ECHO SOUNDING

ECHO SOUNDING - XVII

In continuation of the series of articles on recent echo-sounding apparatus, a description is given herewith of the British Admiralty *Universal Echo Sounder* manufactured by Messrs Henry HUGHES & Son, Ltd., London. A few words have already been said about this apparatus on pages 85 and 86 of *Hydrographic Review*, Vol. XIII, N° 2, November 1936. The following description was supplied by Messrs Henry HUGHES & Son in connection with the exhibition of instruments made during the 4th International Hydrographic Conference, Monaco, April, 1937. During the Conference practical demonstrations were made with the apparatus on board a boat in the port of Monaco and it could be ascertained how accurate and sensitive the indications of the apparatus are even in the shoalest water; the record even revealed very clearly the passing of the boat over mooring chains of ships at anchor in the port of Monaco.

GENERAL DESCRIPTION OF RECORDING GEAR.

This Recorder has been designed to meet the demand for an instrument for registering depths in shallow water with a range to cover the requirements of the majority of ships.

The construction of the case enables accessibility to all parts, and this is arranged by means of hinging the mechanism from the back of the case. The motor is mounted on the back of the hinged base plate and is coupled to a worm shaft driving a worm wheel fixed to a pair of gear wheels. These gear wheels mesh with a pair of sliding gears which by means of a handle on the front of the case can be engaged with one or the other of the fixed gears.

The shaft on which the change gears are mounted is extended to carry a drum with segments. Mounted on this insulated drum is an arm holding the Stylus. When the motor is started the drum revolves in an anti-clockwise direction thus the pen moves from left to right across the paper..

NON-PHASING TYPE DRUM (See fig. 1).

On the drum are segments for marking the depth lines, and a slip ring for the Echo impulse from the amplifier to be brought to the stylus.

Behind the segment ring is an initial suppressor switch for suppressing the initial interference from the transmitting oscillator. Behind the initial suppressor switch is the transmitting switch which discharges the 4 m.f. condenser through the transmitter windings, this oscillatory discharge causing the transmission.

PHASING TYPE DRUM (See fig. 2).

It is clear that if there is an interval between transmission and the instant the stylus passes the zero of the scale, then the recorded depths will not be true, but if the interval is known then the echo depth corresponding to the interval, can be added to the recorded depths, to give the true depths. Advantage is taken of this fact to increase the range of the recorder beyond the depth shown on the scale without the necessity of contracting the divisions of the scale.

The drum is constructed with the following Segment & Slip rings:— Starting from the front we have (1) a plain slip ring for bringing the Echo impulse to the stylus (2) Depth marking segment ring (3) High speed break (4) Low speed break (5) Slip ring connected internally to the inner ring on front of drum (6) Slip ring connected to the outer ring having an insulated segment on front of drum. The rings on the front of the drum are insulated from each other, but are connected by means of brushes which can be rotated so as to advance the signal sent out. This advancing of the signal is known as phasing.

On the drum shaft is a worm driving a wheel mounted on a horizontal shaft coupled to a flexible shaft on the left, which drives the paper roller through means of a worm and wheel; and on the right drives a worm and wheel, the latter being fixed to a cam

operating an interval switch. The interval switch allows the depth lines to be marked on the chart only at fixed intervals.

The gear change is arranged for Ratios of 10 to 1 and 6 to 1. The former ratio is usually used for metric scales and the latter for scales of feet and fathoms.

PAPER

The chart paper is supplied in a damp form in air tight tins. The paper has no lines on it as the zero and depth lines are marked automatically.

The paper is inserted by pulling forward two levers on the side of the tank thus allowing the front cover to hinge down. Inside the front cover are two spring clips on which the paper roller is fixed. The end of the paper is brought up from the back and hangs down the front, the two levers are then pushed up. The end of the paper is then pushed between the bottom rollers by first releasing the friction roller, by means of two springs at the bottom of the side plates. Push end of paper into slot of back roller and give two turns by means of knurled head. Replace friction roller and springs and turn knurled head on right hand side of front roller.

THE AMPLIFIER.

The amplifier shown on Fig. III has only one tuning adjustment, one intensity control and one switch. The adjustment is situated under the voltmeter and is revealed by unscrewing a knurled screw on the panel. On removing this a screw-driver can be inserted into a slot in the shaft carrying the moving vanes of the condenser. By rotating the screw driver the input sensitivity can be adjusted to a maximum; once this is set, no further adjustment need be made. The switch on the right hand side of the amplifier is for switching "on" or "off" the H.T. & L.T. Batteries and initial suppressor switch battery in the Recorder. The intensity control is located on the right hand side of the recorder case. This is adjusted to give a clear echo line and a minimum of cross-noise.

INSTALLATION. (See Fig. IV).

Layout of the whole of Equipment is shown with all external cables on Fig. IV. It will be seen that the Recorder is wired to the transmitting oscillator through the contactor box, and the receiving oscillator connected to the amplifier. Thus the signal sent out is received as an echo, amplified and transferred to the Recorder.

ROTARY CONVERTOR.

On non-phasing gears the Rotary Convertor is situated in the Recorder Gear. This convertor is required for "stepping up" the voltage from the mains voltage to about 400 volts which is used for the transmitting oscillator, and is connected direct.

On phasing type Echo Sounding Gears the Rotary Convertor is situated in the Contactor Box, and steps up the mains voltage to 1000 volts, required for the transmitting oscillator. (See Fig. V.).

BATTERIES.

The anode supply for the amplifier is obtained from 3 dry batteries of 60 volts each, and as only 150 volts are required the remaining 30 volts constitute a reserve, which is used when the other cells run down. The filament supply is a 2 volt accumulator. A charging unit is supplied which enables the accumulator to be charged from the mains.

FITTING OF OSCILLATOR TANKS & UNITS. (See Fig. VI).

These tanks are fitted to the shell of the ship one on each side of the ship, with the oscillator unit mounted on the underside of the lid.

There are two methods of fitting the tanks (1) welding to the ship's shell making a water-tight joint (2) placing a joint ring on the ship's shell and clamping down the tank by means of screw-rods. The gravity feed tank unit should be fitted in an accessible position near the oscillators, and copper pipes run from this to each oscillator tank as shown on Fig. IV.

OPERATION OF GEAR.

To start Recorder (1) turn switch situated on the right hand side of the Recorder to the "ON" position. (2) Turn amplifier switch to the "ON" position. (3) Adjust sensitivity control on recorder to give desired marking.

THE MOTOR AND GOVERNOR.

Principle.

The motor requires only about 120 watts input to drive the Recorder. Its speed is controlled by a centrifugal governor, the wiring of which is shown at the bottom left hand corner of Diagram I. When the correct speed is reached the governor brings two contacts together, which short circuits a resistance in series with the field windings of the motor, increases the field and prevents the speed rising further.

SETTING THE GOVERNOR.

The two contacts which short the field resistance are A & B (Fig. VII). A is a carbon disc mounted in a holder which can be adjusted by means of handle C. There is a clicking device which retains the handle at the desired setting. The contact "B" is mounted on a flat spring which is under compression with motor stopped, but with motor running the centrifugal force on the governor weights D tends to straighten out the flat spring, and brings copper contact B to A, thus shorting out the resistance in series with the motor field.

The two leads from the mains are brought to terminals each side of the motor frame; one of which is connected to a plate carrying the carbon contact holder. The other lead is brought to the carbon brush opposite the slip ring which is fixed to a shaped arm holding the flat spring with copper contact B.

INSTALLATION OF CABLES RUN IN TUBE.

In cases where the cables are run in tube, the following conditions must be observed : (1) Tube not less than 1 1/4" internal dia. (2) Draw in boxes to be used and not inspection bends.

The transmitter and receiver cable is of special manufacture with an extra thick lead covering (total external dia. of cable is 11/16") and is not pliable enough to be drawn through small tube or sharp bends without possible damage to the cable.

Draw in boxes are essential in that the Receiver Cable must be in one whole length, (where no Contactor Box is fitted this condition also applies to the transmitter cable), joints cannot be allowed.

DESCRIPTION OF RECORDER MECHANISM.

The motor A is coupled two-speed gear in the gear box B which is mounted on the baseplate C. The baseplate is fixed to the centre compartment, which being hinged, allows free access to the motor and gear box, and terminals, etc... and where a rotary convertor is necessary, this also may be situated behind the baseplate.

The paper trough D is fixed on the front of baseplate C and mounted on top of the trough is a bracket in which is the bearing for the drum shaft. On the front of this shaft is the drum which is built up of insulated discs with brass rings on the outside. The front ring is continuous, and is for bringing the echo impulse to the stylus by means of brush J. The second ring has segments in for the depth marking lines and has a feed brush H. The next ring has a cam on it, and actuates the switch G, which is the initial suppression switch that is required for suppressing the interference caused by the transmission at the beginning of the scale. The ring at the back is in the form of a cam which operates the transmitter contact switch F. The transmitter operates once every revolution of the drum. The depth lines are only marked at fixed intervals, and this is arranged by means of a switch E situated behind the bracket supporting the drum. On the drum shaft is a worm driving a worm wheel mounted on a shaft driving a worm reduction gear actuating the interval switch.

On the other side of the worm wheel, driven by the worm on the drum shaft, is a flexible drive to the worms and wheel R on the paper drive. Worm wheel R is attached to a spring wound tightly on the spindle of roller Q. The function of this spring is to

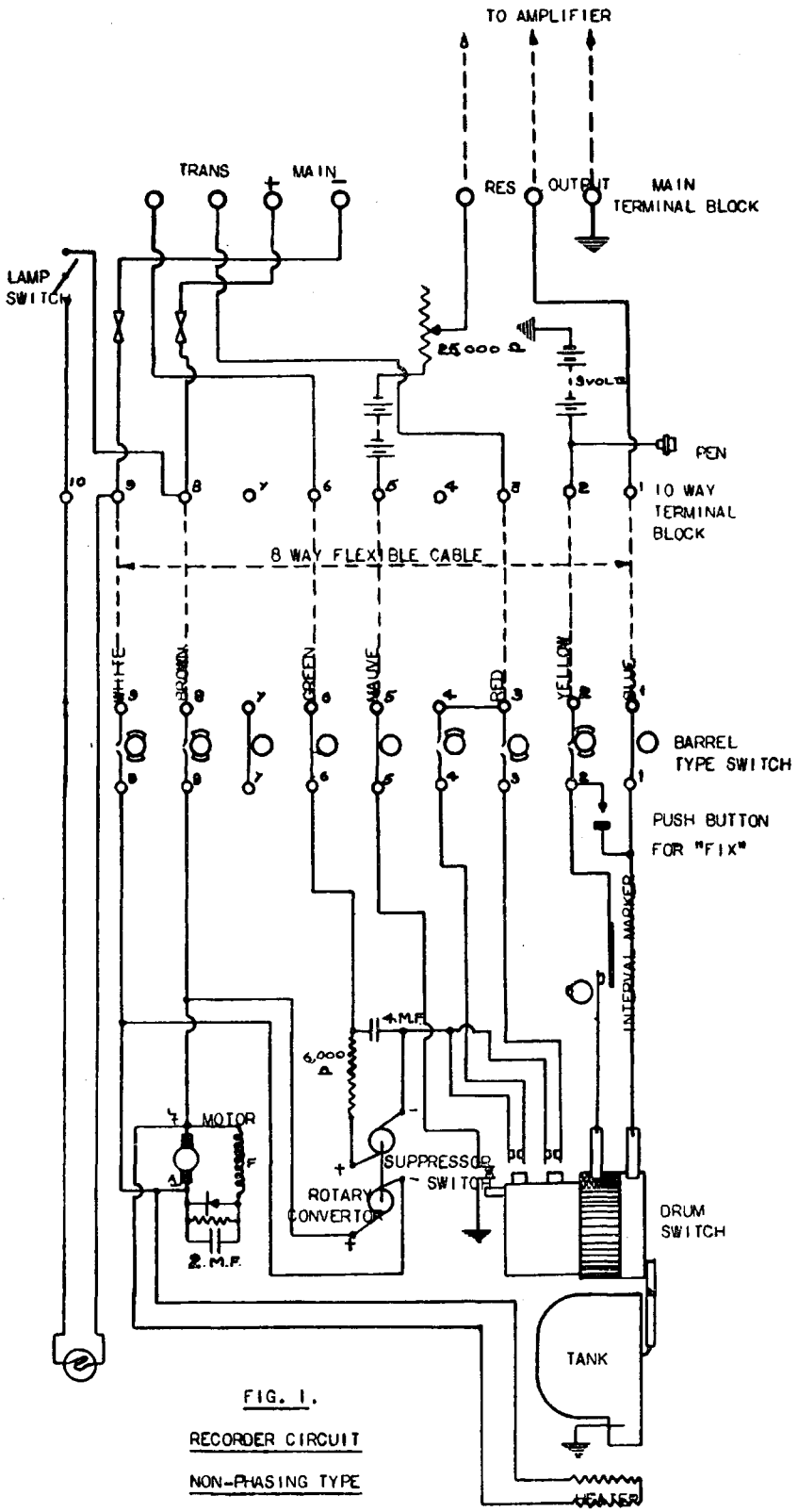


FIG. 1.

RECORDER CIRCUIT

NON-PHASING TYPE

HENRY HUGHES & SON LTD.

A. 449.

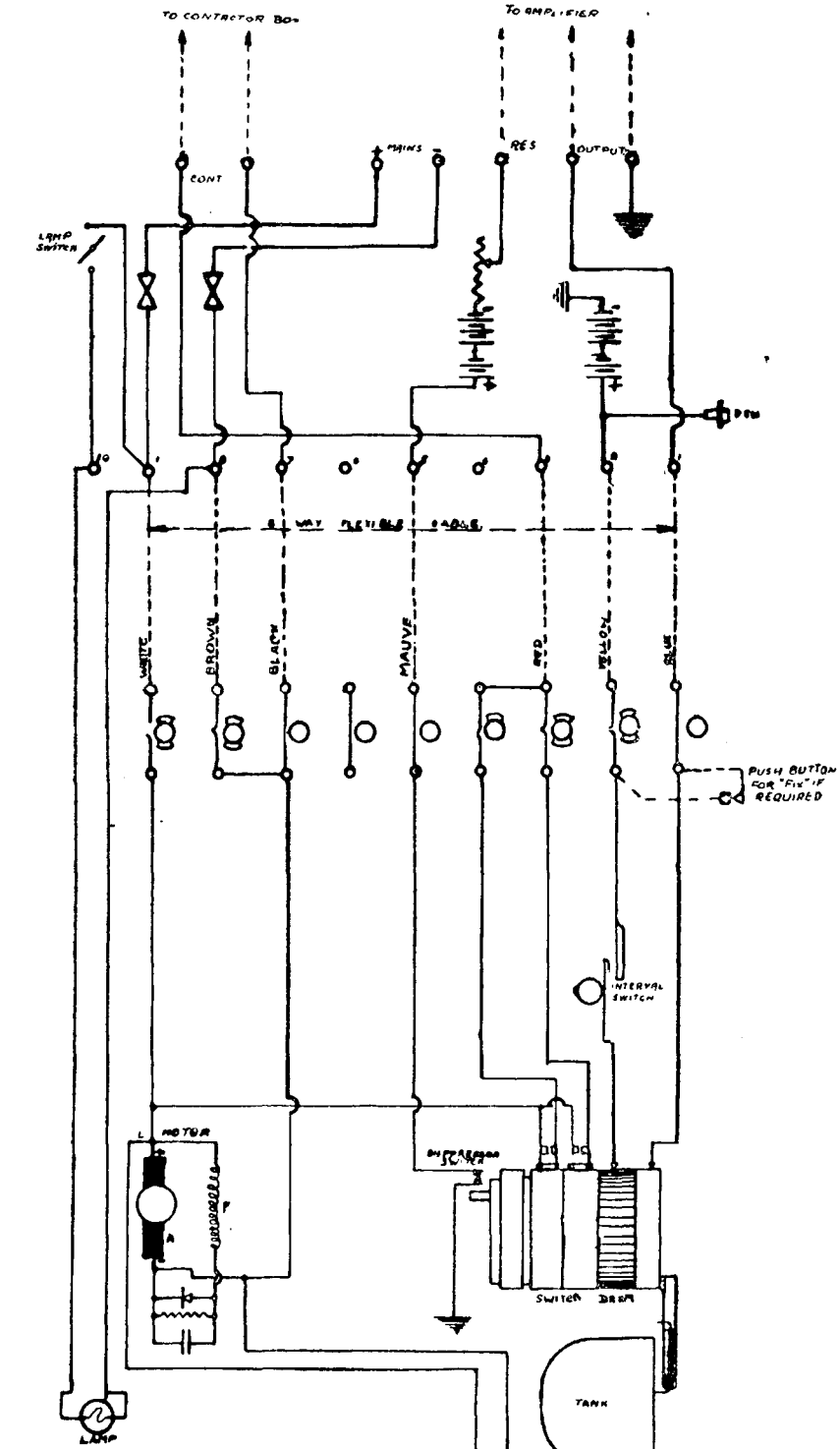


FIG Ia.
RECORDER CIRCUIT
NON-PHASING TYPE
EXTERNAL CONTACTOR

A 449

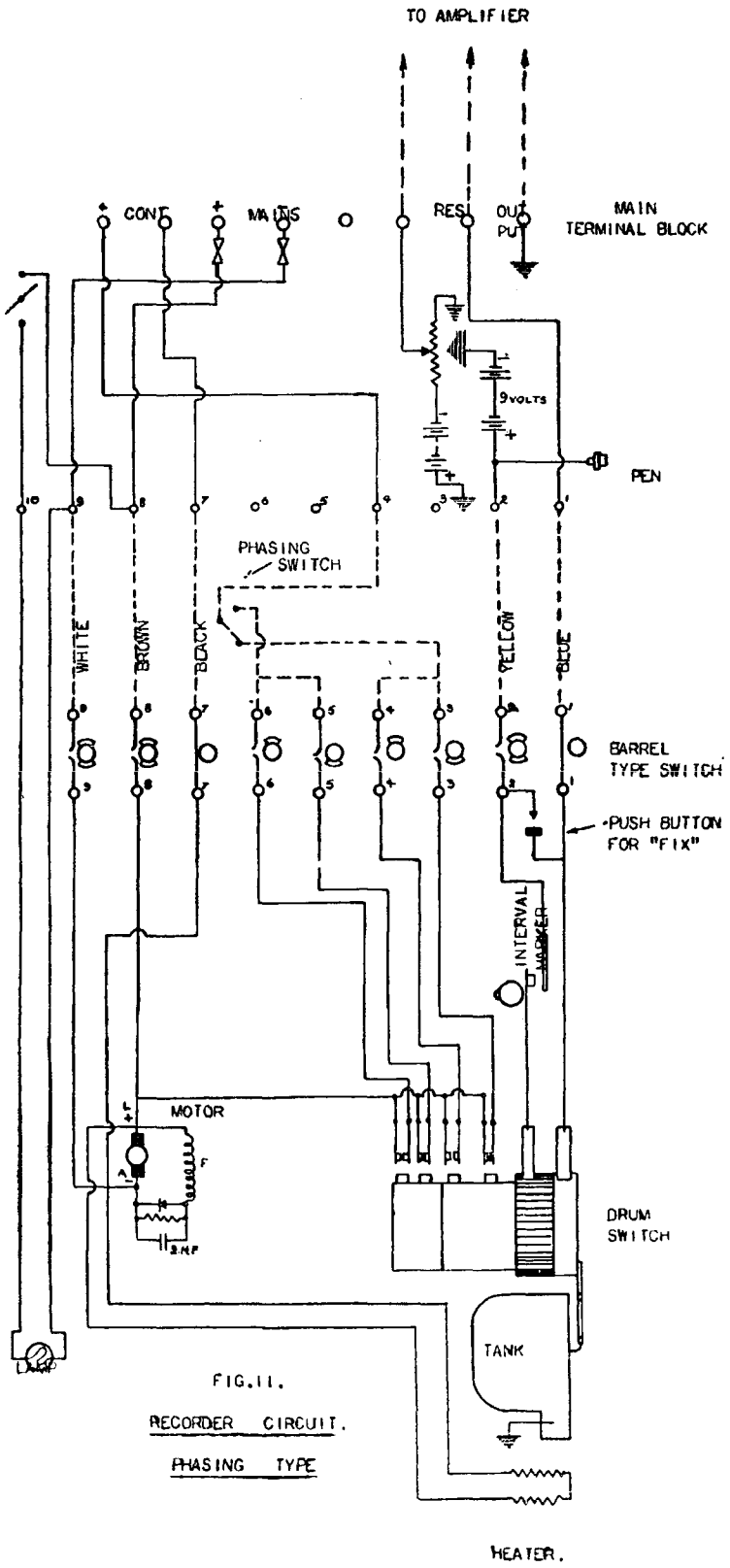


FIG. 11.

RECORDER CIRCUIT.

PHASING TYPE

HENRY HUGHES & SON LTD. A.449.

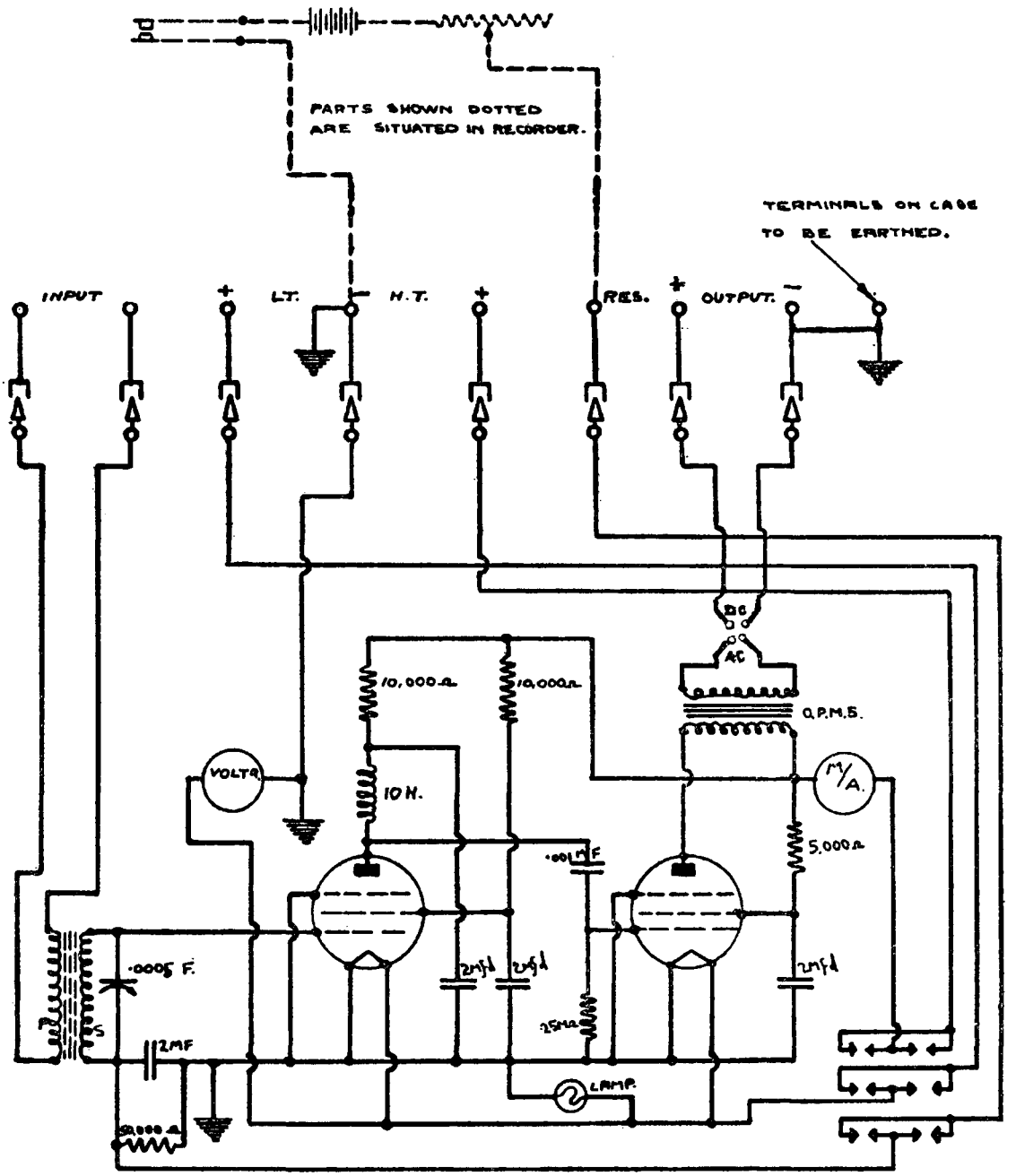


FIG. III

AMPLIFIER CIRCUIT

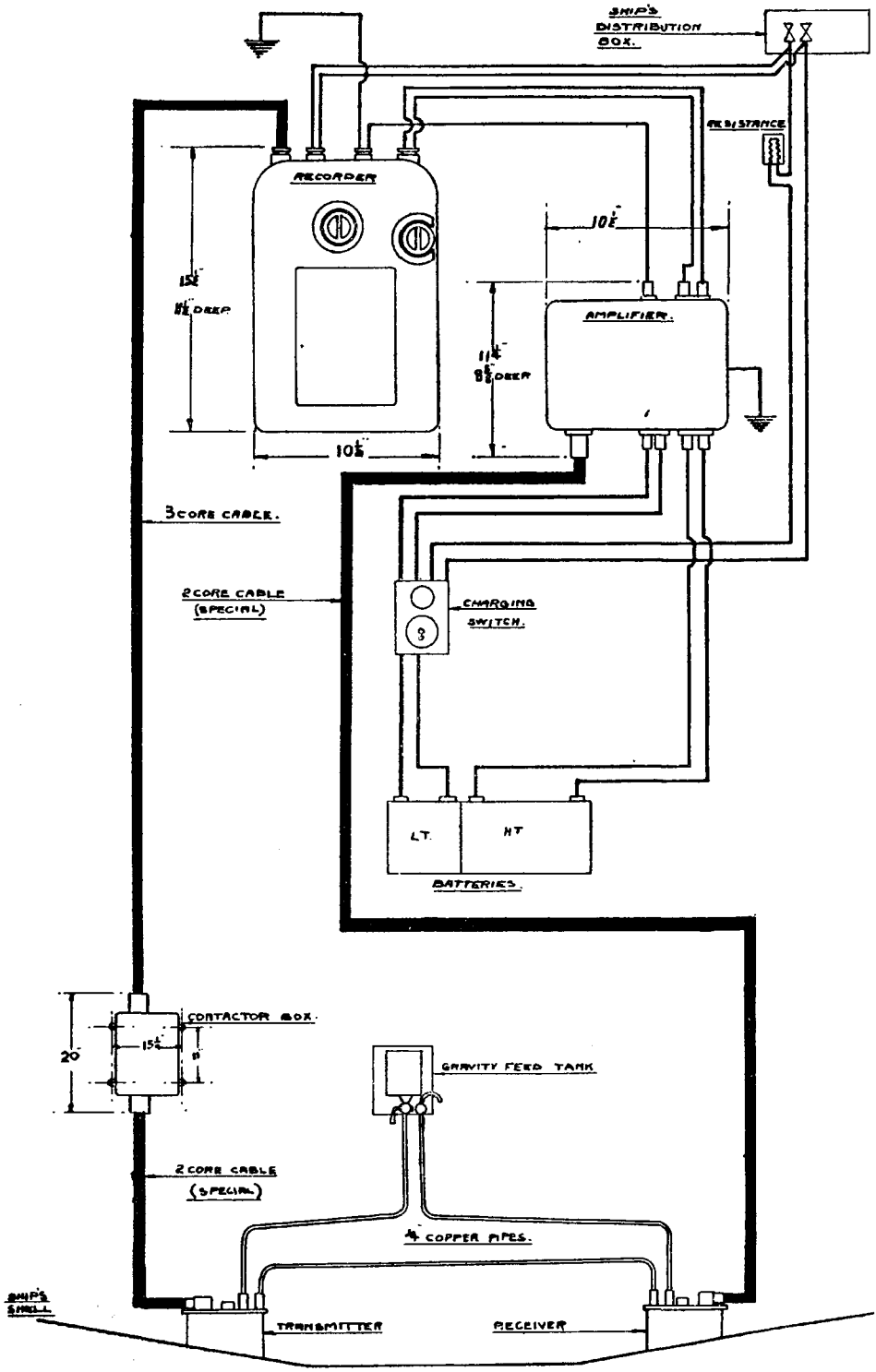


FIG. IV

EXTERNAL WIRING.

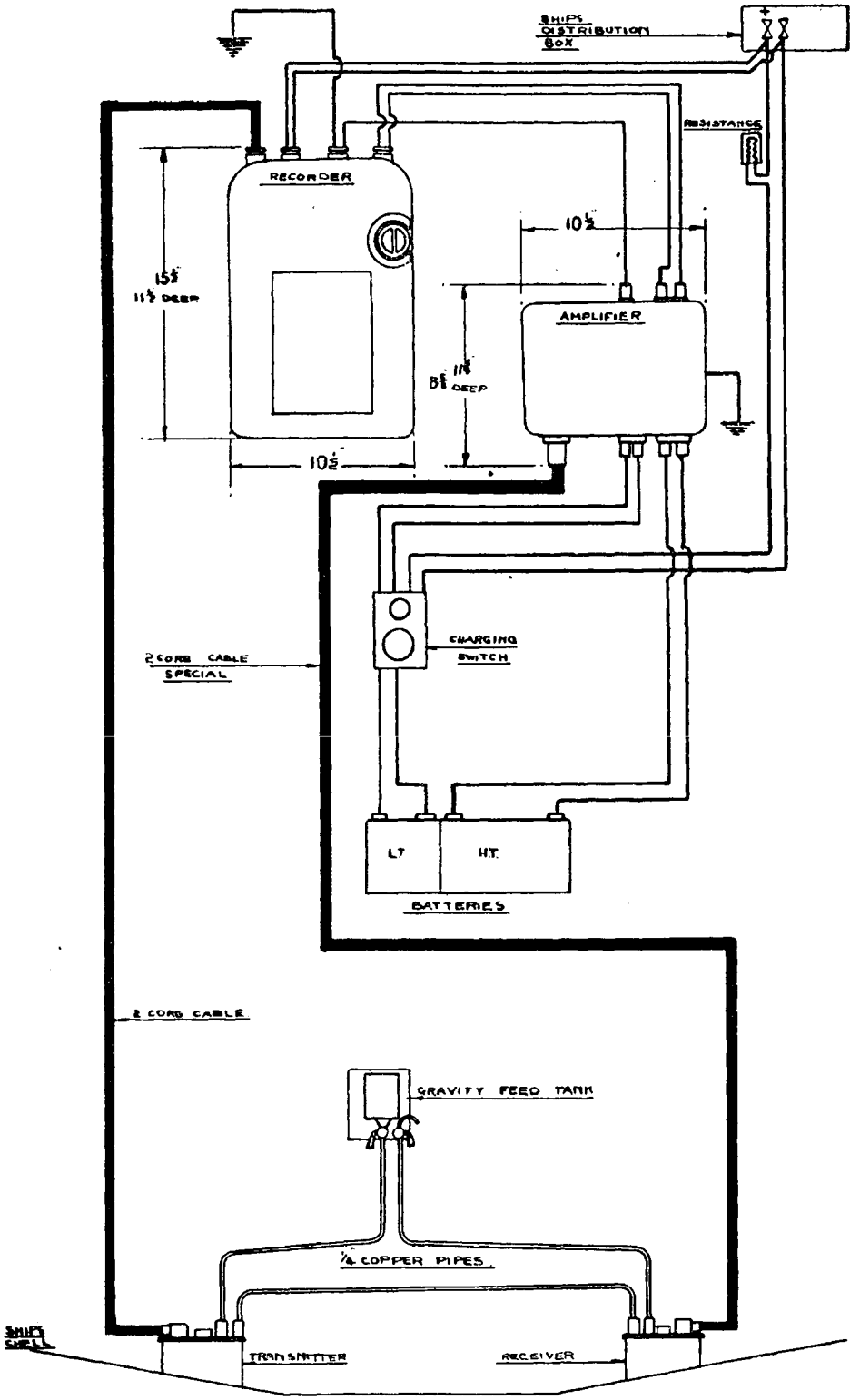
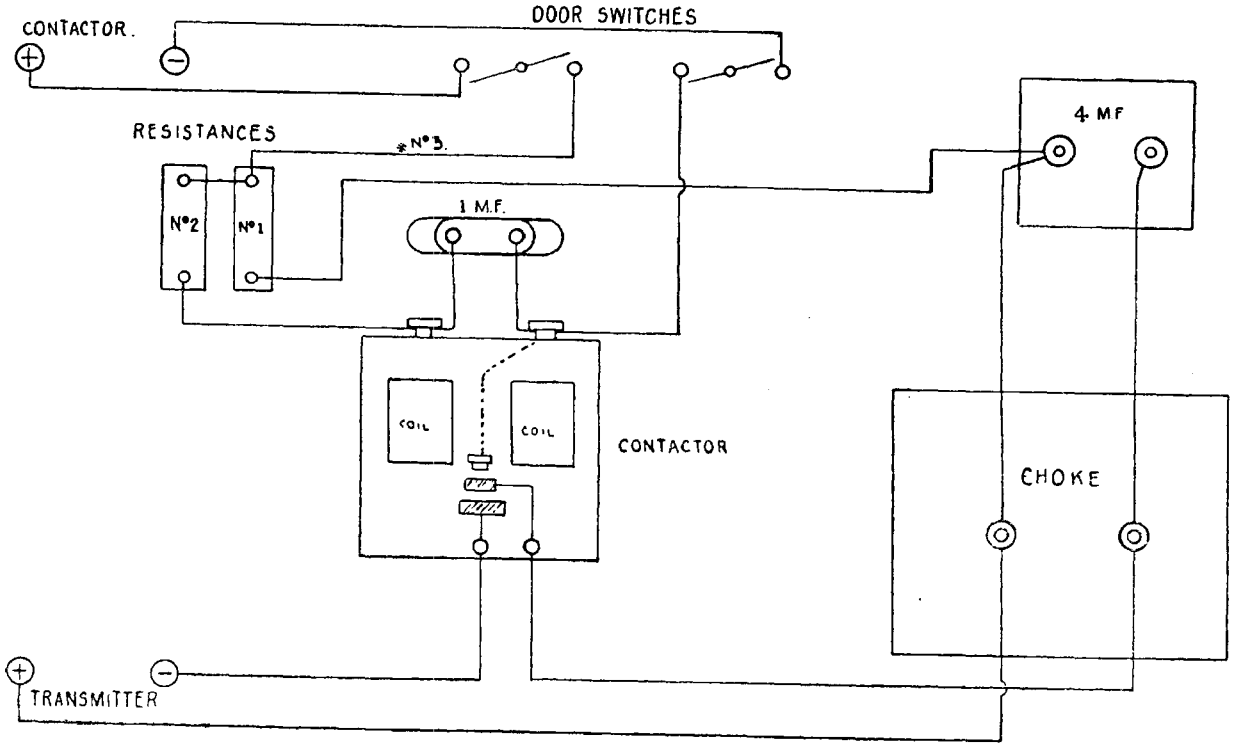


FIG. IVA
EXTERNAL WIRING.



36 VOLT { RES. N°1. 10·5 Ω Z.1.
RES. N°2 15·4 Ω Z.1.

110 VOLT { RES N°1 89 Ω Z 2
RES N°2 350 Ω Z 1.

220 VOLT { RES. N°1. 89 Ω Z 2.
RES N°2 359 Ω Z 1.
RES N°3.* 17+ Ω Z.6.

NOTE

RESISTANCE N°3 IS ONLY REQUIRED FOR 220 VOLT CIRCUIT, AND IS PLACED IN LEAD MARKED *

CONTACTOR BOX WIRING DIAGRAM

FIG. V

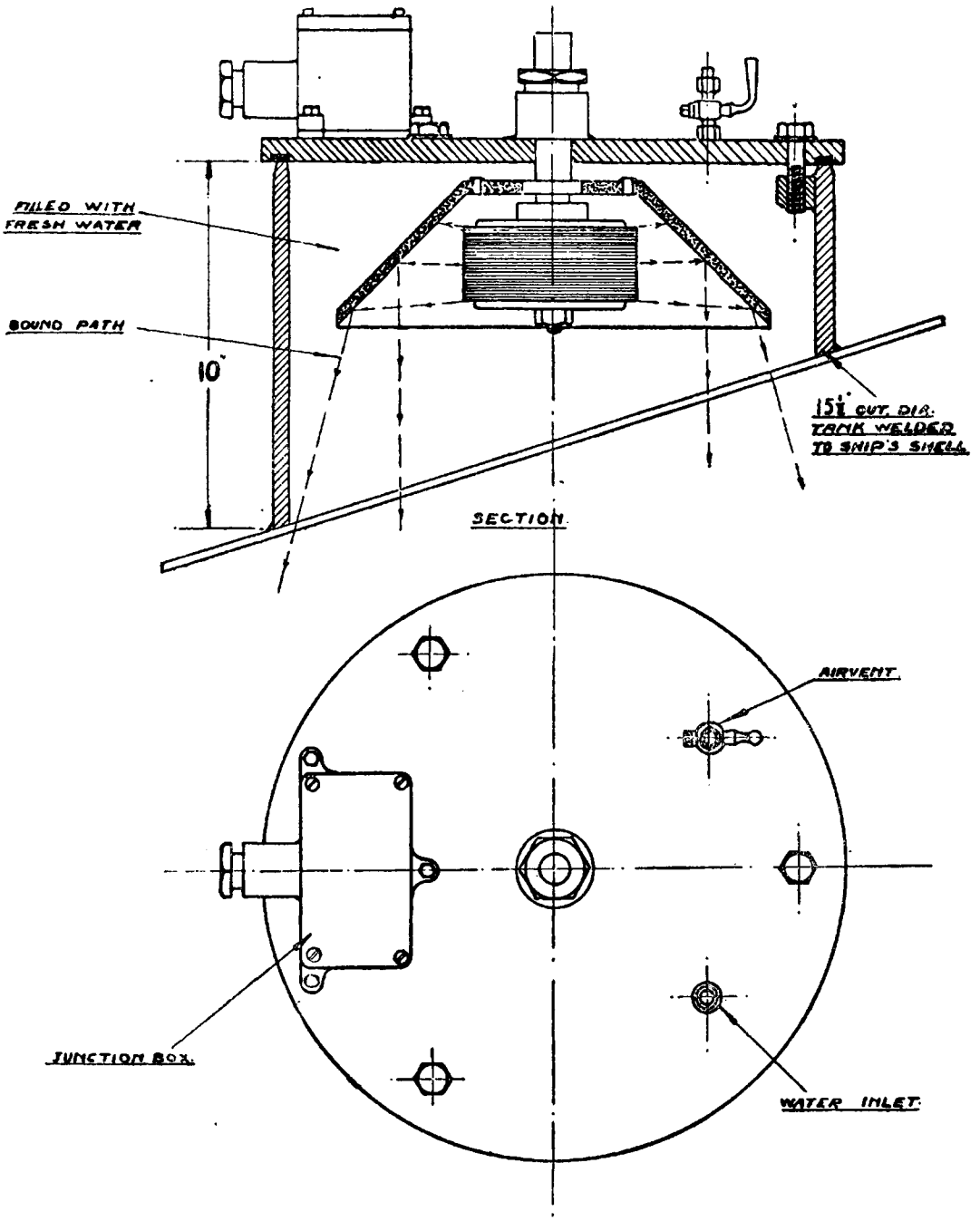


FIG. VI

OSCILLATOR MOUNTED IN TANK.

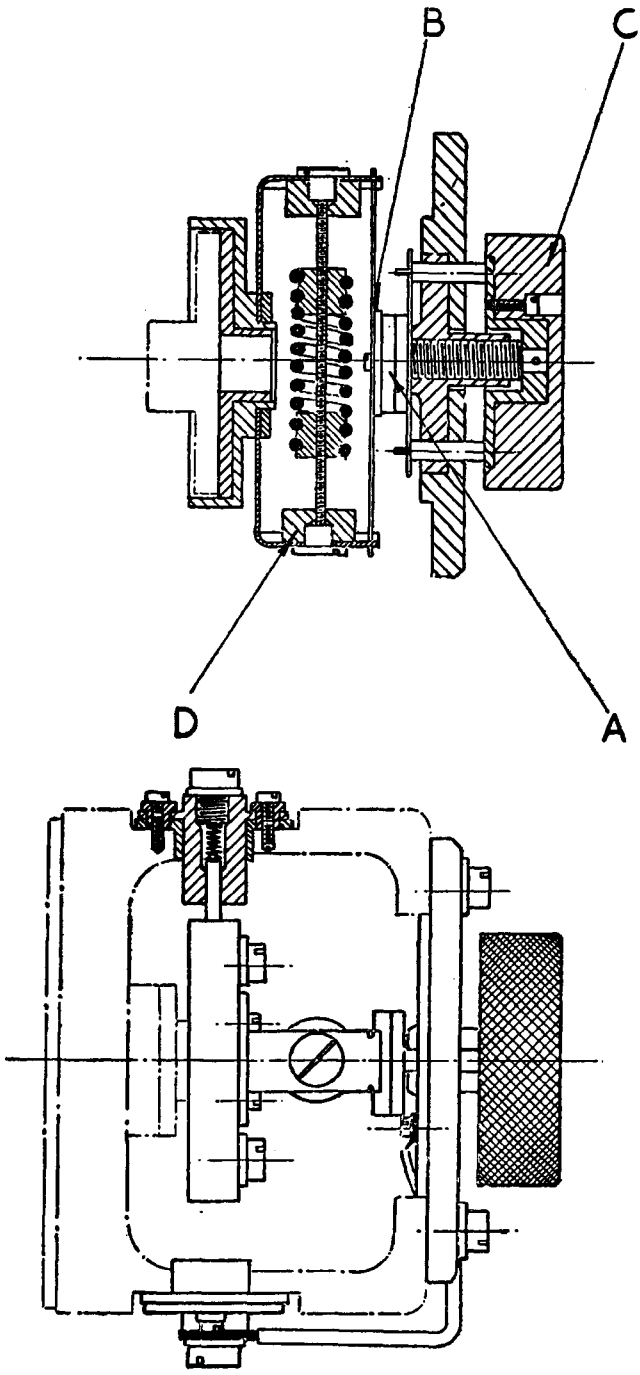


FIG VII.
MOTOR GOVERNOR.

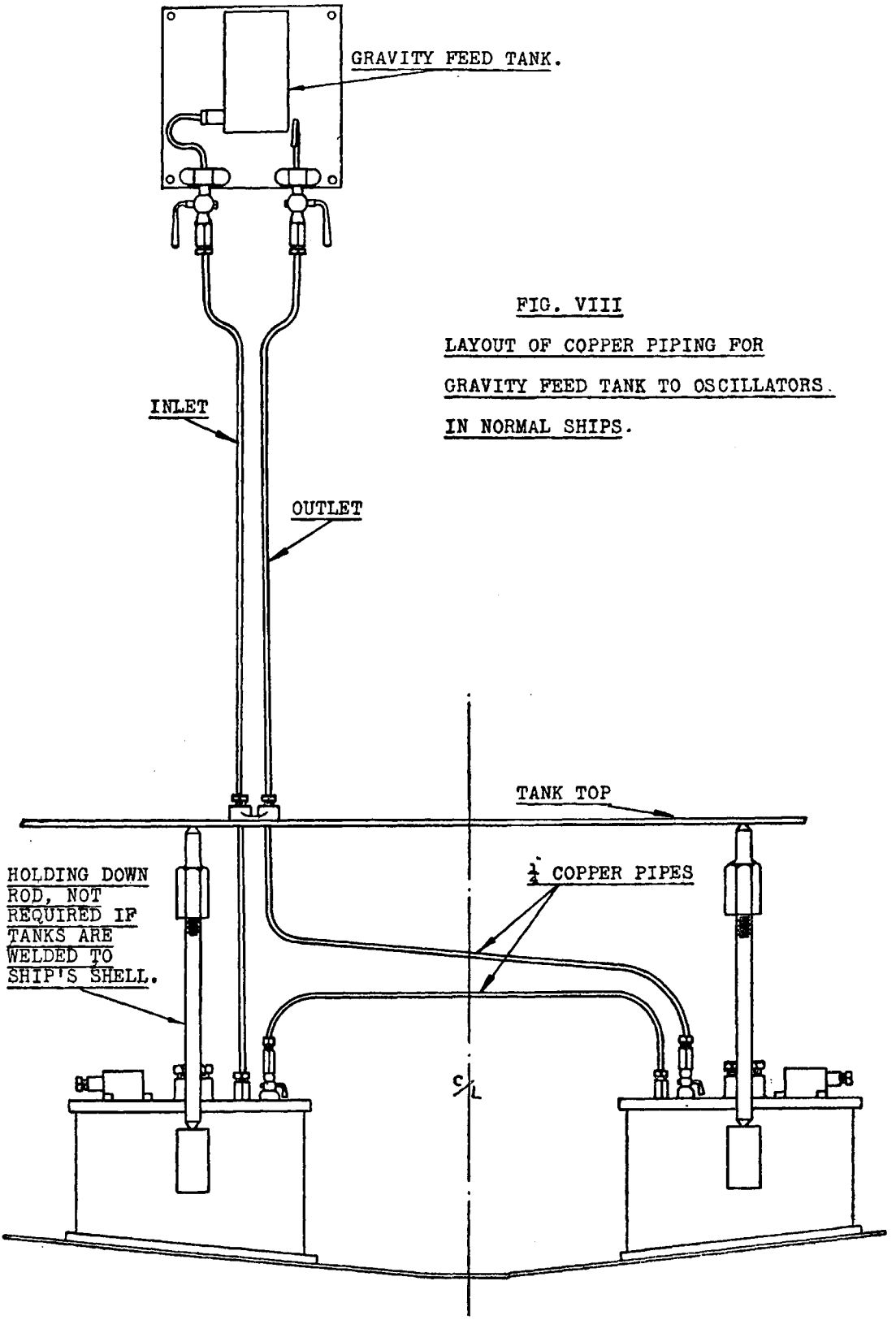
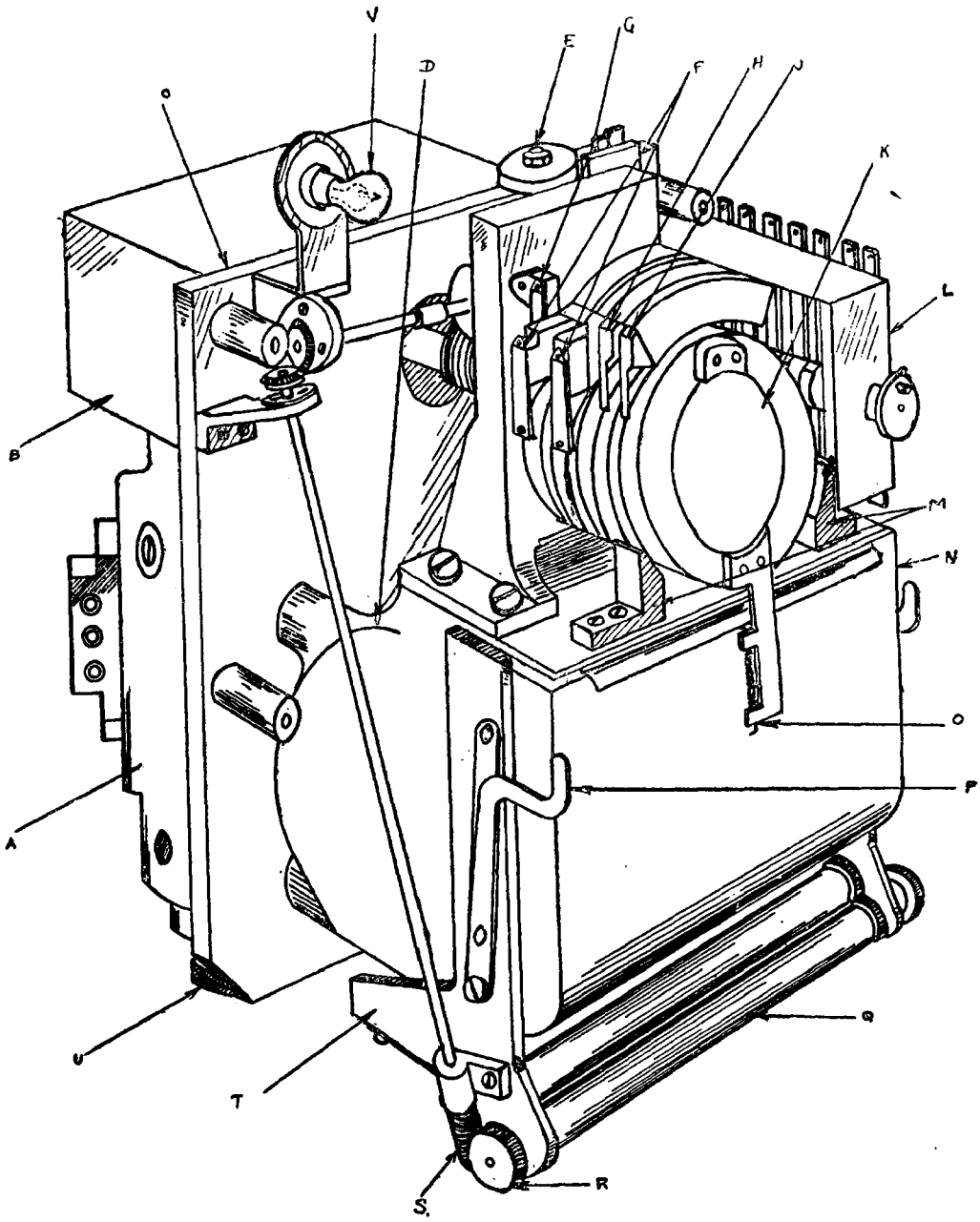


FIG. VIII

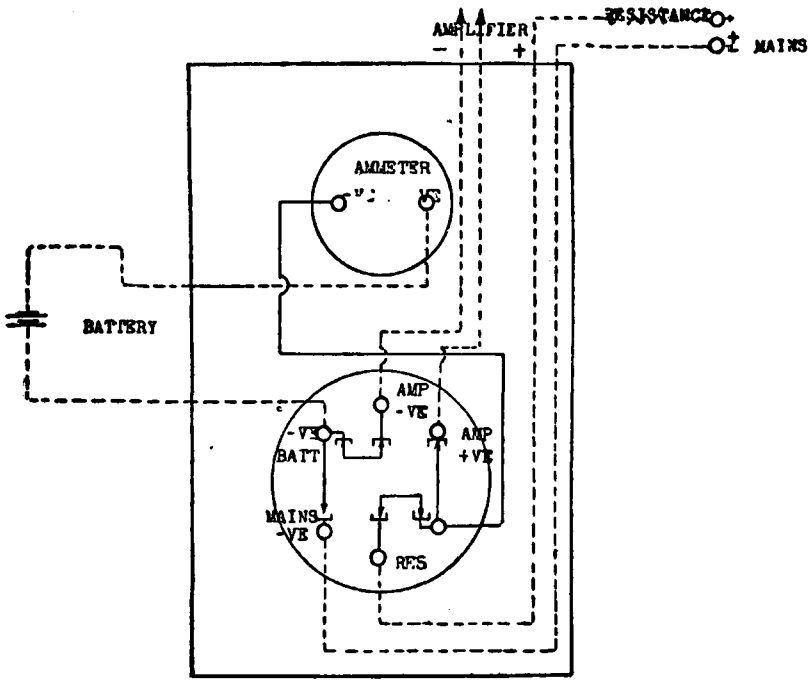
LAYOUT OF COPPER PIPING FOR GRAVITY FEED TANK TO OSCILLATORS. IN NORMAL SHIPS.

SCHEMATIC DIAGRAM

(FRONT VIEW)



HENRY HUGHES & SON LTD.



EXTERNAL WIRING SHOWN DOTTED

BACK VIEW.

give a one way drive to the roller, and therefore allows the roller to be driven by the worm wheel in one direction, and allows the roller to be moved by hand by means of a knob on the right hand side of the roller. This knob is for pulling the paper flat against the cover of the paper trough, or for removing a portion of the chart if required. After the paper passes through the rollers it is then allowed to hang between a heater situated under the case of the Recorder. The heater is in the form of two insulating plates with wire wound round them and a brass cover to prevent damage.

The main switch L is controlled from the outside of the case by means of a flush watertight handle. This handle, besides turning "On" and "Off" the current, also operates the gear change. Thus there are three positions to which the handle can be set, i. e. "ON" with low speed gears engaged; "OFF" or "ON" with High speed gears engaged.

The pen arm is fixed to the outer brass ring under brush J; thus the electrical impulse caused by the echo brought to brush J is transmitted to the cam and the stylus. The stylus is a wire bent down at the ends, one end passes over the paper, and the other passes over the ramps (or insulating blocks). The ramps M are for lifting the stylus on and off the paper. The ramp on the left lifts the stylus while passing over the roller, and lowers it on the paper at the beginning of its traverse across the chart. The ramp on the right again raises the stylus while passing the roller at the top of the trough, and lowers it ready for its next revolution. Attached to this ramp is a rubber wiper which cleanses the stylus every revolution.

The chart and the scale are illuminated by a lamp at the side of the Recorder and controlled by a switch.

The heater for drying the chart is hinged, so that by bringing the heater close to the paper, drying can be made quicker.

ECHO SOUNDING DEVICES

exhibited by the Marconi Sounding Device Company and by the Société de Condensation et d'Applications Mécaniques (S.C.A.M.) during the IVth International Hydrographic Conference, Monaco, 1937.

The MARCONI SOUNDING DEVICE Co, Ltd., Marconi Offices, Electra House, Victoria Embankment, London, W.C. 2, exhibited at the premises of the International Hydrographic Bureau, during the IVth International Hydrographic Conference in April 1937, various echo-sounding devices, with the sale and inspection of which its services are entrusted.

Similar apparatus were exhibited by the SOCIÉTÉ DE CONDENSATION ET D'APPLICATIONS MÉCANIQUES (S.C.A.M.).

The latest patterns include :

The MARCONI ECHOMETER, Type 421, Langevin-Chilowsky system, the description of which is given in *Hydrographic Review,* Vol. VII, N° 2, November 1930, page 105, and Vol. XI, N° 2, November 1934, page 58. This apparatus is graduated up to 160 fathoms. It is the standard big ship equipment worked with a single piezo-electric projector of about one foot in diameter fitted in the bottom of the ship. Soundings are indicated at a rate of 52 soundings per minute, these being shown by means of an oscillographic indicator, which throws a beam of light on the scale. Similar equipment can be supplied with scales of 360 fathoms or 720 fathoms.

The MARCONI ECHOMETER, Type 424. This apparatus is of the Langevin-Florisson type with Echoscope, described in *Hydrographic Review,* Vol. X, N° 2, November 1933, page 170, and Vol. XI, N° 2, November 1934, page 59.

The Echometer, Type 424, is graduated up to 90 fathoms. This equipment is remarkably compact and takes up little space. It is the standard equipment for trawlers and drifters