11/7

38

INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

This material contains information affecting the National Defense of the United States within t
18, U.S.C. Secs. 793 and 794, the transmission or revelation of which in any manner to an un

S-E-C-R-E-T
NO FOREIGN DISSEM

COUNTRY USSR

REPORT

SUBJECT English Translation of Soviet Manual on the NEL-5R Echo Sounder

DATE DISTR. 7 November 1963 50X1-HUM

NO. PAGES 1 50X1-HUM

DATE OF INFO.

PLACE & DATE ACQ

THIS IS UNEVALUATED INFORMATION. SOURCE GRADINGS ARE DEFINITIVE. APPRAISAL OF CONTENT IS TENTATIVE.

1. A copy of a 122-page English translation of a Russian-languag 50X1-HUM manual entitled Description, Operating and Maintenance Instructions and Technical Specifications of the Soviet NEL-5R Echo Sounder (Fish Finder)

2. The echo sounder is designed for measurements of depth and 50X1-HUM automatic recording of the contour of the sea bottom at depths of one to 500 meters, with the ship at rest or in motion. It can also be used to detect schools of fish under the ship's keel and to determine the size and density of the school. 50X1-HUM

Distribution of Attachment (For Retention):

50X1-HUM

Army:	1 copy
Army/FSTC:	1 copy
Navy:	4 copies
Navy/STIC:	3 copies
Air:	1 copy
Air/FTD:	1 copy
DIA:	4 copies
NSA:	6 copies
OSI:	4 copies
ORR:	2 copies
OO/FDD:	1 copy

2
1

50X1-HUM

5 4 3 2 1

5 4 3 2 1

STATE	DIA	ARMY	NAVY	AIR	NSA	XX NIC	OCR
ARMY/FSTC; NAVY/STIC; OO/FDD							

(Note: Field distribution indicated by "#".)

INFORMATION REPORT INFORMATION REPORT

DESCRIPTION, OPERATING AND MAINTENANCE INSTRUCTIONS

AND

TECHNICAL SPECIFICATIONS ON THE SOVIET

NEL-5R ECHO SOUNDER

(FISH-FINDER)

SECRET
NO FOREIGN DISSEM

50X1-HUM

DESCRIPTION, OPERATING AND MAINTENANCE INSTRUCTIONS AND TECHNICAL SPECIFICATIONS ON THE SOVIET NEL-5R ECHO SOUNDER (FISH-FINDER)

SECRET
NO FOREIGN DISSEM

Table of Contents

50X1-HUM

50X1-HUM

Part Two

Maintenance Instructions

Part Three

Photographs of Instruments Explaining the Text

Part Four

Use of the Echo Sounder for Locating Fish and Interpretation of Echograms

50X1-HUM

INTRODUCTION

50X1-HUM

NEL-5R fish finder was built according to echo sounder design developed by Laboratory No 9 of the VNIRO MRP SSSR. This design meets the requirements for searching for schools of fish under the ship's keel and recording on the paper of the automatic recorder vertical cross sections of these schools by which their size and density can also be estimated. The navigational properties of the NEL-4 echo sounder are fully retained.

The navigational echo sounder NEL-4, which has a thyratron in the amplifier output, can not be used to search for fish because the recording instrument registers on the paper only the upper boundary of the school, and this only if the accumulation of fish in the school is quite large. However, even then it is impossible to judge the relative density and size of the school.

As a result of the study made by the All-Union Scientific Research Institute of Marine Fishing and Oceanography VNIRO it was established that the NEL-4 echo sounder, with small changes in design and circuit, can meet the requirements for searching for schools of fish.

The present technical description and maintenance instructions are in four parts. The first three consist of description, maintenance instructions, and photographs of equipment explaining the text, but do not contain any specific instructions on use of the echo sounder in searching for fish.

Part IV "Operation of the echo sounder in search for fish and reading of the echogram" gives concise information on the operation of the fish finder in searching for schools of fish, and contains echogram photographs of schools and groups of fish made in various basins by the All-Union Scientific Research Institute of Marine Fishing and Oceanography in the course of building the fish finder.

This technical description is basically concerned with the electric circuit; consequently, all electric component numbers referred to in the description correspond to circuit diagram Ts 3.870.016-Skhe which is a supplement to the description.

50X1-HUM

PART I

Description

Chapter I

General Information

1.1 Purpose

The NEL-5R echo sounder is designed for measurements of depth and automatic recording of the contour of the sea bottom for depths of 1 to 500 meters, for a ship at rest as well as in motion, with speeds up to 20 knotts, rolling not over 10°, and pitching not over 2°.

Reading and recording of depths are in meters. Accuracy of reading remains constant within the limits of allowable error in the ship's power fluctuations, from rated value, of ± 10% for the direct current system and ± 5 for the alternating current system.

The NEL-5R echo sounder is also designed for detection of schools of fish under a ship's keel and determination of their size in the horizontal as well as in the vertical plane and also for determination of relative density of the schools (by use of a recording instrument).

The NEL-5R echo sounder may be installed on large and small ships.

1.2 Basic Technical Data

Depths are measured in two ranges: 0-100 m and 0-500 m. The indicator has two scales corresponding to these ranges.

For more precise readings of recorded depths and also for making possible "scanning" of the detected schools of fish in a sixty-meter layer of water at any depth from 0 to 240 m, while operating on the 100 m range, supplementary phasing is introduced (anticipation of sending relative to zero of the scale), which corresponds to 5 subranges. For operation on the 500 m range the phasing value for each subrange is 5 times greater than indicated in Table No 1.

The table below gives depth values which may be scanned for operation on any of the 5 ranges.

Subrange	Phasing	Scanning Depths	Overlapping of Adjacent
I	0 m	0-60 m	20 m
II	40 m	40-100 m	10 m
III	90 m	90-150 m	10 m
IV	140 m	140-200 m	20 m
V	180 m	180-240 m	

Table No 1

Note: For operation at depths over 240 m it is necessary to switch to the 500 m range.

The error in measurement, inherent in the design and circuitry of the echo sounder, taking into account the variation of the speed of sound in water for a depth of 1 to 20 meters, does not differ from the calculated by more than ± 0.5 meters.

For depths over 20 meters, the error is not greater than ± 3.5%. Control over the operation of the echo sounder during depth recording is from the recording instrument, and during visual readings from the indicator.

Simultaneous operation of recording instrument and indicator is impossible.

Switching on and off of the echo sounder is done by a toggle switch located on the recording instrument. For operation on direct current, first the PO-550 converter is started by a rotary switch located in the filter.

After switching on, the echo sounder supplies steady depth readings within 30 seconds and can operate continuously for 12 hours. Basic instrument parameters are given below.

50X1-HUM

Basic Parameters of the Instruments

Automatic Recorder

No	Parameter	Ranges 0-100 m	0-500 m
1	2	3	4
1	Paper width	155 mm	155 mm
2	Depth range distributed across the page	60 m	300 m
3	Phasing	See Table No 1	
4	Overlap during change of phase	See Table No 1 and its explanation	
5	Velocity of electric motor	3,145 rpm	629 rpm
6	Revolutions of the pen	185 rpm	37 rpm
7	Velocity of the pen	2 m/sec	0.4 m/sec
8	Pulse voltage supplied to the pen	35 v	35 v
9	Velocity of the paper	25 mm/min	5 mm/min
10	Interval between time markings	0.5 min	2.5 min
1	2	3	4
11	Distance between time markings	12.5 mm	12.5 mm
12	Distance between the scale grid markings	5 m	25 m
13	Scale of the recording	2.6 mm/m	0.52 mm/m
14	One roll of paper secures operation	13 working hours	65 working hours
15	**Voltage supplied to recording on scale grid**	**25 v**	**25 v**

50X1-HUM

Indicator

No	Parameter	Ranges 0-100 m	0-500 m
1	Velocity of electric motor	3,060 rpm	612 rpm
2	Velocity of the indicator disk	450 rpm	90 rpm

Amplifier

No	Parameter	Magnitude
1	Filament voltage of the amplifier tubes and thyratron	5.7 - 6.9 v
2	Kenotron filament voltage	4.5 - 5.5 v
3	Plate voltage	280 - 320 v
4	Amplification factor	2×10^6 to 4×10^6

Relay

No	Parameter	Circuit Voltage Supply ~127; = 100 & 220	~200
1	Voltage supply to transmitting capacitors	1,000 ± 100 v	1,000 ± 100 v
2	Voltage supply to coils	26 ± 5 v	
3	Kenotron filament voltage	4.5 to 5.5 v	4.5 to 5.5 v

Vibrators

No	Parameters	Magnitude
1	Insulation strength	3,000 v
2	Insulation resistance	not less than 10 megohm

50X1-HUM

1.3 Assembly Variations of the Echo Sounder

The NEL-5R echo sounder is assembled according to the type of current and voltage of the ship's electrical system.

Therefore, depending on actual conditions, the echo sounder may be assembled in the variations given in Table No 2.

The table also gives weights of the sets with the spare parts box and equipment for each type of assembly and specifies cables which can be used to interconnect the echo sounder instruments.

1.4 Echo Sounder Power Supply

For all applications of the echo sounder, the power supply is taken from the ship's electrical system of 110 or 220 v direct current, or 127 or 220 v alternating current.

In the case of echo sounder power supply from the ship's 110 or 220 v circuits, a PO-550 converter and a variable dropping resistor are attached to the echo sounder set. Converters, depending on the voltage, are of two types: PO-550 F for 110 v direct current and PO-550 AF for 220 v direct current.

NEL-5R Echo Sounder Variants

No	Echo Sounder Variants	Operating Voltage	Instruments Included in the Echo Sounder: Indicator	Automatic Recorder	Amplifier	Relay	Vibrators	Converter PO-550	Filter	Dropping Resistor	Cable Boxes	Total Intake Power	Total weight of set with spare parts and Accessories	Type of Interconnecting cable	Remarks
1	NEL-5R	127 v	1	1	1	1	2	-	1	-	2	350v-amp		SRM&KNRP	
2	NEL-5R	220 v	1	1	1	1	2	-	1	-	2	350v-amp		SRM&KNRP	
3	NEL-5R	110 v	1	1	1	1	2	1	1	1	2	700 w		SRM	
4	NEL-5R	220 v	1	1	1	1	2	1	1	1	2	700 w		SRM	

Table No 2

S-E-C-R-E-T
No Foreign Dissem

Echo sounder power inputs from the electrical system of the ship, depending on type of current and the echo sounder assembly, are given in Table No 2.

For special circuit features, depending on voltage supply, see section "Special features of echo sounder electrical circuits for 220 v direct current and 127 and 220 v alternating current."

1.5 Echo Sounder Layout

Because of the variety in types of ships, it is impossible to give any definite recommendations for layout of the echo sounder on a ship. Nevertheless, general requirements in distribution of the echo sounder instruments, made apparent during operations, lead to the following:

1. Placement of Vibrators

The vibrators are placed in apertures cut for them on the bottom of the ship. In selecting locations for their placement, it is necessary that at that location and in front of them there be no:

a) underkeel currents impregnated with air bubbles;

b) projecting body sections, intakes, or discharge device which may create a whirlpool or detain air bubbles brought from the surface; and underkeel wash currents containing oil, crude oil, etc.

Vibrators must be placed outside the influence of closely located hydroacoustic equipment, as well as machinery creating intensive vibrations in the ship's hull.

It is necessary that the vibrators be placed close to the diametral plane of the ship, and in order to fulfill this requirement it is permissible to place vibrators along both sides of the ship as well as along one side, and also between different frames.

The base - the distance between vibrators must be equal to one meter. If this requirement can not be met an increase of the base of up to two meters is allowed.

2. Location of Cable Boxes

The cable box is placed in the hold at a distance of not more than 8 meters from the vibrator and in a line between the radiator - relay and vibrator receiver - amplifier.

Installation of cable boxes is not compulsory if the length of these lines does not exceed 8 meters.

3. Location of Relay and PO-550 Converter

50X1-HUM

For convenience of servicing it is desirable to place the relay and the PO-550 converter in the same room. They may be placed in one of the hold compartments which are dry and protected from sharp temperature changes.

Installation in boiler rooms is not permissible.

4. Location of Automatic Recorder, Indicator, Amplifier, Filter, and Dropping Resistor

The automatic recorder, indicator, amplifier, filter, and dropping resistor must be placed in one of the upper heated rooms, usually the wheelhouse. In some cases the indicator may be placed in some other room, such as the chart room. The indicator should be placed so that it is protected from rain and spray.

In the placement of the above mentioned instruments it is necessary to observe the allowable cable lengths given below.

Pick dipole - cable box - amplifier not over 30 meters

Automatic recorder - indicator mot over 15 meters

Automatic recorder - amplifier not over 15 meters

Automatic recorder - relay not over 60 meters

Automatic recorder - converter not over 60 meters

Relay - radiator not over 8 meters

Filter - dropping resistor not over 5 meters

Variable dropping resistor - converter not over 60 meters.

Principle of measuring and recording of depth

Принцип измерения и записи глубин

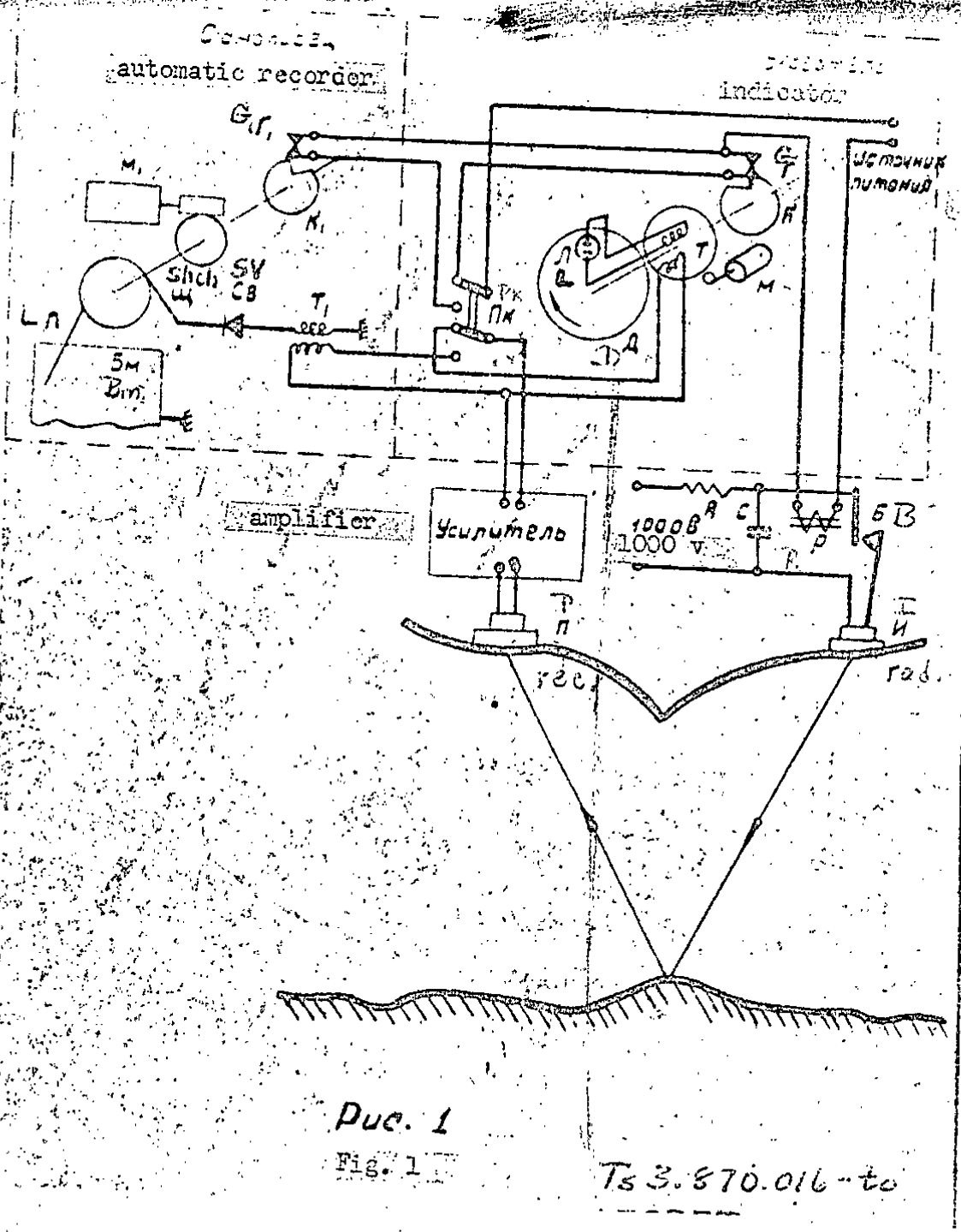


Рис. 1

Fig. 1

Chapter II

50X1-HUM

General Description

2.1 Principle of Measuring and Recording Depth (Fig. 1)

The operation of the sounding device is based on the lapse of time from the transmission of the ultrasonic impulse until its return from the bottom to the receiver.

An indicator is used for visual monitoring of the depth (switch PK is in the "up" position, as indicated on the diagram). When neon tube L, situated on disc D, passes the zero position on the dial, the actuating cam K disconnects the contacts G, as a result of which the shipboard circuit activating the winding of relay R is broken and the armature, acted upon by a spring (not shown on the diagram), closes contacts B. Disc D is operated by a motor M.

The circuit of the transmitting capacitor (fed from a high-voltage rectifier, on the order of 1000 v) and the winding of the oscillation source I, comprised of nickel plates and lying in a recess of the unit, is closed.

An oscillatory process is started by the discharge of the capacitor into the circuit, and a pulse of alternating current is generated by the winding of the oscillation source. The pulse duration is so short that the oscillatory process in the circuit is quickly damped.

The alternating current, in turn, produces an alternating magnetic flux and, due to the effect of magnetostriction, resulting in a change in the linear dimensions of the ferromagnetic bodies located in the varying magnetic field, the oscillator unit will vary its linear dimensions.

The mechanical oscillations of the unit are transmitted to the surrounding medium and diffused in the direction of the ocean bottom in the form of a damping pulse. Since ultrasonic waves possess the property of reflecting off of the boundary of two media of different densities, the ultrasonic oscillations will be reflected from the Ocean bottom and part of them will reach the oscillator receiver P which, by construction, is no different from the oscillator.

The amount of reflection of the pulse is greatly dependent on the character of the ocean bottom; it will be greater for a hard, rocky bottom than for a soft, muddy bottom. Reflection of the ultrasonic oscillation produces a variable contraction of the nickel plates of the unit and, as a result of the reverse magnetostriction effect, a change in its magnetic field with the frequency of the incoming pulses. In

order that the oscillation receiver have a constant magnetic field they magnetize periodically during its operation. 50X1-HUM

A negligible electromotive force will be created by the variable magnetic field in the winding of the oscillator receiver. The ends of the winding are connected to the input of an amplifier, which has as two stages of amplification tubes 6ZhV. At the output of the amplifier is a thyratron, which operates in the navigational mode, and tube 6P3S, which is used in the fish-finding mode. Since the indicator is used only in the navigational mode, an increased ac voltage is fed to the grid of the thyratron and activates it, as a result of which the circuit of the capacitor, connected between the plate and cathode of the thyratron through the primary winding of step-up transformer T, is closed through the thyratron, and the capacitor begins to discharge.

A voltage, increased to on the order of 500 v, is fed from the ends of the secondary winding of this transformer to neon tube L, activating it for a short time.

During the time that the ultrasonic pulse travels from the oscillator to the bottom and back to the receiver, the neon tube, rotated by the motor M at constant speed, stops at an angle proportional to that time and, consequently, to the depth being measured.

Since the transmission of the ultrasonic pulse occurs at the instant that the neon tube leaves the zero position on the dial, the distance along the dial from its zero point to the position of the instantaneous lighting of the neon tube, occurring upon the arrival of the reflected pulse, will be proportional to the depth being measured. The depth scale is graduated in meters. The position of the neon tube when it lights, at the instant the reflected pulse arrives, immediately indicates the depth. Consequently, for each revolution of the disc, at the instant the neon tube moves through the zero point on the dial, energy is transmitted. Further movement of the disc causes cam K to again close contacts G, actuating the relay, and the armature returns to its original position and opens contacts B. The circuit of the oscillator winding and discharging capacitor is broken and it begins to recharge.

During recording of the depth the indicator cuts out and the automatic recorder cuts in (switch Pk is shifted to the lower position). When cam K_1 opens contracts G_1, the transmitting relay is actuated and a pulse is transmitted. The motor M_1 rotates at a constant speed and simultaneously drives cam K_1 and recording pen P. At the instant the pulse is transmitted, the pen is at the left edge of the paper, impregnated with a solution of potassium iodide. The position of the pen corresponds to the zero point on the dial. After the arrival of the reflected pulse and its amplification, the capacitor discharges into the circuit of the thyratron during operation in the navigational mode with the primary winding of output transformer T_1.

When the fish-finding mode is in operation, the output of the amplifier is connected to the output tube 6P3S, whose plate load is also the primary winding of transformer T_1. From the secondary winding of transformer T_1 the current through the selenium rectifier SV goes to brush shch and through the commutator to pen P. During the travel of the pulse the pen rotates through an angle proportional to the depth being measured, and the returning pulse, rectified by the selenium rectifier, passes through the paper and produces an electrolysis of the potassium iodide, leaving a mark on the paper in the form of a short violet line. In this way, a pulse is transmitted for each revolution and a mark for the reflected signal is given. The marks are combined on the paper in a continuous line corresponding to a relief of the bottom.

When there is a school of fish under the keel of the ship, it will partially reflect the ultrasonic oscillations, which will be recorded on the paper in a manner similar to that of the signals coming from the bottom. These signals will appear on the paper in a position corresponding to the depth of the school.

The oscillator is constructed in such a way as to ensure directional radiation of the oscillations. The directed oscillations are radiated over an angle sufficiently large to prevent loss of reflected pulses during slight rolling of the ship and, thus, to guarantee a sufficient concentration of sonic energy for the operation of the sounding device. The condition of the sea exercises a considerable influence on the operation of the sounding device. A rough sea may cause a gap in the indications of depth.

2.2 Correction for the Base Line

As seen from the diagram (Figure 1), the direction of the ultrasonic beam is not vertical but is inclined at some angle. The angle of inclination depends on the base line (the distance between oscillator and receiver) and on the depth.

The base line markedly affects the accuracy of the readings for shallow depths; therefore, in the measurement of shallow depths it is necessary to make the corrections shown in Table 3 or by means of correction tables for use with the sounding device (the indicator dial is evenly graduated: i.e., without corrections for the base line).

CORRECTION TABLE FOR BASE LINE 50X1-HUM

Automatic recorder	True depth in meters corrected for the base line		
	1 m	1.5 m	2 m
1.0	0.9	0.7	--
1.5	1.4	1.3	1.1
2.0	1.9	1.8	1.7
2.5	2.5	2.4	2.3
3.0	3.0	2.9	2.8
4.0	4.0	3.9	3.9
5.0	5.0	5.0	4.9
6.0	6.0	6.0	5.9

The sounding gear is installed aboard a ship with the base line equal to 1, 1.5, or 2 meters. The appropriate correction table is on the right side of the indicator panel, under a celluloid cover.

2.3 Measurement of the depth From the Keel and From the Surface of the Water

The sounding device is ordinarily adjusted in such a manner that it indicates the depth below the transmitter and receiver. However, of necessity its reading must be modified to indicate the depth below the keel and below the surface of the water. It must be kept in mind that in adjusting the automatic recorder and indicator for readings of depth below the keel and below the surface of the water, base line correction tables cannot be used when shallow depths are involved.

If the automatic recorder and depth indicator are adjusted for readings of depth below the sounding device, then in order to obtain the depth below the keel, it is necessary in each reading to take into consideration the vertical distance from the keel to the sounding device. When it is desired to obtain the depth below the surface of the water, it is necessary to add to each instrument reading the distance from the sounding device to the surface of the water, for which the draft of the ship must be known.

50X1-HUM

График поправок на скорость звука

Graph for correcting speed of sound

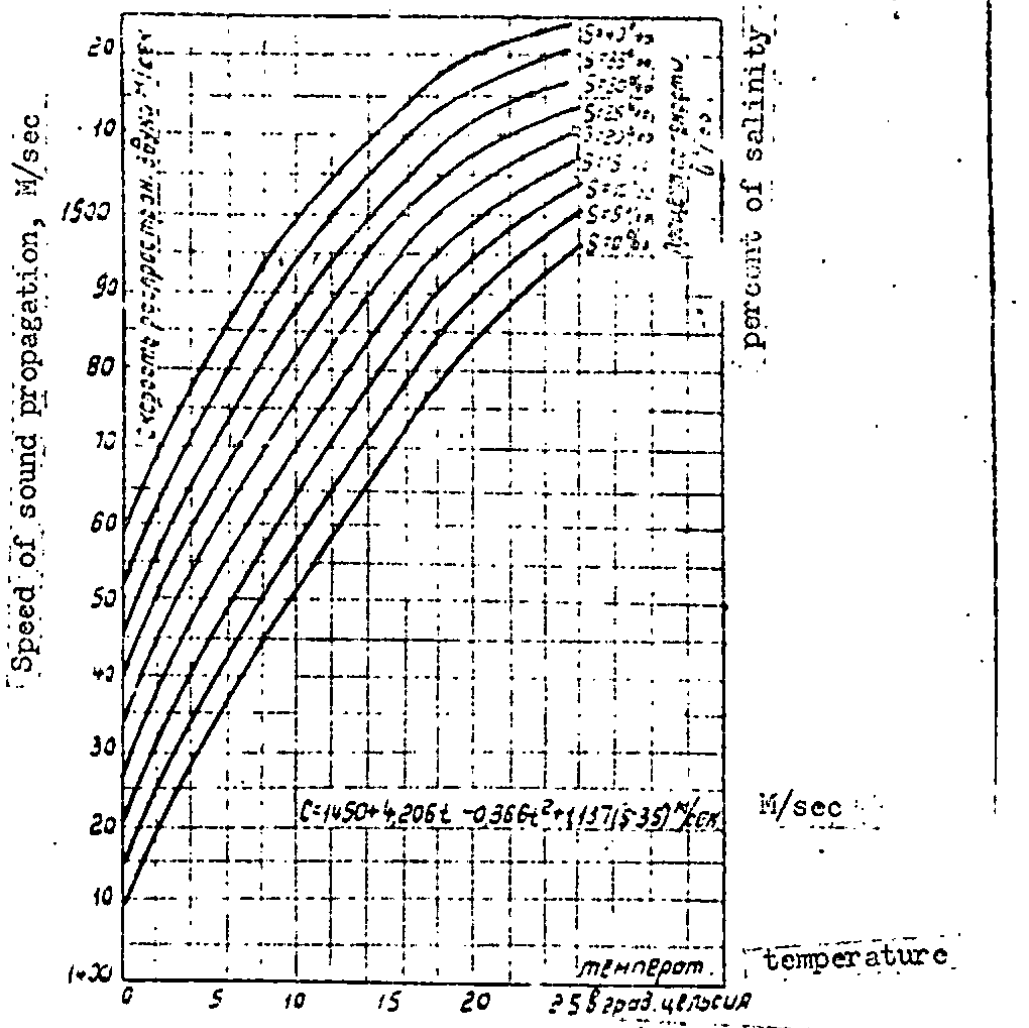


Рис. 2

Fig. 2

Следует заметить, что обычно для целей навигации

2.4 Correction for the Speed of Sound

50X1-HUM

The speed of sound in water is not a constant quantity but depends on the temperature and salinity of the water; therefore, when exact measurements are required, corrections must be made according to the graph in Figure 2.

[The corrections are based] on the formula $\Delta h = (\frac{v}{1500} - 1)$, where Δh is the correction in meters, h is the reading on the sounding device in meters, and v is the speed of sound as determined by the graph.

It should be noted that for ordinary purposes of navigation, corrections for the speed of sound do not have great significance.

2.5 Effect of Different Conditions on the Operation of the Sounding Device

For practical purposes, the movement of a ship does not affect the accuracy of the measurements, since the speed of ships, even the highest, is far less than the speed of sound in water.

It is assumed that the sounding gear operates satisfactorily in measuring a depth of 500 meters with speeds up to 20 knots. With greater speeds and also in rough seas and rolling of the ship, the maximum depth is less, and there may be gaps in the readings. The contour of the sea bottom can also cause gaps in the readings of the sounding gear. They may be more frequent for steeply sloping bottoms and, conversely, less frequent for smooth, level bottoms.

Chapter III

Description of the Sounding Gear Equipment

3.1 Automatic Recorder (Photos 1, 2, 3, and 7)

The automatic recorder servers to record automatically the depth and the direction in which the ultrasonic pulses are sent out. The instrument is a casting consisting of three parts: a hinged cover, a middle section, and a lower section, joined together by hinges.

A tight fit is obtained between the middle and lower sections by means of two bolts.

The cover is locked by a catch with a button, located on the middle section.

On the hinged cover are located:

a) A warning light with a red glass cap which goes on when the depth indicator is turned on.

b) An ac voltmeter, for voltage control of the shipboard circuit or PO-550 converter.

50X1-HUM

v) A phase switch, whose knob, when turned to the right, produces a rotation of the transmitting contacts assembly in the opposite direction from the cams. For operation in the 100-meter range, this produces a lead at the instant of transmission of +40, +90, +140, and +180 meters; and for operation in the 500-meter range, a lead 5 times as great. Thus, for operation in the 500 meter range, a transmission lead of + 90, to + 240 occurs, with a 500 meter limit.

On a metal plate in the middle action are located:

a) An SL-322 electric motor, rated as follows: voltage, 110 v; power, 22 w; 3600-4700 rpm. For operation in the 0-100 meter range, the motor's rpm is equal to 3,145, and for the 0-500 meter range it is equal to 629.

b) An automatic governor (see Fig. 7) for the operation of the motor at a constant speed.

On the frame of the automatic governor are located two contact assemblies, either of which can be connected by turning the knob of the depth-range switch.

The leads from three copper rings, set in the boss of the frame of the automatic governor, are connected to the contacts of the automatic governor. A copper-graphite brush, in a brushholder, fits closely to each of the rings. Brushholders are connected to tubular resistors operating in the automatic governor circuit.

An electric motor, with aid of a reducer, transmits the motion to a central collector and sending cams as well as to a paper winder. The reducer consists of two gears (steel and textolite) set on a tubular shaft. The textolite gear meshes with a worm (on the motor shaft), and the steel gear drives the paper winder through a system of rollers, gears, and a worm.

v) The central collector is set on the tubular shaft of the reducer and consists of two rings, solid metal and laminated with thirteen layers.

Contact plates slide along each of the rings. A holder with a platinum-iridium alloy writing pen is affixed to the solid ring. Lift and drop of the pen during its movement across the paper is controlled by two movable cranks.

g) The tape mechanism consists of two pulling rollers, guiding and reeling. Between the guiding and the reeling rollers is an electric heater. The upper feed roller and the winding roller are connected by a spiral spring drive. On the right side of the upper pulling roller is a handle, for pulling through the paper tape by hand, and on the left side is a spring wire-wound clutch, which provides frictional connection between the gear shaft and the upper pulling roller.

By turning the handle on the pulling roller, disengagement is made and the paper is pulled through.

d) A paper roll compartment consisting of a silumin box and a lid with lock.

e) An electric heater consisting of a wire spiral covered with a rotating metal tube. The electric heater is turned on only during operation on the 0-100 m range.

Located on the right side-wall of the housing are:

a) A toggle switch for changing ranges of measuring depths, 0-100 m and 0-500 m.

b) A pushbuttom switch for special markings. When this switch is turned on, the pen plots a continuous line on the paper.

v) An electric heater switch for drying the paper.

On the opposite side of the metal housing plate are:

a) Tubular resistors inserted in the automatic governor circuit;

b) A crossarm with three contact sets mounted on the shaft passing through the tubular axle of the reducer. Two contact sets are designed for breaking the power supply circuit or transmitting relay coils (a corresponding contact set is cut in depending on the range of measured depths); the third set is connected to the "zero black-out". When the "phasing" handle is turned, the crossarm, together with the contact sets, turns through an angle and provides transmission lead. The crossarm is secured in extreme position by a stop.

Three textolite cams with half-segment cutout. Cams are set on the tubular axle of the reducer, and each of them controls operation of the corresponding contact set.

During the operation of the automatic recorder, the contact set is disconnected when the rotating cam passes under it with its cutout.

The contact set is secured to an angle plate with two screws, by means of which the pressure of the contact set on the cam is controlled. The base of the contact set has the form of a trihedral prism.

Located in the lower section of the housing are the following basic parts and electric components:

1. A relay, switching the operation of the echo sounder from indicator to automatic recorder.

2. A ballast resistor, located in the relay winding circuit.

3. An electrolytic capacitor, connected in parallel to the switching relay.

4. An output transformer.

Located on the right side-wall are: a "zero-black-out" toggle switch, an "automatic recorder" switch, an echo sounder "grid" switch which supplies voltage to all instruments of the echo sounder, a "3A" fuse, a toggle switch for changing the mode of operation of the amplifier ("navigational" - "search"), and the amplification control.

3.2 Depth Indicator (Photographs 4,5, 6 and 7)

The depth indicator serves to indicate measured depths and to control the transmission of ultrasonic pulses.

The entire instrument is enclosed in a cast steel housing with a hinged cover. The cover is attached to the base of the housing by two bolts.

The following elements are mounted on the cover of the depth indicator:

a) ac voltmeter

b) power supply toggle switch

v) toggle switch for switching ranges of measured depths 0-100 m and 0-500 m.

g) amplifier gain control

d) "zero black-out" switch

e) fuses

zh) celluloid shield for table marked "base correction"

z) two circular, concentrically located scales having equal divisions from 0 to 100 m and 0 to 500 m.

All remaining elements of the indicator are mounted on a metal plate within the housing. To the crosspiece is fastened a collar with motor SL-262 having the following rating: 110 volts, 14 watts, 4,000-5,200 rpm.

The shaft of the motor (see photograph 7) is connected to an automatic governor, the design, purpose, and operation of which are identical to that used in the recorder.

A shaft with three textolite cams and one textolite gear passes through the crosspiece and is coupled to a gear on the motor shaft.

The coil of the primary winding of the output transformer is fastened above the crosspiece.

On the upper end of the shaft is a disk (see photographs 5 and 6) with a neon lamp and the secondary coil of the output transformer. Since the secondary coil is located within the primary coil, the windings are inductively coupled to each other.

To the rear, above the neon lamp, is a movable shutter which is held to the center of the disk by means of a spring. The purpose of this shutter is to uncover part of the neon lamp under the 500 meter scale at low speeds (90 rpm). At higher speeds, the shutter pulls away by centrifugal force and uncovers the part of the lamp under the 100 meter scale.

On a curved selumin arm are three grooves in which the pulsing contact groups and the "zero blackout" contact group are fastened by means of angle brackets.

The angle brackets together with the contact groups may be shifted (when it is necessary to regulate the "zero" on the scale) along the grooves in the bracket and can be fixed by set screws in the required position.

Opposite the first two grooves on the bracket are divisions inscribed in meters with the designation 0-100 and 0-500. Opposite the third groove is the designation "GN" [zero blackout] and divisions in meters.

The design of the cams and the contact groups is identical to that used in the recorder.

A special light counter [strobe] is used to control the number of revolutions of the disk. On the crosspiece is a lamp holder with a circular opening for direction light; the holder contains a 6.3 v illuminating bulb. The automatic centrifugal regulator, located above the holder, has round coaxial openings in its base and cover (the cover of the ATsR is shown in photograph 7).

50X1-HUM

When, by means of the rotation of the ATsR, these openings coincide with the opening in the holder, light from the lamp passes through all three openings. Above the ATsR is the indicator disk with an opening covered by frosted glass and a shutter.

When the openings are coincident, the frosted glass is illuminated by light from the lamp.

Since the transfer number from the motor to the disk was chosen as 5:34, the openings will coincide one time for every five revolutions of the disk.

The normal number of revolutions of the disk for the 0-100 scale is 450 rpm. Consequently, the number of light flashes which will be observed through the concentric gap between the scales will equal 90 per minute. Correspondingly, there will be 18 flashes per minute for the 0-500 m scale.

In order that the light flashes for controlling the revolutions of the disk do not disturb the reading of depth measurements, the light is turned on only during checking of the revolutions by turning the gain control all the way to the left.

3.3 Transmitting Relay (Photo No. 8 ar

The transmitting relay excites the vibrator - emitter, which emits ultrasonic pulses. Excitation is brought about by capacitor discharge (charged to 1,000 v) through the vibrator - emitter winding.

The instrument is enclosed in a cast housing with a detachable lid. The lid is fastened by four screws.

All parts and electrical components of the instrument are mounted on a chassis which is set on shock absorbers and secured to the base of the housing with four screws. Located on top of the chassis are:

1. A transmitting capacitor of 2 mf capacity.
2. A relay mechanism consisting of a U-shaped core, two coils, armature, spiral spring, and contacts.
3. A power transformer designed to supply power to rectifiers of high and low voltages.
4. A kenotron operating in the low voltage rectifier circuit, and kenotrons operating in the high voltage rectifier circuit.
5. An electrolytic capacitor of 10 mf capacity acting as a capacitance filter of the low voltage rectifier.

Located underneath the chassis are: terminal blocks-charged resistors which are in the transmitting capacitor charge circuit and which are mounted on an angle bracket welded to the chassis-and a fuse in the power transformer primary winding circuit.

When the current passes through the coils, the armature is pulled against the core and the contacts are disconnected. Charging of the transmitting capacitor takes place at this time.

At the moment of transmission of the signal, the current through the coils is interrupted by contacts in the indicator or the automatic recorder, the relay armature by means of a spring closes the contacts, and discharge of the transmitting capacitor to the vibrator - emitter winding takes place.

3.4. Vibrators (Photo No. 10)

The purpose of the vibrators is to emit and pick up ultrasonic oscillations.

Band-type vibrators represent packages assembled from nickel plates of 0.1 mm in thickness enclosed in bronze housings. The vibrator-emitter and vibrator-pickup have a winding of 16 turns which is placed in special grooves.

The vibrator-emitter does not differ from the vibrator-pickup in any way. The only difference between them is that the vibrator-pickup must be periodically magnetized after its installation.

Any vibrator may be used as a pickup or an emitter vibrator. Because the presence of air in the vibrator housing impairs its operation, a special pin (with elbowed opening from inside) is located on the cover for letting out the air trapped there at the launching of the ship.

Vibrators are installed in apertures cut in the bilge of the ship. They are set in rubber sleeves which provide an airtight installation and decrease the effect of the ship's vibration on the pickup vibrator.

To protect the leads during transportation, the upper portion of the vibrator is covered with a special jacket, which is taken off at the time of installation.

3.5 Cable Boxes (Photo No. 11)

The echo sounder set has two cable boxes in which the connection of the vibrator output leads with the lines leading to the transmitting relay from vibrator-emitter and to the amplifier from vibrator-pickup is made. A general view of the cable boxes is presented in photo No. 11. Since the vibrators have 8-meter output leads, cable boxes, depending on the type of the ship, are placed at a distance of up to 8 meters from the vibrators. If the distance between the vibrator-emitter and transmitting relay, or vibrator-pickup and amplifier, is less than 8 meters, cable boxes (one or both) may be omitted. Cable boxes are airtight.

3.6 Amplifier (Photo No. 12 and 13)

The amplifier is designed to amplify weak voltages originating across the pickup vibrator winding at the instant of the arrival of a reflected pulse. A general view of the amplifier is presented in photo No. 13.

The amplifier (resonance type) is tuned to the frequency of the emitted pulse and has a narrow transmission band. The maximum amplification factor of the amplifier is 2,000,000 to 4,000,000.

The cast amplifier housing is splash-proof. The housing lid is secured to the housing by four screws. The lid has an opening allowing access to the axle of a potentiometer which provides grid bias to the thyratron. The opening is closed with a metal screw plug. In photo No. 13 is shown the amplifier without the housing.

All components of the amplifier are mounted on the chassis. The first two stages amplify the incoming voltage pulse. The first stage, consisting of a 6Zh8 tube, is resonant; the second, consisting also of a 6Zh8 tube, is a voltage amplifier across the resistors; the third stage, a 6P3S tube, is a power amplifier and operates only during the search mode of operation; the fourth, a TG-1-0.1 1.3 thyratron, is an electronic relay and operates during the navigational mode of operation.

The amplifier power supply is derived from a 127 v alternating current, which is supplied to the primary winding of the transformer located on the amplifier chassis.

Located on top of the chassis are:

a) 6Zh8 and 6P3S tubes, a 5Ts4S kenotron, and a TG-1-0.1/1.3 thyratron.

b) Input resonance circuit, tuned to the vibrators' frequency. The coil is covered with a special cylindrical metal shield. The rod coming out through the shield is for tuning the circuit connected to the grid circuit of the 6Zh8 tube.

v) A second resonance circuit is connected to the plate circuit of the same 6Zh8 tube.

g) A power transformer which supplies power to the whole amplifier.

d) A filter choke.

e) An electrolytic capacitor which discharges into the pickup vibrator when the "magnetize" button is pressed. On the front panel of the chassis are: a pickup vibrator magnetization button; the shaft of the potentiometer, which is connected to the thyratron bias circuit; a fuse socket, connected to the power transformer primary winding circuit.

Inside the chassis are located all other electrical components of the amplifier (electrolytic filter capacitors, resistors, and capacitors of different types which make up the amplifier system).

Inside the chassis is also located a relay which switches operation of the echo sounder from the navigation mode to the fish-finding mode.

The amplifier chassis, with all the components on it, can be removed from the housing (see maintenance instructions).

For inspection of the removed amplifier, which may be necessary when defects are detected, an extension cable, located in the spare parts and equipment box, is provided.

Connection of the extension cable is made only when the echo sounder is totally de-energized.

3.7 Converter PO-550 (Photo No. 14)

The converter is designed for conversion of the shipboard direct current into single-phase alternating current supplied to the echo sounder. The converter is of a single armature type with compound drive.

The magnetic system of the apparatus is bipolar and is used for both d-c and a-c. Series and shunt windings are separate. Armature windings for d-c and a-c are connected in series, placed in the same iron slots of the armature, and lead out to corresponding commutator and slip rings.

Converter terminals are on the terminal panel, which is closed with a shield.

3.8. Variable Dropping Resistor (Photo No. 14)

The variable dropping resistor is designed to limit the starting current of the PO-550 converter and to regulate the voltage supplied by the converter.

The variable dropping resistor is a rheostat made of constantan wire, divided into sections and wound on two parallel ceramic tubes across which moves a sliding contact. The variable dropping resistor has a removable cover.

3.9. Filter with Switch (Photo No. 15)

The filter is designed to protect the shipboard electrical system from interference to radio reception due to the echo sounder. The switch serves to supply shipboard power and start the converter.

The filter has a removable cover on which a selector knob is located. On a metal plate inside the housing are located: two capacitors and two chokes connected in a pi circuit, a toggle switch, and two fuses.

Filters made for echo sounder sets which operate on a-c do not have a toggle switch.

3.10. Spare Parts and Equipment Box

The box is in the form of a wooden case with a hinged lid and handle for carrying.

The box contains:
1. Spare parts and accessories.
2. Special and standard tools for minor maintenance, adjustments, and servicing of the echo sounder.

3.11. Box for transporting the Echo Sounder Tube Set

The box is in the form of a wooden case with a lid. Inside the box are receptacles into which are placed tubes of the echo sounder during its transportation.

Chapter IV

Description of the Electrical System

Herein is described the electrical system of the echo sounder, which is designed for supply of direct current of 110 volts from the shipboard circuit.

The 110-v and 220-v dc echo sounders differ only in the windings of the PO-550 converter and variable dropping resistor.

When the echo sounder is powered by the 127-v shipboard circuit or the 220-v AC supply, the PO-550 converter and variable dropping resistor are not connected to the unit. In that case the ac circuit voltage is fed from a filter directly to terminals 25 and 26 of the automatic recorder.

The 127-v and 220-v AC echo sounders differ from each other only in the particulars of certain electrical components.

4.1 Path of the Power Supply for the PO-550 Converter

The voltage of the shipboard circuit through fuses 1 and 2 and filter choke coils 5 and 6 is fed to a rotary switch. For smooth starting of the PO-550 converter the switch has four positions: "OFF", "Start I", "Start II", and "On".

With position "Start I," the current in the right blade goes to terminal 5 of the filter, along wire 3 to variable dropping resistor 10, passes completely through it and goes on wire 4 to terminals 6 and 2 of the filter, thence on wire 2 to the converter, through series winding 11, thence through shunt winding 12, armature "Ya", and along wire 1 to the left blade of the switch. In this case the variable dropping resistor is completely connected and the starting current of the armature is limited.

With position "Start II," the current circuit is similar, but in this case the current passes through only the part of the variable dropping resistor between points "B" and "G"; and with position "On" only the part of the variable dropping resistor between points "V" and "G" remains connected, the variation being accomplished by moving an arm.

4.2 Path of Alternating Current for PO-550 Converter

From the end of the ac commutator of the converter, voltage is supplied by means of wires 1 and 2 to terminals 25 and 26 of the automatic recorder and through fuse 15 to toggle switch 17. When the latter is connected, voltmeter 19 is connected and, at the same time, voltage from the automatic recorder is supplied:

a) from terminals 6 and 7 to terminals 1 and 2 of the indicator and thence through fuses 20 and 21 to voltmeter 22 and toggle switch 23;
b) from terminals 11 and 12 to terminals 4 and 5 of an actuating relay and thence to the primary winding of transformer 24, connected in series to fuse 25;

v) from terminals 18 and 19 to terminals 10 and 11 of the amplifier and thence through fuse 27 to the primary winding of power transformer 26.

Thus, when toggle switch 17 is connected to the automatic recorder, voltage is supplied to the indicator, relay, and amplifier, and, at the same time, to the voltmeters of the automatic recorder and indicator, allowing control of the ac voltage.

4.3 Path of the Power Supply for the Switching Relay

When the indicator is connected, i.e., when toggle switch 23 is turned to the "on" position, the relay is activated, automatically switching the operation of the echo sounder from the automatic recorder to the indicator. Current from the left blade of toggle switch 23 flows to terminal 1 of the indicator, thence to the 6th and 11th terminals of the automatic recorder, along a cable conductor to terminal 4 of the relay and through fuse 25 to the left plate of kenotron 29. Passing through the latter, the current flows to the 3rd terminal of the relay, returning along a cable to terminal 10 of the automatic recorder, passes through winding 30 of the switching relay, through two ballast resistors 31 and 32 to terminal 5, along a cable to terminal 3 of the indicator, and to the right blade of the toggle switch.

Since a pulsating current flows through the coil of the switching relay (after half-wave rectification), electrolytic capacitor 33 is connected in paralled with the coil for smoothing of the pulsation. When the switching relay is activated, the armature is drawn to the electromagnet, and all the movable contacts (a, b, v, g, and d) acted upon by the armature move to the lower position. Pulse transmission control, quenching of "zero disturbances," adjusting the amplification factor, and amplification output are switched to the echo sounder circuit with an indicator. At the same time that contacts "a" become activated, red warning light 34 in the automatic recorder goes on.

When the automatic recorder is in operation, the indicator disconnects. The switching relay is cut off. The armature, acted upon by a spring, switches the movable contacts, and the automatic recorder is cut into the circuit of the echo sounder.

4.4 Path of the Power Supply for Electric Motors SL-262 in the Indicator and SL-322 in the Automatic Recorder

When the indicator is connected, current from the left edge of toggle switch 23 flows through connecting strip 35, an excitation winding, motor armature ya, resistors 37 and 38, the left blade of depth selector switch 39, and returns to the right blade of toggle switch 23.

The contacts of automatic governor 36 are connected in paralled to resistors 37 and 38 for the 0-100 range.

If the contacts are closed, then resistors 37 and 38 are shorted and the current flows directly through the 0-100 contacts to the left blade of the depth selector switch, etc., as indicated above.

When the 0-500 range is connected, the current from the motor armature flows through resistor 40 and ballast resistor 41, the left blade of the depth selector switch, and returns to the right blade of toggle switch 23. The contacts of the automatic governor for the 0-500 range are connected in parallel to resistor 40.

If the contacts are closed, then resistor 40 is bypassed and the current flows directly through the 0-500 contacts, the ballast resistor, etc., as indicated above.

In both contact pairs the pressure of the movable contact against the fixed one is differnet and may be regulated by a spring.

When the motor is turned on, it begins to rotate, and when it reaches critical speed, the centrifugal force overcomes the tension exerted by the spring of the movable contact and breaks the contact pair. In the armature circuit additional resistors are cut in (resistor 40 for operating in the 0-500 range, and resistors 37 and 38 for operating in the 0-100 range.)

The current in the armature decreases, the motor slows, and, as a consequence, the centrifugal force decreases. The contacts again close, the current builds up, the motor speeds up, etc. As a result of the action of the automatic governor, the motor will run at some average constant speed, and a pulsating current will flow through the armature. The speed of the motor is regulated by changing the tension in the spring of the automatic governor.

Capacitors 42 and 43 are designed to lessen sparking at the contacts of the automatic governor. To turn on the automatic recorder, toggle switch 18 is placed in the "on" position. The current from the left edge of toggle switch 17 flows through a series winding; the motor armature ; resistors 45 and 46 (for operation in the 0-100 range) or 47, 48, and 49 and ballast resistor 50 (for operation in the 0-500 range); the left blade of depth selector switch 51; and returns to the right edge of toggle switch 17.

Contacts of automatic governor 44 are connected in parallel to resistors 45 and 46 for operation in the 0-100 range and in parallel to resistors 47, 48, and 49 for operation in the 0-500 range.

The operation of the automatic governor and current circuit and also the functions of capacitors 52 and 53 are similar to the above description for the depth indicator.

When toggle switch 18 is turned on, illuminating bulb 124, connected through auxiliary resistor 125, goes on; and electric heater 127, through toggle switch 126, is connected in series to resistors 128 and 129.

4.5 Path of the Power Supply for the Windings of the Actuating Relay While Operating With the Indicator and Automatic Recorder

50X1-HUM

Windings 54 and 55 of the acutating relay are supplied from a rectifier with kenetron 29 operating in a full-wave mode.

Current from the positive plate of electrolytic capacitor 56 (which serves as a capacitive filter for the rectifier and is designed for pulsation smoothing) flows through coil 55, thence to terminal 6 of the relay, terminal 8 of the automatic recorder, and then, depending on the position of contact "b" of the switching relay, passes to either contact pair 57 and 58 of the indicator or contact pair 59 and 60 of the automatic recorder. When the automatic recorder is in operation, the current flows through contact pairs 59 and 60 (depending on the range of depth being measured), the right blade of the depth selector switch, contact "b" of the switching relay, terminal 9 of the automatic recorder, terminal 7 of the relay, coil 54, and returns to the negative plate of capacitor 56.

When the indicator is connected, contact "b" of the switching relay is in the lower position. Then the current (in the automatic recorder) flows from terminal 8 to terminal 4 and along the cable to terminal 6 of the indicator.

Depending on the range of the depth being measured, the current flows through the appropriate contact pair, the right blade of depth selector switch 39, terminal 5 of the indicator, terminal 1 of the automatic recorder, contact "b" of the switching relay, terminal 9 of the automatic recorder, etc., as indicated above.

Resistor 61 and capacitor 62 constitute a spark quenching circuit for coil 54; resistor 63 and capacitor 64, for coil 55 of the actuating relay. The purpose of the spark quenching circuits is to lessen sparking at the contact pairs of the indicator and automatic recorder. Capacitors 65, 66, 67, and 68 are connected in parallel to the indicator contact pairs for this same purpose.

4.6 Path of Charging and Discharging of the Transmitting Capacitor

Transmitting capacitor 70 charges when contacts 69 of the actuating relay are open. An ac voltage, taken from the secondary step-up winding of transformer 24, is rectified by kenotrons 72 and 73, operating in a voltage-doubling circuit.

When the end of the secondary winding, connected to the plate of kenotron 73, has a positive potential relative to the frame of the instrument, current flows through the kenotron, and capacitor 76 builds up a charge through r resistor 77 on the order of +500 volts.

In the next half-cycle this same end of the winding will have a negative potential relative to the frame of the instrument, and the current will flow through kenotron 72.

In this case, capacitor 75 builds up a charge through resistor 74 on the order of -500 volts. Since capacitors 75 and 76 are connected in parallel through the frame of the instrument, the voltage across them is added, and the transmitting capacitor, connected in parallel to both capacitors, will build up a charge on the order of 1000 volts.

When the contact pairs in the indicator or automatic recorder break the power supply circuit of the actuating relay coil, the circuit of the vibrator-emitter winding and charged capacitor is closed by the contacts of armature 69. Oscillations are now produced in this circuit, and a pulse of alternating current passes through the winding of the vibrator-emitter, creating a variable magnetic field in the material of the vibrator unit. The unit, as a result of damped pulses in the direction of the sea bottom.

After the contact pairs in the indicator or automatic recorder close, the relay armature breaks the circuit of the vibrator-emitter winding, and the process of charging the transmitting capacitor is repeated.

Resistors 74 and 77 are designed to limit the charging current of the capacitors and also to protect the rectifier from short-circuiting through small ohmic resistance of the vibrator-emitter at the instant of transmission.

4.7 Description of the Amplifier's Electrical System

Ultrasonic pulses sent from the vibrator-emitter and reflected from the bottom agitate the vibrator pickup, which is connected to the amplifier. The end of the pickup is connected to terminals 1 and 2 of the amplifier. To this terminal is connected the primary winding of input transformer 132, whose secondary winding, together with capacitors 133 and 134, form a resonance circuit tuned to the frequency of the vibrators.

Within the transformer, in the form of a coil on the compartmented ebonite frame, is a movable core of carbonyl iron for tuning the circuit. Voltage from the ends of this circuit is fed to the grid of tube 149 (6Zh8). In the plate circuit of this tube is a resonance circuit consisting of capacitor 135 and coil 104 with the carbonyl iron core. Oscillations, amplified by the first tube, generate an oscillating voltage at the ends of this circuit. For further amplification this oscillation is fed to the grid of tube 150 (6Zh8) through decoupling capacitor 136.

The purpose of capacitor 136 is to admit amplified oscillations from the first tube to the grid and not to admit the dc component of the plate voltage to the grid of the second tube.

Resistor 107 is located in the plate circuit of the second tube. Oscillations, amplified by the second tube, produce an ac voltage at the ends of this resistor which is fed through decoupling capacitor 137 to the grid of tube 6P3S, operating only in the fish finding mode, or to the thyratron, operating in the navigational mode.

Switching of the echo sounder from the fish finding mode to the navigational mode is accomplished by means of relay 163 of the amplifier, which is turned on by toggle switch 16, located on the automatic recorder. When the toggle switch is turned on, the power supply circuit of the relay is broken - a condition corresponding to the fish-searching mode. In this case the plate voltage is fed to tube 6P3S through contacts "a" of relay 163, terminal 7 of the amplifier, terminal 15 of the automatic recorder, contacts "g" of relay 30, through the primary winding of transformer 80, terminal 16 of the automatic recorder, terminal 8 of the amplifier, and contacts "b" of relay 163. At the same time, output transformer 80 acts as the load of the power amplifier.

When toggle switch 16 is turned on, the relay power supply circuit is closed through resistor 162, terminal 9 of the maplifier, and terminal 17 of the automatic recorder; the relay is actuated and switches the plate voltage from tube 6P3S to the thyratron; and capacitor 165, located in the thyratron plate circuit, is connecred to its cathode through the primary winding of the output transformer.

The signal, reaching the grid of the thyratron, causes it to fire. As a result of this, capacitor 165 discharges through the thyratron and the primary winding of output transformer 80 in the automatic recorder or 81 in the indicator. Discharge of the capacitor into the indicator or automatic recorder is made along the following circuit: the plate of capacitor 165, the plate of the thyratron, the cathode of the thyratron, through contacts "b" of relay 163, terminal 8 of the amplifier, terminal 16 of the automatic recorder, terminal 2 of the automatic recorder, etc., depending on the position of contact "g" of the switching relay, to the primary winding of the output transformer of the indicator or automatic recorder. In the latter case the current passes through the primary winding of transformer 80 and through contacts "g" of the switching relay to terminal 15 of the automatic recorder, terminal 7 of the amplifier, and returns to the second plate of the capacitor.

When the indicator is in operation, current from terminal 2 of the automatic recorder flows along a cable to terminal 7 of the indicator, through the primary winding of output transformer 81, to terminal 13 of the indicator, terminal 23 of the automatic recorder, through movable contact "g" of the switching relay, and returns to the second plate of the capacitor, as indicated above.

A neon tube is connected to the secondary winding of the output transformer in the indicator. When a pulse of current passes through the primary winding, neon tube 82 light. Selenium rectifier 83 is connected to the secondary winding of the output transformer of the automatic recorder. When a pulse of current passes through the primary winding, the current in the secondary winding, rectified by the selenium rectifier, flows along brush 84 to the solid central collector ring, to stylus 85, and through the paper to the frame of the instrument. When the current passes through the paper, an indication of the depth is left on it in the form of a violet line.

50X1-HUM

Due to the fact that the plate of the thyratron is at the potential of the capacitor, the thyratron fires when the latter discharges, since the voltage in the plate is closw to zero. After this, capacitor 165 again begins to build up to a plate charge of +300 volts. Capacitor 165 is charged through the following circuit: resistor 140, capacitor 165, terminal 7 of the amplifier, terminal 15 of the automatic recorder, movable contact "g" of the switching relay, and so on, depending on the position of the contact.

When the automatic recorder is in operation, current from movable contact "g" flows through the primary winding of output transformer 80 to terminal 16 of the automatic recorder, terminal 8 of the amplifier, the slider of potentiometer 86, terminal 4 of the amplifier, terminal 14 of the automatic recorder, contact "v" of the switching relay, and through the contact pair of "zero blackout" 87 on the frame of the automatic recorder. When the indicator is in operation, current from movable contact "g" of the switching relay flows to terminal 23 of the automatic recorder, terminal 13 of the indicator, the primary winding of output transformer 81, terminal 7 of the indicator, terminal 2 of the automatic recorder, terminal 16 of the automatic recorder, terminal 8 of the amplifier, the slide of potetniometer 86, terminal 4 of the amplifier, terminal 14 of the automatic recorder, contact "v" of the switching relay, terminal 24 of the automatic recorder, terminal 11 of the indicator, and through the contact pair of "zero blackout" 88 on the frame of the instrument. Since the frames of the automatic recorder, indicator, and amplifier are electrically connected to each other, the circuit is closed.

The mode of operation of the thyratron depends on the magnitude of the bias voltage on its control grid. Control of the bias voltage is accomplished through potentiometer 86, which, together with resistor 89, forms a voltage divider (the common point of potentiometer 86 and resistor 121 through the contact pair of "zero blackout" is at ground potential).

Control of the amplification factor of the amplifier is accomplished by varying the negative bias at the control grid of tube 149 (6Zh8). Supplying a bias to the grid of this tube is the same as supplying a bias to the grid of the thyratron.

+300 volts is connected to resistor 91, which is connected in series to either potentiometer 92 in the automatic recorder through terminal 3 of the amplifier, terminal 13 of the automatic recorder, and movable contact "d" of the switching relay, or to potentiometer 93 in the indicator through terminal 22 of the automatic recorder and terminal 12 of the indicator.

The cathode of tube 149 (6Zh8) is connected through resistor 94 to terminal 3 of the amplifier: i.e., to potentiometer 92 or 93. The ends of the potentiometers are grounded (through the frame). Thus, for counter-clockwise rotation of the potentiometer slide the positive potential will be increased relative to the ground; and since the grid of the tube through the secondary winding of the input transformer is grounded, its negative potential relative to the cathode will increase. When the slide of the potentiometer in the indicator is turned to the left as far as it will go, light 130 of the revolution counter in the indicator, connected to the secondary winding of stepdown transformer 131, goes on. The purpose of resistors 94 and 95,

connected to the cathodes of tubes 149 and 150 (6Zh8) respectively, is to supply a constant bias to the grids of the tubes for their operation at the desired points on the characteristic curve. Button 112 exists for magnetic biasing fo the vibrator pickup. When it is pressed, electrolytic capacitor 113, charged by the plate voltage through resistor 114, discharges through the following circuit: the positive plate of the electrolytic capacitor, button 112, terminal 1 of the amplifier, the winding of the vibrator pickup, terminal 2 of the amplifier, and the frame of the instrument.

4.8 Path of the Power Supply for the Amplifier

An ac voltage is supplied to the primary winding of the power transformer from terminals 10 and 11 of the amplifier. The primary winding is connected in series to fuse 27. The filaments of tubes 149, 150 (6Zh8), 79 (6P3S), and 167 (TG 1 - 0.1/1.3) are connected in parallel and receive their power from the step-down winding of transformer 26, providing a voltage of 6.38. Voltage for the plates of the tubes is supplied by a full-wave rectifier, in incorporating kenotron 5Ts4S . The ends of the step-up winding are connected to the plate of the kenotron. An output of -300 volts is obtained from the middle point and grounded. Pulsation smoothing of the rectified voltage is attained by a filter comprising electrolytic capacitors 100 and 101 and choke coil 102. +300 volts is supplied to the plate of the first tube through resistor 173, which, together with capacitor 175, acts as a decoupling link.

Voltage across the screen grid of this tube is from a voltage divider, comprised of resistors 105 and 106. The plate voltage is fed to tube 150 (6Zh8) through resistor 107, to the thyratron through resistor 140, and to tube 6P3S through the relay and primary winding of transformer 80.

4.9 Current Flow During Use of a Scale Grid and Special Markings, Made by Means of a Button and Electric Pencil

When markings with an electric pencil and special markings are being made and a scale grid is in use in the automatic recorder, voltage is applied from an amplifier with a voltage divider consisting of resistors 115 and 116. At the same time, the flow of current is as follows: from the midpoint of the voltage divider to terminal 5 of the amplifier, terminal 20 of the automatic recorder, the left blade of toggle switch 18, and so on, to electric pencil 117, contact pair 118 for the scale grid, and button 119 for special markings. When special markings are being made, the current flows through brush 84, the solid collector ring, and stylus 85. When contact pair 118 is closed, current flows through brush 120, a strip on the stylus, and, passing through the paper, returns to "ground."

4.10 "Zero Blackout" Circuit during Operation of Indicator and Automatic Recorder

At the instant of radiation of a pulse the transmission may affect the reception, due to an acoustical or electromagnetic relation between them.

The effect of a disturbance on the amplifier causes a firing of the thyratron and a discharge of the capacitor located in the circuit of its plate on the primary winding of the output transformer, indicator, or automatic recorder.

When the depth measured is slight, the signal reflected from the bottom also affects the amplifier, but no indication of depth occurs, since the capacitor, which has discharged due to the "zero" disturbance, is not able to recharge.

To avoid the effect of a "zero" disturbance in the echo sounder a "zero blackout" circuit has been devised. "Zero blackout" is accomplished by cutting out the thyratron at the instant of transmission. Before the contact pair controlling the operation of the actuating relay are themselves actuated, the "zero blackout" contact pair, in series with potentiometer 86, disconnect, supplying a bias to the grid of the thyratron, and auxiliary resistor 121 cuts in. At this time a negative bias of 140-150 volts is attained at the grid which raises the level of the zero disturbance at the grid of the thyratron, and the thyratron does not fire.

Further movement of a cam causes the "zero blackout" contact pair to close, and the operating pair (automatic recorder or indicator) bypasses the auxiliary resistor. At this time the flow of current will be as follows: from the lower end of potentiometer 85 to terminal 4 of the amplifier, terminal 14 of the automatic recorder, movable contact "v" of the switching relay, and further to "zero blackout" contact pair 87, and the frame of the instrument; or to terminal 24 of the automatic recorder, terminal 11 of the indciator, "zero blackout" contact pair 88, and the frame of the instrument. The lower end of auxiliary resistor 121 in the amplifier is also connected to the frame of the instrument.

Thus, current flows through the "zero blackout" contact pair (indicator or automatic recorder) or the auxiliary resistor when the contacts are open. "Zero blackout" is accomplished in the indicator by means of toggle switch 122 and in the automatic recorder, by toggle switch 123. Each switch is connected in paralled to the contact pair.

Special Features of Echo Sounder Circuits for 220 V Direct Current and 127 v, 220 v Alternate Current.

1. The 220 v echo sounder set uses, in place of a PO-550F converter, a PO-550AF converter whose motor winding is designed for a 220 v shipboard power supply. Winding data for the variable dropping resistor are correspondingly changed.

2. There is no PO-550 converter and variable dropping resistor in the 127 v alternating current echo sounder. The filter does not have a rotary switch.

3. The 220 v alternating current echo sounder is also without the PO-550 converter and the variable dropping resistor, and the filter does not have a rotary switch. In addition to this, the following data of the electrical components in the circuit are changed:

a) The values of the resistors in the automatic governor circuit are changed. Connected in series with a voltmeter is an additional resistor.

b) In the automatic recorder the field windings of the SL-322 electric motor are connected in series. Values of the resistors in the automatic governor circuit are changed. Connected in series with the voltmeter is an additional resistor. The illuminating bulb has a different rating and consequently the additional resistor is absent for its power supply circuit.

Values of the resistors in the power supply circuit of the electric heater for paper drying are changed.

v) Rated values of the primary winding of the power transformer amplifier are changed.

g) Rating of the primary winding of the high-voltage transformer of the relay coil is changed.

Changes and Additions in Specifications of the

NEL-4 Echo Sounder for 220-v Direct Current

No.	Decimal	No.	Name and Type	Electrical & Other Data	Remarks
			V. PO-550AF converter		For 220 v d-c
			VII. Variable dropping resistor		For 220 v d-c
	Zh 7.538.009		Resistor		

Changes and Additions inSpecifications of the NEL-4

Echo Sounder for 127-v Alternate Current

No.	Decimal	No.	Name and Type	Electrical & Other Data	Remarks
			V. PO-550F converter		absent
			VII. Variable dropping resistor		absent
			VI. Filter rotary switch	10A, 250 v	absent

Changes and Additions in Specifications of the NEL-4

Echo sounder for 220-v Alternate Current

50X1-HUM

1	Decimal No.	Name and Type	Electorial & Other Data	Remarks
	2	3	4	5
		I.		
		I. Depth Indicator		
	U7.330.006	Electrical motor SL-262		Field windings in series
	U7.543.127	Additional resistor		in series with voltmeter 17.
	E0.673.200	PE-50-500 Resistor	500 ohm	in series with resistor 38
	E0.673.200	PE-25-1000 Resistor	1000 ohm	Absent
	E0.673.200	PE-25-100 Resistor	100 ohm	in series with left blade of toggle switch 38
	E0. 673.200	PE-25-100 Resistor		Absent
		II. Automatic Recorder		
	U6.760.005	Electric motor SL-322		Field windings in series
	E0.673.200	PE-50-300 Resistor		in series with resistor 46.
	E0.673.200	PE-15-100 Resistor	100 ohm	Absent
	E0.679.100	16 tube, E-14 base	6A,220 v	
	E0.673.200	PE-25-1000 Resistor	1000 ohm	
	U7.543.127	Additional Resistor		in series with voltmeter 18.
	E0.673.200	PE-15-2000 Resistor	2000 ohm	
	E0.673.200	PE-15-2000 Resistor	2000 ohm	

1	2	3	4	5

50X1-HUM

III. Amplifier

	U7.554.094	Power Amplifier		
		Transmitting Relay		
	U7.543,120	Relay Coil		
	U7.543.120	Relay Coil		
	U7.544.008	Transformer		

Chapter VI

Data on Some Echo Sounder Instrument Components

Data on Automatic Recorder Ball Bearings

Dimensions in mm	Make	All-Union Standard	Quantity	Where Located
1	2	3	4	5
5x35x11	202P	612-39	2	Central collector shaft
8x22x7	8	612-39	2	Phasing mechanism shaft
8x22x7	8	612-39	1	Reducer
8x22x7	8	612-39	2	Tape-winding transmission
7x22x7	7	612	2	Electric motor SL-322

Data on Graphite Brushes of the Automatic Recorder

Note: [Left column partly obscured. Hyphen indicates one or more missing numbers or letters.]

Decimal No.	Dimensions	Type	Quantity	Where Located
-7.510.006	25x8x15	MG-4	3	Automatic governor
-7.510.103	4x7x12	EG-2	2	Electric motor SL-322

Data on Ball Bearings for Depth Indicator

50X1-HUM

Dimensions	Make	All-Union Standard	Quantity	Where Located
10x30x9	20 P	612-39	1	Central shaft
8x22x9	8 P	612-39	1	Central shaft
5x19x6	6	612-39	1	Electric motor SL-262
7x22x7	7	612-39	1	Electric motor SL-262

Data for Graphite Brushes for Depth Indicator

Decimal No.	Size of Brushes in mm	Type	Quantity	Where Located
-7.510.006	2.5x8x15	MG-4	3	Automatic governor
-.710.102	4x7x12	EG-2	2	Electric motor SL-262

Technical Data on PO-550F and PO-550AF Converters

Rated Data	PO-550F		PO-550AF	
	= current	current	= current	current
Capacity (in volts)	-	550	-	550
Voltage (in volts)	100	125 ± 10%	200	125 ± 10%
Current (in amps)	Not over 10.8	9.4	Not over 5.4	9.4
cos φ	-	0.47 ± 10%	-	0.47 ± 10%
Frequency (in hz)	-	50 ± 3	-	50 ± 3
Rotational velocity rpm	3000	± 180	3000	± 180
Brushes: Make	G-6	M6	G-6	M-6
Quantity	2	2	2	2
Size	1ox12.5	8x10	10x12.5	8x10
Ball Bearings	All-Union Standard 6266-39 N 1202 2 pieces			

Part Two

Maintenance Instructions

50X1-HUM

Chapter I

Preparation for Operation After a Prolonged Break

Before starting an echo sounder all instruments in the set must be inspected. The inspection is made with the power disconnected.

1.1 Automatic Recorder and Depth Indicator

a) Uncover the instruments. Make sure that the mechanical system is not sticking and operates freely by turning over the mechanism manually - the automatic recorder counterclockwise, by the frame of the automatic governor, and the indicator by the disc in the direction of the arrow. Remove dirt and dust with a rag slightly dampened in gasoline. It is desirable to clean the instrument with compressed air.

b) Check connections and soldered junctions of the assembly wiring.

V) Examine the automatic governor brush holder, and make sure that the brushes are not sticking and that there is a contact between them and the rings of the automatic governor.

g) Rub the automatic governor contact rings and the collectors of the electric motor with a rag dampened in gasoline or alcohol.

d) Put a light bulb and an indicating bulb in the automatic recorder and an rpm control bulb in the indicator.

e) Insert a roll of paper in the chamber of the automatic recorder and load the tape winder.

In order to do this, the pen must be moved beyond the limits of the scale by turning the mechanism counterclockwise by the body of the automatic recorder. To avoid damage, paper should be placed between the pen and the chrome-plated chamber lid.

To insert a roll of paper, pull handles (1 and 2 -- FN:Numbers according to photo 2) on them to release the chamber lid, which is then opened toward yourself. Check the roll of paper (the paper should be rolled straight) and insert it between the discs of plate-like brackets on the lid.

To preserve the dampness of the paper for a longer period of time, a clean damp rag is placed on the bottom of the chamber (under the roll of paper). The damp rag should be placed so as not to touch the paper. Unroll approximately 30 cm of paper tape and close the lid, leaving the unrolled tape outside. Pass the tape through the paper drive rollers

(3 and 4). To do this it is necessary to remove the lower roller. This is done by removing links (5 and 6) holding the roller, leading the paper through, and placing the lawer roller back in its place. Then, with the paper tape push aside the guiding roller and electric heater roller, and feed the end of the tape through the catch of the winding roller. After this, pulling through and winding of the paper tape should be checked by turning the upper paper drive roller manually with the crank. Tension in the paper should be uniform, and the tape should have no wrinkles. 50X1-HUM

To remove a used-up roll of paper tape, it must be taken out of the automatic recorder together with the winding roller. To accomplish this, links (5 and 6) and the spring transmission on the right side must be removed. The winding roller is dismountable; the left hub can be taken off the roller, making it possible to pull the roller out without unwinding the roll of paper.

zh) Check the fuses and close the instrument lids.

1.2 Transmitting Relay

a) Remove the cover and check the connections and soldered junctions.

b) Make sure the relay contacts are clean. If necessary, wipe them off with a rag dampened with gasoline; and if a deposit is detected, clean the contacts with a N 00 fine sand apaer and wipe off the contacts again with the rag.

v) Check the fuses and place the 5Ts4S tubes in the tube sockets.

g) Put the cover on the instrument.

1.3 Vibrators (Emitter and Pickup)

a) After the ship is in the water, the air trapped in the inner cavity of the vibrator housing should be let out. This is done by loosening a special bolt on the vibrator cover. At the appearance of water the bolt is again tightened.

b) Measure the resistance of the vibrator wire insulation relative to the frame. The insulation should not be less than 10 megohms.

v) Megnetize the vibrator-pickup.

1.4 PO-550 Converter

a) Check for reliability of pressure on the brushes and contact between the brushes and collector. If necessary, adjust the brushes. Wipe off the collector with a rag dampened with gasoline or alcohol. It is not recommended that the spring pressure on the brushes be changed.

b) Remove the ball bearing cover. Check for the presence and condition of the lubricant. If necessary, add or change the lubricant.

1.5 Amplifier and Filter

a) Remove the cover and examine the wiring.

b) Check the fuses.

v) Place the tubes in the amplifier tube sockets.

g) Replace the covers on the instruments.

Chapter II

Adjustments

50X1-HUM

2.1 Transmitting Relay

a) Before making any adjustments on the transmitting relay the echo sounder should be switched off.

b) The gap between the contacts should be o.7 - 1 mm. To set this gap screws are loosened and the angle plate (1 -- FN: Photo 8) moved in the required direction, after which the screws are again tightened.

v) The spring tension must provide dependable operation of the relay under fluctuations of the shipboard voltage of 10% of the rated value. To set the spring tension the lock nut (2) must be loosened and tension set with the screw (3), after which the lock nut is again tightened.

2.2 Indicator

a) To adjust the gap between the contacts, the disc must be manually turned clockwise until the contact set which is to be adjusted opens. The distance between the contacts should be 0.6 - 1 mm. Should the distance exceed or be less than the said distance, the gap is correspondingly adjusted by bending the upper contact plate at its base.

b) For the adjustment of the pressure exerted on the contect set cam, the disc must be turned until the half segmental cutout on the cam passes the contact set. The contacts should be closed at this time, but the plates should have no noticeable deflection indicating excessive pressure exerted on the cam by the contact set. If the deflection is large the pressure must be changed by means of the two screws which secure the contact set to the angle plate. Turn the disc again, checking the closing and opening of the contact set and its pressure on the cam. If necessary, repeat the adjustment. Do the same to all contact sets.

v) Before adjusting the rpm of the motor, the strobe light should be adjusted. For this the motor of the indicator must be turned on by opening the motor power supply circuit with the disconnector blade, located on the right support of the rack.

g) Switch on the indicator and turn on the rpm counter light by turning the amplification control handle to the left as far as it will go.

d) Turning the disc manually, match the lens with the opening in the automatic governor lid so that the beam from the light bulb illuminates the round frosted glass on the disc.

e) If the frosted glass is not completely illuminated, three external screws securing the disc to the boss must be loosened. Holding the automatic governor, turn the disc in the proper direction until total illumination of the frosted glass is achieved; then tighten the screws again.

zh) Turn off the indicator. Close the motor power supply circuit with the blade.

50X1-HUM

z) RPM adjustment. The rpm adjustments are made for two speeds: 3060 rpm for the 0-100 m scale, 613 rpm for the 0-500 m scale.

Flashes of a 6.3 v bulb, seen between the scale display in the lower portion of the glass, serve as the motor rpm indicator for the 0-100 m scale. The frequency of flashes is checked with a stopwatch. For the 0-100 m scale there are 90 flashes per minute (60 ± 0.6 seconds).

It is recommended that flashes of a neon lamp be utilized for monitoring of low rpm (0-5000 m scale). The frequency of flashes is also checked with a stopwatch. There are 90 flashes per minute (60 ± 1 seconds) for the 0-5000 m scale.

In monitoring the rpm with a neon light, the position of the amplification control handle must be such that the flashes of the neon lamp are sharp and uniform.

Low rpm may also be monitored with an incandescent bulb, in which case the number of flashes per minute corresponding to normal rpm of the motor is 18.

The rpm setting itself is done in the following manner: a stopwatch is started simultaneously with the flash of the 6.3 v bulb or the flash of the neon lamp. After this the number of flashes is counted and the stopwatch stopped on the last count. If the stopwatch registers less than 60 seconds, the rpm of the motor is above normal, and vice versa.

After this, switch off the echo sounder and, taking off the automatic governor lid held by screws, adjust the spring tension in the automatic governor contact set for the corresponding range (0-100 or 0-500). Increasing or decreasing the spring tension correspondingly increases or decreases the rpm of the motor.

To adjust the spring tension, the set screw on the rack must be released and the necessary adjustment of the spring tension made, with the adjusting screw after which the adjusted position is secured with the set screw. Switch on the echo sounder and check the rpm of the motor as instructed above. If necessary, repeat the adjustment.

For a final fine adjustment the spring tension is more conveniently adjusted by screwing in or unscrewing the stationary contact.

i) Scale adjustment. By scale adjustment is meant the comparison of the echo sounder reading with that of a hand-operated plumb. Both scales must be checked. Before the adjustments, make sure that the rpm control for both scales is set correctly.

The measurements with the hand plumb should be made in depths of around 10 meters to avoid big errors. The plumb reading is obtained by averaging two soundings taken from both sides of the ship and in line with the vibrators. If there are corrections for the base line, they should be applied to the depth measurements. If the measurements disagree, an adjustment is made by moving the angle plate with the contact set in the proper direction. To do this, loosen the bolt fastening the plate in the concave slot. The angle of rotation of the angle plate can be read from the dial in meters.

To adjust the 100 m scale, use the scale marked 0-100 m; and for the 500 m scale, use the one marked 0-500 m. Adjustments of scales, as previously noted, should be made so that the readings of the echo sounder correspond to the depth below the vibrators, because the adjustment for measurements from the keel or surface of the water makes the use of correction tables for the base line difficult.

k) To adjust the contact set for the "zero blackout", the amplification control is turned clockwise until "zero" interference appears. The "zero blackout" toggle switch must be on. The bolt fastening the angle plate to the "zero blackout" contact set is loosened, the toggle switch is turned on, and, by moving the angle plate (and consequently the contact set), the disappearance of "zero" interference is attained. After this, the angle plate is moved slightly in the direction opposite to the rotation of the cams, and the bolt fastening the angle plate is tightened.

2.3 Automatic Recorder

a) The gap between the contacts and the pressure of the contact set on the cams is set in the same manner as described above for the indicator. The only difference is that the turning of the cams is done manually by rotating the frame of the automatic governor counterclockwise.

b) The motor rpm adjustment is done for two speeds:
3145 rpm for 0-100 m scale
629 rpm for 0-500 m scale

The end of the control shaft, which comes out through the reducer housing, serves as the motor rpm indicator for the 0-100 m scale. At the end of the shaft is a pin which is painted red.

At the correctly adjusted rpm of the motor the control shaft makes 74 rpm. For the 0-500 m scale the number of rpm of the recording pen (or the number of transmitting relay operations, if the automatic recorder is operating) is checked directly. If the rpm of the motor is adjusted properly, the pen makes 37 rpm. The adjustment of the automatic governor and it checking stopwatch is done identically to that described for the indicator.

v) When adjusting the pen, check to see that it does not catch the graph paper. For this check the pen is pulled by manually turning the

automatic governor counterclockwise by its frame. If necessary, the end of the pen is bent. If the pressure the pen exerts on the paper is too great, the end of the pen spring should be bent. During its motion the pen should be lowered on the paper to the left of the zero on the graph and lifted after passing the graph. To adjust the time of lowering, the screws that fasten the angle plate must be loosened and the angle plate moved in the direction required. The adjustment of the time of lift is made with the angle plate in a similar manner. After this the screws are tightened and the timing for lowering and lift is checked. If necessary, repeat the adjustment.

g) The left margin of the scale grid markings should match the scale graduations. If they do not coincide, an adjustment is made my moving the contact plate, which slides on a textolite ring with commutator segments. To move the contact plate, it is necessary to release the screws fastening it; then move the plate in the direction of rotation of the collector if the markings of the scale grid are to the left of the corresponding scale graduations, and vice versa.

After shifting the contact plate, tighten the screws. During the adjustment the automatic recoder should be off, because the revolving pen may injure the hand.

d) The scale adjustment is made similarly to that of the indicator. The phase switch must be in position "0".

e) Adjustment of the contact set is made identically to the above described for the depth indicator. The phase switch must be in position "0".

2.4 Amplifier

It is permitted to adjust the grid bias of the amplifier thyratron aboard the ship.

During the operation of the echo sounder it is necessary to adjust the bias so that there will be no interference in the depth signal indicator and the automatic recorder at maximum amplification.

Chapter III

Servicing During Operation

a) When the echo sounder is in operation, it is necessary, for correct readings, that the voltage in the shipboard ciruit not vary from the nominal more than ±10%.

b) In the event that an unusual noise (crackling or grating) appears in the depth indicator or automatic recorder, it is necessary to turn off the echo sounder immediately and not to turn it on again until the disturbance has been located and eliminated.

v) Entries on the automatic recorder or flashes on the neon tube of the depth indicator should be clear, without gaps. If necessary, readjust the amplification or bias applied to the grid of the thyratron.

g) When switching phases and ranges of depths to be measured, the appropriate marks must be made with the electric pencil. To avoid damage to the pen, marks should not be made near it with the electric pencil.

d) At operations on the 0-500 m range the electric heater should be off.

e) If the measured depth approaches 60 meters on the 0-100 m range of operation or 300 meters on the 0-500 range of operation, the phase switch should be switched over to the right position. To avoid damage to contact sets, phase switching should be made when the automatic recorder is in operation.

zh) If the paper dries and the recording becomes weak, the paper must be moved by turning the tape winder manually with the crank.

Periodical Inspections

The following should be done at time of periodic inspection:

1. Take off the bearing covers on the converter and make sure of the presence and cleanliness of the lubricant. If necessary, add or change the lubricant. GOI-54 lubricant should be used for ball bearing lubrication.
2. Check the condition of operating surfaces of all contact rings and collectors in the depth indicator, automatic recorder, and converter. If they are soiled, clean them with No. 00 sand paper.
3. Check the operating suffaces of relay contacts, automatic governor and contact sets. If deposits are found, remove them with fine sand paper.
4. Using the stopwatch, check the number of revolutions of the indicator disc and the automatic recorder pen for operation on both scales.
5. See that there is no sparking in converter brushes at starting.

Chapter IV

Servicing During Docking

50X1-HUM

a) During each routine docking of the ship, the condition of the outside surfuace of the emitter and pickup vibrators should be examined and carefully rid of dirt, barnacles, verdure, oxides etc., without damagining the end surface.

b) See that the vibrator surfaces are not painted during the cleaning and painting of the submerged portion of the ship.

v) During reequiping or installation of new equipment on the ship, see that the rules for installation of the echo sounder are observed.

g) Check the resistance of the vibrator winding insulation. The resistance of the winding insultation relative to the frame should not be less than 10 megohms.

d) See that the instrument lids are not opened unnecessarily and that they are closed and held tight to the frame with spring bolts.

Chapter V

50X1-HUM

Servicing in Time of Prolonged Inaction

For preservation of the echo sounder assembly during prolonged inaction a number of measures, depending on local conditions, must be taken, but generally they are the following:

a) Tubes should be removed from amplifier, relay, automatic recorder, and indicator and placed in corresponding tube sockets in the box for transporting.

b) A thorough cleaning of the instruments to remove dust and dirt should be made.

v) The wires supplying power to the echo sounder from the ship's network should be disconnected and their ends insulated.

g) The outer unpainted metal parts and the inside non-plated instrument parts must be covered with heavy acid-free grease (vaseline GOI-54 or something similar to it).

d) When the ship is put into a dock, see the section on "Servicing During Docking".

e) During repair work in the deck-house where the echo sounder instruments are located, appropriate measures must be taken to protect the instruments.

zh) The instrument lids must be closed and their bolts tightened.

Chapter VI

Dismantling and Assembling

50X1-HUM

When dismantling an echo sounder for the purpose of inspection and correction of possible disrepair, it is permissible to remove and replace the following electrical components and parts:

In the Automatic Recorder

1. Fuses
2. Illumination bulb
3. Signal bulb
4. Automatic governor brushes
5. SL-322 electric motor brushes
6. Transmitting contact sets
7. Automatic governor contact screws
8. Pen with spring
9. Electrolytic capacitor 5 mF x 450 v.

In the Depth Indicator

1. Fuses
2. Automatic governor brushes
3. SL-262 electric motor brushes
4. Transmitting contact sets
5. Automatic governor contact screws
6. Disc with neon lamp
7. Neon lamp
8. RPM control bulb

In the PO-550 Converter

Brushes for d-c and a-c collectors.

In the Filter

Fuses

In the Amplifier

1. Potentiometer
2. Fuse
3. Tubes
4. Electrolytic capacitor 10 mF x 450 v.

In the Relay

1. Fuse
2. Kenotron

3. Contacts
4. Transmitting capacitor 2 mF x 1500.

The indicated dismantling and change are made with the echo sounder switched off.

a) Tubes should be held by their base during their removal. To release a tube the spring catch must be pressed down. All tubes should be removed with a slight rocking.

b) To remove the amplifier chassis from the frame it is necessary to disconnect the hookup wires from the terminals and to unscrew four screws which secure the chassis to the frame.

v) The brushes of the automatic governor and the brushes of the electric motors in the automatic recorder and indicator are replaced when worn out. The automatic governor brushes are removed by removing the brush springs. The brushes of the automatic recorder and indicator are removed from the brush clamps after unscrewing the plastic plug and the adjustment bushings. To remove the motor brushes of the alternateing current rings in the PO-550 converter, the bindings blacking access to the brushholders must first be removed from the lids. The brushes themselves are removed from the clamps after freeing them from pressure springs.

g) In the event of replacement, removal of the transmitting contact sets in the automatic recorder and depth indicator is done by unscrewing two end screws (first unsolder the wire ends). After replacement of the contact sets, they and the zero of the scale must be adjusted.

d) In replacing the contact sets of the screws in the automatic governor of the automatic recorder and the indicator, it is necessary to remove the base to which each of them is fixed. For this, two screws fastening the base to the control disc must be unscrewed.

e) To remove the pen with the spring from the automatic recorder, two screws which hold the plates pressing the pen to the holder must be released and the plates moved aside. After the replacement, adjustment of the pressure and the time of lowering and lifting of the pen must be made. The scale grid and zero of the scale must also be adjusted.

zh) The disc on the indicator is taken off for replacement of the neon lamp or adjustment of the louver mechanism. The disc is taken off by releasing a lock screw and unscrewing the central nut. This nut is unscrewed with a special wrench located in the spare parts box.

z) In order to remove the neon lamp, the ends must be unsoldered at the terminals of the transformer coil and two screws which fasten the lamp to the disc must be replaced.

i) The rpm control bulb on the indicator is replaced in the following

manner: first the right screw of the bulb holder is released; then the socket with the bulb is removed. The disc has openings for acces to this screw which also serve as an access to the lid screw of the automatic governor.

k) When replacing the upper or lower contacts of the transmitting relay, the angle plate with the upper contact must be removed first. This is done by removing two screws which fasten the angle plate to the base. After replacement of either of the contacts, adjustment of the gap between them and adjustment of the scale on the automatic recorder and the indicator is necessary.

l) When removing the transmitting capacitor, the relay chassis must be taken out from the frame, and for this, it is necessary to disconnect the hookup to the frame. After this, loosen the nuts on the capacitor leads and remove the lugs with soldered wires, unscrew the screws that fasten the clamp, and take out the capacitor.

Chapter VII. Typical Malfunctions and Remedies

E. Typical Malfunctions and Methods of Correction

No.	Type of Malfunction in the operation of the echo sounder	Possible Cause	Means of Detection	Means of Correction
1	2	3	4	5
	No depth recordings on automatic recorder and no readings on depth indicator	1. Break in relay - vibrator emitter line.	Remove relay cover and switch on sounder. No spark in relay contacts indicates defects in high-voltage circuit. Disconnect cable wires at terminals 1 and 2 and check relay - vibrator emitter line with megger.	Replace damaged cable.
		2. A high-voltage kenotron burned out.	Spark in relay contacts greatly reduced. Check cathode glow for heating in both high-voltage kenotrons.	Replace damaged kenotron
		3. Breakdown of transmitting capacitor in relay.	No spark in relay contacts. Place insulation between relay contacts and check capacitor with megger.	Replace capacitor.
		4. Relay does not operate.	1) Relay reed loose a) kenotron of power supply windings to relay burned out b) break in wires leading to terminals 6 and 7 or break in one of the coils.	Replace kenotron. Replace cable if damaged. Replace coil if windings damaged.
			2) Tightening relay reed shorts wires to terminals 6 and 7 of relay outside the relay or inside.	If short in cable replace cable. If inside the relay - remove it.

1	2	3	4	5
		5. Break in line vibrator pick-up - amplifier or resistance is low.	No thyratron firing; will fire if grid lead out of first tube (6Zh8) touched with wet finger. Disconnect ends at terminals in instrument, megger check lines of vibrator pickup for soundness and quality of insulation. For break or reduced insulation (below 10 meghoms) disconnect vibrator pickup from terminals in cable box and check: 1. insulation of cable lead to amplifier; 2. insulation of vibrator pickup windings.	Replace vibrator pickup to amplifier cable. Replace vibrator pickup
		6. Defective amplifier.	No thyratron firing when touching grid lead-out of the first tube with wet finger. 1. Check condition of contacts in terminals and solder joints in amplifier wiring. 2. Check amplifier tubes. 3. Check voltage and resistances on separate portions of the circuit.	Tighten terminal screws Check out with spare set of tubes Replace faulty resistors and capacitors.
		7. Demagnetized vibrator pickup	If amplifier and line from vibrator pickup in order, but no reception, then possible that vibrator pickup demagnetized.	Magnetize vibrator pickup.

1	2	3	4	5
	II. Depth recordings absent or faint on automatic recorder when indicator indicates depths.	1. Dry paper	Tape through until damp paper appears.	Replace dry roll of paper.
		2. Pen not pressed down enough when it slides across paper.	Check mechanism by hand. Check pressure of pen on paper.	If the pressure of the spring is insufficient, turn the spring one complete turn.
		3. Poor contact between brushes and collector of automatic recorder.	Check condition of collector and brush pressure against solid collector ring.	If collector dirty clean with rag moistened in gasoline. If brush pressure too weak, increase by releasing outside right screw and tightening left one (screws fastening the block).
		4. Circuit break in contacts of switching relay.	Turn off sounder; press finger on reed of switching relay and check closing and opening of relay contacts.	Adjust corresponding contact set of switching relay by bending springs.
		5. Disrupted circuit of output transformer in automatic recorder	No thyratron firing. Short-circuiting terminals 8 and 7 restores rhythmic firing of thyratron in the amplifier. This indicates break in transformer output circuit. Disconnect cable ends at terminals 15 and 16 of automatic recorder and check for break with tester	

1	2	3	4	5
			Break may be in relay, switching from automatic recorder to indicator (when checking, switch off "zero blackout").	
	III. Depth indications absent on indicator but recordings present in automatic recorder.	1. Transmitting relay not operating	Switch off power supply of motor. Turning manually (clockwise) indicator disc, check operation of transmitting set. 1. If found that one of the sets stays either open or closed, then that set is out of adjustment. 2. Relay reed stays pulled in or released, This indicates short or break in wires connected to indicator terminals. Find short or break with megger or tester. 3. With sounder off, check closing and opening of transmitting relay contact sets by pressing with finger on reed.	Adjust transmitting contact set. If cable damaged, replace. If short or break inside instrument, correct. Adjust contacts of switching relay by carefully bending plate.
		2. Damaged neon lamp.	Thyratron fires but neon lamp does not light. Remove indicator disc, unsolder ends of neon lamp from coil and check if it lights up from megger on 500 v.	Replace neon lamp.
		3. Break in output transformer circuit in indicator.	Thyratron does not fire. Short-circuiting terminals 7 and 8 of amplifier restores rhythmic firing. This indicates break in output transformer circuit.	

1	2	3	4	5
			1. Disconnect cable ends at terminals 7 and 13 of indicator and tester-check soundness of output transformer primary winding (with "zero blackout" off).	
			2. Break may be in switching relay contacts.	Adjust contact set of transmitting relay by carefully blending plate.
	IV. Scattering of flashes across indicator scale and scattering of recording on automatic recorder.	1. Poor grounding of sounder instruments or cables.	Check grounding of sounder instruments and cables.	Correct.
		2. Interference from automatic governor.	To check for automatic governor interference in amplifier, switch on automatic recorder (or indicator) alternately in both ranges. If interference noted, sounder should be switched off.	Clean the contacts of the automatic governor with a fine sand paper "00"
			1. Check automatic governor brushes for spark.	If they spark, clean automatic governor rings with rag moistened in gasoline.
		3. Interference from electric motors of indicator or automatic recorder.	With aid of disconnector disconnect motor in indicator and on automatic recorder turn handle "automatic recorder" to "off". If this stops interference cause is the electric motor.	Clean collector of motor with rag moistened in gasoline.

S-E-C-R-E-T
No Foreign Dissem

Declassified in Part - Sanitized Copy Approved for Release 2013/02/11 : CIA-RDP80T00246A069400270001-2

1	2	3	4	5
		4. Foreign apparatus interferences	If interference remains when motors of indicator and automatic recorder are off, interference, evidently, is from foreigh units. Check location and reliability of vibrator-amplifier line grounding.	Eliminate unreliable grounding.
	V. Considerable discrepancy between depth readings of recorder and indicator.	1. Weak pressure of governor brushes.	Sticking of governor brushes in brush-holders.	Eliminate sticking.
		2. Burned contacts in governor.	Deposits on governor contacts.	Clean contacts with fine sandpaper.
		3. Automatic governor adjustment upset.	Stopwatch count shows deviation from normal rpm on one range.	Adjust governor contact set for corresponding range.
		4. Instant of pulse sending (relative to scale zero) shifted.	Data obtained by sounding line differs from dial reading.	Adjust corresponding set.
	VI. Scale markings not plotted or omissions on paper of automatic recorder.	1. Insufficient pressure on brush applying dc voltage to pen.	If during operation on electric stylus normal recording appears, reason is probably poor contact between brushes and collector.	Adjust brush pressure.

S-E-C-R-E-T
No Foreign Dissem

Declassified in Part - Sanitized Copy Approved for Release 2013/02/11 : CIA-RDP80T00246A069400270001-2

1	2	3	4	5
		2. Break in dc line from amplifier.	If special indication button and electric stylus do not operate, circuit from amplifier to terminal (20) of automatic recorder is disrupted.	Restore circuit
	VII. Pen tears paper.	1. Paper moved to one side, pen catches edge and tears it.	Switch off sounder. Open paper box and check paper roll.	Press finger on side of roll to straighten.
		2. Pen tears edge of paper.	Switch off sounder and turn motor counterclockwise by its frame, checking for proper pen lift and drop.	Adjust pen lift and drop.

S-E-C-R-E-T
No Foreign Dissem

Declassified in Part - Sanitized Copy Approved for Release 2013/02/11 : CIA-RDP80T00246A069400270001-2

50X1-HUM

Part Three

Photographs of Instruments Explaining the Text

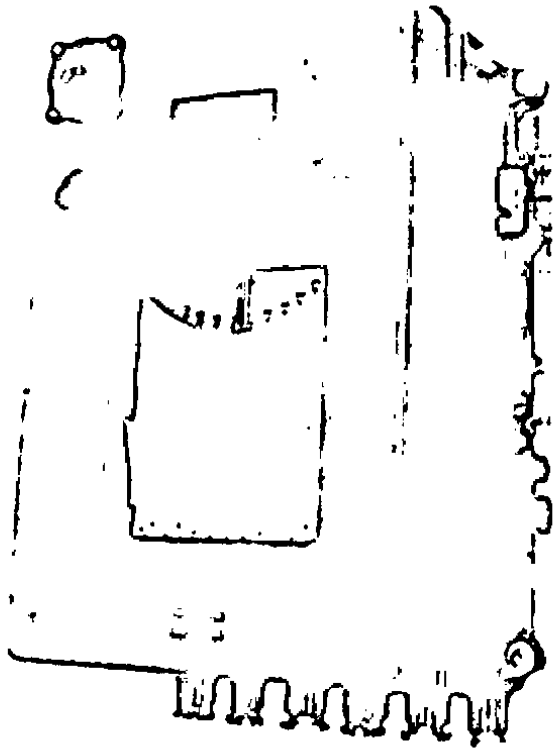


Photo 1. Recorder. General view.

50X1-HUM

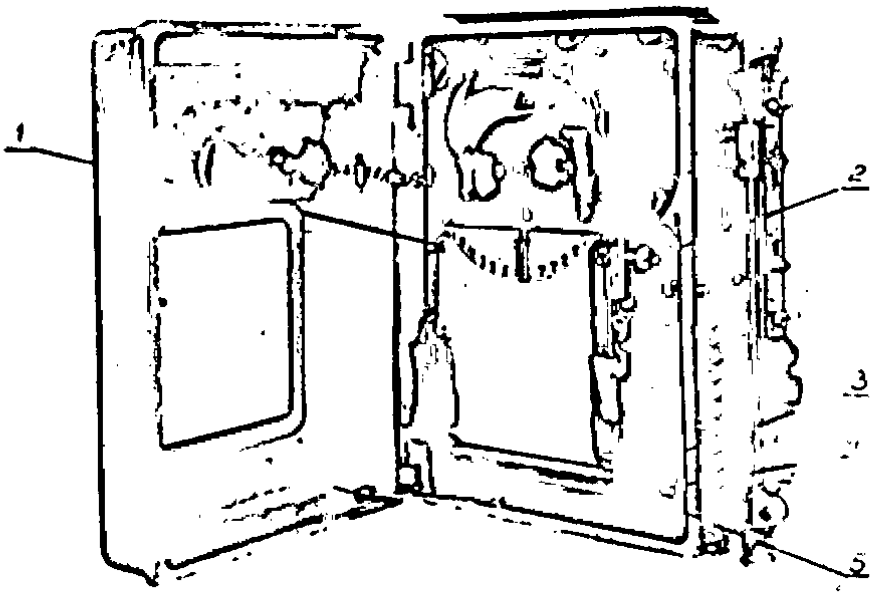


Photo 2. Recorder with cover open

50X1-HUM

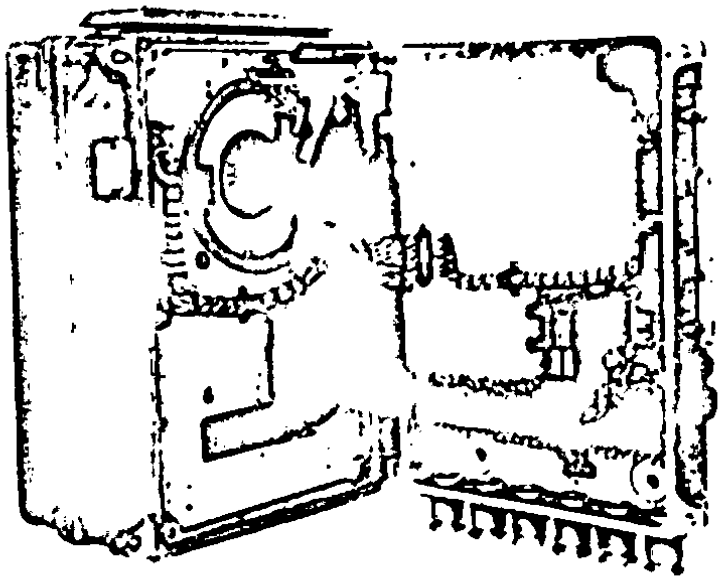


Photo 3. Recorder view with back cover open

50X1-HUM

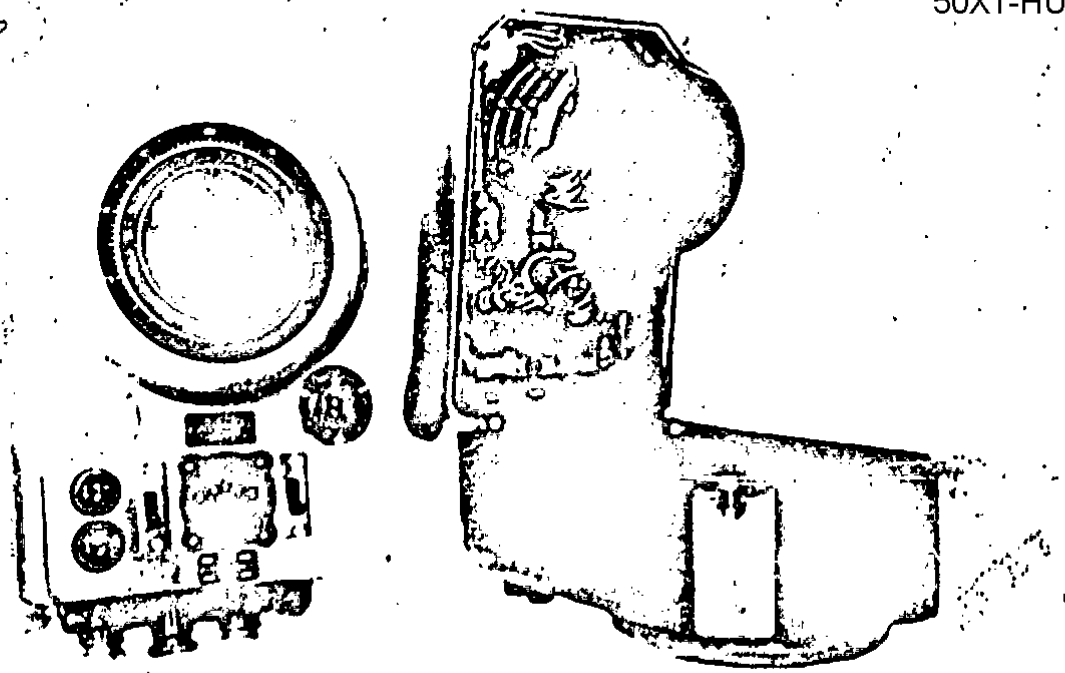


Фото 4. Указатель. Общий вид и вид с открытой крышкой.

Photograph 4. Indicator. General view and view with open cover.

							Ц2.870.016-ТО	
Изм.	Лист	№ докум.	Подпись	Дата				
			МСП 101			Лит.	Лист 93	Листов 124

50X1-HUM

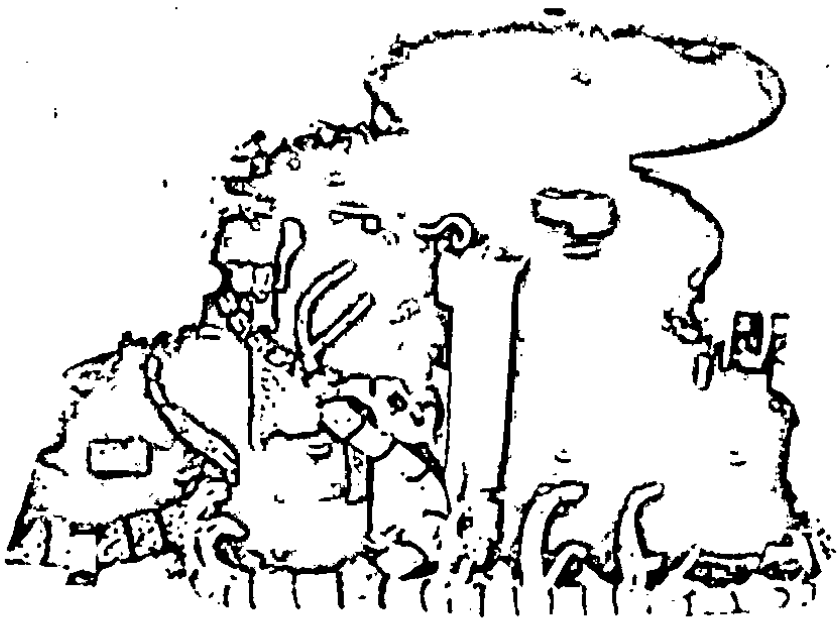


Фото 5. Указатель. Вид на механизм без корпуса

Photograph 5. Indicator. View of the mechanism without the housing.

			Составил			Ц3.870.016-ТО
			Проверил			
№ пр.	Подпись	Дата	Принял			
№			[illegible]		№ зон	Лист 74 | Листов 124

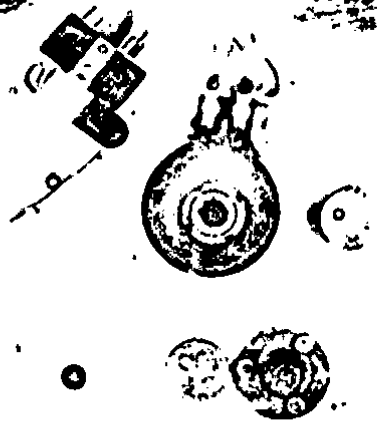


Фото 6. Диск указателя.
Photo 6. Indicator disk

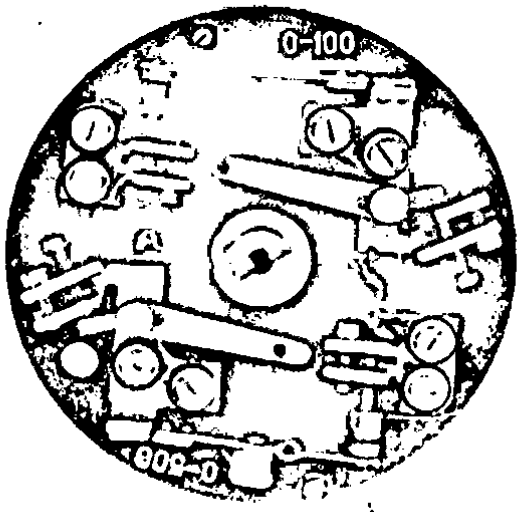
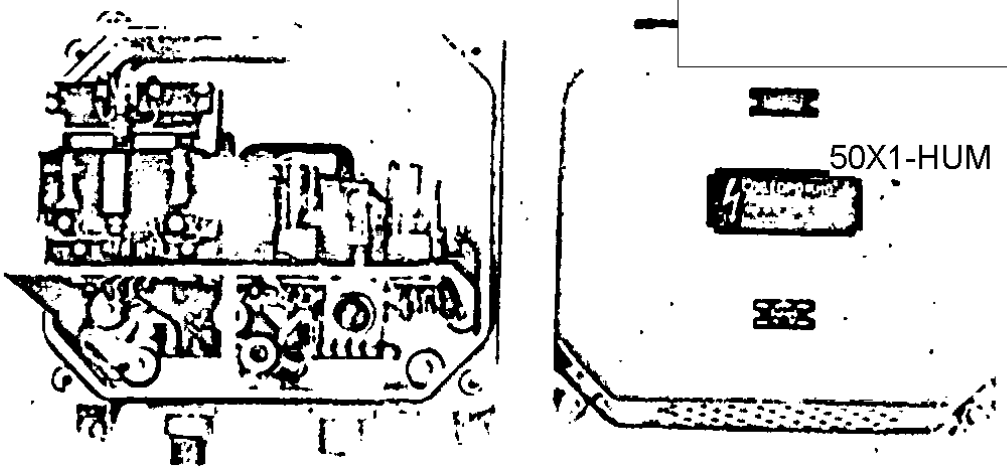


Photo 7. Automatic centrifugal regulator



50X1-HUM

Фото 8. Реле. Общий вид.

Photograph 8. Relay. General View.

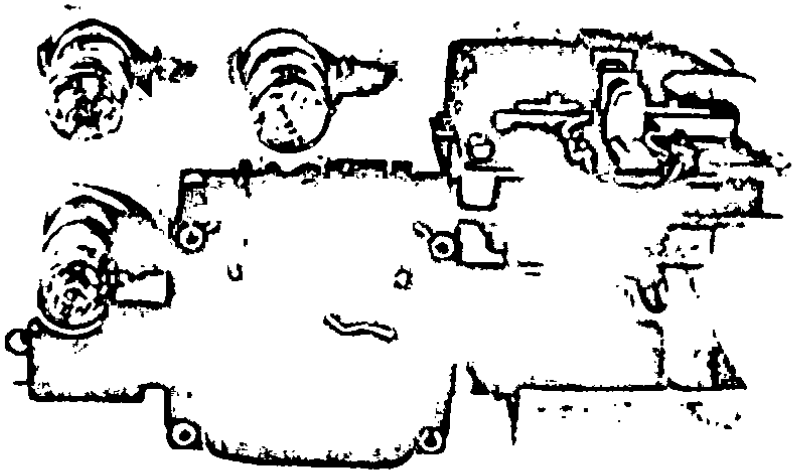


Фото 9 Реле

Photograph 9. Relay

									Ц3.870.016-ТО

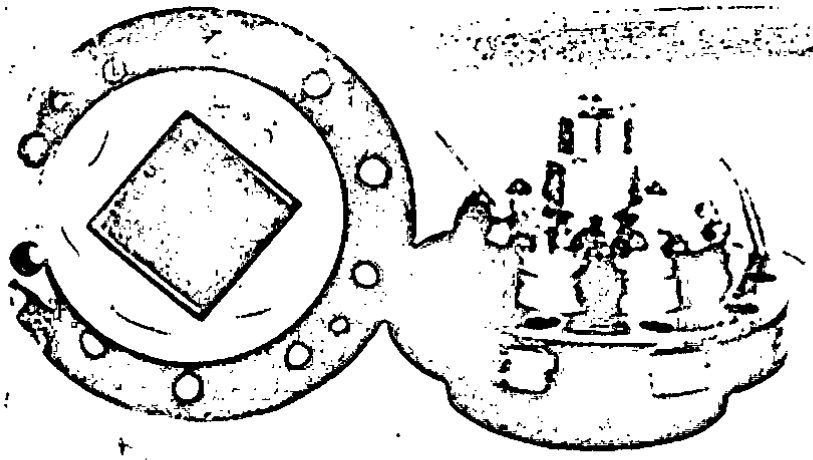


Фото 10. Вибраторы. Вид сбоку и снизу.

Photograph 10. Vibrators. Side and Bottom views.

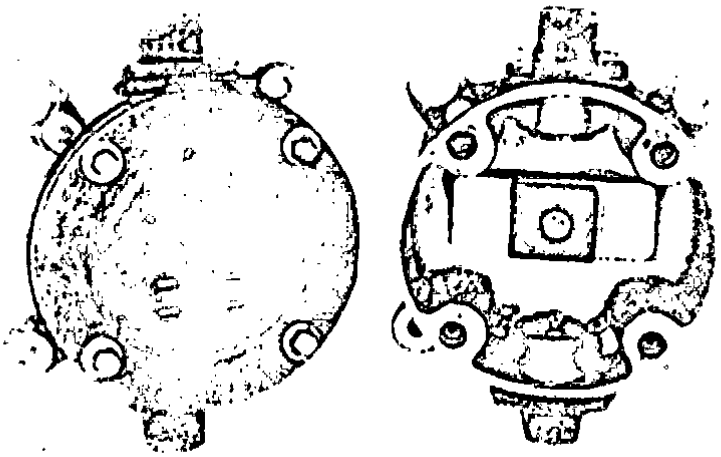


Фото 11. Кабельные коробки.

Photograph 11. Cable Boxes.

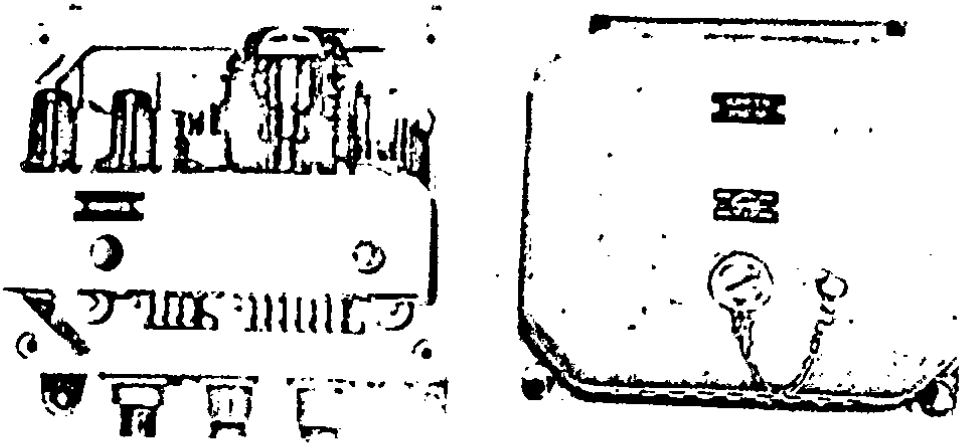
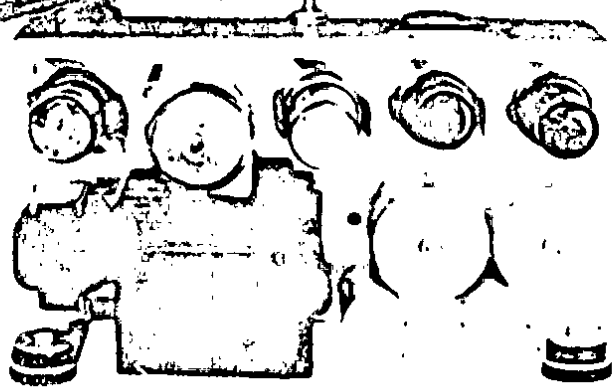


Фото 12. Усилитель. Вид с открытой крышкой.

Photograph 12. Amplifier. View with removed cover.

50X1-HUM



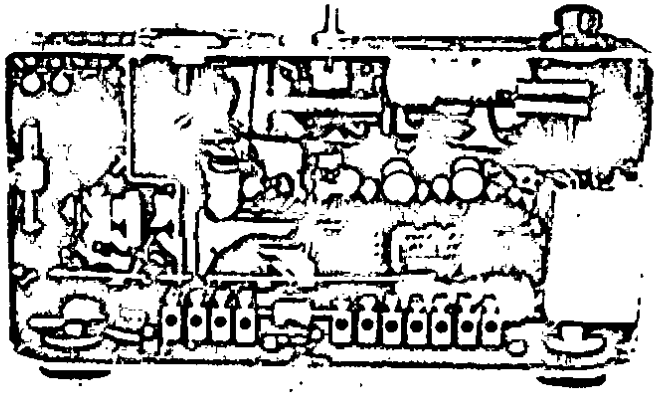


Фото13. Усилитель Вид сверху и Вид на монтаж.

Photograph 13. Amplifier. Top view and bottom view showing parts placement.

50X1-HUM

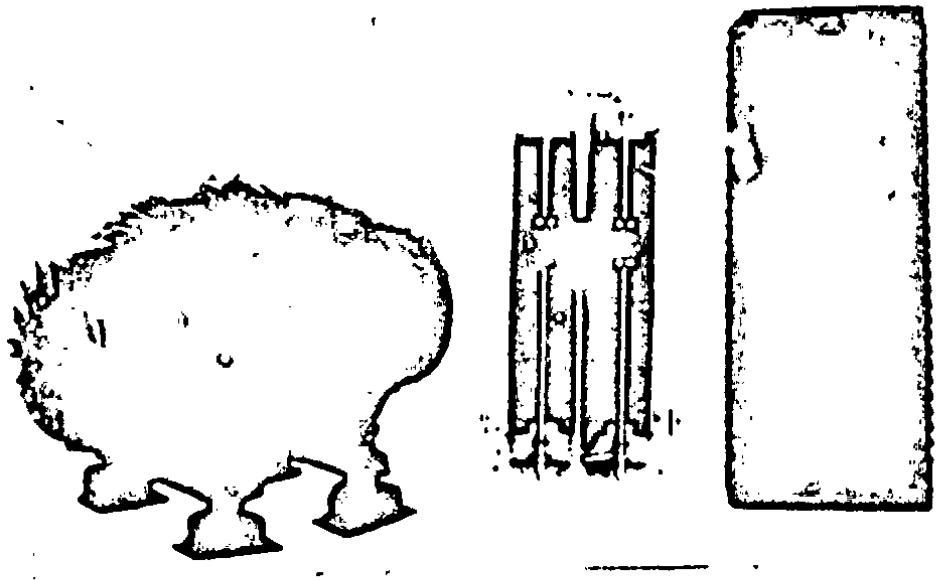


Фото 14. Преобразователь и переменное гасительное сопротивление.

Photograph 14. Converter and variable dropping resistor.

50X1-HUM

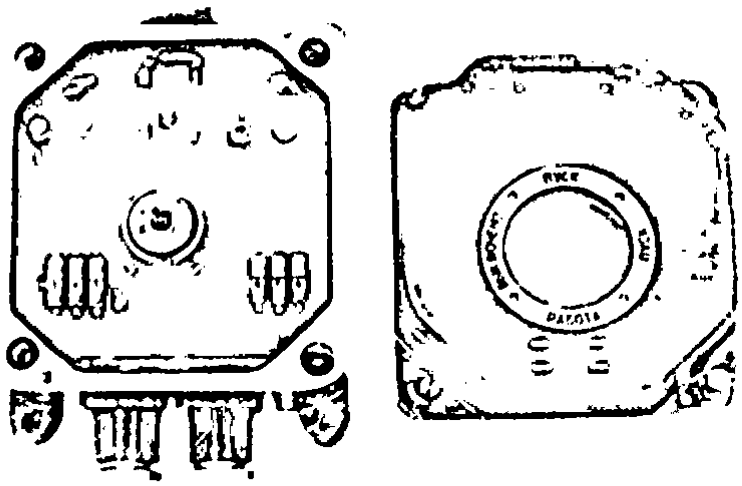


Фото 15. Фильтр. Вид с открытой крышкой.

Photograph 15. View of the filter with cover removed.

Part Four

Use of the Echo Sounder for Locating Fish and Interpretation of Echograms

50X1-HUM

Chapter I

Operating Modes of the Echo Sounder

As was noted above, a recorder is used when searching for schools of fish. In this case, the operating mode switch of the recorder must be placed in the "search" position.

A distinction must be made between the two operating modes of the echo sounder when searching for schools of fish:

1) the search mode
2) the recording mode

It is necessary to operate with maximum amplification in the search mode; otherwise, small schools of fish will not be fixed on the electrochemical paper of the recorder. After the school has been detected, the amplification is decreased to that minimum value at which the school is still fixed on the electrochemical paper of the recorder. This operating mode is called the recording mode, since the smaller gain of the amplifier, the more accurate will be the determination of the size of the the school.

This may be explained by examining the directivity pattern of the dipoles of the echo sounder. As is known, the directivity pattern of the dipoles has a shape such as that shown in figure 1. This pattern is characteristic of both the radiating and receiving dipoles of the sounder.

Thus, one may consider with a sufficient degree of accuracy that the dipole does not radiate in the space beyond the limits of the directivity pattern. The width of the directivity pattern, that is, the directivity angle α depends on the geometric dimensions of the radiating surface of the dipole. There exists the following relationship between the angle α and the dimensions of the radiating surface of the dipoles:

$$\sin \alpha/2 = L/a$$

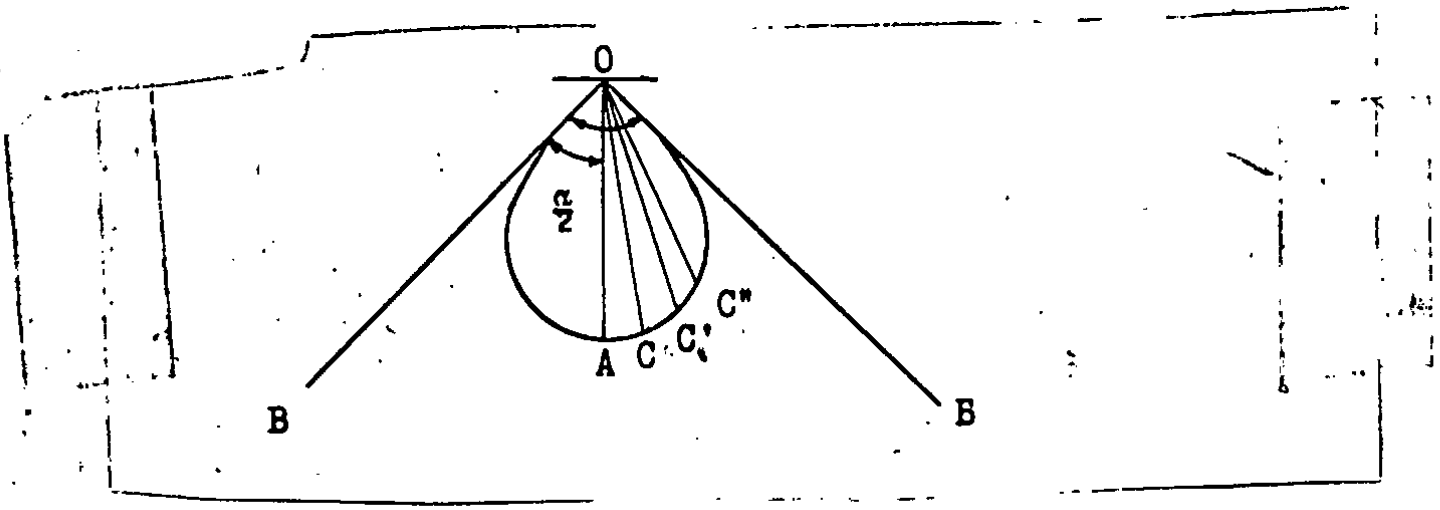
where:

L = wavelength;

a = the side of the radiating surface of the dipole.

The maximum radiation intensity (reception) occurs in the direction of the axis (OA) of the directivity pattern.

Further away from the axis of the directivity pattern (OC, OC', OC") radiation intensity (reception) drops and becomes equal to zero in the direction OB and OB.



Directivity Pattern of the Dipole
Figure 1

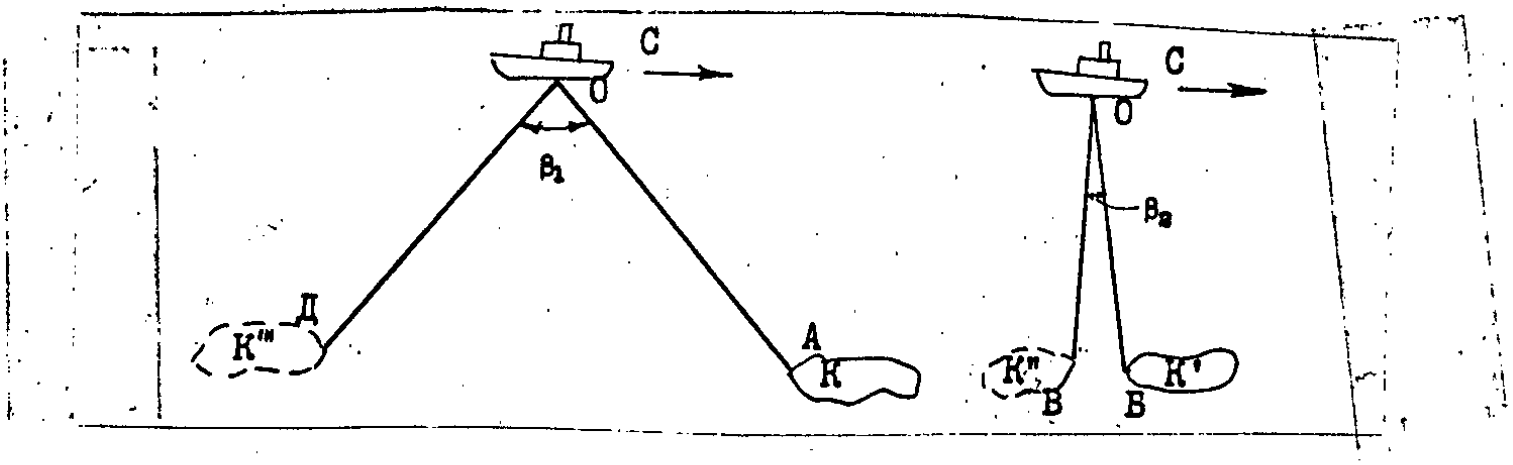
In order to, detect concentrations of fish it is desirable that the dipoles have a sufficiently wide directivity pattern; thus, at these times,

a large surface will be needed for radiation. In order to determine the size of the school, it is necessary to make the directivity pattern as narrow as possible, since the error in determining the extent of the school and its depth will be magfified if the angle of directivity is large.

Let us examine the causes of errors in determining the size of a school which are dependent on the shape of the directivity pattern.

1.1 Error in Determining the Extent of the Shoal

Let us assume that a vessel "C" is moving in the direction shown by the arrow in figure 2. At point "A" the extreme right beam of the directivity pattern "OA" comes into contact with a school of fish "K" a record of which is started on the electrochemical paper of the recorder. Recording will continue until the school is located in the zone of irradiation, that is, until the school appears to be in position "K", or beyond the limits of the zone of irradiation, relative to the vessel as a result of the vessel's movement. The school will cease to be recorded when the extreme left beam of the directivity pattern "OД" no longer touches the school.



Determining the Error in Recording the Depth of a School

Figure 2

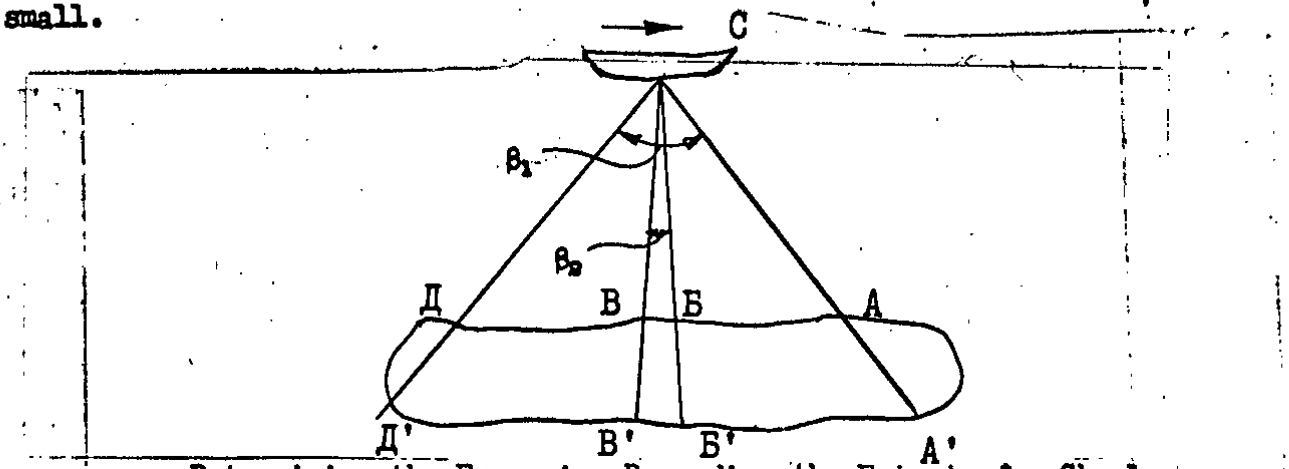
If the directivity pattern were very narrow (almost a straight beam), that is having a small angle β2, then the record of the school would begin at point "B" and would stop at point "B". In this case, the extent of the record of the fish school on the electrochemical paper would almost equal the true extent of the school (if we consider the scale of the record in a horizontal direction).

But if the angle at the top of the directivity pattern were great, the determination of the extent of the school would involve an error.

1.2 Errors in Determining the Depth of the School

Let us examine figure 3 for an explanation of the causes of error in determining the depth of a school.

The depth of the school is equal to the size of the sector "ББ'." Consequently, if point "Б" (or "В") were recorded on the electrochemical paper as the uppermost point of the school and point "В'" (or "В'") as the lowermost point, then the depth of the school would be correctly reflected. It will occur if the directivity pattern is narrow, that is, if angle "β2" is small.



Determining the Error in Recording the Extent of a Shoal

Figure 3

In case of a wide directivity pattern point "А" (or "Д") (closest to the dipole) will be recorded as the uppermost point, since it is still located in the zone of irradiation and its distance from the dipole is the greatest. Consequently, the error in determining the depth of a school for the case of a wide directivity pattern will be determined by the difference in lengths of beans ОА-ОВ .

Thus, as a result of the fact that the directivity pattern has a conical shape, errors will occur in determining both the extent of a school and its depth.

These errors are reduced by decreasing the gain. This can be explained as follows:

It is known that the amplifier of the echo sounder has a certain sensitivity threshold. This means that signals having an intensity less than a predetermined value (the sensitivity threshold) cannot be amplified to the magnitude necessary to be recorded on the electrochemical paper of the recorder. When searching for fish at a particular depth, the signals arriving from directions lying beyond the limits of angle β2 will be less intense than the sensitivity threshold and, consequently, will not be fixed

on the paper of the recorder. Angle $\beta 2$ is called the operating angle of the directivity pattern. When the gain is reduced, angle $\beta 2$ decreases and approaches zero (the directivity pattern is compressed). 50X1-HUM

Hence, the error in determining the size of the school will be reduced.

C

C

Chapter II

Interpreting Echograms

50X1-HUM

2.1 Determining the Depth of a School

The width of the electrochemical paper of the recorder is 155 mm. When operating in the 100-meter range, 60 meters of distance will be covered on the paper. Thus, one meter of distance occupies 25 mm on the paper.

To determine the depth of a school of fish it is also possible to use the scale markers, the distance between which equals 12.5 mm on the paper, which correspond to a depth of 5 meters. When switching to the 500-meter range, the speed of movement of the pen on the paper is decreased by a factor of 5. Consequently, the electrochemical paper of the recorder covers 300 meters of distance in this case, and one meter equals 0.5 mm on the paper. The distance between adjacent scale markers corresponds to a depth of 25 meters.

2.2 Determining the Extent of a School

In order to determine the extent of a recorded school, proceed as follows: The interval between time markers when operating in the 100-meter range is 30 seconds. Thus, it is possible to determine from the recording the length of time that the vessel was over the school. Knowing the speed of the vessel, it is possible to determine the extent of the school.

Example:

The echo sounder was operating in the 100-meter range. The school was recorded on the paper over a period of 1.5 intervals. The speed of the vessel was 5 miles per hour. It is required to determine the extent of the school.

1) The time during which the vessel passed over the school equals $1.5 \times 30 = 45$ sec.

2) The extent of the school equals $\frac{(5)\ (1852)\ (45)}{3600} = 116$ meters.

It should be remembered that the distance between adjacent time markers equals 12.5 mm; the vessel was located over the school for 30 seconds.

Thus, by knowing the extent of the school on the echogram in millimeters, it is possible to determine the length of time that the vessel was above the school, and, knowing this and the speed of the vessel, it is possible to determine the extent of the school. The extent of a school when operating in the 500-meter range is determine in an analogous manner.

One must also remember that, in this case, the interval between time markers equals 150 seconds (5 times greater than with the 100-meter range) and the distance between markers equals 12.5 mm. 50X1-HUM

Using the table given below, it is simple to determine the extent of a school at any speed of the vessel within limits of 1 to 10 mph; here it is necessary to operate at minimum gain.

Table for Determining the Extent of Schools

Vessel speed mph	100-meter range: Extent of school on echogram between markers	100-meter range: Extent of school on echogram with length of 1 mm	500-meter range: Extent of school on echogram between markers	500-meter range: Extent of school on echogram with length of 1 mm
1	15.5	1.24	77.5	6.2
2	31	2.48	155	12.4
3	46.5	3.72	232.5	18.5
4	62	4.96	310	24.8
5	77.5	6.2	388	31
6	93	7.44	465	37.2
7	108.5	8.7	542.5	43.4
8	124	9.9	620	49.6
9	139.5	11.2	700	56
10	155	12.4	775	62

At times during the use of the recorder the phenomenon of a second echo may be observed on the electrochemical paper. This phenomenon may be explained by the fact that the electrochemical paper records a signal which has been reflected from the bottom twice, that is, it has twice covered a path from the surface to the bottom and return. A characteristic example of a record of a second echo is given in photograph 27.

Samples of recordings of fish schools with appropriate explanations are given in the next chapter of this part.

Chapter III

50X1-HUM

Photographs of the echograms of schools of fish recorded in various basins by the All-Union Scientific Institute of Maritime Fisheries and Oceanography (VNIRO).

Фото 1. Запись скоплений сельди в Норвежском море на дрейфе. Сельдь держится в слое 10-15 м. Улов 300 кг на сеть.

Photograph 1. Recording of herring concentration in the Norwegian sea in a drift. The herring is in the 10 - 15 meter layer. 300 kg catch per net.

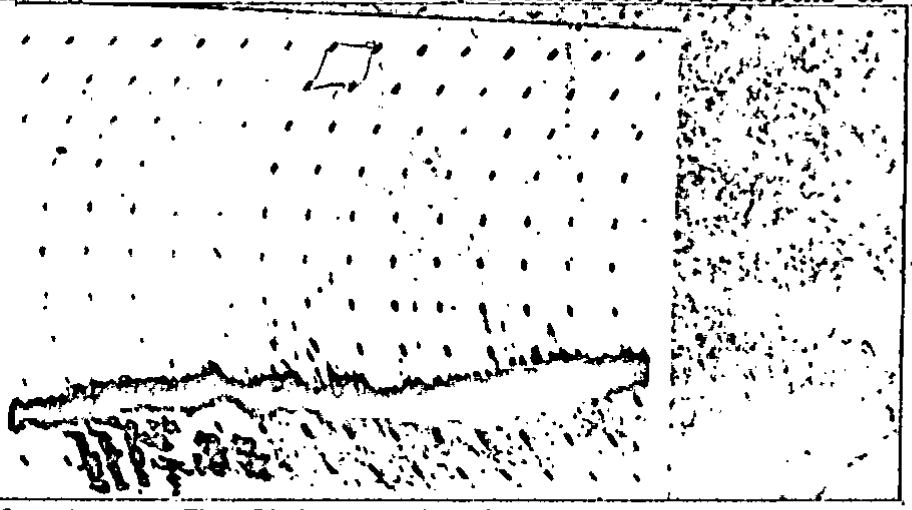
Photograph 2. Recording of herring concentration in the Norwegian sea. The herring is in the 5 - 25 meter layer. Individual groups are at the very surface. Speed of the ship is 8 knots.

Фото 2. Запись скоплений сельди в Норвежском море.

Photograph 3. Recording of codfish concentration in cape Sharapov region (Barents sea) at a depth of 72-75 meters. Speed of the ship is 3.8 knots.

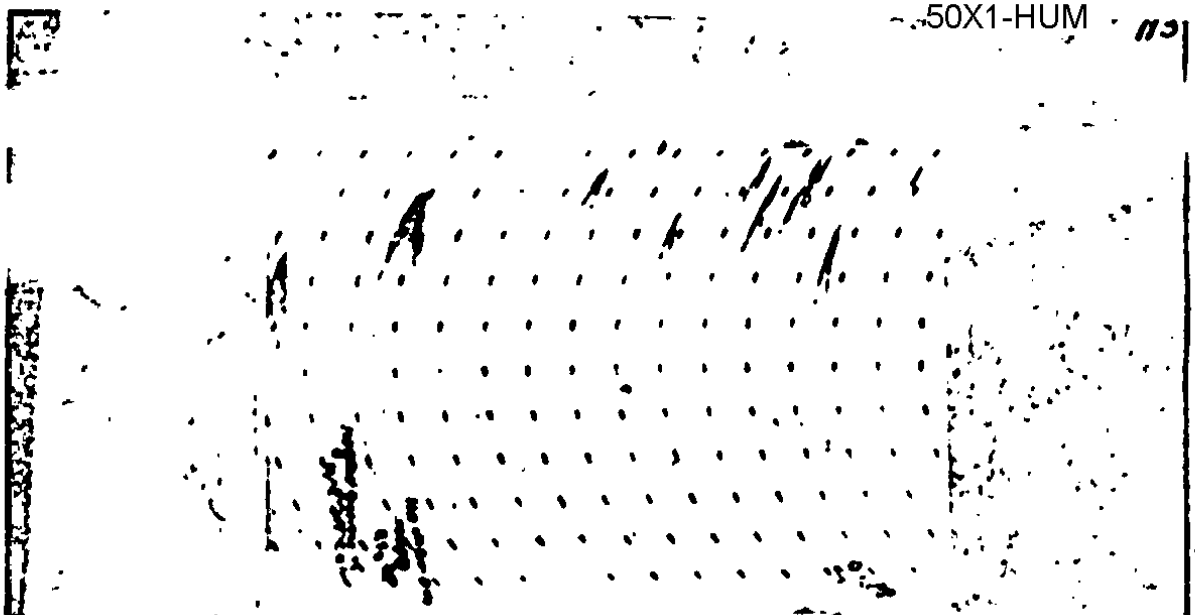
фото 3. Запись скопления трески в районе м. Шарапов (Баренцово море) на глубина 72-75м. Скорость судна 3,8 узла.

Photograph 4. Recording of codfish and haddock concentration in the region of Kil'din island (Barents sea) at depths of



40-50 meters. The fish are tightly bunched on the bottom. The catch by RT19 is 5-7 tons per hour of trawling. Speed of the ship is 7 knots.

фото 4. Запись скопления трески и пикши в районе о.Кильдин.



Photograph 5. Recording of groups of herring in the region of cape Set'-Navalok (Barents sea) at a depth of 5-20 meters from the surface. The catch of a commercial seiner is up to one ton per throw of the sweep-net. Speed of the ship is 6 knots.

Фото 5. Запись стай сельди в районе м. Сеть-Наволок /Баренцово море/ на глубине от 5 до 20 м. от поверхности. Уловы промыслового сейнера до одной тонны за замет кошельковым неводом. Скорость судна 6 узлов.

Photograph 6. Recording of groups of herring in southern Caspian sea. The herring is at the depth of 3-12 meters below the surface. Speed of the ship is 6 knots.

Photograph 7. Recording of groups of herring in a drift (southern Caspian sea). The herring is at depths between 3 and 45 m.

Фото 7. Запись стай сельди в дрейфе /южный Каспий/. Сельдь находится на глубинах от 3 до 45 м.

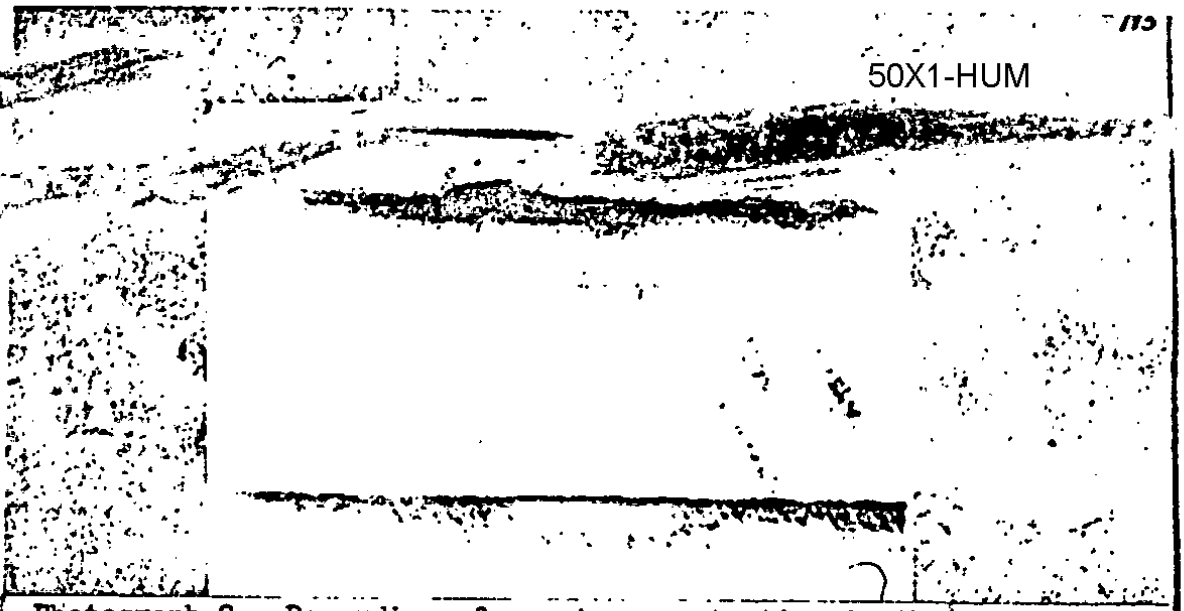
Photograph 8. Recording of sprat concentration made during fishing with an electric light in the region of cape

Sagyndyk (central Caspian sea). A light with a wire mesh [trouble light] was lowered to a depth of 17 meters. A fast accumulation of sprat is noticed in the illuminated area.

Фото 8. Запись скопления кильки-пряслов на электросвет в районе м. Сагындык /средний Каспий/. Лампа с конусной сеткой опущена на глубину 17м. Заметно быстрое накапливание кильки в зоне освещения. Улов 90 кг. за один подъем сетки.

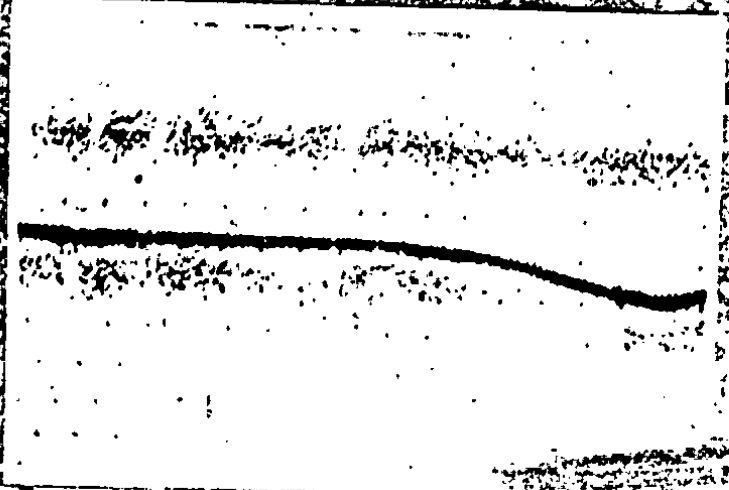
Catch was 90 kg. per lift of the net.

									Ц3.870.016-ТО	
Изм.	Кол.уч.	Лист	№ док.	Подпись	Дата					
				мсп - 10-у.			Назн.	Лист 114	Листов 126	



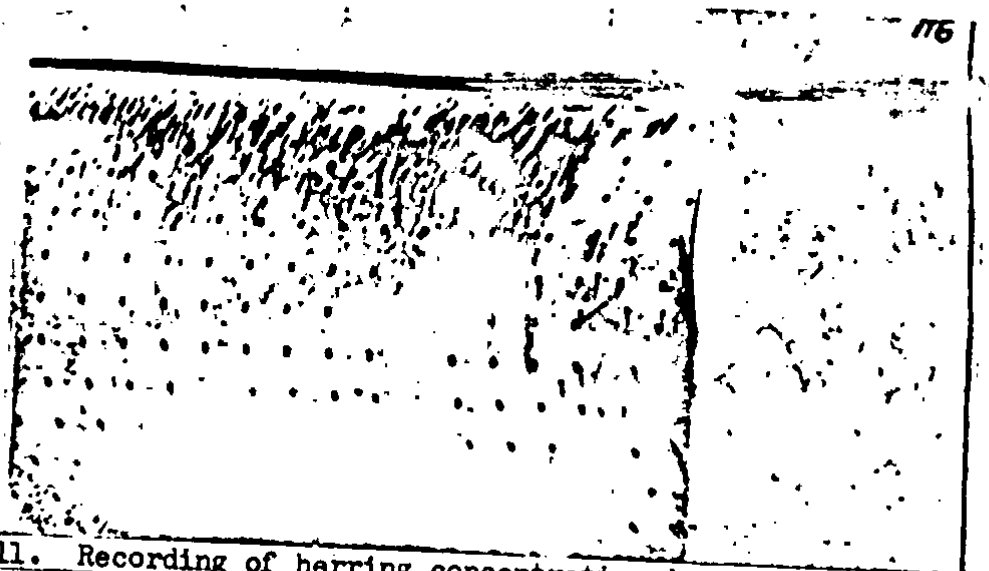
Photograph 9. Recording of sprat concentration in the cape Sagyndyk region. The depth is 50 m. A net with a light was dropped to a depth of 20 meters. The main bulk of sprat is located just above the net. Catch was 27 kg. per lift of the net.

Фото 9. Запись скоплений кильки в районе м. Сагындык. Глубина 50 м. Сетка с лампой опущена на глубину 20 м. Основная масса кильки расположена несколько выше сетки. Улов 27 кг за один подъем сетки.



Photograph 10. Recording of sprat concentration in the region of Aleksandr-bay (central Caspian sea). Separation of sprat into two layers is noticed.

Фото 10. Запись [illegible]

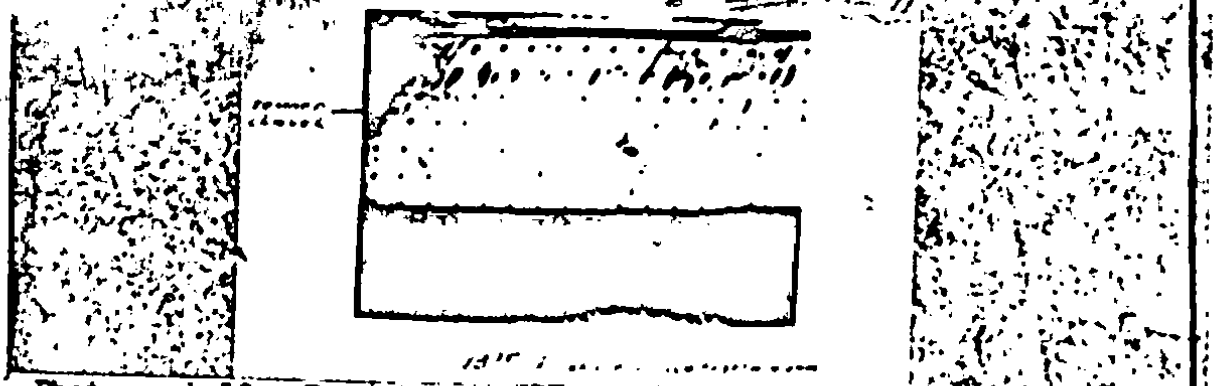


Photograph 11. Recording of herring concentration in the region of Kurinskiy Kamen' (south Caspian sea). Shoals of sprat are in the upper layers.

Фото 11. Запись селёди в районе Куринского камня (южный Каспий). Стаи кильки расположены в верхних слоях.

Photograph 12. Recording of sprat concentration in the region of Neftyanye Kamni (Caspian sea). The main bulk of fish are in the bottom layers. Depth is 68 m. Speed of the ship is 8 knots.

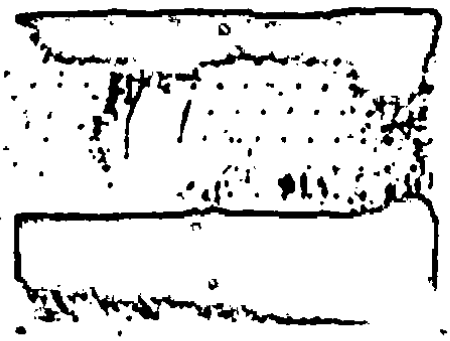
Фото 12. Запись



Photograph 13. Recording of sprat concentration in the Gulf of Riga (Baltic sea) at a depth of 38 m. The fish are in the upper layers of the water. Speed of the ship is 9 knots.

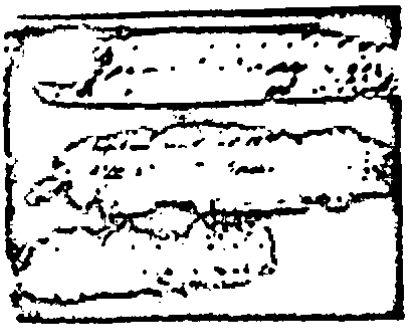
Фото 13. Запись стай салаки в Рижском заливе /Балтийское море/ на глубине 38 м. Рыба держится в верхних слоях воды. Скорость судна 9 узлов.

Photograph 14. Recording of sprat shoals in the Gulf of Riga (Baltic sea) at a depth of 45 m. The fish are in the bottom layer.



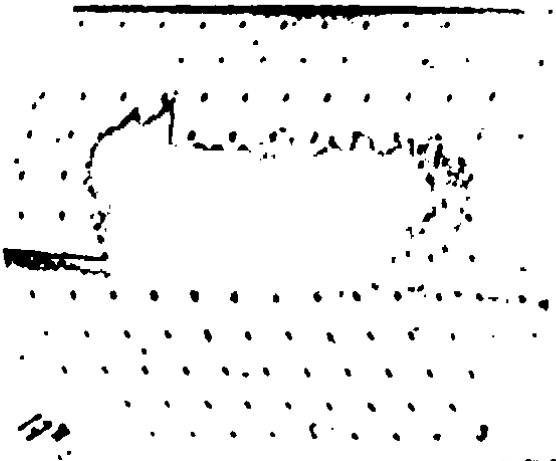
Speed of the ship is 7 knots.

Фото 14. Запись стай салаки в Рижском заливе /Балтийское



Photograph 15. Recording of shoals of sprat in the Gulf of Riga (Baltic sea) at a depth of 20 m. Speed of the ship is 3 k.

Фото 15. Запись стай салаки в Рижском заливе /Балтийское море/ на глубине 20м. Скорость судна 3 узла.



Photograph 16. Recording of concentration of anchovies of 380 m. in length in the Gelendzhik region (Black sea). The catch with a purse-seine was 5,000 kg.

Фото 16 Запись скопления хамсы протяженностью 380м

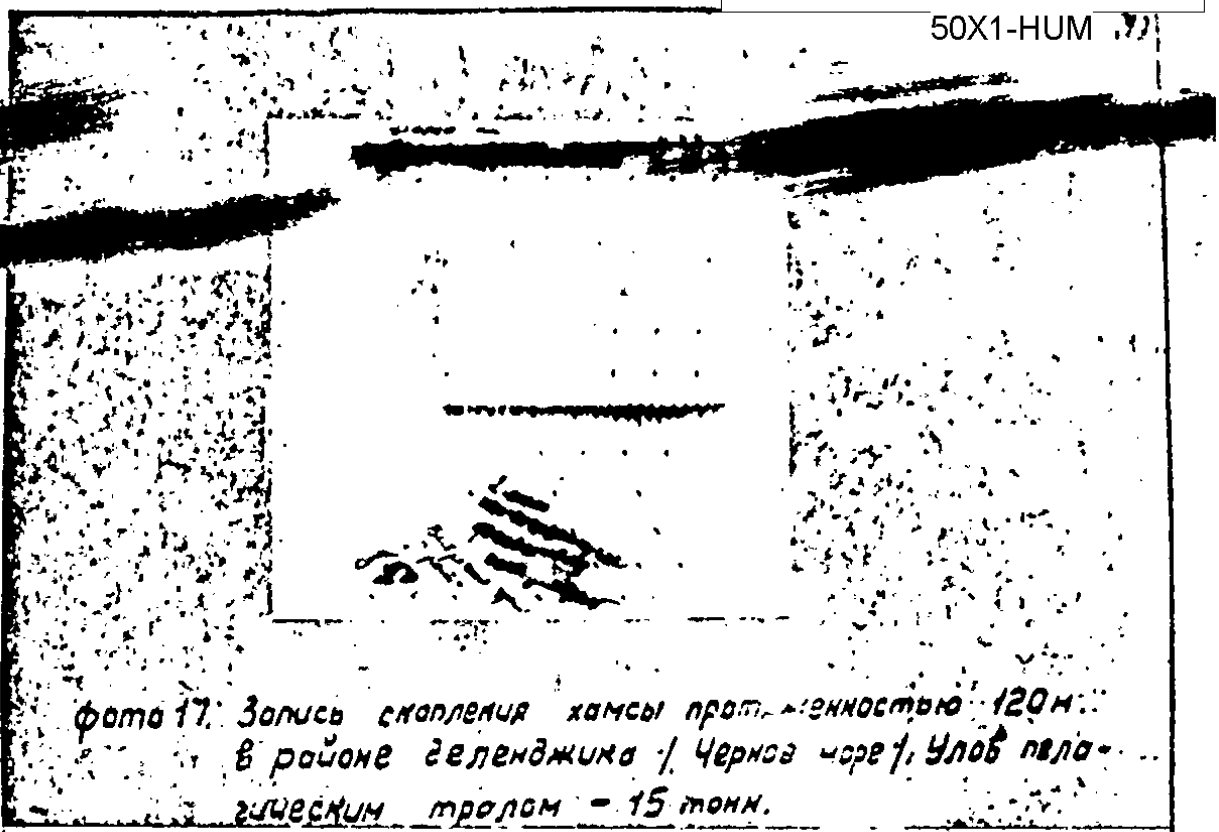
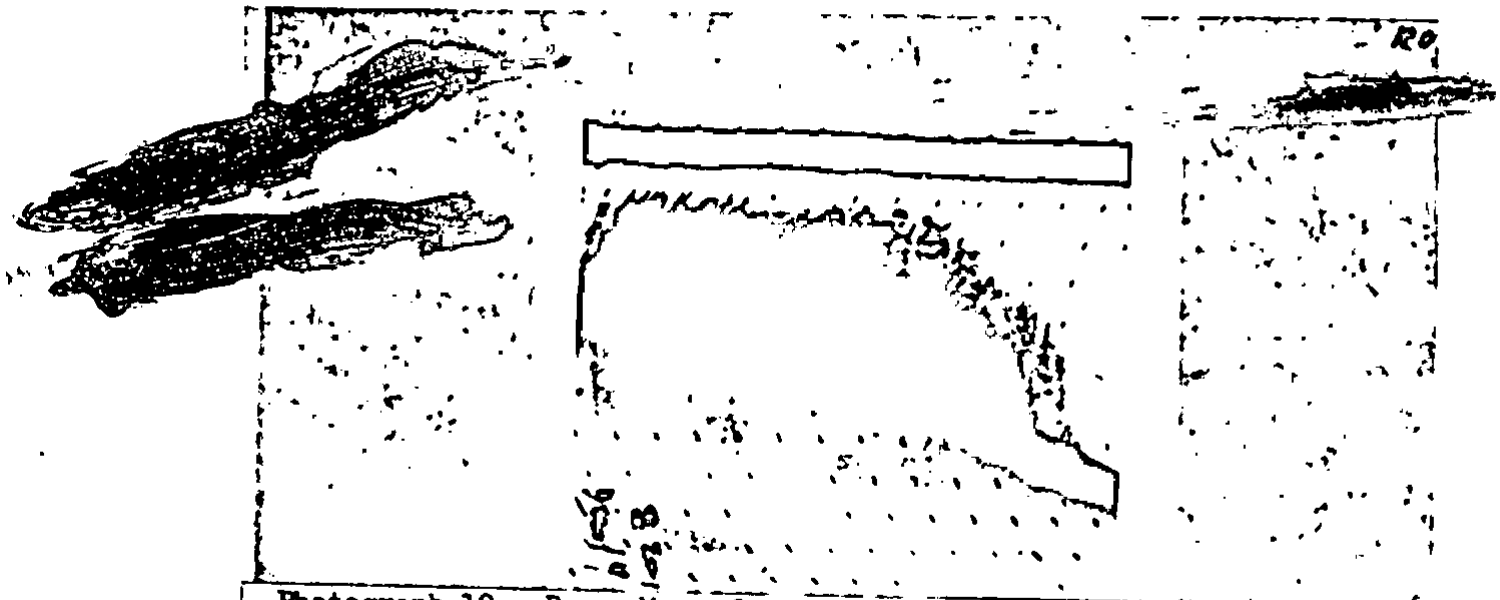


Фото 17. Запись скопления хамсы протяженностью 120 м в районе Геленджика (Черное море). Улов пелагическим тралом - 15 тонн.

Photograph 17. Recording of concentration of anchovies, 120 meters in length, in the Gelendzhik region (Black sea). The catch with the pelagic trawl - 15 tons.

Photograph 18. Recording of concentration of horse mackerel, 480 m. in length, in the cape Aiya region (Black sea).

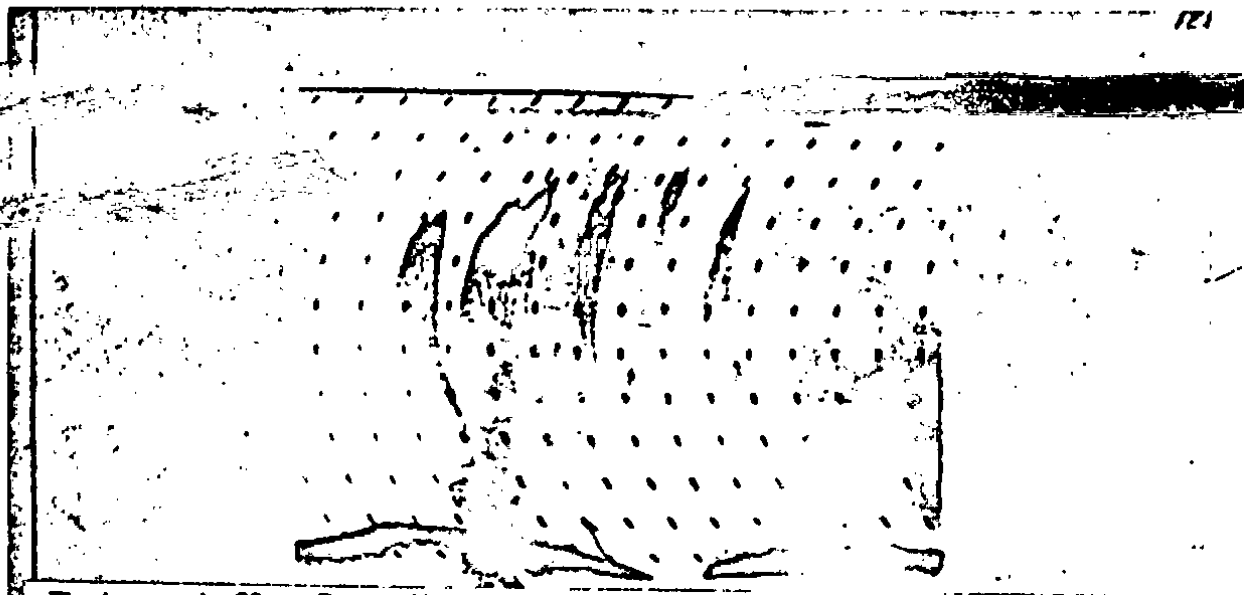


Photograph 19. Recording of concentration of horse mackerel, 520 m. in length and at depths from 10 meters to the bottom.

Фото 19. Запись скопления ставриды протяженностью 520м. Глубина залегания: от 10м до дна.

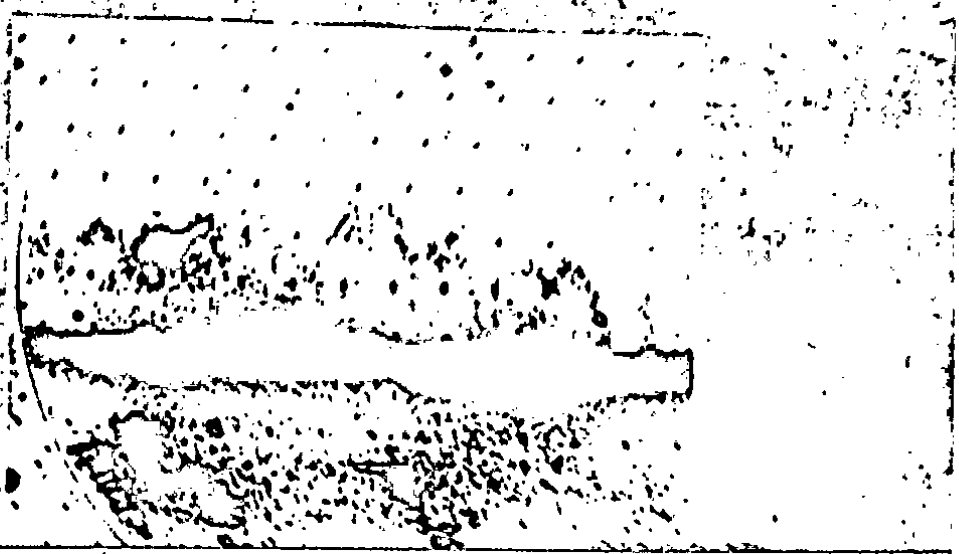
Photograph 20. Recording of concentration of capelin in Teriberskaya bay (Barents sea) at depths 20 - 45 meters. Speed of the ship - 4 knots.

Фото 20. Запись скопления мойвы в зал. Териберская



Photograph 21. Recording of groups of capelin in Motovsk bay (Brents sea). Depth 55-60 meters. Fish are 10 - 25 meters below the surface. Speed of the ship - 6.5 knots.

фото 21. Запись стай мойвы в Мотовском заливе (Баренцово море). Глубина 55-60м. Рыба расположена в 10-25 м. от поверхности. Скорость судна 6,5 узла.

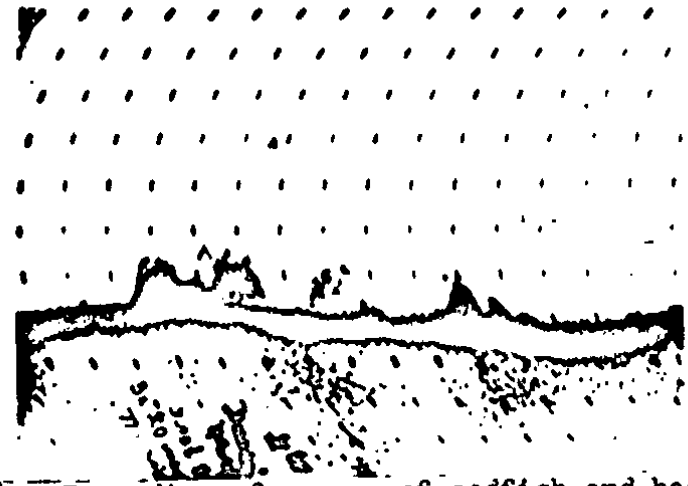


Photograph 22. Recording of groups of codfish on Kel'din shoal (Barents sea) at a depth of 165 meters. Catch of commercial trawlers is 3-4 tons. Speed of the ship is 3.8 k.

фото 22.

Photograph 23. Recording of groups of codfish in Barents sea. The fish are close to the bottom.

Фото 23. Запись стай трески в Баренцовом море. Рыба держится на грунте.



Photograph 24. Recording of groups of codfish and haddock in the Kil'dik island region (Barents sea). The fish are in the bottom layers. The catch - three tons for 20 minutes of trawling. Speed of the ship - 3.5 knots.

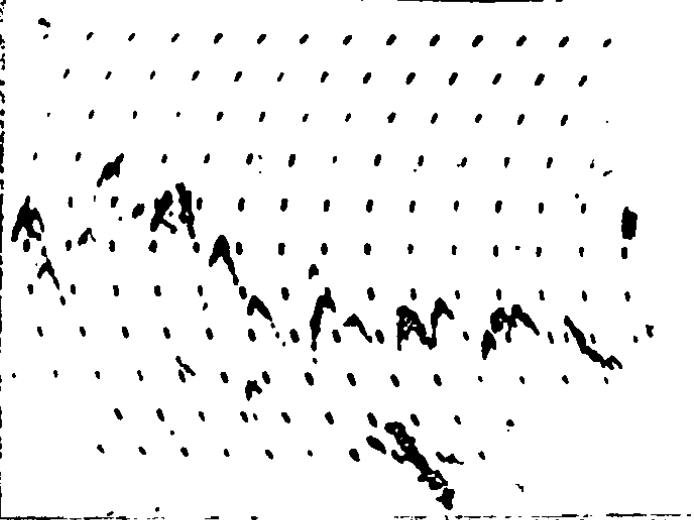
Фото 24. Запись стай трески и пикши в районе о-вов Кильдик (Баренцово море). Рыба находится у дна. Улов три тонны за 20 минут траления. Скорость судна 3,5 узла.

ЦЗ.870.016-ТО

Photograph 25. Recording of groups of codfish in the region of the island Kil'dik (Barents sea). The fish are at depths between 5 and 25 m. The catch - 4 to 5 tons per trawl.

Фото 25. Запись стай трески в районе острова Кильдин (Баренцово море). Рыба держится на глубине от 5 до 25 метров. Уловы 4-5 тонн за одно траление. Скорость судна 6 узлов.

Speed of the ship - 6 knots.



Photograph 26. Recording of groups of haddock in Barents sea at depths 65-70 m. Speed of the ship - 4 knots.

фото 27. Запись второго эхо от грунта в районе острова Анде /. Баренцово море/. Скорость судна 10 узлов.

Photograph 27. Recording of the second echo off the bottom in the region of island Ande (Barents sea). Speed of the ship - 10 knots.

50X1-HUM

U S S R

Ministry of the Shipbuilding Industry

Tenth Main Administration

TECHNICAL DOCUMENTATION ON TYPE NEL-5R MAGNETOSTRICTION ECHO-SOUNDER, 220 V, DC WITH RECORDER AND DEPTH INDICATOR

Ts3. 870. 016 - tf

Set No. 1048

Concurrence:

Representative of VNIRO MRP SSSR

Plant Lab. No. 9, VNIRO

/Sheyn/

24-08-54

Purpose of Documentation

The documentation is an inseparable part of the echo sounder during its entire operation, from the moment it is turned over at the factory to the day it is completely worn out.

1. Forms 1, 2, 3, and 4 are filled out at the factory when the apparatus is turned over for use. The correctness of the data entered in Forms 1, 2, 3, and 4 are examined by the chief of the department of technical design at the factory and by the recipient (Form 4).

2. At the completion of dockside tests, Form No 5 is filled out and signed by the appropriate deliverer and navigator.

3. At the conclusion of tests at sea, Form No 6 is filled out and signed by the appropriate deliverer, the navigator, and an inspector from the navigation department.

4. Information on equipment failures and maintenance work is entered in Form 7 and the form is signed by the navigator and an inspector from the navigation department.

5. During periodic tests conducted by the inspection personnel or by a representative of the manufacturing firm, conclusions regarding the operation of the echo sounder are entered into Form 8.

6. When the echo sounder is operational, the navigator records once each month, in Forms 9 and 10, information of the use of spare parts and the lifetimes of replaced parts.

7. All other remarks, not called for by special forms, are entered in the record sheet.

8. The navigator is responsible for keeping the log on board ship. All information must be entered in accurate, legible handwriting.

Form NO. 1.

Technical Documentation Applicable to the Echo Sounder.
Technical Description of the Echo Sounder NEL-5R Ts3.870.016-TO with Drawings:

1. Circuit Diagram of the Echo Sounder NEL-5R Ts3.870.016-SE
2. Wiring Diagram of the Echo Sounder NEL-5R Ts3.870.016-SK
3. Installation Diagram of the Echo Sounder NEL-4 U3.870.008-S

Form No. 2

Technical Ratings for the Echo Sounder

50X1-HUM

1. Feed voltage from ship power network: 220 Volts DC
2. Range of measurement and recording depth: 1 - 500 meters
3. Revolutions per minute of the electric motor of the automatic recorder:
   a) in the 100-meter range: 3,145 rpm
   b) in the 500-meter range: 629 rpm
4. Revolutions per minute of recording pen:
   a) in the 100-meter range: 185 rpm
   b) in the 500-meter range: 37 rpm
5. Revolutions per minute of the electric motor of the indicator:
   a) in the 100-meter range: 3,060 rpm
   b) in the 500-meter range: 612 rpm
6. Revolutions per minute of the indicator disk:
   a) in the 100-meter range: 450 rpm
   b) in the 500-meter range: 90 rpm
7. Paper speed in automatic recorder:
   a) in the 100-meter range: 25 millimeters per minute
   b) in the 500-meter range: 5 millimeters per minute
8. Recording paper width: 155 millimeters
9. One roll of recording paper in the automatic recorder lasts:
   a) in the 100-meter range: 13 hours
   b) in the 500-meter range: 65 hours
10. Recording Scale of the automatic recorder:
    a) for the 100-meter range: 2.6 millimeters equals one meter
    b) for the 500-meter range: 0.52 millimeter equals one meter
11. Total weight of the echo sounder: about 200 kilograms (not counting the spare-parts and equipment or the box for transporting tubes).

Form No 3.

List of Devices Making Up the Echo Sounder Installation With Weights and Sizes (Not Counting Weight of Cable)

(To be filled in at factory upon surrender of equipment)

No.	Instr. No.	Name	Wt. Kg.	Length mm	Width mm	Depth mm	Diameter mm	Quantity
1	1048	Recorder (autom.)	30.4	515	345	290	-	1
2	1048	Indicator	13.4	426	240	228	-	1
3	1048	Relay	11.5	318	310	200	-	1
4	1048	Amplifier	10.6	305	290	185	-	1
5	1048	Filter	4	260	165	140	-	1
6	1048	Vibrator with Parts installed	25.5	283	-	-	270	2
7	1048	Variable Voltage Dropping Resistor	7.8	490	194	138	-	1
8	1048	Converter(PO-550) with filter	70	418	295	475	-	1
9	1048	Spare Parts and Equipment Box	13	410	300	245	-	1
10	1048	Box for transporting Tubes	3	320	135	170	-	1
11	1048	Cable Box	1.7	184	134	82.5	-	2
12	1048	Box with electro-chemical paper	-	411	266	206	-	1
13	1048	Documentation	-	-	-	-	-	1

Form No 4

Results of Factory Tests

50X1-HUM

1.	Ship power supply voltage:	220 v
2.	Current consumption of echo sounder (with recorder and amplifier in operation in 100-meter range)	2.4 amp
3.	Starting current (amplifier and recorder turned on):	5.2 amp
4.	Test of total installation on vibration stand:	NOT TESTED
5.	Warm-up time of echo sounder:	30 seconds
6.	Insulation Resistance of converter in operating condition (after four hours operation):	10 megohms

Automatic Recorder

7.	Current consumption (in 100-meter range):	0.54 amp
8.	Maximum voltage surge fed to pen in navigation mode:	74 volts
9.	DC voltage fed to recording of scale grid:	28 volts
10.	Test of electric-motor rpm:	
	a) rpm of control shaft in 100-meter range:	74
	b) contacts per minute of sending group in 500-meter range:	37
11.	Insulation resistance in cold condition:	100 megohms
12.	Insulation breakdown test:	OK

Indicator

13.	Current consumption(in 100-meter range):	0.32 amp
14.	Voltage at rpm-control tube:	6.3 volts
15.	Test of electric-motor rpm:	
	a) flashes per minute of strobe landp, in 100-meter range:	90
	b) flashes per minute of neon lamp, in 500-meter range:	90
16.	Insulation in cold condition:	100 megohms
17.	Insulation breakdown test:	OK

Amplifier

18.	Current consumption:	0.36 amp

19. Filament voltage of amplifier tubes and thyratron: 6.1 volts
20. Filament voltage of hot-cathode rectifier tube: 4.9 volts
21. Plate voltage [illegible]
22. Resistance of insulation of power winding in power transformer in cold condition: 100 megohms
23. Gain control characteristic: See Enclosure 1

Relay

24. Current consumption: 0.55 ohm
25. Feed voltage of sending capacitors: 1,080 volts
26. Filament voltage of hot-cathode rectifier tubes: 4.9 volts
27. Feed voltage of coils: 26.0 volts
28. Insulation resistance in cold condition: 100 megohms

Vibrators

29. Hermeticity of vibrators tested on hydraulic stand: in accordance with Paragraph 50 of specifications TU ZhZ 870 016-TU
30. Insulation resistance following compression tests: 400 megohms

Box

31. Watertightness: in accordance with Paragraph 47 of TU ZhZ 870 016-TU

Echo sounder No. 1048 suitable for use.

Chief OTK _____(sig.)
22 May 1956

Received by: _____

Form No. 5

50X1-HUM

Echo sounder installed on board ship _____

by factory representative _____

_____ 19____

Vertical distance from keel to vibrators _____

Vibrator-emitter between frames _____ and _____

Vibrator-pickup between frames _____ and _____

Datum line between vibrators _____

Distance from vibrator-emitter to centerline _____

Distance from vibrator-pickup to centerline _____

Results of Dockside Tests

Place _____

Date _____ 19____

RPM Test

1. Depth Indicator:
   a) Flashes per minute of strobe lamp in 100-meter range _____
   b) Flashes per minute of neon lamp in 500-meter range _____

2. Automatic Recorder:
   a) RPM of control shaft in 100-meter range _____
   b) Contacts per minute of a sending group in 500-meter range _____

Time	Ship's Voltage	Depth Shown by Indicator	Recorder Indications		Actual Depth Under Vibrators	Remarks
			with thyratron	with 6P3 tube		

No Foreign Dissem

responsible deliverer: _____
(title) (name)

navigator: _____
(name)

inspector from
navigation department: _____
(name)

Form No 6

Results of Tests On the Echo Sounder at Sea

50X1-HUM

Location of tests _____

Tests begun _____ 19____

Tests completed _____ 19____

Time	Speed	pitching of ship (degrees)	Ship's voltage	Echo Sounder Readings			Nearest Depth given on	Depth measured by Fish-	Remarks
				Indicator	Recorder with thyratron	Recorder with 6P3			

Adjustment and delivery by _____
(name of organization)

Echo sounded accepted for use by _____, Navigator
(name)

Responsible deliverer _____
(title) (name)

Inspector for navigation department _____
(name)

Form 7

Information on Malfunctions Located during Maintenance

50X1-HUM

No.	Date the Malfuntion was located	Types and Causes of Malfunctions	By whom, where, and when the Malfunction was corrected
		(The form is blank)	

Form 8

Remark on the Echo Sounder Check by the Person who made the inspection

No.	Date	Remark and Signature
		(The form is blank)

Form 9

Spare Parts and Tools Expenditures for the Echo Sounder

No.	Name of the spare parts and tools	Cause of the break-down	Date Signature
		(The form is blank)	

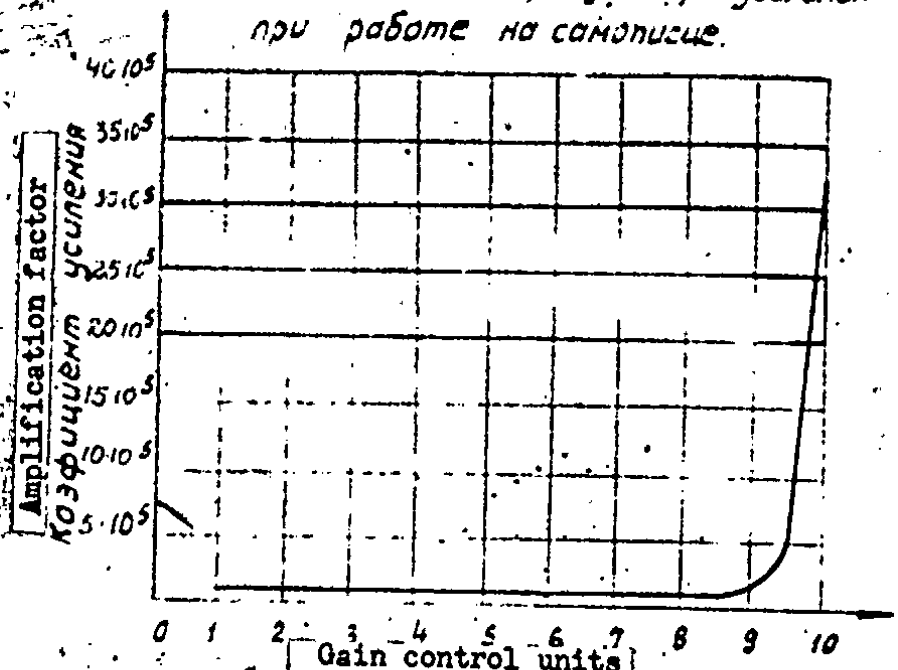
Form 10

Record Sheet for Work Time
(filled out once a month)

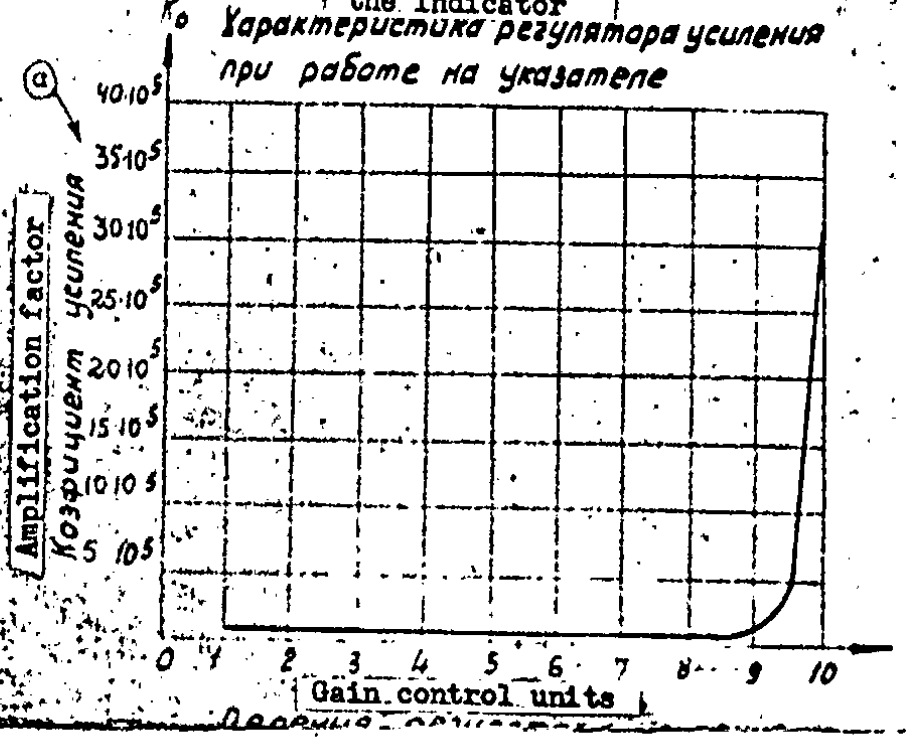
Date	Echo Sounder operating time	Signature of Ships navigator

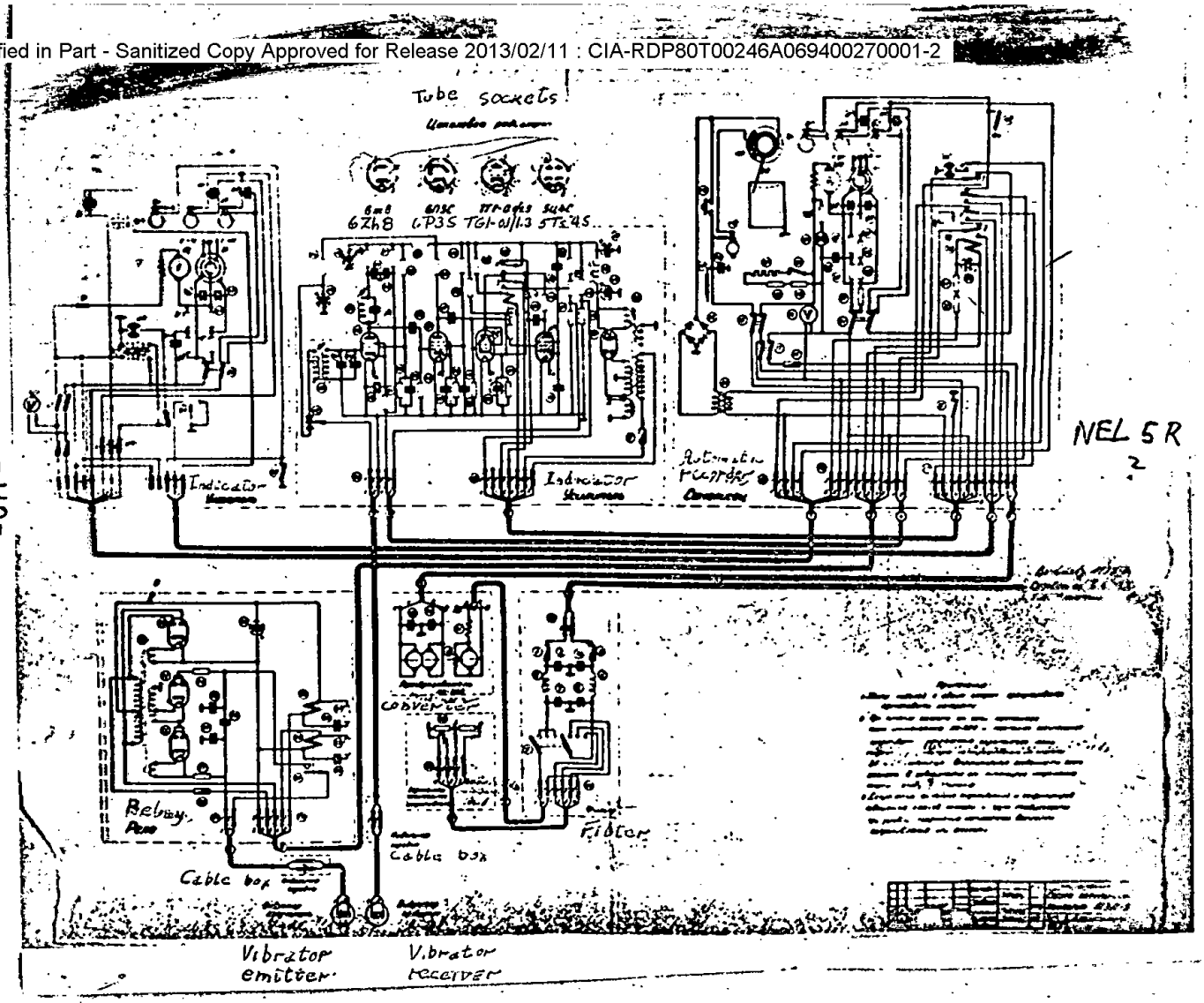
Appendix 1
Приложение №1

Gain control characteristics for operation on automatic recorder
Характеристика регулятора усиления при работе на самописце.

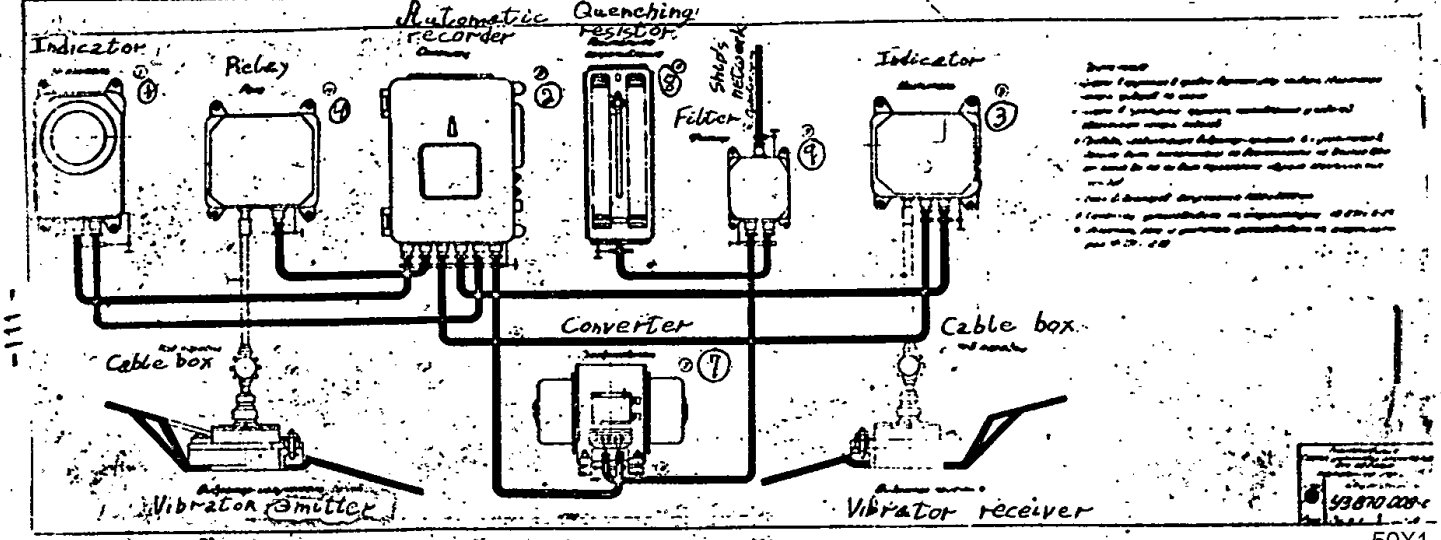


Gain control characteristics for operation on the indicator
Характеристика регулятора усиления при работе на указателе



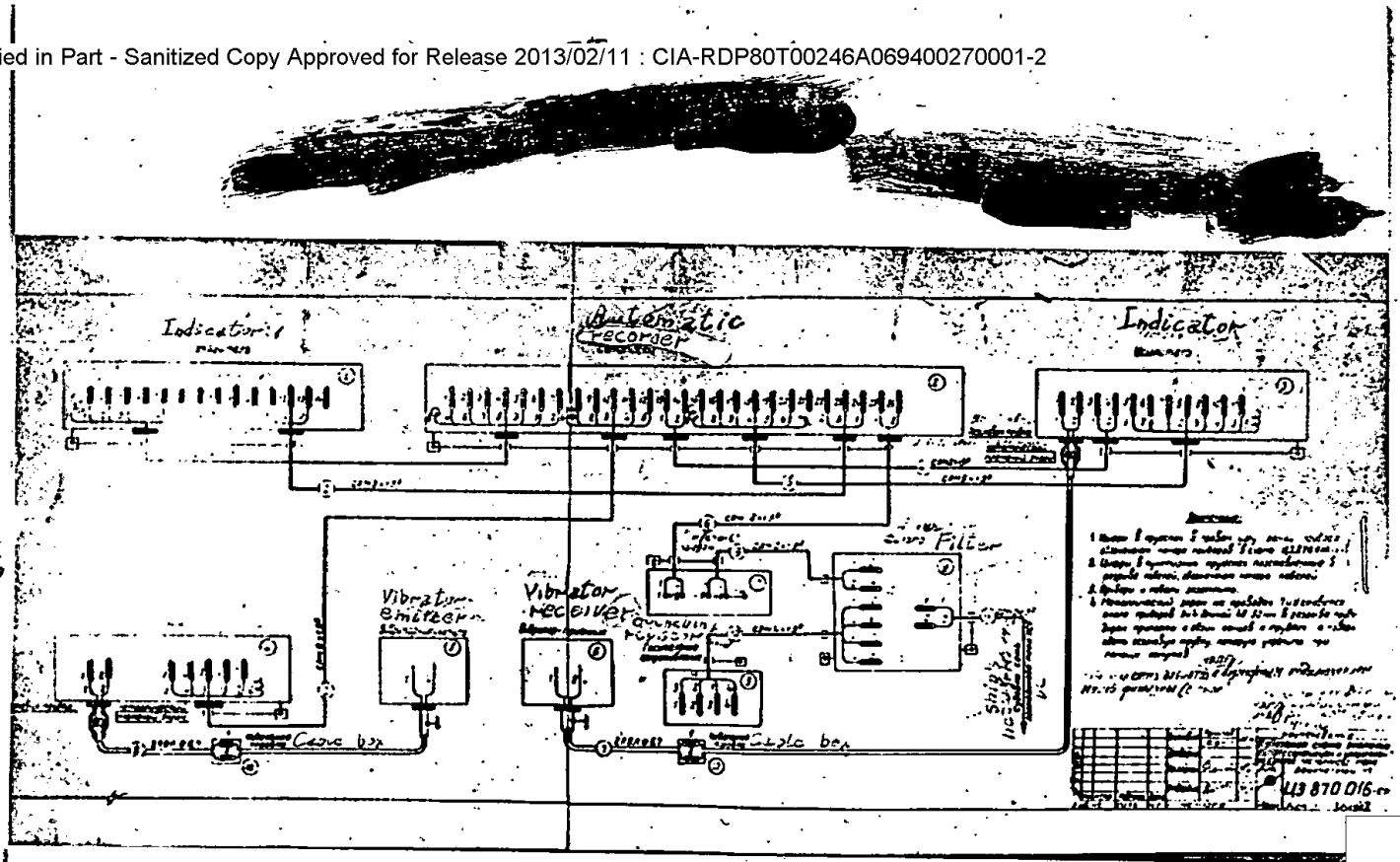


SECRET



50X1-HUM

SECRET



SECRET

No	Schematic No	Decimal Designation	Name of Part	Quantity	Electrical and Other Data	Remarks
1						
2			Indicator			
3	20		Fuse PK-3	1	3 a	Gost 5010-49
4	21		Fuse PK-3	1	3 a	Gost 5010-49
5	22	U6.369.003	Voltmeter EV-46	1		
6	23	Ye6.122.019	Toggle switch	1	6 v, 220 v	
7	35	U7.534.008	Connector	1		
8	36		Contacts ATsP	1		
9	37		Resistor PE 25-100 ohm - II	1	100 ohm	Gost 6513-53
10	38		Resistor PE-25-250 ohm - II	1	250 ohm	Gost 6513-53
11	39	Ye6.722.019	Toggle switch	1	6 a, 220 v	
12	40		Resistor PE-25-500 ohm - II	1	500 ohm	Gost 6513-53
13	41		Resistor PE-25-100 ohm - II	1	100 ohm	Gost 6513-53
14	42	Ye0.673.403	Capacitor K5G-I-600-0.025-II	1	0.025 µf	
15	43	Ye0.673.403	Capacitor K5G-I-600-0.025-II	1	0.025 µf	
16	57	U7.520.051	Contacts set	1		
17	58	U7.520.051	Contacts set	1		
18	65	Ye0.673.403	Capacitor K5G-I-600-0.025-II	1	0.025 µf	
19	66	Ye0.673.403	Capacitor K5G-I-600-0.025-II	1	0.025 µf	
20	81	Ts7.547.015/016	Output transformer	1		
21	82	Ts7.540.002	Neon lamp	1		
22	88	U7.520.051	Contacts set	1		
23	93	U7.538.051	Resistor T K-50A-0.5	1	50 Kohm	
24	122	17.518.201	Toggle switch	1	3 a, 220 v	
25	130		Bulb type 15	1	0.28a,6.3v	Gost 2204-43
26	131	U7.554.091	Transformer	1		
27	141	Ye0.673.403	CapacitorK5G-MA-2v-600-0.5-II	1	0.5 µf	
28	151	U7.531.009	Socket board	1	10 sockets	
29	153		Motor SL-262	1		
30	169	U7.531.003	Socket board	1	3 sockets	

No	Schematic No	Decimal Designation	Name of Part	Quantity	Electrical and Other Data	Remarks
			Recorder			
37	15		Fuse PK-3	1	3 a	Gost 5010-49
38	16	17.518.201	Toggle switch	1		
39	17	Ye6.722.019	Toggle switch	1		
40	18	Ye6.622.019	Toggle switch	1		
41	19	U9.369.003	Voltmeter EV-45	1		
42	30	U7.552.011	Telephone relay	1	2000 ohm	
43	31		Resistor PE-15-500 ohm-II	1	500 ohm	Gost 6513-53
44	32		Resistor PE-15-500 ohm-II	1	500 ohm	Gost 6513-53
45	33	Ye0.673.408	Capacitor K3G-1-V-300/5-N	1		
46	34		Bulb type 15	1	0.28a, 6.3v	Gost 2204-43
47	44		Contacts ATsR	1		
48	45		Resistor PE-50-45 ohm-II	1	45 ohm	Gost 6513-53
1	46		Resistor PE-50-250 ohm-II	1	250 ohm	Gost 6513-53
2	47		Resistor PE-50-250 ohm-II	1	250 ohm	Gost 6513-53
3.	48		Resistor PE-50-100 ohm-II	1	100 ohm	Gost 6513-53
4	49		Resistor PE-50-100 ohm-II	1	100 ohm	Gost 6513-53
5	50		Resistor PE-50-100 ohm-II	1	100 ohm	Gost 6513-53
6	51	Ye6.722.019	Toggle switch	1		
7	52	Ye0.673.403	Capacitor K6G-I-600-0.025-II	1	0.025 mu	
8	53	Ye0.679.403	Capacitor K6G-I-600-0.025-II	1	0.025 mu	
9	59	U7.520.051	Contacts set	1		
10	60	U7.520.0f1	Contacts set	1		
11	67	Ye0.673.403	Capacitor K5G-I-600-0.025-II	1	0.025 mu	
12	68	Ye0.673.403	Capacitor K5G-I-600-0.025-II	1	0.025 mu	
13	80	U7.554.090	Transformer	1		
14	83	Ye0.662.401	Selenium rectifier VS-18-1	1	75 ma, 100 v	
15	84	U7.520.053	Contacts set	1		
16	85	U7.691.001	Pen	1		

No	Schematic No	Decimal Designation	Name of Part	Quantity	Electrical and Other Data	Remarks
17	87	U7.520.051	Contacts set	1		
18	92	Ye0.673.106	Resistor SP-1-28-22A-13	1	22 K ohm	
19	117	U7.691.004	Holder (electric pencil)	1		
20	118	U7.520.050	Interrupter	1		
21	119	16.723.001	Pussbutton switch	1	0.5a, 120v	
22	120	U7.520.052	Contacts set	1		
23	123	17.518.201	Toggle switch	1	3 a, 220 v	
24	124	Ye0.679.100	Tube Ts3, base Ye 14	1	110v, 15w	
25	125		Resistor PE-15-100 ohm-II	1	100 ohm	Gost 6513-53
26	126	17.518.201	Toggle switch	1	3a, 220v	
27	127	U7.538.037	Dryer	1		
28	128		Resistor PE-25-250 ohm-II	1	250 ohm	Gost 6513-53
29	129		Resistor PE-25-500 ohm-II	1	500 ohm	Gost 6513-53
30	142	Ye0.673.403	Capacitor K6G-MP-2v-600-0.5-II	1	0.5 mf	
31	143	Ye0.673.403	Capacitor K6G-MP-2v-600-1-II	1	1 mu	
32	152	U7.531.004	Socket board	1	4 sockets	
33	153		Motor SP-322	1		
34	175	U7.531.009	Socket board	1	10 sockets	
35	177	U7.531.009	Socket board	1	10 sockets	

S-E-C-R-E-T
No Foreign Dissem

No.	Schematic No.	Decimal Designation	Name of part	Quantity	Electrical and Other Data	Remarks
			Amplifier			
41	26	U7.554.383	Transformer	1		
42	27		Fuse	1	1 amp	GOST 5010-49
43	79	Ye0.678 000	6Ш3С (6P3S) Tube	1		
44	86		Resistor SP-I-26-10A13	1	10 kohm	GOST 5574-50
45	89	Ye0.673.102	Resistor VS-1-100 kohm - 10%	1	100 kohm	
46	91	Ye0.673.102	Resistor VS-0.25-620 kohm - 10%	1	620 kohm	
47	94	Ye0.673.102	Resistor VS-0.25-510 ohm - 10%	1	510 ohm	
48	95	Ye0.673.102	Resistor VS-0.25-150 ohm - 10%	1	150 ohm	
1	100	Ye0.673.407	Capacitor K3-1a-450/10-M	1	10 microfarad	
2	101	Ye0.673.407	Capacitor K3-1a-450/10-M	1	10 microfarad	
3	102	U7.554.093	Choke	1		
4	103	Ye0.763.102	Resistor VS-1-10kohm- 10%	1	10 kohm	
5	104	U7.554.096	Plate Circuit	1		
6	105	Ye0.673.102	Resistor VS-0.25-82 kohm-10%	1	82 kohm	
7	106	Ye0.673.102	Resistor VS-0.25-82 kohm-10%	1	82 kohm	
8	107	Ye0.673.102	Resistor VS-1-100 kohm-10%	1	100 kohm	
9	108	Ye0.673.403	Capacitor KBG-M2-400-0.1-II	1	0.1 microfarad	
10	109	Ye0.673.403	Capacitor KBG-M2-400-0.1-II	1	0.1 microfarad	
11	110	Ye0.673.403	Capacitor KBG-M2-400-0.1-II	1	0.1 microfarad	
12	111	Ye0.673.403	Capacitor KBG-M2-400-0.1-II	1	0.1 microfarad	
13	112	Ye0.673.403	Capacitor KBG-M2-400-0.25 -II	1	0.25 microfarad	
14	113	Ye0.673.407	Capacitor KE-2-450/10-M	1	10 microfarad	
15	114	Ye0.763.102	Resistor VS-0.5-20 kohm-10%	1	20 kohm	
16	115	Ye0.673.102	Resistor VS-0.5-200 kohm-10%	1	200 kohm	
17	116	Ye0.673.102	Resistor VS00.5-200 kohm -10%	1	200 kohm	

18	121	Ye0.673.102	Resistor, VS-0.25-100 kohm-10%	1	100 kohm
19	132	U7.554.095	Input transformer	1	
20	133	Ye0.673.405	Capacitor KGK-3-A-390-II	1	350 micromicrofarad
21	134	Ye0.673.405	Capacitor KTK-2-M-51-II	1	51 micromicrofarad
22	135	Ye0.673.405	Capacitor KGK-3-D-390-II	1	390 micromicrofarad
23	136	Ye0.673.401	Capacitor KSO-5-500-A-2000-II	1	2,000 micromicrofarad
24	137	Yeo.673.401	Capacitor KSO-5-500-A-2000-II	1	2,000 micromicrofarad
25	138	Ye0.673.403	Capacitor KBG-I-600-0.025-II	1	0.025 microfarad
26	139	Ye0.673.403	Capacitor KBG-I-600-0.025-II	1	0.025 microfarad
27	140	Yeo.673.102	Resistor VS-1-82 kohm-10%	1	82 kohm
28	145	Ye0.673.102	Resistor VS-0.25-1000 kohm-10%	1	1,000 kohm
29	146	Ye0.673.102	Resistor VS-0.25-330 kohm-10%	1	330 kohm
30	147	Ye0.678.000	Kenotron (hot-cath.rectifier) 5 ЦЧС (5TsChS)	1	
31	148	Ye0.673.403	Capacitor KBG-M2-400-0.25-II	1	0.25 mf
32	149	Ye0.678.000	6Ж8 (6Zh8) Tube	1	
33	150	Ye0.678.000	6Ж8 (6Zh8) Tube	1	
34	153	U7.531.004	Terminal panel	1	4-terminal
35	160	U7.531.007	Terminal panel	1	7-terminal
36	161	Ye0.673.102	Resistor VS-2-3.9 kohm - 10%	1	3.9 kohm
37	162	Ye0.673.102	Resistor VS-1-39 kohm - 10%	1	39 kohm
38	163	U171.80.47	Relay RKM	1	
39	164	Ye0.673.407	Capacitor KE-1a-50/30-M	1	50 mf
40	165	Ye0.673.403	Capacitor KBG-M2-400-0.25-II	1	0.25 mf
41	166	Ye0.673.403	Capacitor KBG-M2-400-0-0.25 - II	1	0.25 mf
42	167	Ye0.678.000	TG1 (TG1)-0.1/63 tube	1	
43	173	Ye0.673.102	Resistor VS-1-24 kohm-5%	1	24 kohm
44	174	Ye0.673.102	Resistor VS-0.25-330 kohm-10%	1	330 kohm
45	175	Ye0.673.407	Capacitor KE-2-450/10-M	1	10 mf
46	178	Ye0.673.102	Resistor VS-1-82-kohm-10%	1	82 kohm
47	179	NK0.467.000	Resistor VS-2-1-56000-II	1	56 kohm
48	180	NK0.467.000	Resistor VS-0.25-1-2.33-II	1	330 kohm Set-270,330 510,620 kohm

			Relay			
4	24	U7.554.382	Transformer	1		
5	25		Fuse PK-1	1	1 amp	GOST 5010-49
6	29	Ye0.678.000	Hot-cathode rectifier 5II4C (5Ts4S)	1		
7	54	U7.543.121	Coil	1		
8	55	U7.543.121	Coil	1		
9	56	Ye0.673.408	Capacitor KEG-1-M-450/10 M	1	10 mf	
10	61	Ye0.673.102	Resistor VS-0.25-1500 ohm-10%	1	1,500 ohm	
11	62	Ye0.673.403	Capacitor KBG-MP-2v-200-1-II	1	1 mf	
12	63	Ye0.673.102	Resistor VS-0.25-1500 ohm-10%	1	1,500 ohm	
13	64	Ye0.673.403	Capacitor KBG-MP-2v-200-1-II	1	1 mf	
14	69	Ts7.521.004	Contact	1		
15	70		Capacitor KBM-MN-1500-2-II	1	1.5 mf	TU-302-100-49
16	72	Ye0.678.000	Hot-cathode rectifier 5Ts4S (5II4C)	1		
17	73	Ye0.678.000	Hot-cathode rectifier 5Ts4S "	1		
18	74		Resistor PE-50-5000 ohm-II	1	5,000 ohm	GOST 6513-53
19	75	Ye0.673.403	Capacitor KBG-MP-2v-600-0.25-II	1	0.25 mf	
20	76	Ye0.873.403	Capacitor KBG-MP-2N-600-0.25-II	1	0.25 mf	
21	77		Resisotr PE-50-5000 ohm-II	1	5,000 ohm	GOST 6513-53
22	154	U7.531.018	Terminal panel	1	2-terminal	
23	170	U7.531.005	Terminal panel	1	5-terminal	
			Filter			
29	1	16.733.307	Fuse PN-10	1	10 amp	
30	2	16.733.307	Fuse PN-10	1	10 amp	
31, 32	3, 4	Ye0.673.413	Capacitor KE-500/220-2x0.5-II	1	0.5 mf (x2)	
33	5	U7.554.173	Choke	1		
34	6	U7.554.173	Choke	1		
35, 36	7, 8	Ye0.673.413	Capacitor KE-500/220-2x0.5-II	1	0.5 mf (x2)	
37	9	Ye6.722.097	Packaged switch	1	10 amp; 250 v	
38	155	U7.571.125	Fuse panel	1	for 2 fuses	
39	156	U7.531.003	Terminal panel	2	for 3 terminals	

S-E-C-R-E-T
No Foreign Dissem

Converter PO-550

45	11		Winding	1	
46	12		Winding	1	
47	13	Ye0.673.403	Capacitor KBG-MN-400-0.5-II	1	0.5 mf
48	14	Ye0.673.403	Capacitor KBG-MN-400-0.5-II	1	0.5 mf

Variable Voltage-Dropping Resistor

4	10	U7.548.022	Resistor	1	
5	157	U7.531.004	Terminal panel	1	for 4 terminals

Cable No.	Make	No. of conductors	From	To	Designation
			(2) Automatic recorder	(1) Indicator	
1	SRM8x1.5Ø	1	terminal 6	terminal 1	Indicator power supply
		2	terminal 7	terminal 2	Indicator power supply
		3	terminal 5	terminal 3	Relay power supply
		4	terminal 1	terminal 5	to the sending group
		5	terminal 4	terminal 6	to the sending group
		6	terminal 2	terminal 7	to output transformer
		7	terminal 3	terminal 8	to transformer signal tube
		8	-	-	spare
2	SRM3x1.5Ø		(2) Automatic recorder	(1) Indicator	
		1	terminal 24	terminal 11	quenching of zero noise
		2	terminal 22	terminal 12	to the gain control
		3	terminal 23	terminal 13	to output transformer
3	SRM6x1.5Ø		(2) Automatic recorder	(4) Relay	
		1	terminal 8	terminal 6	control of the sending pulse
		2	terminal 9	terminal 7	control of the sending pulse
		3	terminal 10	terminal 3	relay power supply
		4	terminal 11	terminal 4	rectifier power supply
		5	terminal 12	terminal 5	rectifier power supply
		6	-	-	spare

S-E-C-R-E-T
No Foreign Dissem

Declassified in Part - Sanitized Copy Approved for Release 2013/02/11 : CIA-RDP80T00246A069400270001-2

4	SRM2x1.5Ø		②Automatic recorder	③Amplifier	
		1	terminal 13	terminal 3	gain control
		2	terminal 14	terminal 4	quenching of zero noise
5	SRM8x1.5Ø		②Automatic recorder	③Amplifier	
		1	terminal 15	terminal 7	to output transformer
		2	terminal 16	terminal 8	to output transformer
		3	terminal 17	terminal 9	
		4	terminal 18	terminal 10	transformer power supply
		5	terminal 19	terminal 11	transformer power supply
		6	terminal 20	terminal 5	to the scale grid collector
		7	-	-	spare
		8	-	-	spare
6	SRM2x1.5Ø		⑦ Converter 550 m	② Automatic recorder	
		1	terminal 1	terminal 25	ac voltage lead-in
		2	terminal 2	terminal 26	ac voltage lead-in
7	PVL Ø6.7 two wires in steel conduit of 3/4" Ø		⑥ Vibrator pickup	③ Amplifier	
		1	-	terminal 1	passage of signal to the amplifier
		2	-	terminal 2	passage of signal to the amplifier

7	PVL Ø6.7 two wires in steel conduit of 3/4" Ø	1 2	⑥ Pickup vibrator terminal 1 terminal 2	⑩ Cable box terminal 1 terminal 2	
8	PVL Ø6.7 two wires in steel conduit of 3/4" Ø	1 2	④ Relay terminal 1 terminal 2	⑤ Vibrator emitter - -	power supply to emitter power supply to emitter
9	SRM2x1.5Ø	1 2	⑨ Filter terminal 3 terminal 4	⑦ Converter 550 m sistor terminal -R terminal +R	Converter power supply Converter power supply
10	SRM4x1.5Ø	1 2 3 4	⑨ Filter terminal 5 terminal 6 terminal 7 terminal 8	⑧ Variable dropping resistor terminal 3 terminal 2 terminal 1 terminal 4	
11	SRM2x1.5Ø	1 2	Ship's power	⑨ Filter terminal 1 terminal 2	Supply of ship's power Supply of ship's power
8	PVL Ø6.7 two wires in steel conduit of 3/4" Ø	1 2	⑩ Cable box ④ Relay terminal 1 terminal 2	terminal 1 terminal 2 ⑩ Cable box terminal 1 terminal 2