fig. 40 consists of three lines of motion:

a) line of motion for transposing the components of the distance run into rotation of friction mechanism disks;

b) line of motion for setting the dial of the scale of the main parallel;

c) line of motion for introducing an automatic correction into the scale with a change in the ship's position in latitude.

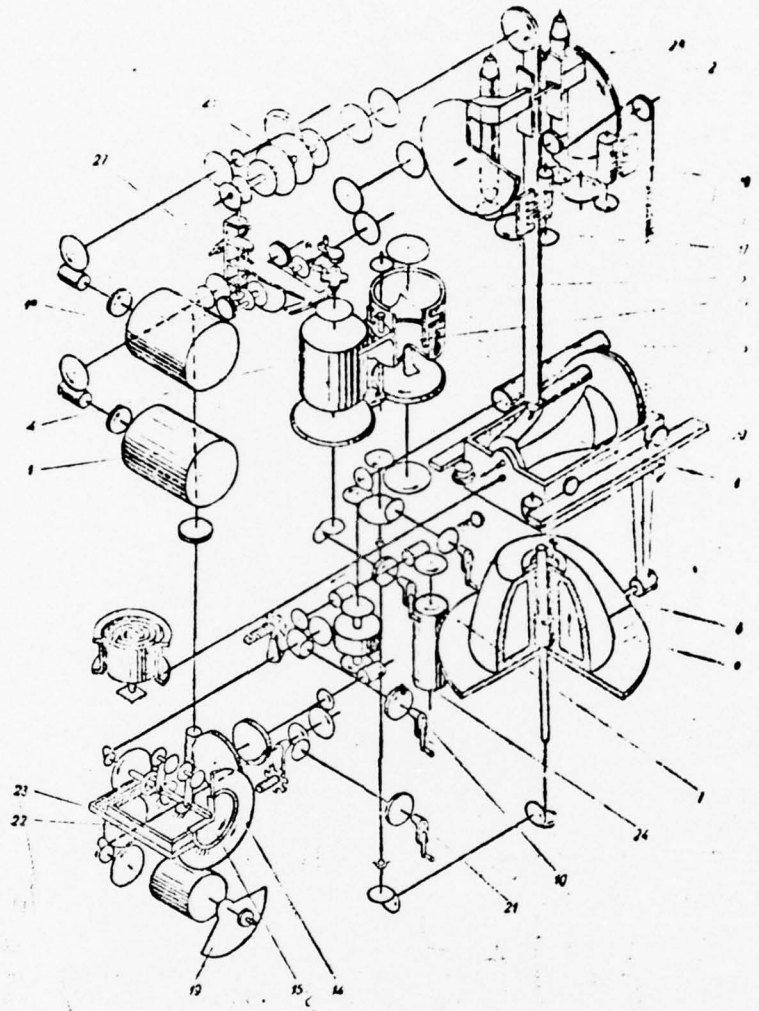


Рис. 40. Кинематическая схема прибора П-3:

1 и *1а* — поднимающий электродвигатель типа СЧ-201; *2* — диск фрикционного механизма; *3* — диск фрикционного механизма; *4* — масштабная шкала грубого отсчета; *5* — масштабная шкала точного отсчета; *6* — маховик установки масштаба в пределах диапазонов; *7* — маховик установки диапазонов масштаба; *8* и *9* — конуид; *10* — маховик установки широты главной параллели; *12* — шкала; *14* — шкала грубого отсчета широты главной параллели; *15* — шкала точного отсчета широты главной параллели; *17* и *18* — ключи СНЧ; *19* — переключатель широт; *20* — каретка; *21* — маховик ввода текущего значения широты; *22* — индекс точного отсчета; *23* — индекс грубого отсчета; *24* — дифференциал; *25* — щуп; *26* — пружина; *27* — коробка скоростей; *28* — фрикционный механизм

Fig. 40. Functional diagram of Apparatus P-3

Fig. 40. Functional diagram of Apparatus P-3:

1 and 1a -- receiving electric motors type Sch-201;

2 -- friction mechanism disk;

3 -- friction mechanism disk;

4 -- dial for an approximate reading of scaling ratio;

5 -- dial for precise reading of scaling ratio;

6 -- hand wheel for setting the scaling ratio within the range limits;

7 -- hand wheel for setting the scaling ratio ranges;

8 and 9 -- conoid;

10 -- hand wheel for setting the main parallel of latitude;

13 -- shield;

14 -- dial for approximate reading of main parallel of latitude;

15 -- dial for precise reading of main parallel of latitude;

17 and 18 -- SPCh keys;

19 -- latitude switch;

20 -- carriage;

21 -- hand wheel for introducing instantaneous value of latitude;

22 -- index for precise reading;

23 -- index for approximate reading;

24 -- differential;

25 -- probe;

26 -- transmission gear;

27 -- gear box;

28 -- friction mechanism

Entering into the first line of motion are SCh-201 receiving electric motors 1 and 1a, four-stage transmission gear 26, friction mechanism disks 2 and 3, and transmitter-keys SPCh 17 and 18.

The component of the distance run along line N - S, i.e., $S_{N-S} = S \sin K$ (where S -- ship's path; S_{N-S} -- component of the ship's path along line N - S; and K -- ship's course), proceeds from the transmitter of Apparatus P-1 to receiving electric motor 1 of Apparatus P-3.

Similarly the component of the distance run with respect to longitude, i.e., $S_{O-W} = S \cos K$, proceeds from the corresponding transmitter of Apparatus P-1 of the ship's automatic position plotting system "PUT'" to receiving electric motor 1a of Apparatus P-3.

Receiving electric motors 1 and 1a of the components of the distance run rotate disks 2 and 3 of friction mechanism 28 through corresponding four-stage transmission gear 26 and 27. [66

Friction mechanism 28 closes and opens transmitter-keys 17 and 18 and thereby activates the receiving motors of the plotting board of the plotting table (See electrical circuit shown in Fig. 8). The velocity of rotation of friction disks 2 and 3 depends on the gear ratio set in the gear train.

As previously mentioned the transmission gear in Apparatus P-3 is four-stage. To each stage there corresponds a fixed scaling ratio selected for work on the chart:

Stage I: from 1:50 000 to 1:100 000

Stage II : from 1:100 000 to 1:200 000

Stage III: from 1:200 000 to 1:400 000

Stage IV: from 1:400 000 to 1:800 000

The change-over to the corresponding scaling range of the chart selected by the gear of the first line of motion is a function of the second line of motion -- the line for setting the dials of the selected chart's scaling ratio (scale of the main parallel). The setting of the corresponding scaling ratio in Apparatus P-3 is by means of two drum type dials; dial 4 for an approximate reading and dial 5 for a precise reading. Since the entire spectrum of the chart's scale is divided into four intervals, the scaling drums for both the approximate and the precise reading also have four dials.

For convenience in working with the apparatus and to preclude the possibility of setting up incorrect scaling data when transfering from one scaling range to another, there is -- along with the change-over by the gear -- a turning of dial 4 for an approximate reading and also a turning of shield 13* of dial 15 for a precise reading. Thus in Apparatus P-3

* Translator's note: Error -- should read 14.

there is a block system of special gear in the transmission box with the dials of the scaling drums displayed for approximate and precise readings.

The setting of the scaling ratio within the limits of each range is by means of hand wheel 6, which turns dial 5 for precise reading and shifts the dial index of dial 4 for and approximate reading. Crossing from one range to another is accomplished by a 90° turn of hand wheel 7. In setting hand wheel 7 to one of the ranges selected there occurs -- in addition to a change in the range of the scaling ratio in drum dials 4 and 5 -- a change-over by both transmission gears to the corresponding range; then friction disks 2 and 3 rotate with a velocity corresponding to the range selected. The velocity of the corresponding operation of SPCh keys 17 and 18 depends not only on the velocity of rotation of the friction mechanism disks but also on the operation of the third line of motion -- the line for introducing the data of the instantaneous scaling ratio into the friction mechanism and also for introducing a correction in the value of the scaling ratio with a change in latitude of the ship's position.

The introduction of the instantaneous scaling ratio is accomplished in [67
Apparatus P-3 by setting the cylinders of the friction mechanism at the fixed working radius of the disks.

With each mounting of a chart on the board the setting of the instantaneous scaling ratio in Apparatus P-3 must be performed so that the radius of the friction mechanism disks will be precisely determined for the fixed instantaneous scaling ratio at all latitudes. Besides introducing the instantaneous scaling ratio into the friction mechanims from the third line of motion, the introduction of a correction in the value of the scaling ratio is also required for a change in latitude of the ship's position.

From the navigation course it is known that on the chart with a Mercator projection the scaling ratio of the chart increases $\sec\varphi$ times with an increase in latitude. Consequently, in the initial setting of the scaling ratio the mechanism as a whole has to take into account the change in the scaling ratio as a function of the change in the instantaneous latitude.

The problem of automatically introducing a correction in Apparatus P-3 for a change in the scaling ratio with a change in φ_t is solved by a prior auxiliary conversion of the value of the scale of the main parallel into the scale corresponding to the latitude at the equator, i.e., by reducing the scale of the main prallel of a given chart to the equatorial scale:

$$M_{eq} = M_{mp} \cos \varphi_{mp},$$

where M_{eq} -- scale at the equator;

M_{mp} -- scale at the main parallel (scale of the given chart);

φ_{mp} -- latitude of the main parallel.

Then from M_{eq} and the instantaneous latitude φ_t of position the value is determined of the radii of the disks in friction mechanism 28, the value by which the cylinders closing SPCh keys 17 and 18 must be revolved.

The value of the radii of the disks in the friction mechanism corresponds to the value of the instantaneous scaling ratio M_t and is derived

either as $M_t = M_{eq} \sec \varphi_t$

or as $M_t = M_{mp} \cos \varphi_{mp} \sec \varphi_t$.

Kinematically this problem is solved in Apparatus P-3 by two conoids of the third line of motion in the following manner: In setting up a chart on the plotting board, the scaling range of the main parallel is selected by means of hand wheel 7. Then the scale of the main parallel of the chart selected for the work is set up by means of hand wheel 6; thus conoid 8, which solves the problem

$$M_{mp} = f(M_{eq}, \varphi_t) = M_{eq} \sec \varphi_t,$$

shifts and is set according to the scale of the main parallel. Then, by means of hand wheel 10 for setting the latitude of the main parallel, dial 14 for an approximate reading and dial 15 for a precise reading are set at this value, i.e., φ_{mp}, and thus conoid 9 rotates, solving the problem

$$M_{eq} = M_{mp} \cos \varphi_{mp}.$$

The value of the inclination of the probe of this conoid determines the scale of the chart at the equator. The probe of conoid 9 is rigidly bound with tray 20 of conoid 8 and thus the equatorial scale is obtained through the shifting of conoid 8.

With the rotation of hand wheel 10 of the main parallel of latitude simultaneously with the rotation of conoid 9, through differential 24, conoid 8 also turns to the value of the main parallel of latitude.

In order for conoid 8 to solve the problem of finding $M_t = M_{eq} \sec \varphi_t$, the instantaneous latitude is introduced into its rotation in the form of an infinitely small increment:

$$\Delta\varphi = \varphi_t \pm \varphi_{mp},$$

it is introduced into conoid 8 by means of hand wheel 21 through differential 24. The value of the instantaneous altitude is determined from the moving indices 22 and 23 for the precise reading and approximate reading, respectively, of the mechanism for setting up the latitudes.

Probe 25 of conoid 8 shifts in proportion to the instantaneous scale and the cylinders of friction mechanism 28 revolve according to the radii corresponding to the instantaneous scale.

With a further change in the ship's position in latitude, receiving motor 1 of the components of the distance run along N - S will rotate, meanwhile rotating conoid 8 and movable indices 22 and 23 of the instantaneous latitude. Since one mile of the component of the distance run along N - S is equal to one minute of latitude, the conoid and moving indices are continually adjusting to the instantaneous latitude and thus automatically introduce a correction expressed through a continuous change in the radii of the revolving cylinders on friction disks 2 and 3.

The resulting values of the components of the distance run, reduced to the scale of the chart, proceed, from the cylinders of the friction disk mechanism, to the synchronous transmission keys SPCh 17 and 18.

When the ship crosses the equator indices 22 and 23 as well as conoid 9 must rotate in the opposite direction. This is accomplished by reversing, by means of switch 19, the winding of SCh-201 and by the simultaneous reversing of SPCh key 17 (See Fig. 7).

SPECIAL ELECTRIC CLOCKS

Purpose of the Clocks [69

Special electric clocks installed in the CIC are used to service the operation of individual plotting boards and devices of the CIC.

The special clock system consists of one primary electric clock (EPCh) and several secondary electric clocks (EVCh) of the same design.

The secondary electric clocks indicate the time in hours, minutes, and seconds. The primary electric clock does not give the time directly; it is a mechanism that measures the time and brings an entire group of secondary clocks into operation by way of transmitting direct-curerent impulses every 10 seconds.

The entire special clock system is supplied from 24 v storage batteries.

The Primary Electric Clock

The primary electric clock is a mechanism trnasmitting direct-current impulses every 10 seconds to the secondary electric clocks.

The primary electric clock can service at one time no more than six secondary clocks hooked up in parallel with the primary clock. The primary clock is installed in the vertical position only.

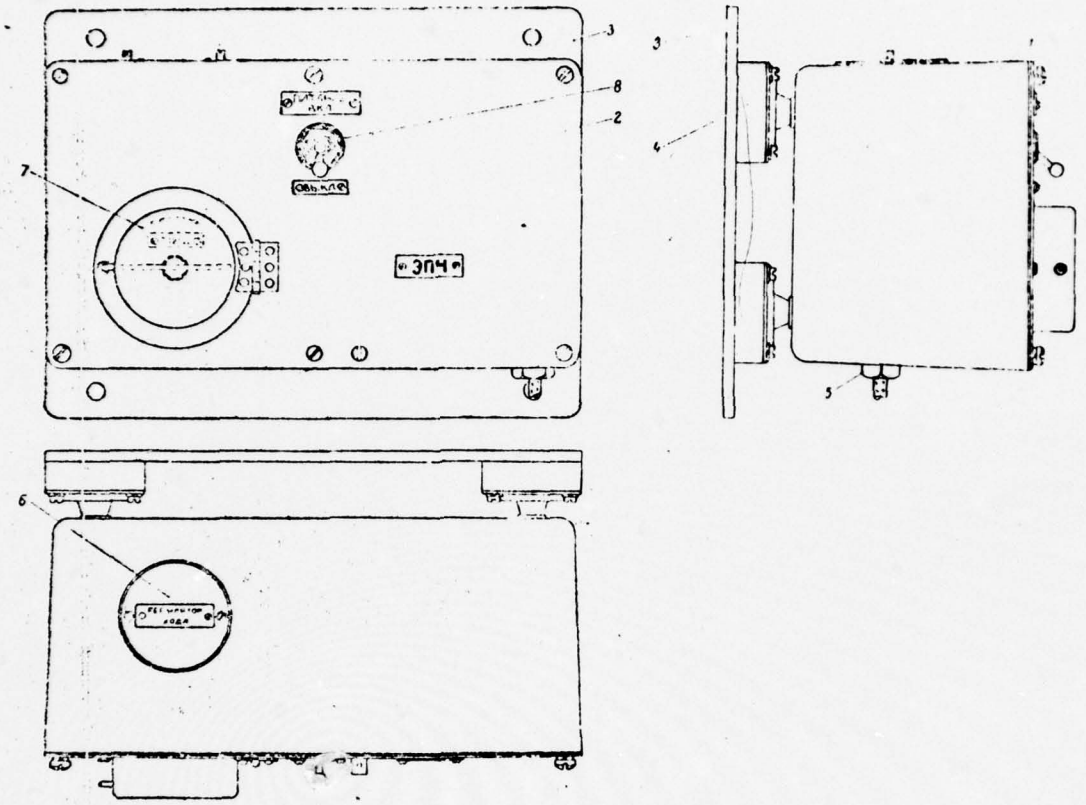


Рис. 41. Общий вид первичных электрочасов

Fig. 41. Over-all view of the primary clock

The primary electric clock, an over-all view of which is shown in Fig. 41, consists of the following basic parts:

a) clock mechanism;

b) code relay KDR-1;

c) four-pole switch;

d) terminal plate;

e) casing;

f) plate with shock absorbers.

The clock mechanism of the primary electric clock is the standard clock mechanism of a ship's clock (MCh) with motive energy from a steel spring coil located in a special cylinder with cover. The cylinder is linked with the gear drive of the clock mechanism by means of a toothed rim. The motor and the gear drive are located between two brass plates connected by four pillars. Holes in the plates serve as bearings for the motor and gear drive spindles.

The uniformity of motion of the clock is regulated by means of a special mechanism, the so-called "escapement" consisting, as in a standard ship's clock, of an anchor wheel with an escape pinion and motion regulator 6 located on the plate which has corundum bearings for spindles. On the bridge, to which the bearing of one end of the regulator (balance) spindle is secured, there is a scale with the letters "P" (increase) and "U" (decrease) and the stem of the regulator which can be turned to vary the degree of the clock's motion. If the clock is slow the stem must be turned in the direction of the letter "P" and if it is fast, in the direction of the letter "U." [72

The basic difference between the primary electric clock and a standard ship's clock is that the former does not indicate the time directly. Its objective is the regular transmission of direct-current impulses into the over-all circuit of the secondary clocks. Therefore, instead of hands, the primary clock has a special mechanism for transmitting direct-current impulses. This mechanism consists of impulse gear and a KDP-1 type code relay. The electrical circuit of the impulse gear of the primary electric clock is shown in Fig. 42.

The impulse mechanism consists of a gear wheel with 15 teeth which is brought into operation by the clock's gear drive. In addition to this, three pairs of springs with contacts act on the gear wheel. [72

Each pair of springs is displaced, with respect to its neighbor, by 1/3 step of a wheel tooth. On the ends of the springs pallets made of ivory are mounted which slide along the polished surface of a tooth as the wheel rotates.

In each pair of springs the pallets are displaced with respect to one another by a small amount, of the order 0.2 - 0.3 mm, in the direction of the wheel's rotation.

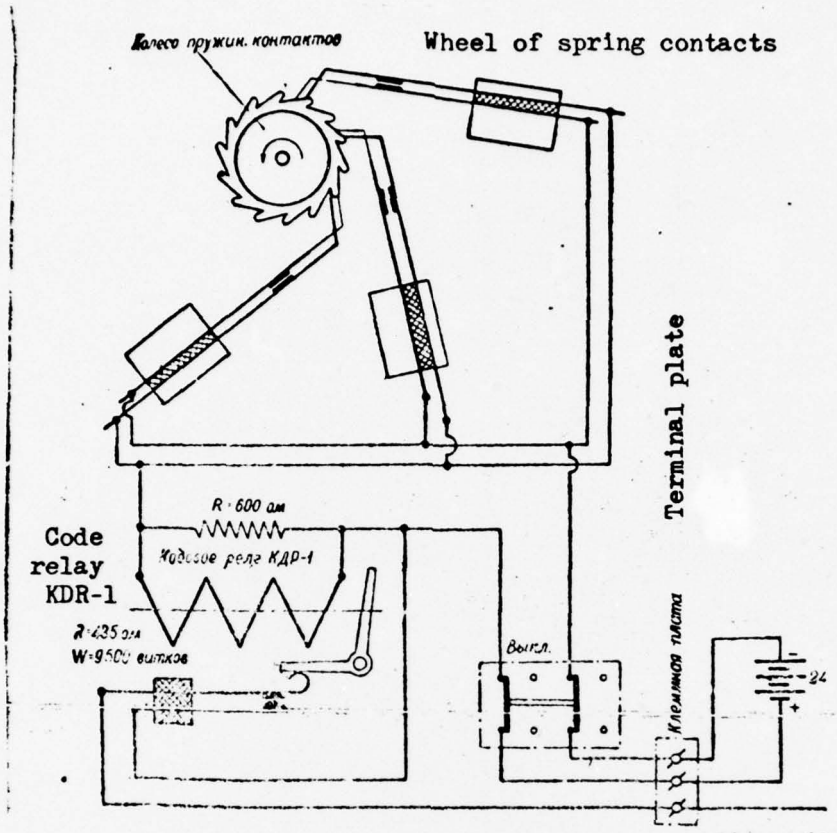


Fig. 42. Impulse mechanism of the primary electric clock

The closing and opening of the contacts of one of the pairs of springs occurs according to the following scheme:

Position I (Fig. 43). A tooth has escaped pallet No. 1. The pallet of spring No. 2 is still on the top of the tooth. Contact No. 1 has dropped onto contact No. 2 and therefore has closed the supply circuit of the code relay.

Position II (Fig. 44). After 1 - 2 seconds the tooth escapes the pallet of spring No. 2. Both springs have fallen into the notch of the next tooth and the contacts are broken, thus breaking the supply circuit of the code relay.

After the wheel turns 1/3 of a step in this manner the code relay will be connected to the supply source by means of the contacts on the second pair of springs.

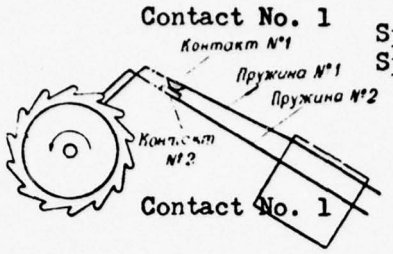


Рис. 43. Первое положение контактов импульсного приспособления первичных электрочасов

Fig. 43 First position of the contacts of the impulse mechanism of the primary electric clock

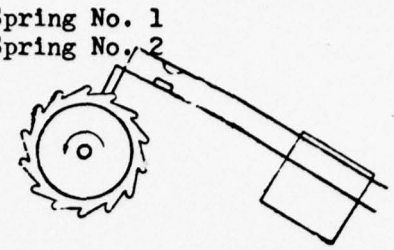


Рис. 44. Второе положение контактов импульсного приспособления первичных электрочасов

Fig. 44 Second position of the contacts of the impulse mechanism of the primary electric clock

In 450 seconds the wheel makes exactly one turn. Each pair of contacts opens and closes 15 times during one rotation of the wheel. Thus, during one rotation the code relay transmits n = 15 x 3=45 impulses. Consequently, each impulse is transmitted every

$$t = \frac{450 \text{ sec}}{45} = 10 \text{ sec.}$$

The springs of the contacts are mounted on angle bars fastened to the front plate of the clock mechanism with dowels and screws. The springs are connected in parallel by means of assembly wire and they areconnected to the power supply and code relay through common terminals. [73

With the closing of the contacts of one of the three pairs of springs of the impulse mechanism the contacts of the code relay are activated each time and transmit a current impulse into the circuit of the secondary clocks.

In order to eliminate sparks during the breaking of the contacts of the impulse mechanism of the clock mechanism, the winding of the code relay is shunted by a non-wirewound resistance of 600 ohms.

The switching on and off of the impulse mechanism of the primary electric clock is accomplished by means of a switch whose lever is brought out through the cover of the casing.

For convenience in mounting, a terminal plate is installed in the device which has three pairs of terminals: the corresponding numbers are placed on the cross-connecting jumpers of the terminals:

No. 1 -- "+" of the battery;

No. 2 -- "-" of the battery;

No. 3 -- "impulse".

The clock mechanism, switch, code relay and terminal plate are mounted on a common base which is secured to the back wall of the clock casing by means of six screws.

The casing of clock 1 (Fig. 41) is a parallelepiped with rounded corners, without front cover 2. On the back wall of the casing are mounted shock-absorber supports which are brought to the outside. From the inside of the back wall blocks with threaded openings are welded for fastening item 4.

Inside the front cover of the caseing, in the inner corners and centered in its upper and lower parts, threaded pillars are welded for fastening the cover of the casing. On the top wall over the "escapement" an aperture has been made for the spindle of the regulator. The spindle screws into a shutter which closes the aperture. The spindle passes through the aperture to a fork on the stem of the regulator. The shutter can rotate about its axis which coincides with the axis of the balance of the "escapement." There is an index on the shutter and a scale on the casing with the letters "P" and "U". By turning the shutter toward "P" or "U" it is possible to accelerate or slow down, respectively, the motion of the clock. The aperture of the casing is enclosed from above by a circular cover which is secured by two screws for sealing purposes. On the outside of the cover the inscription "Motion regulator" is affixed. In the bottom of the casing there is junction box 5 for leading in the power supply of the three-core cable RShM. The casing is enclosed by a cover with a rubber gasket. The switch lever protrudes through the corresponding opening in the cover. Above and below the opening for switch 8 are the inscriptions "Power on" (above) and "Off" (below).

In the cover, opposite the winding shaft of clock mechanism 7, there is an opening for inserting the winding key; through this opening the key is turned on the winding shaft.

The winding key is protected by a cover which locks with a special spring catch. In winding the clock it is necessary to rotate the winding key only in the direction indicated by the arrow.

The cover is secured to the casing of the clock by six screws. [74

For protection against shock the clock is shockproofed by means of four shock absorbers 4 which secure the clock to the special plate.

THE SECONDARY ELECTRIC CLOCK

The secondary electric clock, an over-all view of which is shown in Fig. 45, is used to indicate the time in hours, minutes, and seconds in the form of a five-digit number; the first two digits denote the hours; the second two digits -- the minutes; and the fifth digit -- tens of seconds.

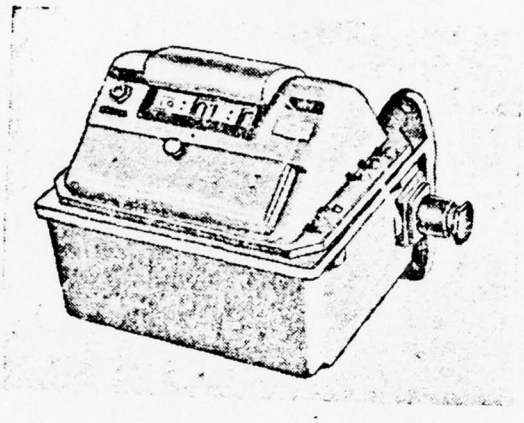


Fig. 45 Over-all view of a secondary clock

The secondary clock is supplied from the same current source as the primary clock and is connected with the primary clock by a conduit which transmits a current impulse from the code relay of the primary clock to the electromagnet of the secondary clock.

The secondary clock consists of the following basic parts:

a) four electromagnets;

b) four drums;

c) four push buttons;

d) group of contacts;

e) spark arrester;

f) two four-pole switches;

g) terminal plate;

h) casing.

Four identical electromagnets, consisting of a coil, yoke, pivoted armature and spring, serve to rotate four time-disks. For this purpose

levers with pawls are secured to the armatures of the electromagnets by means of pins and bolts (Fig. 46).

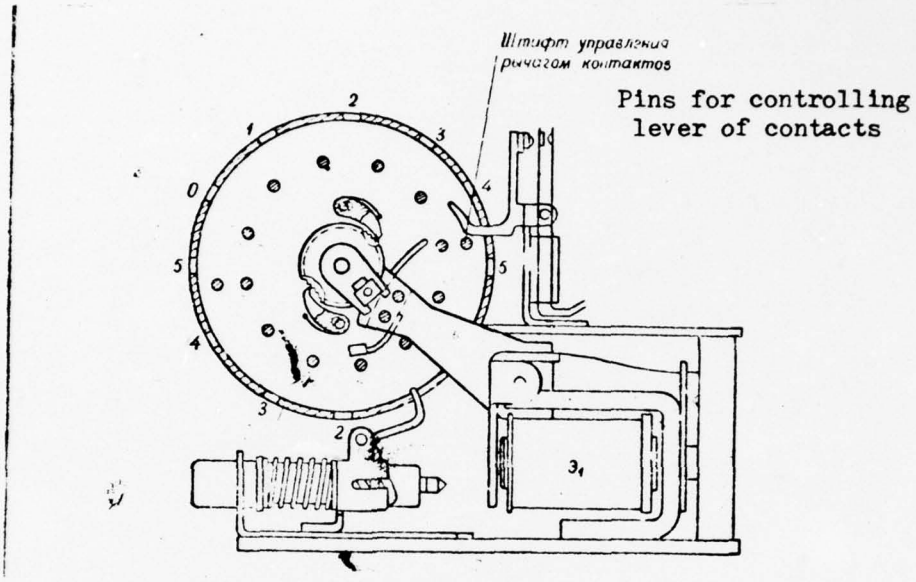


Fig. 46. Diagram of the operation of the drum for seconds (Position I)

On the levers of the drums are the locking devices which differ from one another in shape and dimensions as a consequence of the different turn angles of the drums. A lever is secured to the armature in such a way that the center of its pivot coincides with the axis of the armature. The motion of the armature is regulated by a screw which secures the flat spring of the electromagnet to the extended bent-back end of the armature. The other end of the spring of the electromagnet is set in the slot of a plate whose vertical movement regulates the tension of the spring. [75

The electromagnets are secured to the chassis of the clock by means of pins and screws through holes in the base of the electromagnet.

The four time-drums indicating the time in hours, minutes and seconds are made of an aluminium alloy. On the cylindrical surface of the white drums are black digits. To prevent any failure in regulation when setting the time by the buttons, on one edge of the cylindrical surface of the drums there are slots (Fig. 47), the number of which is equal to the number of digits

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on the drum. The drums are drilled through both ends. In the openings are placed the pins for locking the drums, the stops, and the pins for controlling the lever of the contacts.

The pins for setting the drum are evenly spaced along the circumference and they fix the position of the digits in the window of the clock's casing; the number of pins is equal to the number of digits on the drum. The stops which are kinematically connected with the ratchet of the drum serve to impart rotation to the drum when the electromagnet of a given drum is activated. The pins for controlling the lever of the contacts are positioned farther [76 from the center of the drum than the pins for locking the drum and serve to close the contacts for supplying the electromagnet of the next time drum. The number of pins on each drum depends on the time required for one revolution of a given drum. The drum for seconds makes one revolution in 2 minutes; therefore it has two pins for transmitting an impulse every minute to the electromagnet of the drum for the minute units. The drum for the minute units makes one revolution in 10 minutes; therefore it has one pin for transmitting an impulse every ten minutes to the electromagnet of the drum for tens of minutes. The drum for tens of minutes makes one revolution in 2 hours; therefore it has two pins for transmitting an impulse every hour to the electromagnet of the drum for hours. The time-drums rotate on a common axis mounted between two supports, while the supports of the drum are mounted on the chassis of the clock by means of screws and pins.

Four special buttons are used to quickly set the indication of the hours. Each drum is electrically connected with its button. The buttons and electrical circuit of the secondary clock are designed so that in setting the readings [77 by the buttons the impulse line is switched off and electrical communication through the contacts between adjacent time drums is broken. In this way it is possible to set the reading of each drum in any order so that neither the communication between the drums nor the impulse from the primary clock will have an effect on the readings.

Each button is a piston on one end of which is mounted an insulated contact. A guide pin is inserted in the center of the piston which prevents the button from rotating and on the other end there is a stop for the return spring and for limiting the movement of the button. The piston moves through two bearings: the base of the button and the base of the support. Insulated spring contacts are mounted on the bases. When the button is pressed the contacts close and the corresponding electromagnet is activated. When the button is released the contacts are broken and the drum shifts by one digit. To change a certain number of digits it is necessary to press and release the button an equal number of times. The buttons of the drums for minutes are mounted on a common base but those for seconds and hours are mounted on separate bases.

The group of contacts provides for interaction between the time drums and consists of three contacts of similar structure. On the angle bar -- which is the base of the contacts -- are mounted two springs with contacts

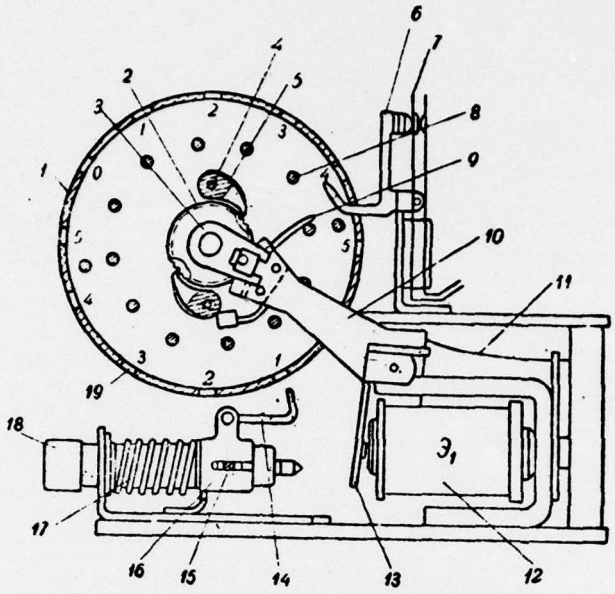

Fig. 47. Diagram of the operation of the drum for seconds (Position II):

1 -- drum; 2 -- ratchet wheel; 3 -- link with slide; 4 -- pivot of the stop; 5 -- spring of the stop; 6 -- contact lever; 7 -- contact springs; 8 pin for locking drum; 9 -- drum locking device; 10 -- lever with pin; 11 -- spring of electromagnet; 12 -- electromagnet; 13 -- armature of electromagnet; 14 -- lever of setting device; 15 -- pin of push button; 16 -- support for push button; 17 -- spring of push button; 18 -- push button; 19 -- slot of drum

and stopping devices. At the top of an angle bar, mounted on a pivot, is a bent-back lever; its one end interacts with the pin of the drum and its other end (insulated end) interacts with the springs of the contacts. The pin of the drum, at a specific moment in time, turns the lever whose insulated end acts on the spring contacts and closes them; thereupon the corresponding electromagnet is activated. When the pin escapes the lever, the springs of the contacts straighten out and contact is broken, while the lever returns to its initial position.

At the moment that the contact is broken the corresponding drum, under the action of the spring of the de-energized magnet, turns by one digit.

The spark-arresting devices (See Fig. 48, Electrical circuit of the special electric clocks), each of which consists of a non-wirewound resistor and condenser, serve to extinguish sparks in the contacts of code relay KDR-1 of the primary clock. Each spark-arresting device is connected in parallel to the winding of an electromagnet of the secondary clock.

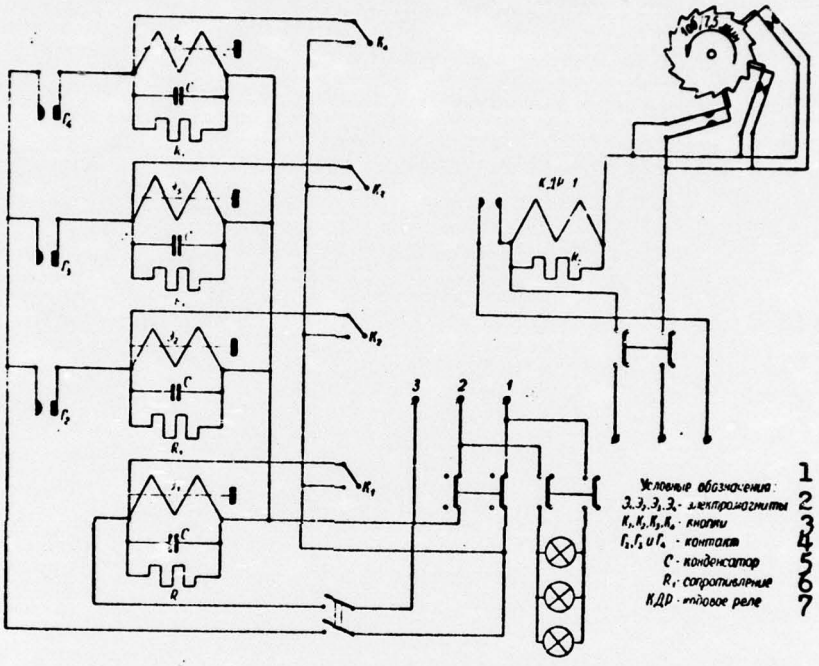

Fig. 48. Electrical circuit of the special electric clocks

1 -- Legend; 2 -- electromagnets; 3 -- buttons; 4 -- contacts; 5 -- condenser; 6 -- resistance; 7 -- code relay

For switching the power on and off and for illuminating the clock there are two double-pole switches, one of which is mounted on the cover of the casing and controls the illumination of the drum scales. The other switch is mounted on the general base of the clock and controls the energizing of the electromagnets. The clock's power supply is brought to a special terminal plate installed in the upper chassis of the clock.

The operation of the secondary clocks proceeds according to the functional diagram shown in Fig. 48 and in the kinematic diagrams shown in Figs. 46 and 47.

The first magnet, the armature of which turns the lever with the slide and ratchet, is activated by the direct-current impulse from the primary electric clock. When the impulse ceases the spring of the electromagnet pivots the armature with the lever in the reverse direction and the ratchet, by means of stops, turns at the moment when the pin for locking the drum is at the upper end of the locking device. On the surface of the drum for seconds are two digital scales, ranging from 0 to 5 for each cycle.

The digits denote tens of seconds; a turn of the drum from one digit to another occurs every 10 seconds.

With the replacement of the digit 5 by the digit 0 the recording of a minute ends; thereupon the pin which controls the lever of the contacts pivots this lever, thus closing the contacts of the second electromagnet which controls the turning of the drum for the minute units; the contacts are open at the end of the turning of the drum for seconds. The second operating magnet turns the drum for the minute units; on its surface are 10 digits ranging from 0 to 9. The digits designate the minutes and the drum turns by one digit every minute.

With the replacement of the digit 9 by the digit 0 the recording of 10 minutes ends; and the pin of the given drum closes the contacts of the third electromagnet which operates and turns the drum for the tens of minutes which has on its surface 12 digits on two scales ranging from 0 to 5. The [79
digits of the drum for minutes designate tens of minutes and the drum turns by one digit every 10 minutes. With the replacement of the digit 5 by the digit 0 the recording of an hour ends and the pin closes the contacts of the fourth electromagnet which operates and turns the drum for hours which has on its surface 24 digits; the turning of the drum by one digit occurs every hour.

In order to set the readings, each drum has a button which activates the corresponding electromagnet when pressed.

With the return of the button to its original position, under the action of the return spring, the electrical circuit of the electromagnet is broken and the drum turns by one digit.

In order to set the readings on the drums correctly, the lever of the setting device is pivoted to the button by means of a pin; when the button is pressed the upper end of the lever enters the slot of the drum and makes it possible to close the circuit of the electromagnet. If the button is pressed before the shifting of the digit from the preceding operation has been completed, the circuit of the electromagnet does not close since the lever is still on the drum and limits the movement of the button.

All devices of the instrument are located in a common rectangular case having a cover with labels.

VIKO Distribution Box (Device No. 7)

Device No. 7 (Fig. 49) is an intermediate device between radar detection stations on the one hand and VIKO (circular repeater radar scope display) on the other. The power supply for VIKO and also for the synchronous communication devices proceeds from a radar station into Device No. 7. Moreover, the stations are connected with VIKO via Device No. 7 by the following circuits: "bow of the ship" signal and synchronization of the rotation of the coils of the circular scanning tubes. Device No.7 can service up to five VIKO's at one time; therefore it has five identical assemblies for distribution, safety, and signalling. [80

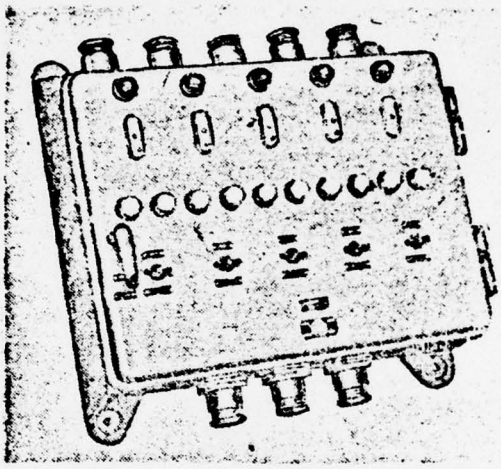

Fig. 49. Over-all view of Device No. 7

A supply voltage of 220 v, 427 cps, and 110 v, 50 cps, from common bus-bars is delivered to the corresponding VIKO via a four-pole switch, fuses (included in each pole) and a terminal plate. The switching on and off is signaled by the lighting of neon lamps. If a fuse burns out the illumination of the corresponding neon lamp ceases.

A voltage supply of 220 v, 50 cps, is delivered via fuses and terminal plates to devices for warming-up the VIKO.

A voltage supply of 220 v, 427 cps, is delivered via the contacts of a type ZU-2 safety device to signal lamps, the lighting of which signals the operation of this device. Each signal lamp services two safety devices inserted in the three-phase supply circuits of the receiving selsyns for the course of one's own ship and for the rotation of the coils of the VIKO scanning tubes from corresponding station transmitters.

In order to synchronize the transmitter and the receiving selsyn, there are contacts for matching in both radar station and VIKO, between which the electrical communication is accomplished via Device No. 7 with protection provided by fuses from short circuiting of these contacts. Protection of the circuit of the "bow of the ship" signal is also provided by fuses.

In design Device No. 7 is shaped in the form of a cast box; it is hung on a bulkhead. On the front cover which serves as the device's panel there are switches and neon signal lamps. The front cover is mounted on hinges and can be easily opened for access to the interior and to the mounting of the device. The fuses are located on the inner side of the back wall of the device. The latter are mounted on standard terminal blocks. Near each group of fuses there is an instruction plate giving the current rating of the fuse. The terminal blocks on which the fuses are mounted also serve as outlets for linking Device No. 7 with VIKO and the radar stations. There are 9 junction boxes for leading cables into the casing of the device.

CHAPTER VIII

WORK INSTRUMENTS AND ACCESSORIES

List of Instruments and Accessories [81

Special work instruments and accessories are used to perform the task of plotting the situation on the plotting boards of the Combat Information Center. A list of these instruments and accessories as distributed among CIC apparatus is given in Table 1.

Ruler With Parallel Movement

The mechanical ruler with parallel movement shown in Fig. 50 is located on the upper working surface of the board of the plotting table and is used for working on the board. It consists of four basic sections: detachable ruler, protractor with vernier, two arms and fastening device.

The detachable ruler is made of transparent plastic. The same scale for measuring distances in cables is inscribed on both edges of the ruler. In the middle of the ruler there are scales for the speed in knots for time intervals equal to an integral number of minutes. The speed of a target in knots is determined by these scales.

The ruler has metal strips for joining it to a metal extension which pivots on the same axis as the knob of the instrument and can rotate 360° in either direction. There are two index pointers on the extension for taking readings, with a difference of 180°, on the protractor. The presence of two indices makes it possible to take readings in any position of the ruler without having to move it on the plane of the board of the plotting table. There is a vernier on the extension so that the ruler can be set with an accuracy up to 15 minutes. The extension is equipped with a special stopping device in order to fix the ruler in any required position. This instrument has three detachable rulers for scaling ratios: 1:50 000, 1:100 000, and 1:150 000.

The protractor of the instrument is a metal disk 122 mm in diameter along the periphery of which there is a degree scale ranging from 0° to 360°, with 1° divisions.

For convenience in reading reciprocal bearings, the scale is provided with two rows of markings, the difference between them being equal to 180°. [84

Table 1

Distribution of work instruments and accessories among CIC apparatus

Name of work instrument and accessories	Units of measure	Apparatus								Boards			Total	Storage site
		Ps	Pn	Pm	Pv	Pa	Du	Commander's table	PIS table	No 1	No 2	No 3		
Ruler with parallel movement	Items	1											1	On apparatus
Detachable ruler for ruler with parallel movement	"	3											3	Inside apparatus
Speed finders by method of comparison of distances traversed	"	1	1										2	Inside apparatus
Speed finders by method of comparison of distances traversed for the large scaling ratio	"	1	1										2	Inside apparatus
Speed finders (set consists of 3 items)	Set	1	1		1	2							5	Inside apparatus
Slide rules	Items	1	1		1	1							4	Inside apparatus
Bearing converters	"	1	1		1	2							5	Inside apparatus
Protractors	"	1	1		1	2							5	Inside apparatus
Detachable rulers for protractors	"	3	1		2	6							12	Inside apparatus
Parallel rules 600 mm in length	"		1		1	1							3	Inside apparatus

Table 1

Name of work instrument and accessories	Units of measure	Apparatus								Boards			Total	Storage site
		Ps	Pn	Pm	Pv	Pa	Du	Commander's table	PLS table	No 1	No 2	No 3		
Parallel rules 300 mm in length	Items			1									1	Inside Apparatus Pn
Indicators of the effective range of torpedoes	"			6									6	Same
Dividers	"	1	1	1	1	1							5	Inside apparatus
Beam compasses	"					1							1	"
Drawing compasses	"	1	1	1	1	1							5	"
Rulers	"						1						1	"
Set of special colored pencils for glass	Set	2	2		2	4							10	"
Set of ordinary colored pencils	"	2	2		2	4		2	2				14	"
Mark NV "Konstruktor" graphite pencils	Items	2	2	2	2	2		2	2				14	"
Penknives	"	1	2	1	2	3		1	1				11	"
Soft erasers for erasing pencil recordings	"	1	2	1	2	2		1	1				10	"
Fluid for removing pencil recordings, in bottles, 100 gm	"	1				1							2	"
School chalk	"									2	2	2	6	On the boards
Clean cloth	grams	50	50	50	50	100			100	100	100	100	600	Inside apparatus
Tracing paper in reels	reels	1	1		1								3	Inside Apparatus Ps

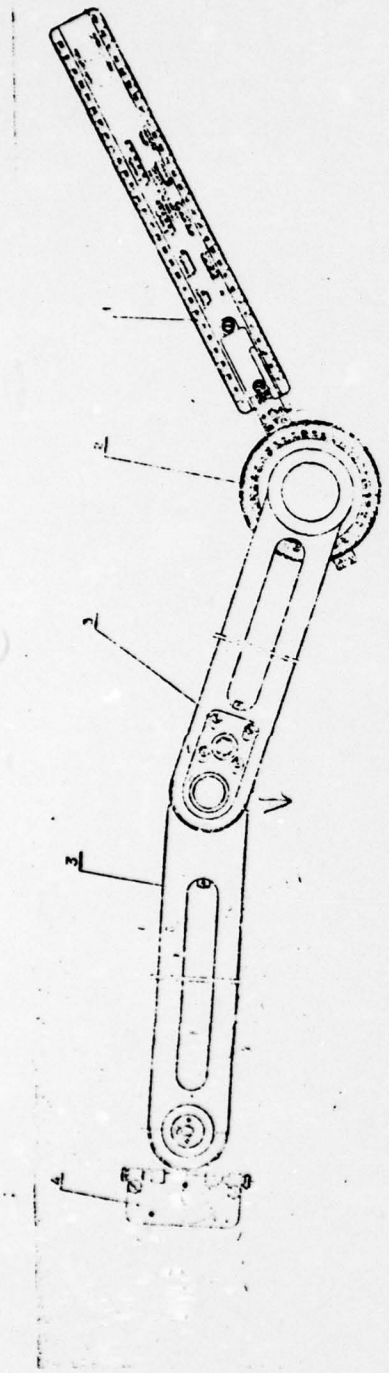

Fig. 50 Over-all view of ruler with parallel movement:
1 -- ruler; 2 -- limb; 3 -- arms; 4 -- fastening device

In moving the ruler over the work surface of the plotting board the protractor does not rotate and always occupies the same previously fixed position with respect to the rectangular grid of the working surface of the plotting board. For the initial setting of the protractor a special stopping device located on the protractor must be pushed out so that the protractor can rotate about its axis in either direction.

The arms of the instrument are used for the parallel movement of the ruler over the working surface. There are two arms coupled together.

The parallel movement of the ruler is accomplished through the rigid steel strips which connect the arms of the assembly. The rigidity of the steel strips is governed by two adjusting screws.

A mounting device is used to attach the assembly of the mechanical ruler to the cover of the plotting table. The device has two screws between the centers of which is located the axis of the holder of the assembly. The holder is secured to the cover of the plotting table by three screws. Such a mounting provides for the possibility of free movement of the entire mechanical ruler in the vertical plane.

Speed Finders

The following aids are used in the CIC for quickly determining on the plotting boards for the air or surface situation the motion parameters of targets (speed and distance traversed by the target):

a) speed finders by the method of comparison of distances traversed;

b) speed finders for Apparatus Ps and Pn;

c) speed finders for Apparatus Pv and Pa;

d) slide rules.

Speed finders are reticular nomograms of the velocity formula:

$$V = \frac{D}{T}$$

where V - velocity of target;

D - distance;

T - time.

The nomograms are ruled on plates made of colorless organic glass. Each situation plotting board has three speed finders.

The slide rules are computing devices used to determine any of the motion parameters of a target: speed, time, and distance, when any two of the indicated parameters are known.

Each situation plotting board has one slide rule whose uniform scales are plotted in the scaling ratios corresponding to those of the working surface of a given plotting board.

The universal speed finder -- by the method of comparison of distances traversed, shown in Fig. 51 -- is used to determine the speed of a target by way of comparing distances traversed during the same interval of time, with the speed of one's own ship being known. [85

Such speed finders can be used to determine the speed of a target on plotting boards of any scale.

On the nomograms constructed for speed-finders the speed of a target is taken as the parameter whereas the time and distance are taken as coordinates of the points on the plane. The time is plotted along the axis of the abscissas while the distance is plotted along the axis of the ordinates. The numerical values of the speed, from 0 to 80 knots, are given on the nomogram. The maximum distance on the nomogram of the speed finder is 120 mm, so that a plotting of 0.5 miles in the largest scaling

ratio comes to 13.7 cables.

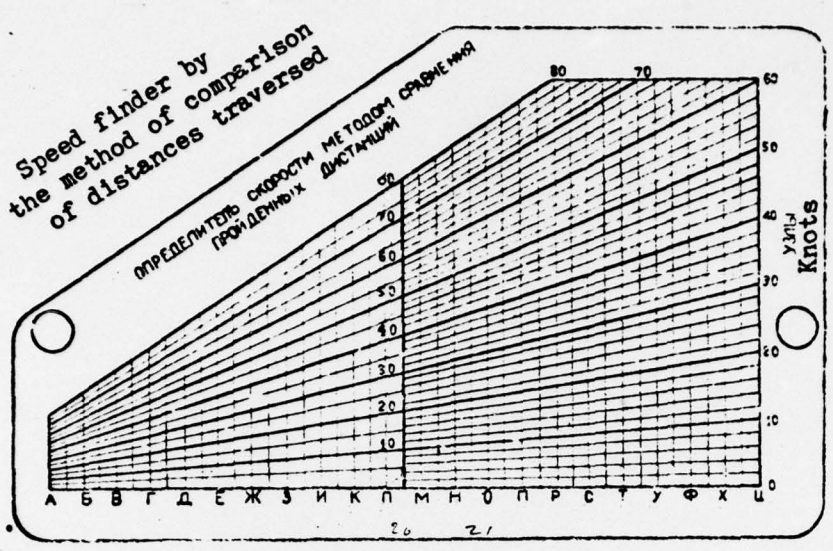

Fig. 51. Speed finder by method of comparison of distances traversed

Therefore in using a given speed finder the interval of time for the plotting of points must be within the following limits:

For plotting board Pn:

with plotting scale 0 - 5 miles: from 10 sec to 1 min;

with plotting scale 0 - 20 miles: from 40 sec to 4 min;

with plotting scale 0 - 50 miles: from 1 min 40 sec to 10 min.

For plotting board Ps:

with plotting scale 1:50 000: from 10 sec to 2 min;

with plotting scale 1:100 000: from 20 sec to 4 min 40 sec;

with plotting scale 1:150 000: from 30 sec to 7 min 00 sec.

In view of the fact that the maximum time for the largest scale (0 - 5) [86
is extremely small and comes to one minute, then, for the determination of the speed of targets plotted in the large scales, the speed finder

for the large scale -- shown in Fig. 51 -- is used, wherein the maximum distance on the nomogram is equal to 200 mm, and this allows an increase in time greater than a factor of 1.5.

Thus, for example, for the 0 -5 mile scale on the Pn plotting board the time interval of plotting must be within the limits ranging from 30 seconds to 1 minute and 40 seconds.

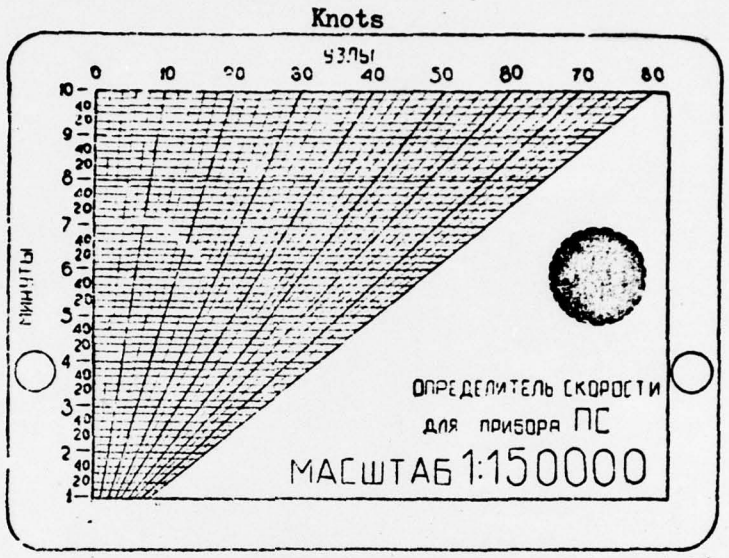

Fig. 52 Speed finder for Apparatus Ps.
Scale: 1:150 000

The speed finder for plotting board Ps, shown in Fig. 52, and the speed finder for plotting board Pn, shown in Fig. 53, are used to determine the speed of a surface target from the segment of the path traversed by the target during a specific interval of time and also to determine the time a target will reach a given point at the known speed of the target.

The reticular nomogram plotted on a colorless plate made of organic glass expresses the velocity formula:

$$V_{knots} = \frac{6D \text{ cables}}{T \text{ min}} .$$

Each apparatus is assigned three speed finders: Apparatus Ps, for scales 1:50 000, 1:100 000, and 1:150 000; Apparatus Pn, for scales 0 - 5 miles, 0 - 20 miles and 0 - 50 miles.

The nomograms of Apparatus Ps and Pn differ from the nomograms of the universal speed finders using the method of comparing distances traversed only in the fact that on the given nomograms the time is plotted along the axis of the ordinates while the distance is plotted along the axis of the abscissas. [87

The numerical values of the speed likewise range from 0 to 80 knots.

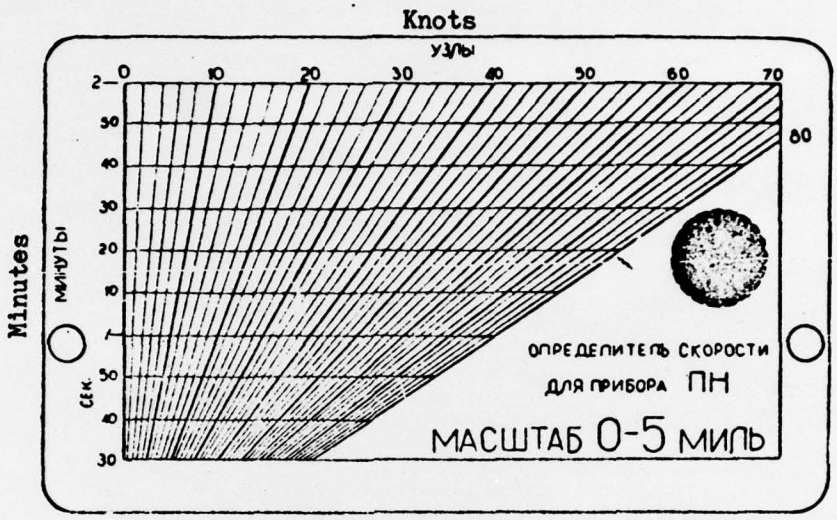

Fig. 53 Speed finders for Apparatus Pn.
Scale: 0 - 5 miles.

For greater efficiency the speed finders for each scale have circles of different colors.

The speed finders for Apparatus Pv and the speed finders for Apparatus Pa solve the very same problems as the speed finders for Apparatus Ps and Pn. The speed finders are used in plotting the course of a target on plotting boards Pa and Pv and are used to determine the motion parameters of air targets.

Each speed finder is a plate of organic glass, on one side of which is drawn a reticular nomogram of the the velocity formula:

$$V \text{ m/sec} = \frac{3.08\ D \text{ cables}}{T \text{ min}} .$$

Each plotting board is assigned three speed finders: Apparatus Pv, for scales 0 - 20 miles, 0 - 50 miles, and 0 - 100 miles; Apparatus Pa, for scales 0 - 50 miles, 0 - 100 miles, and 0 - 200 miles.

For greater work efficiency the speed finders for each scale have a correspondingly colored circle.

The construction of the nomograms for the speed finders is similar to the nomograms for Apparatus Pn and Ps. The numerical values of the speed on the speed finders range from 0 to 300 m/sec.

Slide Rules

Two types of slide rules are used in the Combat Information Center: [88

a) slide rules for determining the speed of surface targets;

b) slide rules for determining the speed of air targets.

The slide rule for determining the speed of surface targets, shown in Fig. 54, is a computing device and is used to determine any of the motion parameters of a target (speed, time, and distance) from the formula:

$$V_{Knots} = \frac{6\,D \text{ cables}}{T \text{ min}}.$$

Similar slide rules are used for plotting the course of a target on plotting boards Ps and Pn. Each plotting board has one slide rule.

The slide rules are similar to a conventional slide rule and have four scales: one uniform scale for triple-scaling and three functional scales in logarithmic form; one of the logarithm scales is a sliding scale. The uniform scales are used to measure the distance traversed by targets plotted on the boards, while the logarithmic scales are used to calculate any of the motion parameters of a target.

One of the fixed logarithmic scales represents the distance in cables from 1 to 70 cables, while the other -- the speed from 1 to 100 knots. On the sliding scale the time is plotted in minutes with accuracy up to 10 seconds.

Above the logarithmic scales is a conventional slide-rule slide with a cross-hair inscribed on the glass.

The slide rules for the air targets are used to determine any of the motion parameters of a target (speed, time, and distance) from the formula:

$$V \text{ m/sec} = \frac{3.08\,D \text{ cables}}{T \text{ min}}.$$

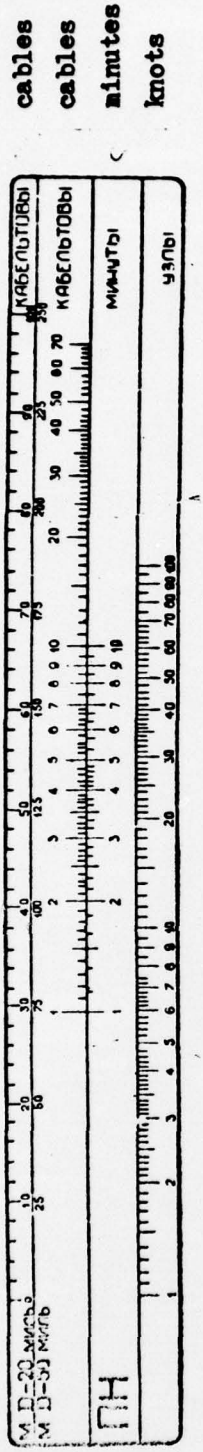

Fig. 54. Slide rule for Pn

The slide rules are used in plotting the course of a target on the Pa and Pv plotting boards. [89

Each board is assigned the slide rules calibrated in the scales used for plotting targets on these plotting boards.

In design they are similar to the slide rules for surface targets and differ only in the markings on the scales.

The Bearing Converter

The plotting of the positions of targets on a plotting table and boards is conducted according to true bearing and distance to a target. Some information centers (infra-red radar and sonar stations) give the bearing on a target as a relative bearing. The bearing converter is a device used to convert a relative bearing to a true bearing. The bearing converter consists of two compass cards arranged concentrically in the same plane; the inner card can move freely about its axis. The cards are made of colorless organic glass. the fixed card is colored white on the reverse side.

Protractor With Detachable Ruler

The protractor with ruler is a device used primarily to determine the course of a target as well as to measure the distance traversed by a target and, in certain cases, to determine its speed.

The device is used in plotting the course of a target on boards Ps, Pn, Pa, and Pv.

The device consists of:

a) a protractor for determining the course of a target;

b) a ruler for plotting the course, measuring the distance traversed by the target and determining the speed of the target.

The protractor is made of colorless organic glass in the form of a sector of a circle of radius 110 mm. Along the circumference of the protractor there is a degree scale ranging from 250° - 90°, with 1° divisions; for convenience in reading the scale there is a double row of digital markings with a difference of 180° between them.

An extension secured to a detachable ruler rotates on the axis of the protractor. On the knob of the protractor there is a special clamping device making it possible to fix the ruler in any position.

To insure accuracy up to 15 minutes in measuring the course of a target the protractor has a vernier. Radial lines are drawn on the surface of the protractor every 10°.

Depending on the type of board the protractor has one to three detachable rulers. For measuring on the plotting board the distances traversed by targets the rulers have a uniform scale with one or two rows of markings.

The scale of each ruler corresponds to the scale of the working surface [90
of the board on which the given ruler is used.

On each ruler, in addition to the scales for measuring distance, there are speed scales for time intervals equal to an integral number of minutes.

The number of detachable rulers assigned to each type of board is given in Table 2.

Table 2

Type of board	No.	Ruler data	Remarks
		Scales	
Ps	3	1:50 000, 1:100 000, 1:150 000	Separate ruler for each scale
Pa	3	0 - 50, 0 - 100, 0 - 200 miles	Separate ruler for each scale
Pv	2	0 - 20, 0 - 50, 0 - 100 miles	One ruler is used for scales 0 - 20 and 0 - 50 miles; another ruler is used for scale 0 --100 miles
Pm	1	0 - 20 and 0 - 50 miles	Same ruler for all scales

Indicators of the Effective Range of Torpedoes

The indicators of the effective range of torpedoes, a typical diagram of which is shown in Fig. 55, are special nomograms engraved on a 3 x 190 x 260 mm plate of colorless organic glass. The indicators are used to solve tactical problems associated with torpedo firing.

All six indicators are intended for use only on the maneuvering board and are stored inside the board in a special case.

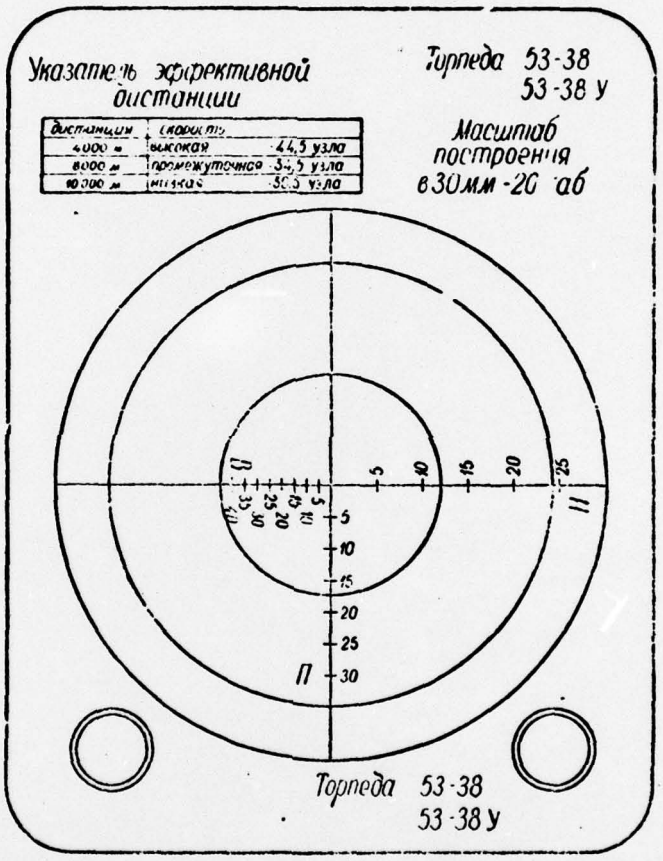

Fig. 55 Indicators of effective range for torpedo 53-38, 53-38y

The nomogram of each indicator consists of concentric circles and velocity scales. The number of circles on each indicator is equal to the number of velocity regimes for a given type of torpedo. The largest circle is intersected by two mutually perpendicular lines. Plotted on the radii formed by these lines are the velocity scales whose number corresponds to the number of velocity regimes of the torpedo.

The scale on the greatest radius, designated by the letter "H", corresponds to the minimal velocity of the torpedo and to the distance traversed by the torpedo at the given velocity. The scale designated by the letter "B" corresponds to the maximum velocity of the torpedo and to the distance traversed by the torpedo at the given velocity.

For each type of torpedo a separate indicator is prepared listing its tactical-technical data.

The Vernier Caliper [91

The vernier caliper (Fig. 56) is used for work on the working surface of the Pa plotting board. The caliper has a rule 810 mm in length calibrated for the scales 0 - 50 and 0 - 100 nautical miles with the value of a division equal, respectively, to 1 and 2 cables. On the rule there is a slider in which a special colored pencil is inserted. The pencil is clamped to the slider by means of a screw. The rule is pivoted to a support and can rotate about its axis in any direction.

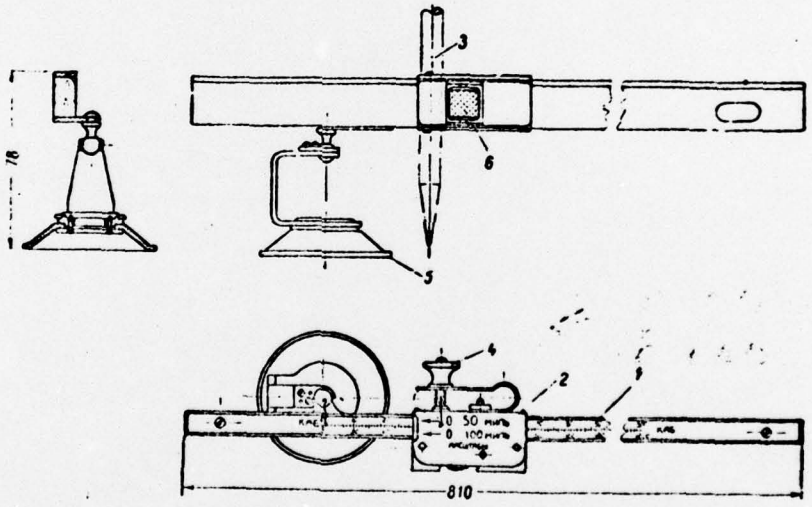

Fig. 56 Vernier caliper:

1 -- rule; 2 -- slider; 3 -- pencil; 4 -- clamping screw; 5 -- gutta-percha suction device; 6 -- roller for setting slider

For convenience in using the rule on the vertical polished working surface of organic glass there is a gutta-percha suction devise at the base of the support. The axis of the support and the axis of the pencil are at equal distances from the axis of the rule. At the base of the support there is an organic glass plate with cross hairs for precise setting of the caliper at the initial point from which it is required to measure distance. [92

The slider is set in the required position by means of a roller located on the lateral side of the slider. In order to quickly set the slider in the required position the roller must be pressed out by means of a clamp on the roller assembly.

Special Pencils

Special pencils are used in the CIC for plotting the situation on boards made of organic glass. Pencil inscriptions are easily removed by a special solvent so that the working surface remains polished and without scratches.

Ordinary colored pencils damage the working surface and are therefore prohibited.

CHAPTER IX

Inventory [93

The following items are used for work in the Combat Information Center:

a) table for the pantograph;

b) table for CIC Commander;

c) table for watch service of radar jamming equipment (PLS);

d) seats for personnel;

e) cabinets for storing reserve property, documents, journals, forms, etc.

The table for the pantograph consists of a 1000 x 1000 mm wooden collapsible panel and of a shaped metal leg connected by hinges with the board of the table.

The panel is fastened by hinges to one of the CIC bulkheads and along with the leg can be swung upwards and secured in a vertical position to the bulkhead if there is no need to work with the pantograph.

The desk of the CIC Commander and the PLS table are 600 x 1000 mm panels covered with linoleum and secured to the deck by four legs.

Each table has two locking drawers. The height of a table from the deck is 800 mm.

The seats for personnel swivel. The height of a seat can be adjusted from 680 to 850 mm above the deck. The seats are circular, 320 mm in diameter, and covered with leather. The pedestal of the seat is welded to the deck and has two stirrups for the feet.

The cabinets for storing reserve property are metal, with dimensions 400 x 800 x 1600 mm. Each cabinet is divided vertically into two compartments: wide and narrow.

In the wide compartment there are eight drawers, six of which are shallow and two deep; in the narrow compartment there are two removable metal shelves which can be re-arranged as desired. The narrow compartment has a hinged door which in the closed position does not permit the drawers of the wide compartment to open.