

When the draught of the ship is great the hull provides sufficient screening for the low-frequency system if the separation is of the order of 50 ft. or more. In ships of very shallow draught, however, it becomes difficult to provide efficient screening and the gear does not discriminate between the echo and the direct sound in shallow water. As already stated, the high-frequency gear requires no hull screening and in this respect should behave well in all types of craft. This property of the high-frequency system is a great asset.

c) *Simplicity and reliability.*

These two factors are of paramount importance in any gear which has to be used under average ship conditions. They become all the more important if the safe navigation of the ship depends on the depth recorder. Although the magnetostriction depth gear has been in use for a relatively short time only, it is possible already to form an estimate of its reliability and to correct some minor faults in its design. The most vulnerable element of any echo sounding gear is the part which is mounted in the water-filled tanks on the hull. These tanks are sometimes wellnigh inaccessible, and a defect in either the transmitter or the receiver is therefore liable to cause inconvenience and expense. In the magnetostriction system, both the transmitter and the receiver function even if flooded with water, so that the maintenance of watertightness is not vital. Provided insulation of good quality is used on the few turns (10 or 12) of wire which constitute the winding of the oscillator, no further attention should subsequently be required during the normal life of the cables. This feature is very important in gear which may be fitted in an almost inaccessible position in the ship.

d) *Directional Properties.*

The magnetostriction system may have any degree of "directionality" required. Hitherto it has been found satisfactory to use a conical beam of sound of semi-apical angle  $20^\circ$  or  $30^\circ$ . The comparative ease with which the receiver can be screened from the transmitter is due to the relatively short wavelength (about 4 in.) of the sound, and the directional properties of the conical reflectors.

Another advantage of the directional characteristic is that the soundings are taken directly, or almost directly, beneath the ship; little or no sound is transmitted sideways and the receiver is therefore insensitive to echoes from submerged cliffs or banks. In this respect also the directional beam is more discriminative of detail than non-directional types and is less liable to miss a submerged rock or a wreck. It has been urged against the directional system that it is affected by the roll of the ship and by steeply sloping banks. Whilst it is true that some echoes may be missed under such conditions, the case is not so bad as it first appears. It must be remembered that the sea-bed is not a mirror, and that sound of short wavelength is returned to the receiver from directions other than the simple reflecting angle. The trawler record shown in Fig. 23 is a sufficient answer. Under the worst conditions of rolling, however, the record of the bottom contour would appear as a dotted instead of a continuous line.

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## RECENT IMPROVEMENTS IN THE ULTRASONIC ECHO SOUNDING APPARATUS

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### *THE ULTRASONIC ECHO SOUNDER OF THE LINER NORMANDIE.*

For reasons of safety all navigational instruments are doubled in their installation aboard the *Normandie*. There are two echo sounders, one sonic and one ultra-sonic. It might interest readers to learn some of the results obtained with the latter apparatus.

At first it was thought that the use of the sonic echo sounder might be accompanied by difficulties on board the *Normandie*, since, owing to the vessel's great speed it was feared the parasitic noises might cause serious interference in the reception.

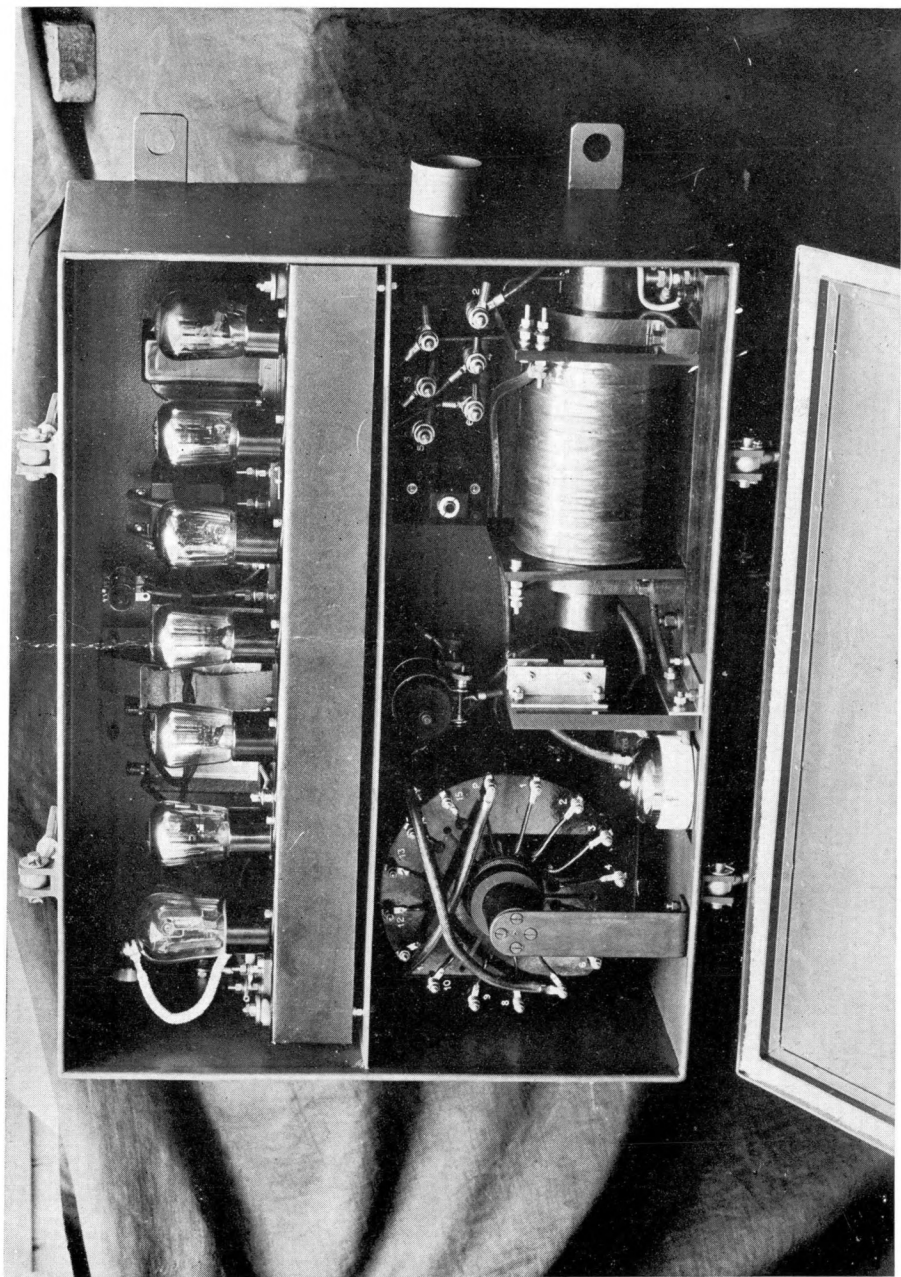


FIG. 2  
*Emetteur-récepteur ultra-sonore ; ouvert.*  
*Ultrasonic emitter-receiver. Open.*



FIG. 6

*Indicateur SCAM-TOULY, type côtier.*

*SCAM-TOULY Indicator, coastal type.*

The apparatus, manufactured by the Société de Condensation et d'Application Mécanique was installed by the C<sup>ie</sup> Radio-Maritime. The installation comprised originally two projectors S 16 of the LANGEVIN-TOULY type, triple-ply, demountable afloat (See *Hydrographic Review*, Vol. XI, No. 2, November 1934, p. 46), installed symmetrically, one to starboard and the other to port (one being in service, the other was provided as a spare); a spark emitter and a receiver in one bottom compartment adjoining the transmitters and finally, in the chart-room, a MARTI recording device of the type 0-200 m. constructed by the firm S. MARTI. Close to the recording receiver was a special sound amplifier with batteries and the apparatus for charging same.

Thanks to the precautions taken in the mounting by the Cie Radio Maritime, the ultrasonic echo sounder functioned satisfactorily from the very first voyages in 1935 at speeds of 28 to 30 knots. There were, however, occasions when the echoes were lacking.

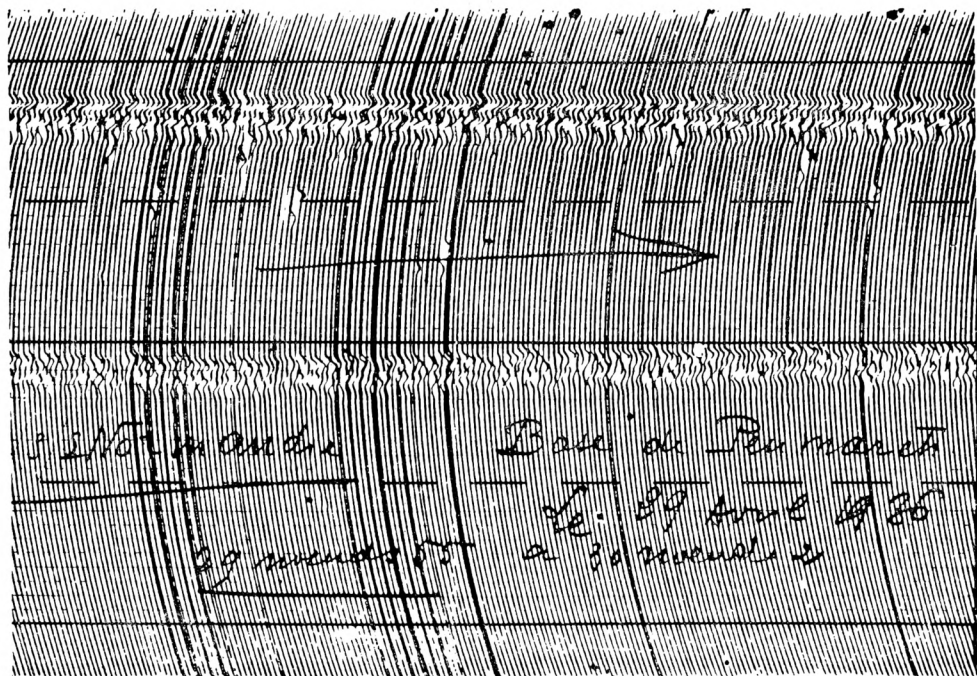


FIG. 1

Record of echoes from the ultrasonic sounding apparatus on board the "Normandie".

In order to improve the operation, one of the S 16 projectors was replaced by a S 4ter projector (surface transmitter with 3-ply quartz plate directly in contact with the sea-water). The results are remarkable and the echoes very intense. The photograph (Fig. 1) shows the shape of the bottom configuration at about 110 metres while the ship was making 30 knots, using 6 lamps only in the amplifier of the ultrasonic receiver. The recording oscillograph was oscillating slightly, which explains the apparent length of the emission and the echo. Note the scarcity of parasitic noises and the sharpness of the echo.

#### NEW ULTRASONIC SOUNDER OF THE LANGEVIN-FLORISSON TYPE WITH SCAM-TOULY RECORDER.

In Vol. XI No. 2, Nov. 1934, p. 46, the *Hydrographic Review* gives a description of the indicator of the SCAM-TOULY type with neon lamp. The S.C.A.M. has now developed a new type of sounder which offers several improvements over the older types. The new sounder is manufactured in two types, viz.—

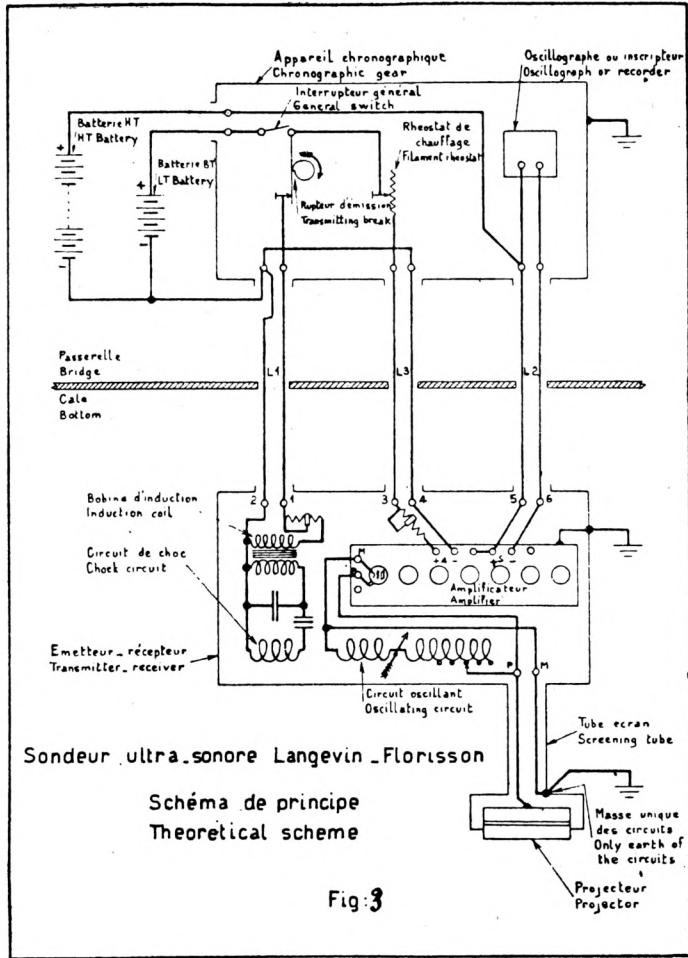
The "Navigation" type (400 metres and 218 fathoms).

The "Coastal" type (150 metres and 62 fathoms).

*The Ultrasonic Projector.* The projectors have undergone no change; generally the

S. 23 projector (with effective emitter diameter of 100 mm.) is used with the "Coastal" type and the projectors S. 4ter or S. 16 (effective diameter of emitter, 220 mm.) with the "Navigation" type. In certain cases, where it is desired to sound to very great depths, the projector S. 7bis is employed (with effective diameter of emitter of 310 mm.).

*Emitter-Receiver.* A metallic cabinet, with water-tight openings, is located in an easily accessible place near the projector, containing (Fig. 2) the transmission apparatus at the bottom with the amplifying device above. On the left wall there is attached in



a water-tight manner the screening tube coming from the projector. Fig. 3 shows in diagram the principle of the apparatus. Three cables with two conductors connect the emitter-receiver with the chronographic apparatus (indicator or recorder). The emission cable  $L_1$  is led to the induction coil. The secondary windings of this coil excite the choke circuit with the discharge spark gap, the choke circuit being coupled with the oscillating circuit of the projector. A fixed resistance in series with the primary of the emission coil permits an adjustment of the hook-up as well as a permanent adjustment of the intensity (according to the length of the lead  $L_1$ ). The oscillating circuit is fitted with a certain number of connections and, further, comprises two sliding coils on a tube support. In this manner there is a possibility of an easy adjustment of the frequency most suitable to the type of projector in use. These are :

Projector S.23 .....	65 kilo-cycles.
» S.4ter .....	37 »
» S.16 .....	39 »
» S.7bis .....	29 »



FIG. 4

*Indicateur de fonds système SCAM-TOULY.  
Echo sounding indicator SCAM-TOULY type.*

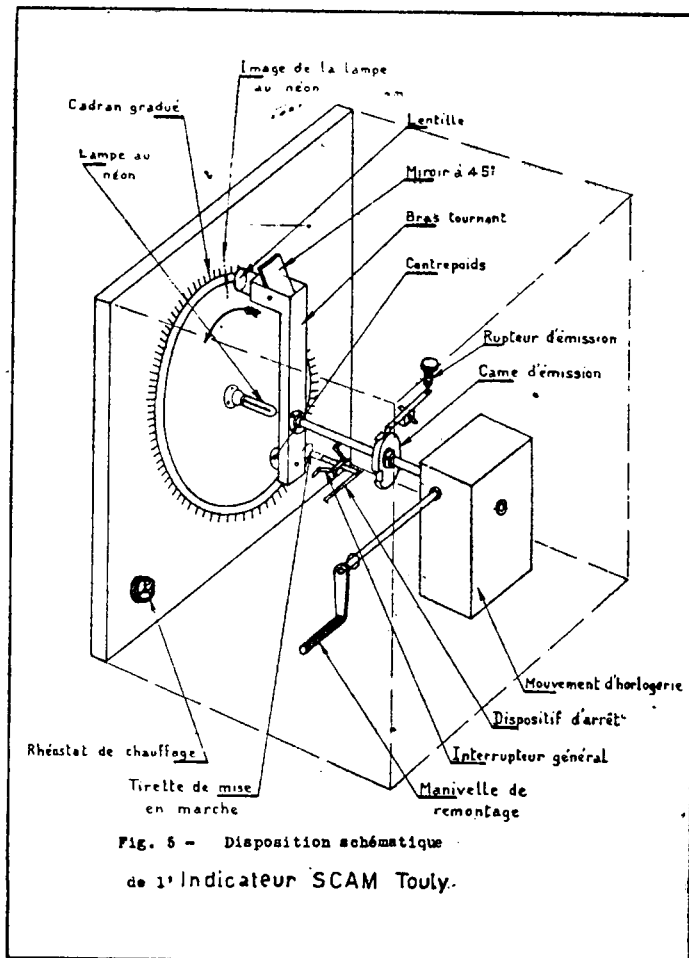


FIG. 5

Diagrammatic representation of the SCAM-TOULY indicator.

The receiver has 7 tubes. The supply tube is of a special type with insulated grid, called a "horn" tube. The last tube is of a different type depending upon the type of chronograph employed.

The tubes are supplied by a battery of 4, 6 or 8 volts, a galvanic battery of 80 volts (for the plate voltage) and a polarisation battery of (-4 to -13 volts).

*BOTTOM INDICATOR, SCAM-TOULY SYSTEM. (Hydrographic Review, Vol. XI, No. 2, p. 48).*

The new indicator (Fig. 4) does not differ essentially from the old but at the same time comprises several important improvements.

The electric motor is replaced by a robust clock mechanism making 15 turns in 8 seconds. A handle to one side, at the right, is furnished for winding up the mechanism, each winding providing for an operation of about 10 minutes' duration.

The electrode neon tube in the shape of a spiral is replaced in this new indicator by a special rectilinear neon lamp with three electrodes which has the further advantage of being an oscillograph. Fig. 5 shows the diagram of the circuits. The neon lamp is secured behind the dial and in the axis of the graduated circle. An arm, revolving at a constant speed due to the clock mechanism, carries a mirror at 45° and a lens arranged in such a manner that the lamp throws a beam of light on the graduated scale. On the axis of the device one sees the position with regard to the zero mark on the



scale at the instant of emission — or, generally speaking, the graduation corresponding to the draft of the ship.

The dial is graduated around the entire circumference. Thus the indicator provides for the possibility of reading equally the depths comprised between 400 and 800 metres. The reading of the echoes is facilitated by the push-button switch located at the bottom and to the left of the dial which allows the emission to be suppressed as desired.

The apparatus is started and stopped by means of a push button located to the left and below the dial. This button releases the rotating arm and closes the main switch of the sounder.

The neon lamp is supplied by a dry galvanic battery, well insulated, of 220 volts. The appearance of the luminous streak caused by the echo gives some indication of the nature of the bottom. A single narrow line shows a flat bottom or one slightly inclined. With a smooth bottom and inclined surface the line will be less brilliant and wider. Where there are indentations in the bottom, cliffs or wrecks, there will be a group of lines observed (multiple echoes). Where the bottom is soft mud (ports, mouths of rivers etc.), one frequently notes two echoes, one coming from the surface of the soft mud and the other from the hard bottom beneath.

Fig. 6 shows the "Coastal" type of indication. Its scale is limited to 150 metres.

*ELECTROLYTIC RECORDER : SCAM TOULY SYSTEM.* (Patent SGDG - license MARTI).

In this recorder for ultrasonic soundings, recently brought out by S.C.A.M., there is employed a band of moist electrolytic paper, which unrolls slowly from top to bottom. This band is supported on a metal surface which is connected to the negative pole of the circuit leading from the amplifier. In front of the paper a metallic stylus is carried by a moving arm. By means of a suitable cam, the arm describes the arc of a circle from left to right, transverse to the band, at a pre-determined speed, returning rapidly to the position of rest at the left. The same movements are repeated periodically. The stylus is connected to the positive pole of the circuit leading from the amplifier.

At the beginning of the movement of the stylus across the band a second cam releases the ultrasonic emitter by means of an interrupter. Thereupon the current coming from the amplifier passing through the stylus to the metal plate through the moist paper electrolytically decomposes the salts with which the paper is impregnated and leaves a brown mark on the paper. With each arc described by the stylus one sees the first mark on the paper corresponding to the instant of emission of the signal and a second mark given by the echo of the signal. As the paper slowly unrolls, the beginnings of the echoes successively traced on the paper, show the profile of the ocean bottom at a scale depending upon the speed of the vessel. An interrupting device electrically insulates the stylus during the time it is returning to its zero position.

In order to facilitate the depth reading, a cylinder with disks marked at equidistant intervals presses against the moist paper and marks by electrolysis the lines corresponding to each 10 metres' depth. Fig. 7 shows the graphic record. The first dotted line above indicates the level of the ocean. Below these are shown the lines of emitted signals. The entire width of the band is graduated from 0 to 300 metres. The sharpness of the echoes and the distinctness of the marks obtained is due in this case to the fact that here there is no vibratory movement of the pen of the oscillograph.

Fig. 8 shows the external appearance of the apparatus and Fig. 9 shows the instrument with the cover removed. A wall stand of some light alloy is attached to the bulkhead and supports the entire apparatus. The dimensions are 454 mm. breadth, 796 mm. height and 323 mm. width. A large window in the box permits the apparatus to be viewed while in operation, with the cover in place. An opening at the top gives access to the control and regulating devices of the apparatus.

The paper, which is the result of long and difficult research, is delivered in a sealed watertight box, and moistened in advance ready for immediate use. It has a width of 185 mm. the registering portion having a width of 150 mm. In the most popular model of recording device, the soundings are made every 3 seconds and the paper unrolls in such a manner that the arcs of the successive circles are spaced 0.75 mm. apart. The unrolling rate is 90 cm. per hour. By means of a copying stylus one can mark on the record any note or information desired (such as the hour, position, etc...) without stopping the operation of the device.



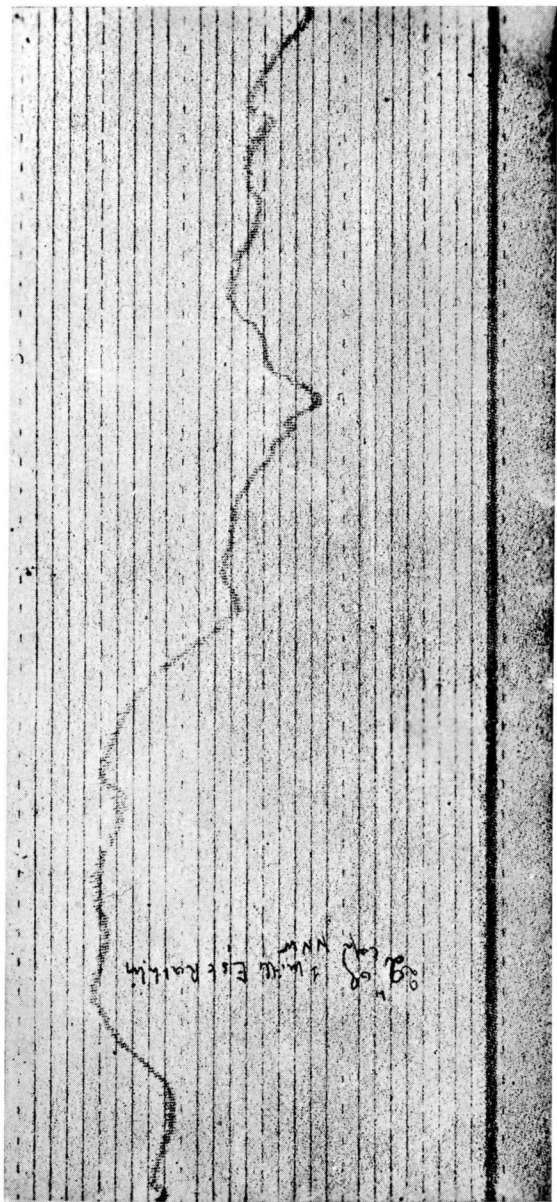


FIG. 7

Reproduction d'un enregistrement par électrolyse d'échos ultra-sonores.

Electrolytic reproduction of a record of ultrasonic echoes.

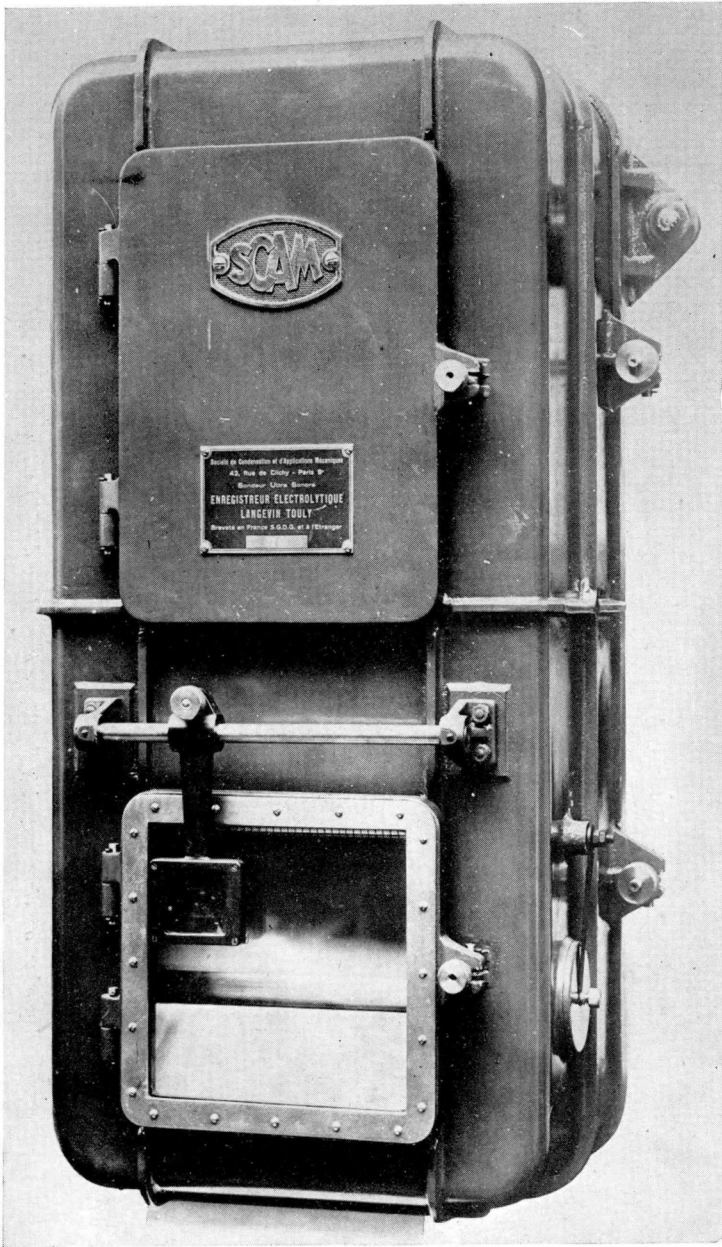


FIG. 8.

*Enregistreur électrolytique. système SCAM-TOULY, licence MARTI.*

*Electrolytic recorder, SCAM-TOULY system : MARTI license.*

A large magnifying glass located outside permits one to read the soundings more closely if desired.

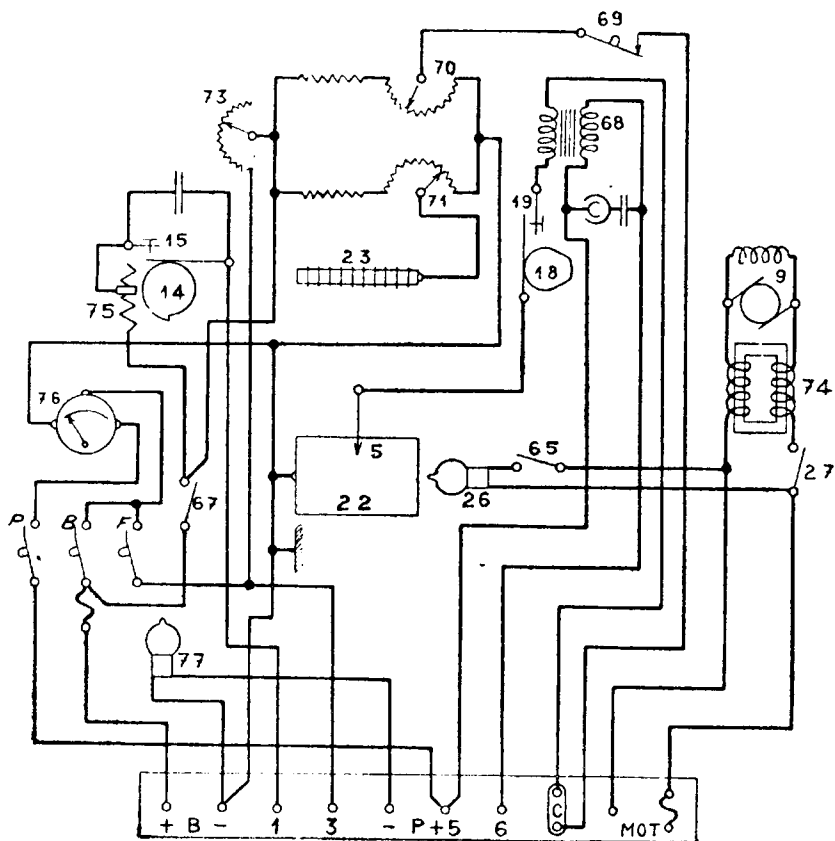


FIG. 10  
Diagram of the electrolytic recorder.

Fig. 10 shows the diagram of the apparatus. The marks are the same as on Fig. 9. At the top, on the right is the electric motor 9 (generally a 7-volt motor operating on a storage battery of 8 volts) and the centrifugal speed regulator 11. The constant speed shaft of this motor drives through reduction gear comprising a pinion and tangent screw, and cam and the emission interrupter 19, the cam 16 and the oscillating arm 17 with the stylus 5.

The roll of paper is held in the paper box 21 which carries the metal plate 22 where the inscriptions are made, the marking roller 23 and the mechanism for winding the paper 24. A lamp 26, illuminates the paper in the region of the marking.

At the top of the paper are the various devices: 6 is the switch for starting and stopping; 27 the switch of the motor; and 56 the switch for the illuminating lamp. The potentiometer of the stylus 70 provides the stylus with a small positive potential which is adjustable so that the stylus may leave a faint trace on the paper of the arc described, thus facilitating following the signal to its corresponding echo. A marking button for the hours 69 is provided so that a slight mark can be made when the button is pressed which serves as an indication on the diagram when no written memorandum is made. The potentiometer 71 of the marking cylinder indicating the depth markings can be adjusted as desired in order to regulate the intensity of these graduations on the paper band. Finally, at 73 is the rheostat for the adjustment of the sensitivity of the instrument. This is actually the heating rheostat of the receiving amplifier (the apparatus operates with the same emitter-receiver as the SCAM-TOULY indicator, with however a power tube inserted in the last stage of the amplifier).

A voltmeter, 76, indicates as desired the voltages of the anode battery of the amplifier, the 8-volt storage battery and the heating circuit for the filaments of the tubes in the amplifier when buttons marked *P*, *B* and *F* are turned.

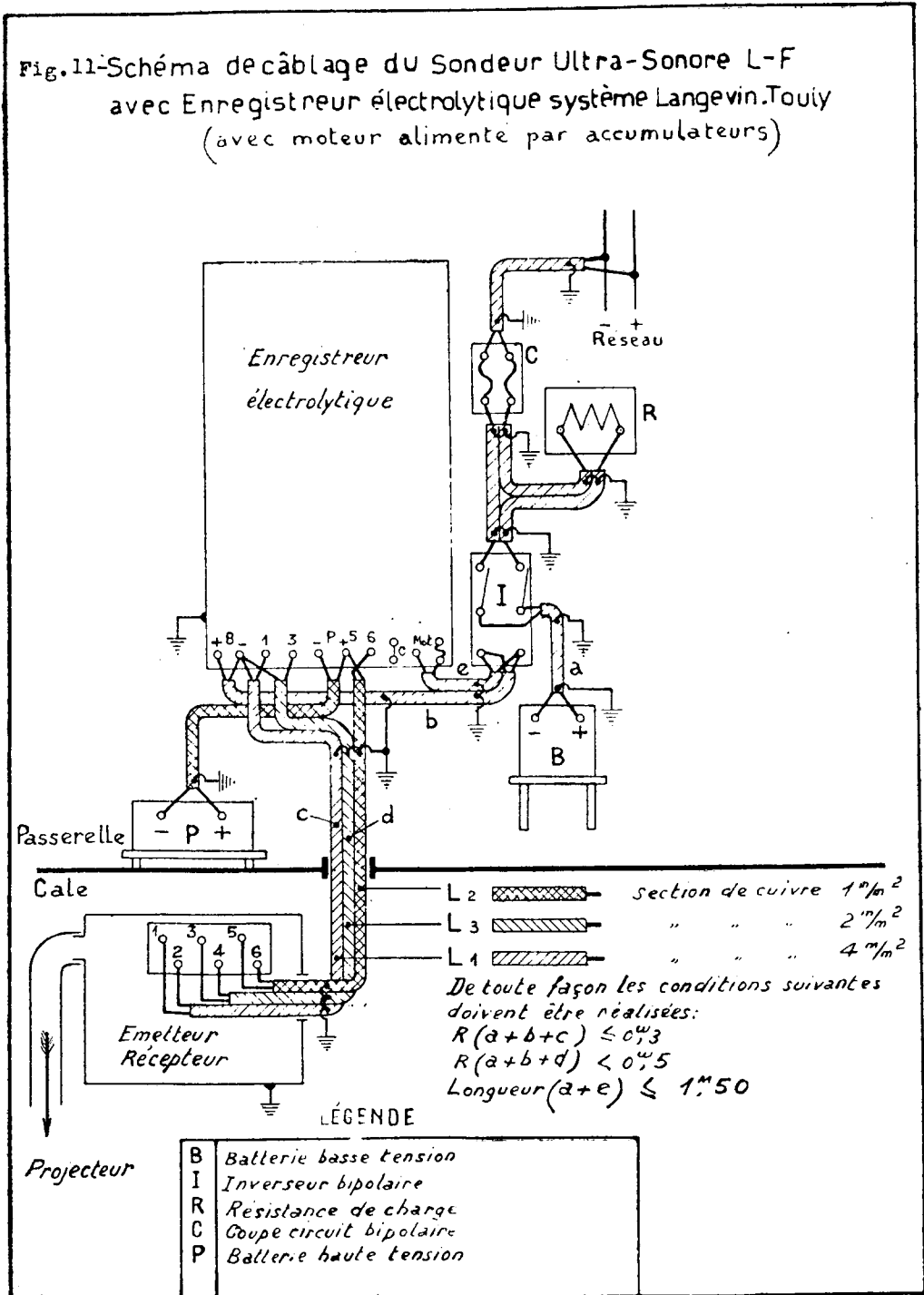


FIG. 11

Wiring Diagram of the Ultrasonic Sounder L. F. with electrolytic recorder, Langevin-Touly system

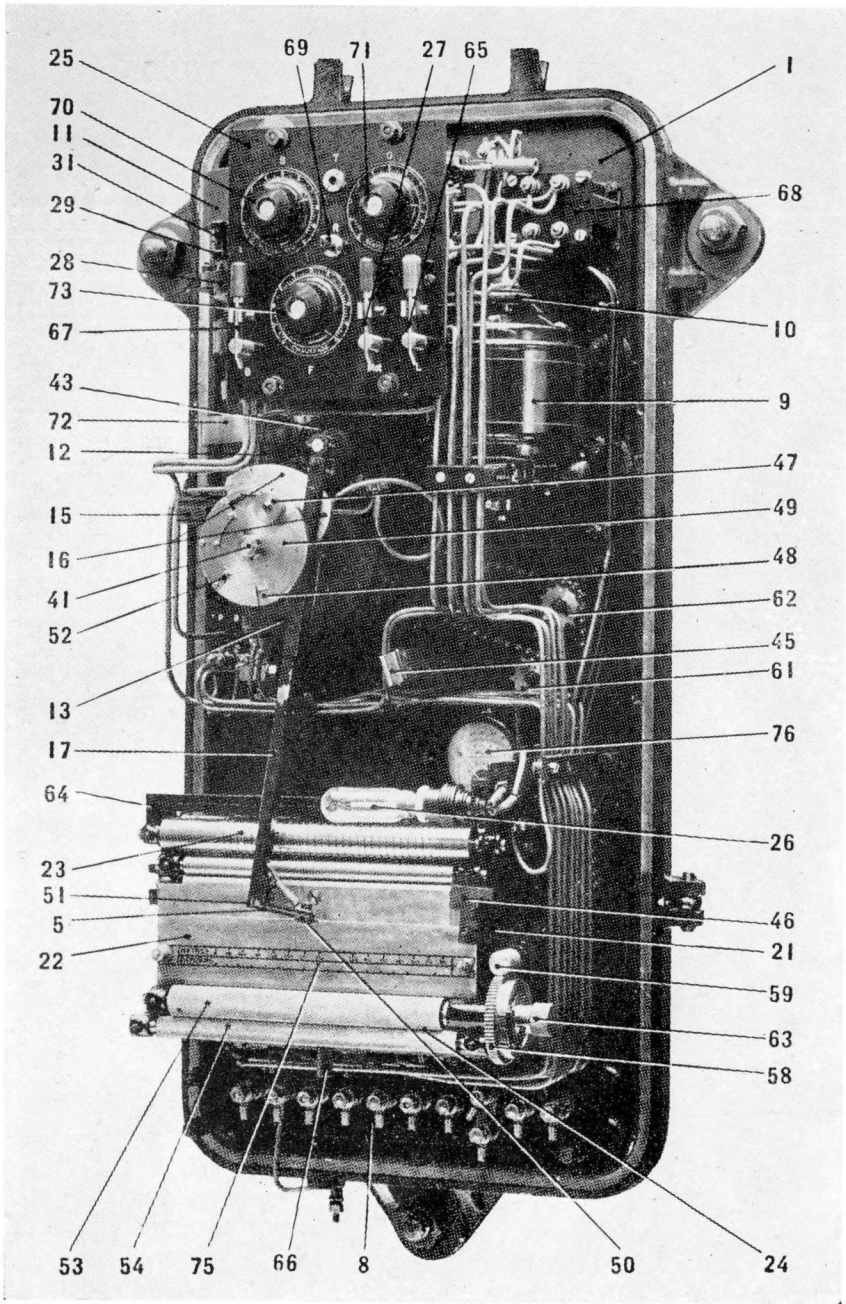


FIG. 9  
 Enregistreur électrolytique, capot enlevé.  
 Electrolytic recorder - Cover removed.

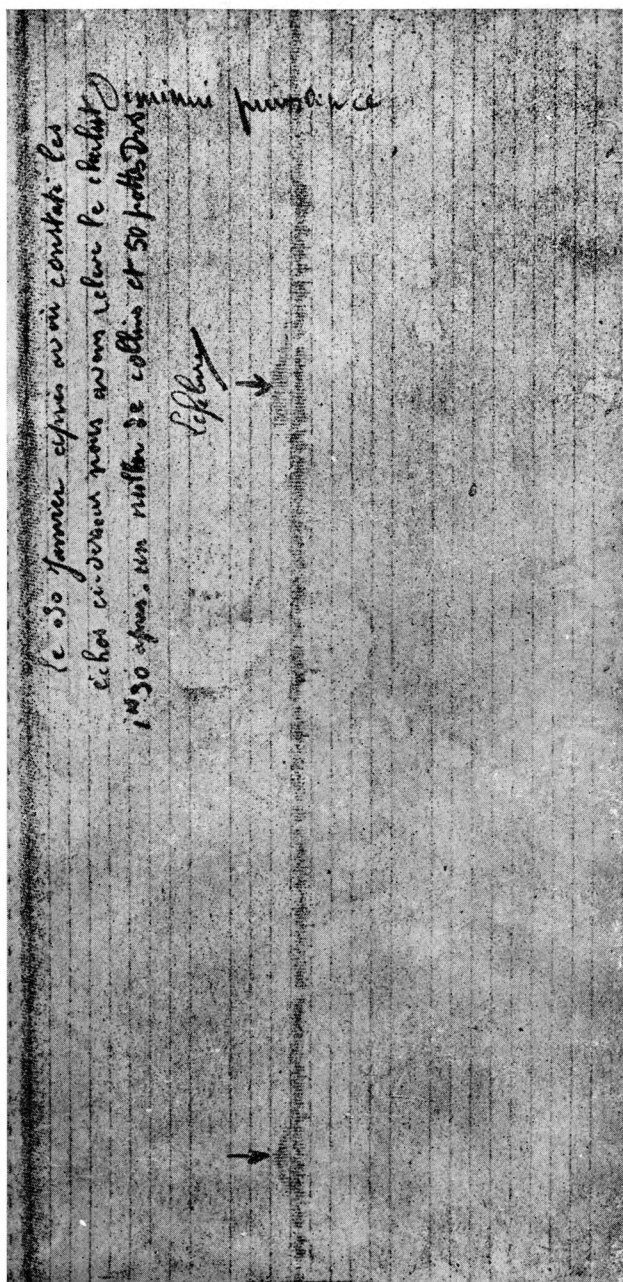


FIG. 12

Reproduction photographique d'un enregistrement d'échos ultra-sonores sur bancs de poissons.  
 Photographic reproduction of the record of ultrasonic echoes from a shoal of fish.

At 52 is the device for changing the zone of the recording apparatus. By means of a locking screw 47 the inscription cam is shifted with relation to the emission cam so that the angles correspond mechanically to the successive multiples of 300 metres.

At the bottom of the apparatus, at 6, is the limiting plate.

The registering paper leaves through a small opening at the bottom of the box and rapidly dries in the open air. It may be caught in a basket, for instance, placed below the instrument.

If the recording device has remained inoperative for some time it will suffice to unroll by hand a little of the paper until a place is reached where the paper is still moist and therefore sensitive. In case the apparatus is to be stopped for a prolonged period, the unused portion of the roll may be returned to the box and preserved for some time in this manner.

Fig. 11 shows the general wiring diagram of the ultrasonic sounder *FL* with the electrolytic recording device.

The new type of recorder has several important practical advantages.

Although reduced in size to prevent incumbrance, it is a robust apparatus for use on board, giving great accuracy; and is easy to operate. It requires no smoke apparatus or ink-filled recording pen and does not necessitate a special amplifier (with its batteries and its charging devices).

It is thought that the following rather curious record obtained by a trawler from Boulogne in the North Sea which is reproduced here (Fig. 12) might be of interest. While steaming without the trawls the recording device was in operation when the attention of the captain was attracted by the phenomenon of a very clear double echo (shown by the arrow at the left) which was repeated after about a dozen echoes. After some time the phenomenon was again repeated (arrow at the right) with the same clearness, and the captain decided to return to the locality and put over his drag-nets. After one and a half hours the nets were drawn in filled with fish, as certified elsewhere by the inscription on the band made by the owner of the vessel. This gives proof of the possibility, long suspected, of obtaining echoes from shoals of fish. The phenomenon, furthermore, has been confirmed several times, especially with shoals of herring.

