ECHO SOUNDING (*)

X

I. — BRITISH ADMIRALTY ECHO SOUNDING GEAR, TYPE 752

The British Admiralty published a Standard Work on Echo Sounding Gear, in August 1930, from which the following is extracted -

GENERAL DESCRIPTION OF BRITISH ADMIRALTY ECHO SOUNDING GEAR, TYPE 752.

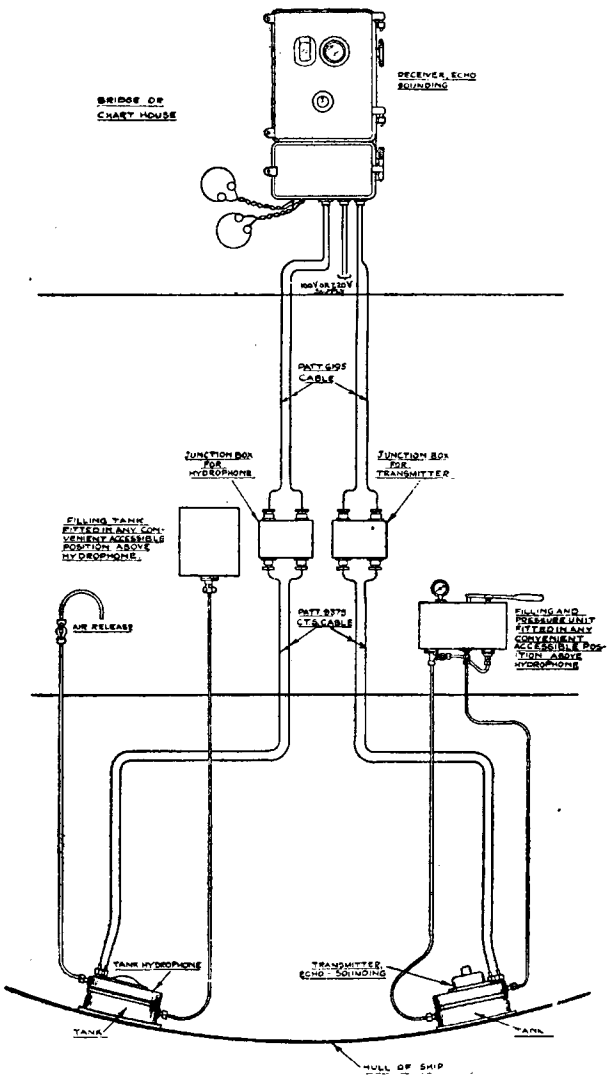


FIG. 1

The principal parts of the Type 752 Echo Sounding set are :

a) A *Transmitter* which produces the sound impulse.

b) A *Hydrophone* which picks up the echo from the ocean bed.

c) A *Receiver* which makes the echo audible to the operator and contains the time-measuring device and graduated scale for reading off the depth of water.

The receiver contains also the switches for operating the transmitter and hydrophone.

Fig. 1 shows the general arrangement of the set.

(*) See *Hydrographic Review*, Vol. VII, N° 2, November 1930, p. 105.

TRANSMITTER TANK.

The transmitter tank is of oval shape with a circular face on top provided with studs to take the transmitter diaphragm. The lower face of the tank is shaped to fit the hull, the joint being made by means of a channel section dermatine washer.

The tank is kept in position against the hull by means of bolts passing through brackets attached to the ship's frames.

A tapped hole is provided in one side of the tank for the attachment of the pressure and filling pipe.

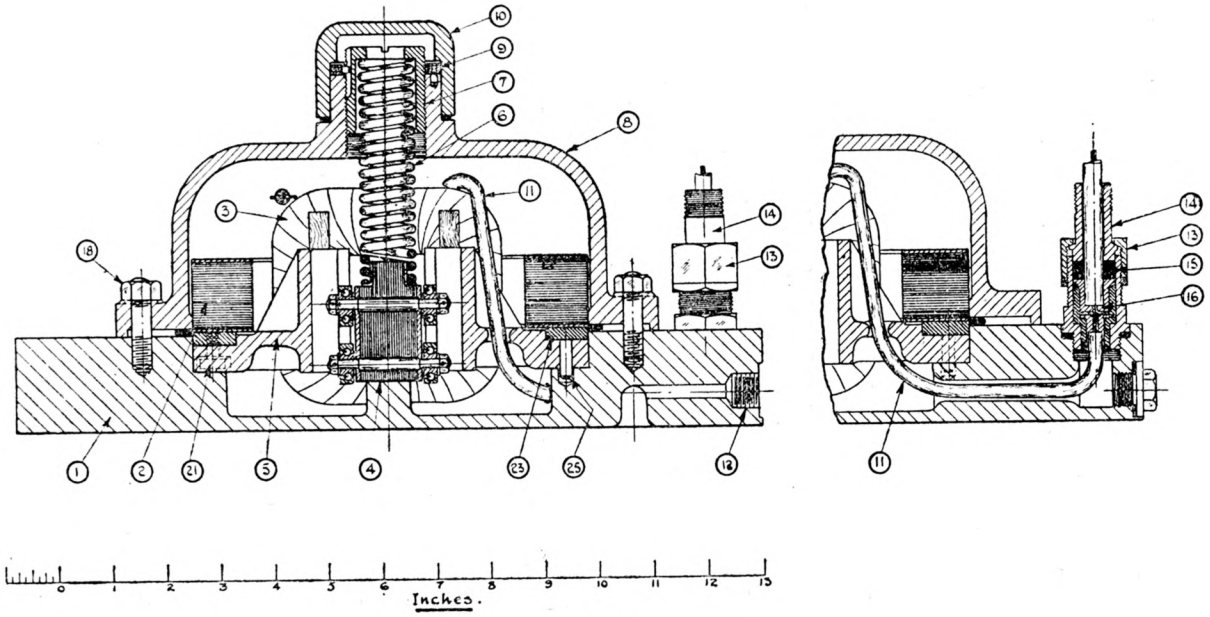


Fig. 2

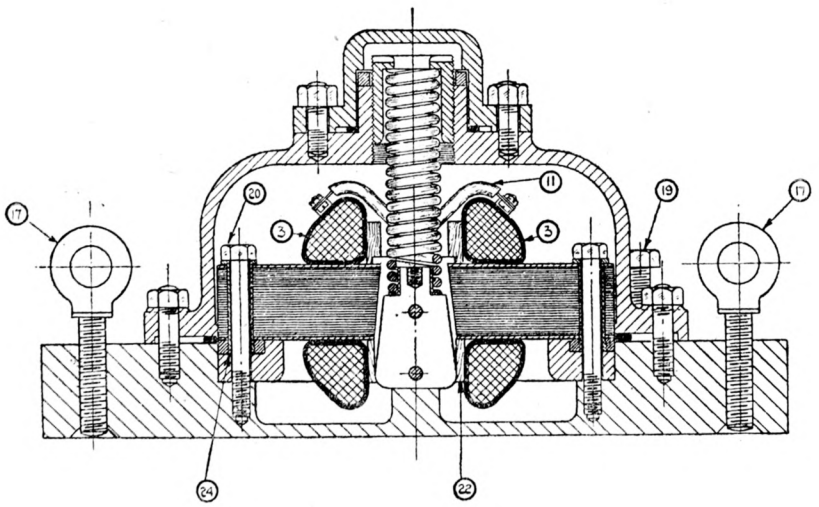


Fig. 3

TRANSMITTER (*see* Fig. 2, 3 & 4).

The A/S 2 type transmitter consists of a diaphragm (1), to which is bolted an electro-magnet unit consisting of a laminated core (2), carrying two coils (3), and guides for a hammer (5). The hammer (4), provided with four ball races, moves in the guides and is held against the diaphragm stud by a spring (6). The upper end of the spring bears against an adjusting sleeve(7) which is screwed into the casing (8) of the transmitter — the casing being bolted down to the diaphragm. A locking ring (9) is fitted to the adjusting sleeve to prevent it slacking back after adjustment, and the whole protected by a watertight cover (10).

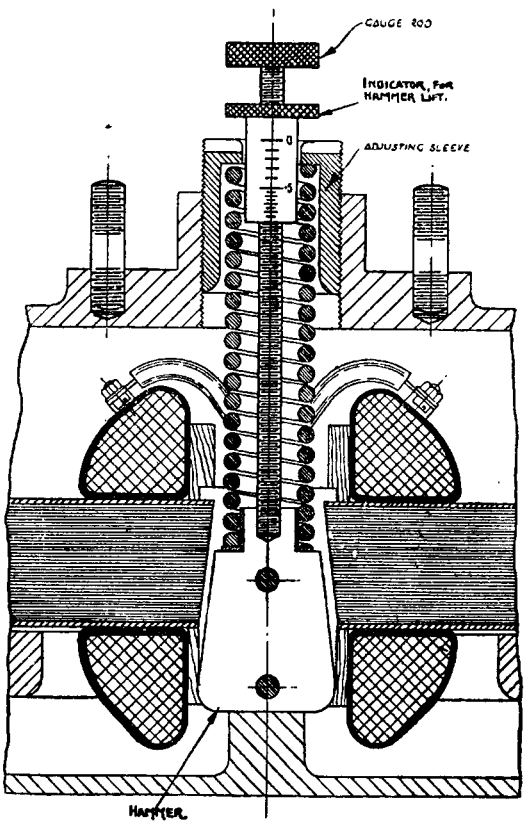


FIG. 4

Two glands are fitted on the upper face of the diaphragm, through which are taken the electrical leads (11) to the coils. A tapped hole (12) is provided on the edge of the diaphragm for the attachment of the air release pipe. This hole is in communication with the face of the diaphragm and allows air to escape when the transmitter tank is being filled with water. Care must be taken that the transmitter is fitted with this hole at the highest point.

The transmitter is bolted down to the top face of the transmitter tank, the joint being made by means of a dermatine washer.

PRESSURE AND FILLING UNIT (Fig. 5).

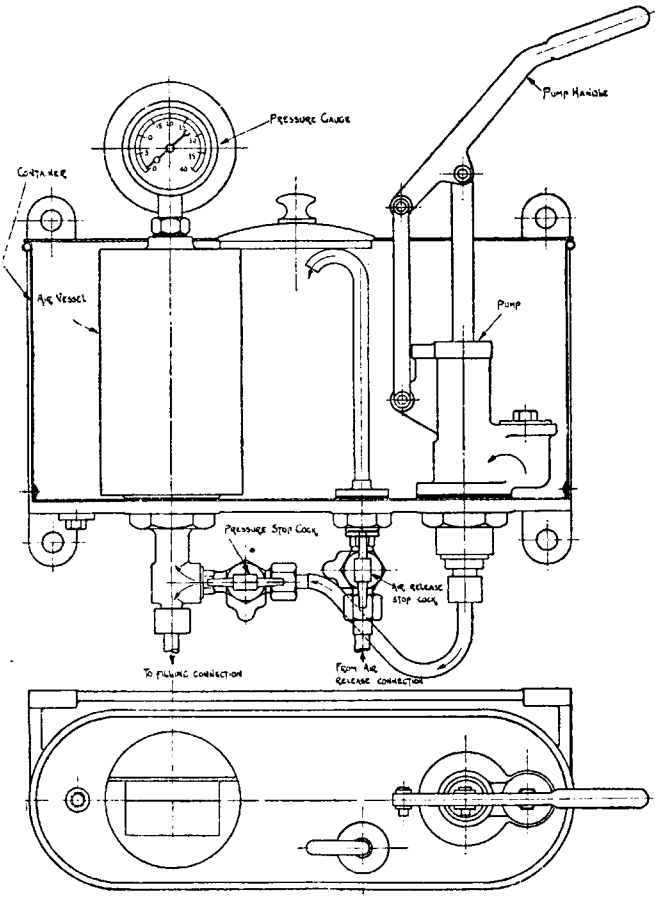


FIG. 5

This consists of a brass container in which is situated a pump connected by a copper pipe through a stopcock to the filling connection on the side of the transmitter tank.

Another copper pipe from the air release connection on the edge of the transmitter diaphragm is taken through a stopcock to a connector in the bottom of the container. This pipe is continued inside the container and terminates with a rounded open end under the lid.

An air vessel with an external pressure gauge is fitted inside the tank and connected to the filling pipe between pump and transmitter tank so that the gauge registers the pressure in the system.

THE HYDROPHONE (Fig. 6).

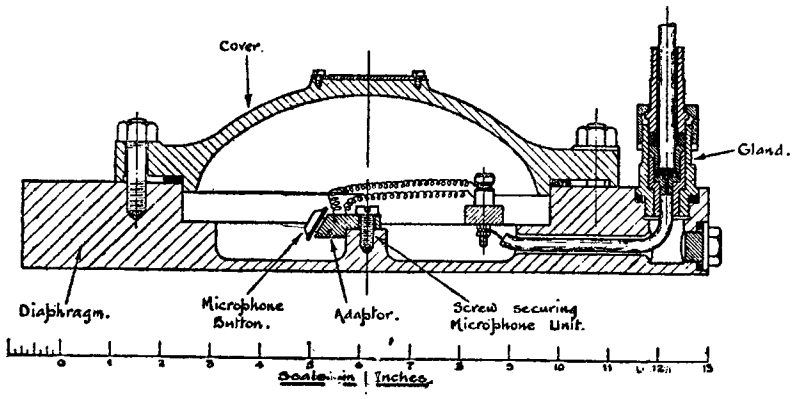


FIG. 6

The type A/S 1 hydrophone consists of a diaphragm similar to that used with transmitter, with a raised boss in the centre on which is screwed a microphone unit consisting of a bakelite adapter and microphone with electrical leads for connecting to two terminals inside the hydrophone. The external electrical leads are brought in through two glands on the upper side of the diaphragm. A tapped hole is provided at the side of the diaphragm for the attachment of the air release pipe. This hole is in communication with the face of the diaphragm and allows air to escape when the hydrophone tank is being filled with water. Care must be taken that the hydrophone is fitted with this hole at the highest point.

The hydrophone is bolted down to the top face of the hydrophone tank, the joint being made by means of a dermatine washer.

A domed cover is bolted to the top of the diaphragm.

HYDROPHONE TANK FILLING UNIT.

Consists of a tank fitted in any convenient accessible position above the hydrophone. It is connected by a copper pipe and cock, to the filling connection on the side of the hydrophone tank. An air release pipe is fitted to the connection on the edge of the hydrophone diaphragm and terminates in a curved open end in a position a little below the level of the tank. The air release pipe is fitted with a stopcock also.

THE RECEIVER.

The type A/S 1 receiver consists of a box in which is mounted a small shunt motor driving through a 10:1 reduction gearing a cross shaft which carries at one end the slow speed switch for the transmitter and at the other the telephone brushes for short-circuiting the telephones. Between the motor and the reduction gear is mounted the high-speed switch for the transmitter circuit.

Above the gear box a continuation of the motor shaft carries two governor weights. These weights tend to fly outwards as the speed of the motor

increases and by so doing control the position of spring-loaded governor brushes relative to the governor resistances mounted on top of the gear box. The position of the governor brushes relative to the governor resistance controls the speed of the motor and the action of the governor weights keeps the speed of the motor constant.

The telephone shorting disc to which is secured a frame carrying the depth scale is mounted on a bearing concentric with the bearing of the shaft carrying the telephone brushes, and is operated through suitable gearing by a handwheel outside the box. A lamp to illuminate the depth scale is mounted near the scale pointer.

Connected to the telephone brushes are two slip rings through which the electrical connections to the telephone terminals are made by means of copper braids held against the slip rings by springs. The telephone brushes are secured to the shaft by a knurled nut which works on a left-handed screw thread to prevent slacking back when the gear is working.

Secured to the box near the telephone brushes is a unit comprising the telephone transformer and telephone condenser. This also serves as an anchorage for the copper braids connecting with the slip rings.

Near the motor is mounted a terminal block with three terminals, to which are connected the electrical leads for the motor, transmitter, switches and lamp.

The lower part of the box contains the controlling switch for operating the electrical circuits. This switch is of the rotary drum type and is divided into three sections. The left-hand section controls the hydrophone circuit, the centre section the positive supply from the ship's mains to the transmitter, motor and lamp, and the right-hand section the negative return to the ship's mains. The right-hand section is so arranged that the transmitter is not switched on until the motor is running. The switch is operated by an external handle fitted with a special securing bolt for locking in the "off" position. It is put to the "on" position by turning in a clockwise direction to its full limit. There are two intermediate positions — the first makes the hydrophone circuit only and a light stop is provided, and the second in which no stop is provided makes the motor circuit in addition. A button push is fitted below the switch handle which, when pressed, returns the switch to the "off" position. This ensures a quick break and prevents arcing on the drum contacts. Fitted also in the lower part of the box are fuses in the supply leads from the ship's mains and the telephone terminals.

The lid of the box, which is in two sections, is secured, when closed, by special securing bolts. These bolts are operated by a key, which is also used for the control switch securing bolt and the lids of transmitter and hydrophone junction boxes.

Fitted to the front of the box is a milliammeter, which shows the current flowing in the microphone circuit, and an adjustable resistance which increases or decreases the sensitivity of the microphone by altering the current flowing.

A window is provided to enable the scale to be read with the box closed, and this is fitted to take a dark shade. The dark shade when not in use is kept in a pocket inside the lower lid.

Inside the upper lid is an electrical circuit diagram.

General information concerning the working and operation of the apparatus has been communicated in the *Hydrographic Review*(*). For further details the reader is referred to the "*Instructions for Echo Sounding Gear, Type 752*", published by the British Admiralty in 1930, B. R. 309, price 2s. 6d., in which special chapters are devoted to Electrical Circuits, Adjustment of Receiver, Transmitter and of Motor Speed.

The chapter concerning the operating of the Gear deals with the means to obtain sounding, to maintain soundings, to obtain a sounding when approaching the land from deep water, and provides full information for the training of operators.

It is stated that experience has shown that echoes are louder in shallow water than in deep water, and that a hard ocean bed gives rise to louder echoes than a soft ocean bed when depths are the same.

The following paragraphs concerning the accuracy of the instrument are quoted :-

ACCURACY OF THE INSTRUMENT.

When the receiver adjustments have been made and the motor adjusted to its correct speed of 180 r. p. m., the following factors affect the accuracy of soundings :-

(1) Temperature, salinity and pressure of the ocean.
(2) Draught of ship.
(3) Alteration in transmitter lag.

TEMPERATURE, SALINITY AND PRESSURE.

These vary with the seasons and in different localities and result in variations in the velocity of sound through the water. All scales are graduated for a velocity of sound of 4,800 feet/second, and this is correct when the temperature of the water is 40° F., salinity 35 parts per thousand and at atmospheric pressure. As far as they affect the accuracy of soundings obtainable with Type 752 echo sounding set, the effect of salinity and pressure can be neglected, as the maximum error that can be introduced is about 0.4 %

For ordinary navigation purposes, the effect of temperature can be neglected, as will be seen by reference to the table below.

The table gives the corrections necessary when very accurate results are required, and these are expressed as percentages of the observed depth.

The *temperature of the sea* means the average temperature between instruments and bottom, but for practical purposes it may be taken as the temperature at two fathoms below the keel.

Temperature of the sea (°F.)	30	40	50	60	70	80	90
Percentage error	−1.5	0	+1.4	+2.7	+3.8	+4.7	+5.4

(*) See *Hydrographic Review*, Vol. V, N° 1, May 1928, pages 131 *et seq.*

The sign indicates that the correction is to be applied as shown to the observed depth in order to obtain the correct depth.

For further information on sounding velocities, see Hydrographic Publication H. D. 282, "*Tables of the Velocity of Sound in Pure Water and Sea Water for use in Echo Sounding and Sound Ranging*".

DRAUGHT OF THE SHIP

The depth scale is graduated to allow for the mean depth of instruments below the water line at light draught. A correction is necessary, therefore, when the ship is at deeper draughts. The draught for which the scale is graduated is shown on the scale, and the difference between this and the draught at the time soundings are taken should be applied to the observed depths.

Example of applying temperature and draught corrections :

Observed depth = 108 fathoms 3 feet.

Temperature of the sea = 76° F.

Draught for which scale is graduated = 18 feet.

Draught at time of sounding = 20 feet.

Percentage error from table = + 4.3.

Addition for temperature : $\frac{4.3}{100} \times \frac{108.5}{1}$ fathoms = 4 fms. 4 ft.

Addition for draught : 20 – 18 feet = 2 feet.

Correct depth = 108 fms 3 ft. + 4 fms. 4 ft. + 2 ft. = 113 fathoms 3 feet.

ALTERATION IN LAG OF TRANSMITTER.

The measured lag which is stamped on a plate attached to the transmitter may alter slightly, though never to an extent that would affect ordinary navigational work. Opportunity should be taken from time to time of checking the readings of the set when extreme accuracy is required, such as for surveying in shallow water. The following procedure should be followed. With the ship stopped in 10 to 20 fathoms and over an even bottom, take soundings each side midway between transmitter and hydrophone. Carefully check the length of the lead line and compare the soundings obtained with the echo soundings, corrected for temperature and draught of ship. If the comparison shows that there is a definite difference between the two, check the motor speed and receiver adjustment. Should these prove to be correct, it may be assumed that the transmitter lag has altered to the extent of the difference between the echo sounding and lead line sounding. If the echo is reading deep, the lag has increased and the receiver should be readjusted allowing for the greater lag.

A special chapter of publication B. R. 309 provides full information on the electrical tests, care and maintenance of Transmitter, Hydrophone and Receiver.

II. — FATHOMETER OF THE SUBMARINE SIGNAL CORPORATION

UNIVERSAL, TYPE 432.

The Fathometer of the Submarine Signal Corporation of Boston, Mass., U.S.A., has been mentioned in the "*Hydrographic Review*", Vol. V, N° 1, May 1928, page 143, and a brief description of the essential elements of the Fathometer has been described on pages 143-153 of the volume.

This description corresponds to Type N° 431 of the Fathometer, which is the type used on Commercial and Naval ships for taking continuous soundings.

The Bureau has now been informed by the Submarine Signal Corporation that in addition to this type of Fathometer they have also a new type N° 432, or Universal Fathometer including some recent improvements, a description of which is given below from a pamphlet issued by the Company.

General

The Fathometer, Universal Type 432, represents the latest development in visual echo sounding equipment for making measurements of the depth of water beneath a vessel.

All installations of the Submarine Signal Fathometer incorporate the principle of "echo sounding". This is, briefly, the operation of producing sounds of an intensity such as will cause them to travel to the ocean floor and be reflected back as echoes of sufficient strength to actuate a receiving apparatus. The time of travel of these sounds through water (at the rate of approximately 4.800 feet per second) is translated by means of accurate timing equipment into measurements of the depth beneath the keel. The measurements are visually indicated by the flashes of a red light upon a dial, for depths of from about 2 fathoms to approximately 125 fathoms. For the measurement of depths in excess of about 125 fathoms, the return of the "echo" to the receiving apparatus is identified by means of telephone receivers. The depth of water through which the sounds have travelled is then determined by noting the position of a rotating white light with respect to a fixed scale at the moment when the echo is heard.

Each installation of a Fathometer is made to meet the specific requirements of the vessel upon which it is to operate and for the service which is to be rendered by it.

The successful operation of the equipment depends upon the correct location of the units comprising it.

The installation contains no delicate apparatus requiring expert adjustment and maintenance; it measures depths instantly and accurately without slowing down the ship and has proved itself accurate, reliable and seaworthy.

Fathometer, Universal Type 432.

The Fathometer, Universal Type 432, for making depth measurements allows a navigator to obtain accurate soundings of from about 2 to 1,000

fathoms or more beneath the keel of a vessel whether the ship is at rest or moving at full speed.

This Fathometer allows visual indications of depth in a range from about 2 to 125 fathoms to be obtained automatically with an accuracy to within one-half of a fathom. Depths above 125 fathoms are measured by audible means with an accuracy which is dependent upon the experience and skill of the operator. Depths as great as 1,500 or 2,000 fathoms may be measured with an error not to exceed 5 or 10 fathoms.

The sounding operation with the Universal Type 432 Fathometer is accomplished either visually or audibly, depending upon the depths which are to be measured at the time. The depth indications are obtained from one or the other of two concentric dials.

For depths from about 2 to 125 fathoms, visual automatic measurements are obtained with flashes of red light appearing on the outer dial, as long as the Fathometer is kept in operation.

In measuring depths greater than 125 fathoms, a switch on the front of the Indicator throws a white light into rotation about the inner dial. The operator, by using telephone receivers, is then able to determine the depths by observing the position of the rotating light at the instant that the returning sounds are heard after they have echoed back from the sea bottom.

Since there is no physical contact with the bottom, soundings are made as simply and accurately when the ship is making full speed as when it is not moving.

Description.

The principal parts comprising the Universal Type 432 Fathometer installation are the Fathometer Indicator, which controls the operation of the system and indicates the depths; the Oscillators which produce the submarine sounds upon which the sounding operation is dependent; the Hydrophones which receive the sound echoes reflected from the ocean bottom, and the Filter Amplifier which amplifies the sound echoes in such a manner as to operate the indicating apparatus contained in the Fathometer Indicator. In addition to these parts, there are a Control Box; a Power Unit which comprises a motor generator, starter and switch-board; a battery box with batteries for use with the Filter Amplifier and the necessary equipment for mounting the Oscillators and Hydrophones.

The Fathometer operates, as previously indicated, with two distinct sounding ranges. The shoal range includes the minimum measured depths up to 125 fathoms. The deep range includes depths from 125 fathoms to the maximum depths which can be obtained by an operator.

Although the method of obtaining soundings is the same in principle for both ranges, the details of operation differ.

Shoal Range.

In the shoal range the sound producer is a Type 399 oscillator mounted inside the ship either in contact with the hull or suspended in a water tank.

The sound produced by this oscillator is powerful but of very short duration, resembling a heavy hammer blow. About 24 signals are produced per minute.

The hydrophones, which receive the sound signals and their echoes, are also mounted in a tank inside the ship and are especially sensitive to the type of signal emitted by the oscillator. The hydrophone circuit is connected to the Filter Amplifier which, in addition to amplifying the signal, eliminates disturbing stray noises and converts the sound echo into an electrical impulse which flashes a rotating neon tube, thereby causing a visual indication of depth to appear on a dial. Because of the characteristic red colour of the flash, the system for obtaining depths in the shoal range is usually referred to as the "Red Light Method."

Deep Range.

In the deep range the sound producer is a Type 324 oscillator mounted in a heavy casting which is rivetted to the outside of the hull. This oscillator produces a clear, musical note of about 1/10 of a second duration. Normally about 24 signals are produced per minute.

In receiving the sound echoes from the sea bottom a tuned hydrophone is used. It is particularly sensitive to the musical note emitted by the oscillator. Current from the tuned hydrophone passes through an electrical filter in the Filter Amplifier which allows current of the desired signal frequency to pass but suppresses all others. From the filter the current passes to an amplifier which energizes the telephone receivers used by the operator.

While soundings in the deep range are being made, a narrow beam of white light from an incandescent lamp moves steadily around a calibrated dial. The operator obtains depth measurements by observing the position of this beam of white light at the instant the echo signal is heard in the telephone receivers. Depth finding by this means is often referred to as the "White Light Method."

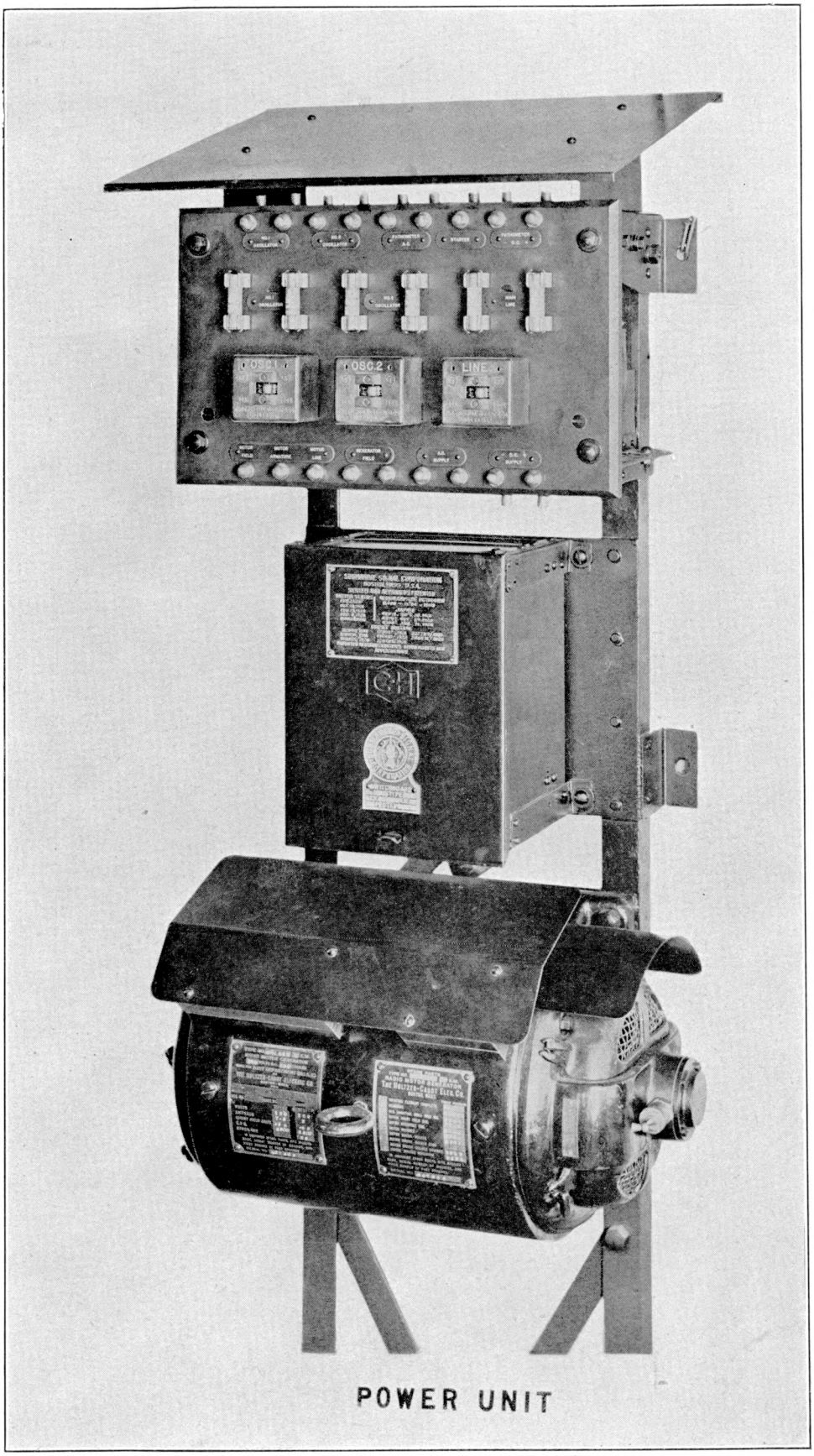
Fathometer Indicator.

The Fathometer Indicator, illustrated on opposite page contains the time measuring apparatus and dials used for indicating depths.

The time measuring apparatus consists of two lights (red for the shallow and white for the deep sounding range) which are mounted upon two concentric discs. These lights rotate behind graduated scales by means of a constant speed motor connected through suitable gear trains. The disc carrying the red light rotates rapidly (190 times per minute) and the one carrying the white light slowly (47-½ times per minute).

Interlocking with the gear trains are two cam systems, one of which operates the Type 399 oscillator for the shoal range once in every 8 revolutions of the red light, and the other of which operates the Type 324 oscillator for the deep range once in every two revolutions of the white light. The cams are arranged so that either one or the other of the oscillators operates, as indicated above, as the corresponding light passes the initial point on its scale. The distance, therefore, on the dials through which either light has moved when the echo signal returns actually measures elapsed time, but

FATHOMETER INDICATOR
UNIVERSAL TYPE 432



GROUPE GENERATEUR

inasmuch as the dials have been calibrated in fathoms, the correct depth is read directly from the position of the lights on their corresponding dials.

The speed of rotation of the motor in the Indicator is shown by a "reed" frequency meter located above the two dials. When the middle reed is vibrating, the motor is operating at the proper speed for making either shallow or deep soundings. The motor speed may be increased by turning the Speed Control at the lower right-hand side of the Indicator control panel clockwise, or decreased by turning it counter-clockwise.

The use of the Hydrophone Control at the lower left-hand side is described later on.

The change of the Fathometer from shoal range sounding (Red Light Method) to deep range sounding (White Light Method) and vice-versa, is obtained by a turn of the switch button in the middle of the control panel on the front of the Fathometer Indicator. This switch controls the circuits so that either the Red Light or White Light Methods of soundings can be used as desired.

Oscillators.

Two oscillators are provided as sound producers.

For the shoal range a Type 399 Oscillator is the sound producer. This oscillator is provided with a plunger which is lifted against the action of a spring by a strong direct current electro magnet. When the current through the magnet ceases, the spring drives the plunger with uniform strength at each blow against a diaphragm. The oscillator may be suspended in a large water tank, in which case the sound is transmitted from the diaphragm through the water surrounding it to the ship's skin and thence to the ocean, or it may be mounted, depending on the construction of the ship, with the diaphragm directly in contact with the ship's skin, in which case no water tank is required.

For the deep range a Type 324 Oscillator is provided. In this type of oscillator a tuned diaphragm is subjected to forces from a strong alternating current electro magnet. The frequency of the alternating current is such as to suit the pitch of the oscillator diaphragm. As long as the alternating current is maintained in the magnet, the diaphragm continues to vibrate emitting a powerful note having a frequency of about 1,050 cycles.

The latter oscillator is mounted in a heavy casting rivetted to the outside of the hull of the ship. The oscillator diaphragm is thus directly in contact with the sea water.

Both types of oscillators are of simple, rugged construction, are sealed water-tight at the Factory and require no attention.

Hydrophones.

Three hydrophone receiving units, two for the shoal and the third for the deep range, are included in the installation .

For the shoal range two hydrophones comprise the sound receiving unit. These hydrophones are mounted in a small tank of water bolted against the inner skin of the ship, the hull forming one side of the tank. They are

essentially water-tight telephone transmitters and are particularly sensitive to the highly damped signals produced by the impact oscillator.

For the deep range a single hydrophone is provided. This hydrophone is mounted in a separate tank near the keel where it will be favourably located for receiving the less powerful signals echoed from great depths. Although similar in principle to the hydrophones used for obtaining soundings in the shoal range, the general appearance and characteristics are distinctly different and this hydrophone is especially tuned for efficient response to the sound waves produced by the Type 324 Oscillator.

Control of the sensitivity of the hydrophones is obtained by regulation of the knob located at the lower left side of the Indicator control panel.

Filter Amplifier.

The Filter Amplifier is a rigid aluminium box. It contains two associated amplifier circuits, one for use primarily in the shoal range and one for the deep range. Electrical circuits from all hydrophones are brought to a switch by means of which any one hydrophone can be selected for use.

A shelf in the Filter Amplifier holds a set of dry cells supplying current for several of the units comprising the installation including the hydrophones.

The Amplifier for the shoal range in independent of that for the deep range. The former includes apparatus for operating the neon tube which indicates the soundings in the shoal range. The latter includes an electrical filter and a pair of telephone receivers for use in detecting the amplifier signals for soundings in the deep range.

Control Box.

The Control Box is a rigid aluminium case similar in general appearance to the Fathometer Indicator and Amplifier cases.

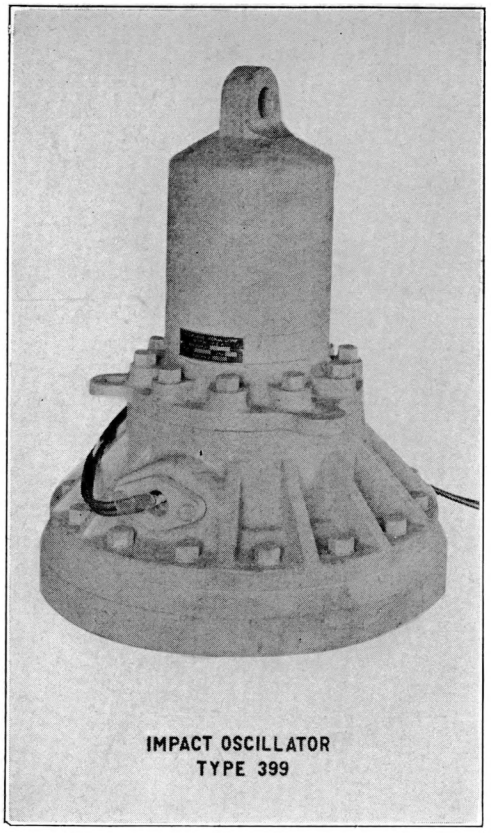
It contains the main control switch for operating the Fathometer installation; resistance units and a D. C. ammeter for controlling the Type 399 Oscillator current; a D. C. voltmeter for indicating the voltage of the ship's supply; a charging unit and switch for the storage cells (located in an external battery box) supplying the filament voltage for the vacuum tubes in the amplifiers and a battery eliminator supplying plate voltages for the amplifier tubes. A ruby bulls'-eye signal on the front of the case indicates, when illuminated, that the amplifier tube filaments are operating.

Battery Box.

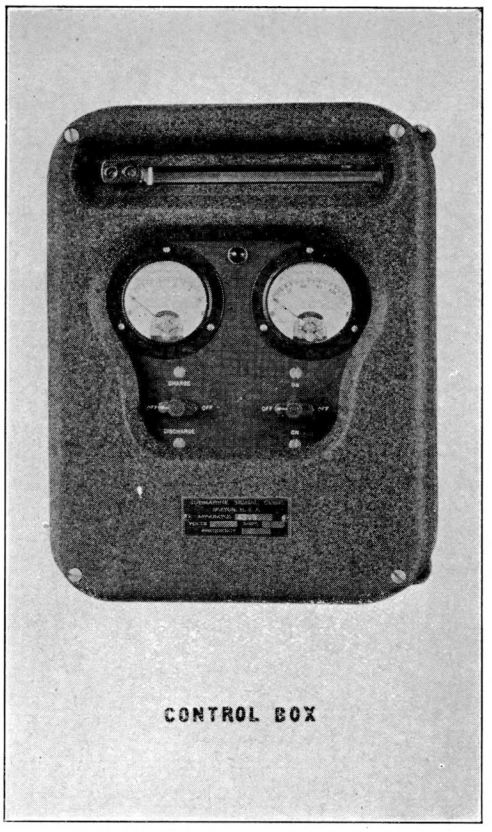
An external battery box is provided to house the storage cells which supply the filament voltage for all of the vaccuum tubes.

Oscillator Power Supply.

The Type 399 Oscillator used for the shoal range is operated by direct current from the ship's line. Resistances are provided to regulate the amount

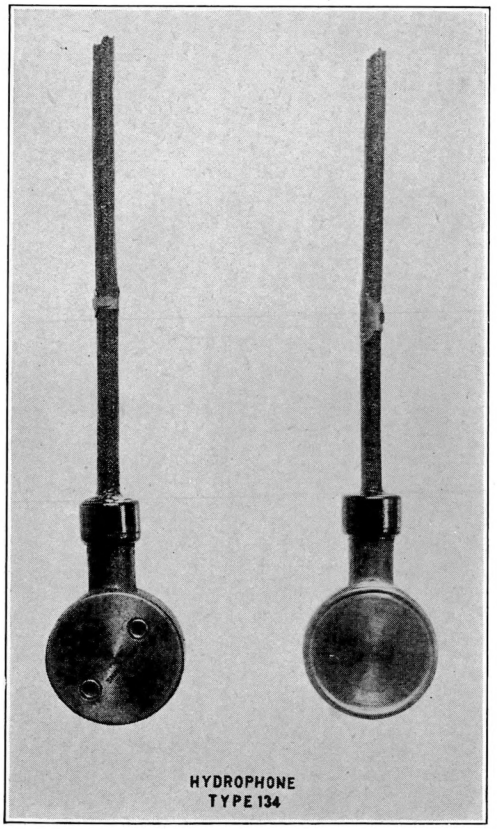


IMPACT OSCILLATOR
TYPE 399

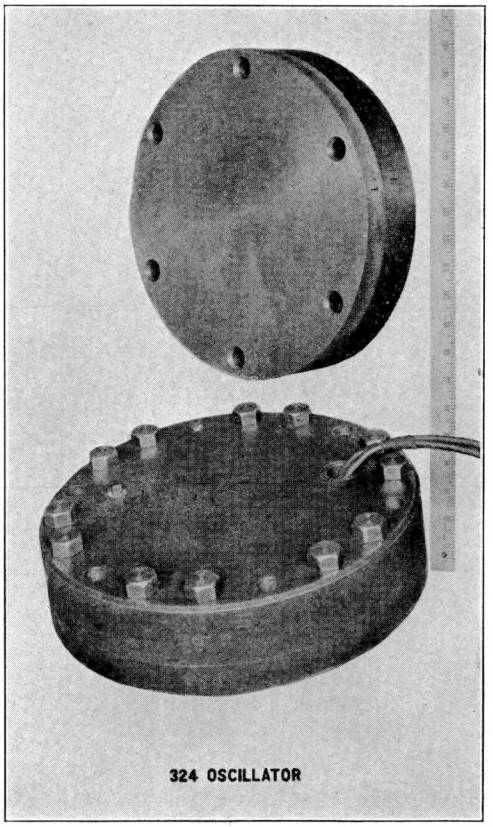


CONTROL BOX

BOITE DE COMMANDE



HYDROPHONE
TYPE 134



324 OSCILLATOR

of current input which is indicated by an ammeter located on the front of the Control Box.

The Type 324 oscillator for use in the deep range requires alternating current of 525 cycles frequency. A Power Unit which comprises a special motor generator, remote control starter and switchboard is provided for the operation of this oscillator.

The three units are compactly mounted on a single base and contain all the apparatus necessary for converting the direct current power of the ship's line to alternating current suitable for operating the Type 324 oscillator. By means of a remote control starter, the motor generator may be started and stopped from the Indicator and except for initial adjustments at the time of installation and ordinary care in maintenance, the power unit requires no attention.

Operation and Maintenance.

Details regarding the operation and maintenance of the Fathometer, Universal Type 432, are fully outlined in instructions which accompany it in shipment.

All units are conveniently and permanently located so as to be readily accessible but out of the way of accidental injury. All parts are rugged and so designed as to give continuous service with ordinary care.

The maintenance of the Fathometer installation is confined practically to the renewal of vacuum tubes and dry cells in the Filter Amplifier from time to time.

Installation.

The complete installation of the Fathometer, Universal Type 432, may be made by any shipyard under the supervision of the Submarine Signal Corporation.

Principal Equipment required for Submarine Signal Universal Type 432 Fathometer

Net Weights and Dimensions.

	Part Number.	*Net Weight.*	*Height.*	*Width.*	*Depth.*
Fathometer Indicator	432	60 lbs.	17-3/16"	13-1/16"	6-7/8"
Filter Amplifier	436	95 "	21"	17-3/4"	9-5/8"
Control Box.	437	25 "	14-1/4"	11"	7"
Oscillator.....	399*A*	290 "	21"	17-5/16"	—
Oscillator Mounting	401	—	—	—	—
Oscillator.....	324	92 "	12-3/8" Dia.	3-3/8"	—
Hull Casting	326	150 "	21" Dia.	—	3-9/16"
Hull Connection Box.....	316*A*	19 "	13-7/8"	5-1/2"	4-1/4"
Battery Box	392*A*	51 "	12"	18"	10"
2 Hydrophones (each)	134	1 "	3-1/2"	2-1/8"	1-1/8"
1 Hydrophone.....	341*A*	10 "	7-1/8"	5-5/8"	3-1/2"
2 Hydrophone Tanks (each)	356	93 "	16-5/8"	21-1/4"	14-1/4"
2 Tank Mountings	156	—	—	—	—
Power Unit (including Motor Generator, Remote Control Starter and Switchboard)	371	305 "	64-3/4"	19-3/4"	15-7/8"

General Data.

The maximum current required by the Universal Type 432 Fathometer installation is 10 amperes at 115 volts.

The battery shelf of the Amplifier swings downward increasing overall height to 23".

The type of Hydrophone Tank used depends on the construction of the vessel. Other types of tanks than the 356 may be supplied, depending upon the requirements.

The height of the power unit includes legs 22" long which may be shortened to any desired length. If necessary, the motor generator may be mounted separately, further reducing the overall height to 27-1/4".

With all apparatus disconnected, the insulation resistance of the cable system to ground should be at least one megohm.

As a matter of interest in connection with the use of the Submarine Signal Corporation's Fathometer a statement, made by Commander W. E. Parker of the U. S. Coast & Geodetic Survey and which appeared in the

January, 1928 edition of the review "*Motorship*", is quoted, which illustrates the co-operation of the U. S. Coast & Geodetic Survey and the Submarine Signal Corporation.

"The United States Coast and Geodetic Survey has been co-operating "with the Submarine Signal Corporation during the last two years in improving "this apparatus and testing it under all kinds of conditions that are encoun- "tered in hydrographic surveying. Three such machines are now installed on "surveying vessels and in the near future all survey ships will be equipped "with this apparatus. The machines were used continuously during the last "surveying season with excellent results. The Commanding Officer on one of "the ships of the Survey reported that with the aid of his echo sounding "machine he accomplished so much more hydrography than would have been "possible without that apparatus that the machine paid for itself the first "season — about 4 months.

"During the recent cruise by the writer through the uncharted waters "west of the Hawaiian Islands the echo sounding machine was used conti- "nuously in navigating the ship among the shoals and reefs that abound in "these waters. Soundings were taken at intervals of ten minutes in deep "water and at more frequent intervals as the depths decreased; one minute "soundings were taken over shallow banks.

"By this means it was possible to cruise at full speed day and night "through waters known to be dangerous but for which adequate charts are "non-existant. The risk was small since we knew at all times exactly the "depth under the ship and how rapidly the depth was changing. About three "thousand soundings were taken and recorded along a track of approximately "two thousand miles and all of these soundings were taken without slowing "down or in any way interfering with the navigation or progress of the ship.

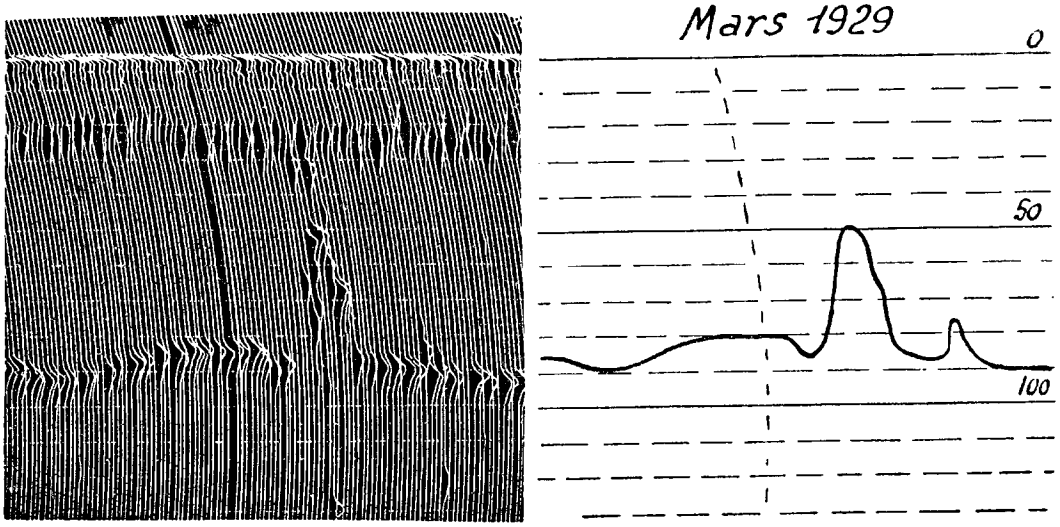
"A merchant ship equipped with this apparatus should be able to make "port during thick weather or avoid dangerous shoals, by soundings alone. "Given an adequate chart, the master should be able to spot his position at "any time by a comparison of a set of echo soundings with the charted "depths and lay his course with at least as much confidence as from astro- "nomic sights.

"This development is one which should be watched closely."

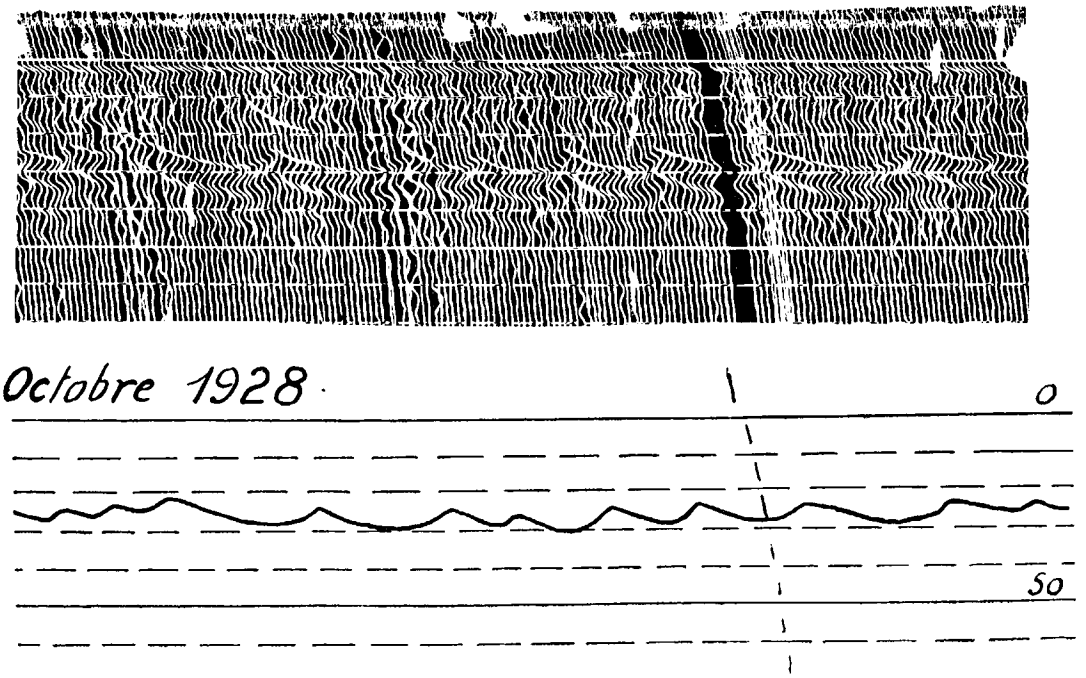
At the time the above article was written in January, 1928, the U. S. Coast and Geodetic Survey had only three of their boats equipped with the Submarine Signal Corporation's Fathometer. At the present time they have 13 ships equipped and three additional boats are on order to be equipped, which will make a total of 16 of their boats equipped with Fathometers.

III. — RECORDS OBTAINED BY MEANS OF ULTRA-SONIC APPARATUSES

Ingénieur Hydrographe Principal P. MARTI has forwarded to the International Hydrographic Bureau several samples of records of acoustic soundings taken by means of his continuous recording device in conjunction with ultra-sonic appliances.



The above diagram shows a very narrow rocky ridge situated in the region of the Catwick Islands (Indo-China) and demonstrates the



advisability of using continuous recording in all hydrographic operations. This ridge, revealed by 9 consecutive sonic soundings only, *i.e.*, in less than 30 seconds, would very possibly not have been noticed had the research been carried out solely by means of optical analysers. It is a part of a shoulder of a submarine volcano the existence of which was thus discovered.

The second diagram shows curious undulations in the bottom of the sea in the Hainan Strait.

The third diagram shows a sample of a record obtained by means of the new ABRAHAM type Oscillograph, small model. It shows up the improvement made since 1928 as compared with the former type.