

NEW TYPES OF ULTRA-SONIC SOUNDERS

by

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Ultra-sonic echo-sounding apparatus of the Langevin-Chilowsky system have already been described in *Hydrographic Review*, Volume XV, No. 2 (Nov. 1938, pp. 30-54). It has been possible to pursue certain research work during the years of the occupation and the present article is intended to give the results thereof.

It is known that the Langevin-Florisson ultra-sonic sounding equipment consists mainly of :—

- a) Ultra-sonic projector ;
- b) Transmitting-receiving apparatus ;
- c) The depths-reading apparatus—indicator or recorder ;
- d) The source of electric power and the electrical protection devices.

Ultra-sonic projector (1). — The aim of the new research work was mainly to do away with the brittleness of the projector to shocks, to increase its power although reducing weight and dimensions. The projector still includes the vibrating triplet with steel plates and piezo-electric quartz mosaic; it is, however, made and mounted in a new way. The quartz is connected to the steel plate by means of a gluey substance remaining permanently in a "pasty" condition (i.e. unbreakable), and the inner plate is strongly maintained in position at the moment when the projector is mounted at the workshop by means of isolating and elastic wedges. Thanks to these arrangements and to the use of watertight joints, the new projector is of very great strength (2). Further, the projector is non-sensitive to the influence of hydrostatic pressure. The latter may increase or decrease abruptly by 15 kg/cm² (213 lbs/sq. in.) or even more without the transmitting and receiving power of the instrument being altered. With the same useful transmitting diameter, the new projector, compared with the former, has an electroacoustic output improved by about 30%.

The following series of piezo-electric ultra-sonic projectors have been created by the SCAM :—

Type	Useful diameter	Proper frequency	Mean range	Use
S.23	100 mm.	65,200 p.s.	1,50(3) to 150 m.	Coastal service, estuaries, roadsteads, etc.
S.32	140 mm.	53,200 p.s.	2 to 300 m.	Hydrography, small coasting vessels, small trawlers.
S.24	220 mm.	37,500 p.s.	2 to 800 m.	Hydrography, general navigation (iron-built ships); trawlers.
S.30	220 mm.	37,500 p.s.	2 to 800 m.	Hydrography, general navigation (wooden-built ships, submarines).
S.34	310 mm.	29,150 p.s.	3 to 2000 m.	Great depths service and cable ships.

Figures 1 and 2 show the projectors in common use, type S.24 and S.30.

The advantages relative to weight and dimension obtained for the whole apparatus fixed to the hull and fitted with S.24 projector (instead of S.4 ter) are, for instance, as follows :—

(1) S.G.D.G. patent.

(2) Out of 418 projectors of this new system already in service 10 apparatuses have been examined at the workshops after several years' functioning. None of them show any modification of power. One of them had been mounted on the trawler « Cap-Nord » which was damaged astern in July 1946 by a mine.

(3) If desired, soundings may be operated from 20 to 30 cm. (8 to 12 in.) depth by using two projectors in close proximity to one another, one for transmitting, the other for reception.

1° *Weight.*

Former S. 4 ter projector with fixings	98 kg.
Pedestal	<u>148 —</u>
	Total..... 246 kg.
	(540 lbs)
S.24 projector (including fixings)	49 kg.
Pedestal	<u>50 —</u>
	Total..... 99 kg.
	(217 lbs)

Consequent diminution in weight : 60%.

2° *Dimension.* The hull unit fitted with S.4 ter is on an average 192 mm. (7.5 in.) high; the diameter of the hull adjustment is 620 mm. (24.5 in.) For the S.24, these dimensions are respectively 110 mm. (4.5 in.) and 535 mm. (21 in.). The height and the diameter are thus reduced by 43% and 14% respectively.

Type 0-15 transmitter-receiver. — The transmitting unit, still on the spark system, has not been altered from that used in the former transmitting-receiving apparatus. However, improvements have been made in the shock circuit resulting in higher ultra-sonic transmitting power.

The receiving unit includes a new 4 penthode-valves amplifier, using about 220-volt anode tension. The sensitivity, higher than that of the former amplifier, is controlled by means of a potentiometer polarising a variable slope characteristic valve which is placed inside the indicator or recording apparatus.

The whole system is placed in a watertight coffer the dimensions of which have been slightly reduced. It is mounted in the vicinity of the projector and needs no watching. Figure 3 shows the apparatus closed; figure 4, the apparatus open. The transmitting unit is shown at the lower part, the induction coil at the right hand, the tuning coil on the left, and the receiving unit on the upper part.

418-type indicator. — This indicator is similar to the former 0-400 metre *clockwork* type. It is contained in an alpac box with improved impermeability; the electric-wire entrance is fitted with stuffing-box. The dimensions of the apparatus have been reduced. Figure 5 shows the apparatus from the exterior, fitted with the following controls :—

- Crank for winding-up the clockwork ;
- On-off switch on the right side laterally ;
- Handle regulating the sensitivity controlling the polarising potentiometer (at the lower part of the front side, left) ;
- Nut for interrupting transmission (at the lower part, front, right), enabling soundings to be taken beyond 400 metres, (219 fathoms).

The dial diameter is 198 mm. (8 in.). In this type of apparatus the clockwork has been retained on account of its simplicity and also because of the absence of electrical interferences. The revolution speed is 1.875 revolutions per second, i.e. 15 revolutions per 8 seconds, corresponding to 400 metres (219 fathoms) range for a complete revolution of the dial. The former neon valve, of rather weak luminosity, has been replaced by a new neon valve, so-called No. 4 type, of larger luminous power; this greatly facilitates the reading of depth indications. The ciphers and divisions of the plexiglas dial are indirectly lighted by means of three 6.5-volt 0.3 A. bulbs connected parallel wise, with a small controlling resistance in series. These three bulbs are located in the metal cover placed at the centre of the dial, the filaments being located in the plane of the dial in order to procure diffused light on the latter. The intensity of the lighting is regulated so as to permit the convenient use of the apparatus during the night.

Figure 6 shows the interior of the apparatus, the front being open. On the right-hand side is the winding-up crank; underneath, the on-off switch; in the centre the rotating bulb-bearing arm, and to the left the voltmeter permanently connected to the accumulator battery terminals during the sounding operation, thus enabling the accumulator voltage to be ascertained.

The width of the transmitting and echo light spot varies according to the duration of the electrical impulse corresponding to the transmission or to the echo of the reception, at the exit of the amplifier.

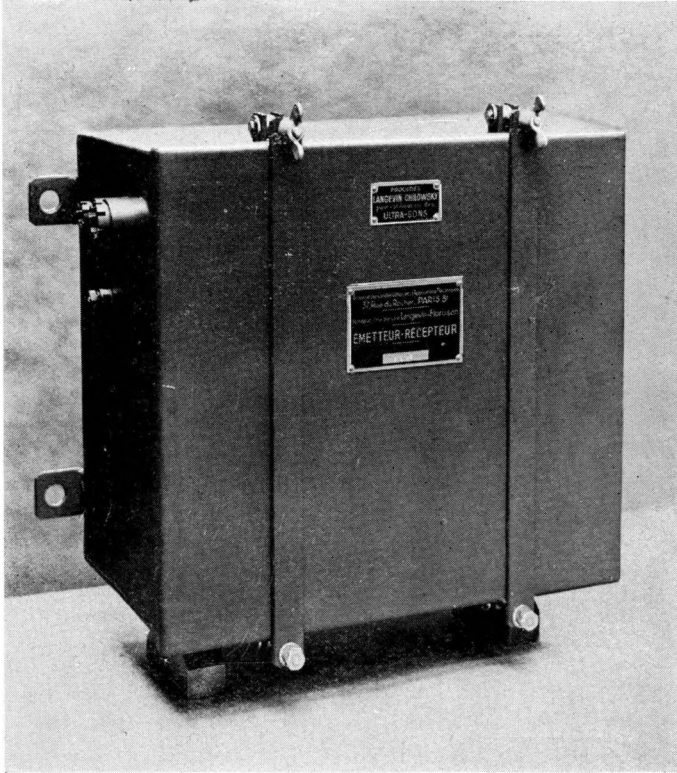


Fig. 3

Transmitter-receiver (type 015) closed up.

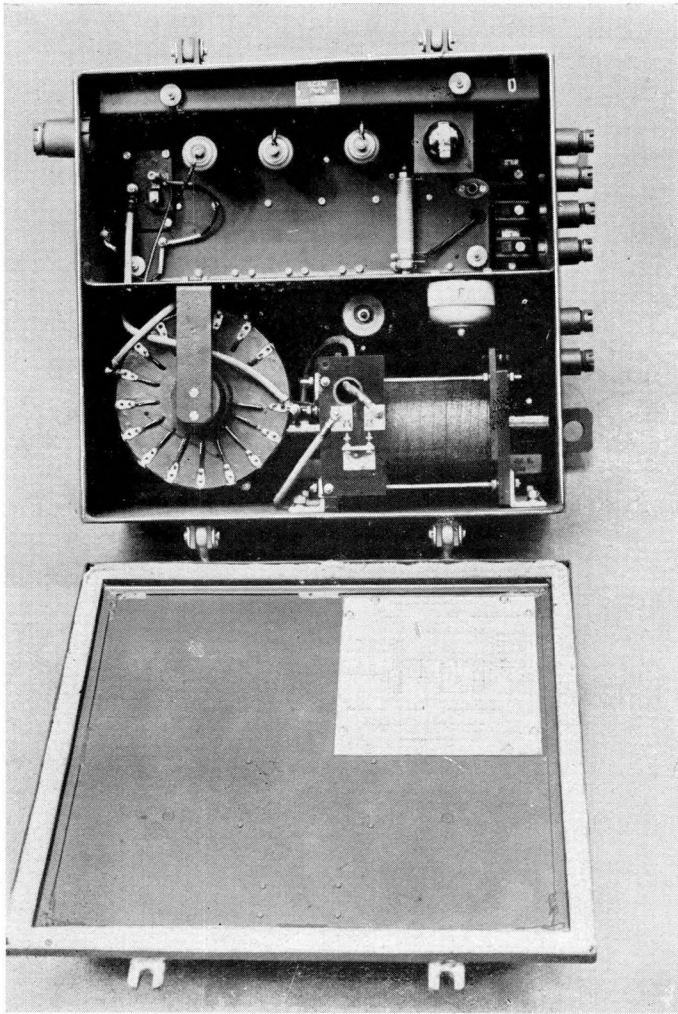


Fig. 4
Transmitter-receiver (type 015) open.

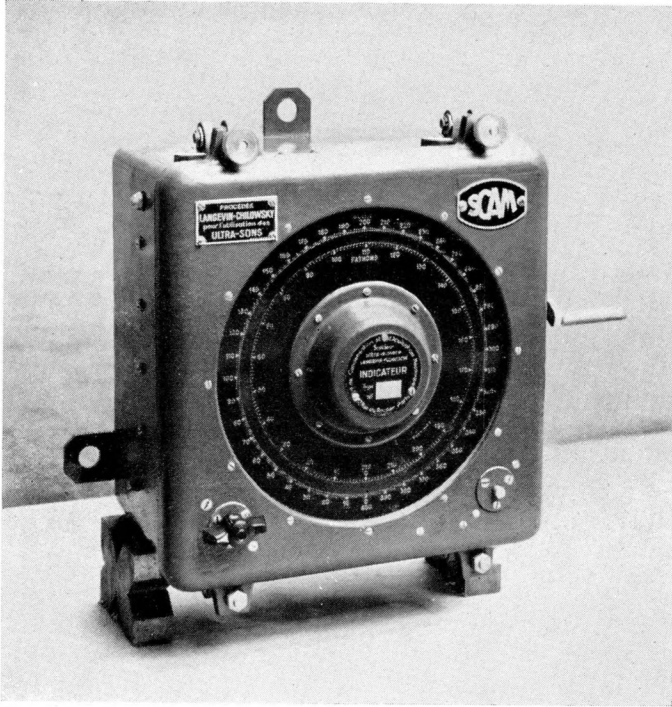


Fig. 5
Indicator (type 418)

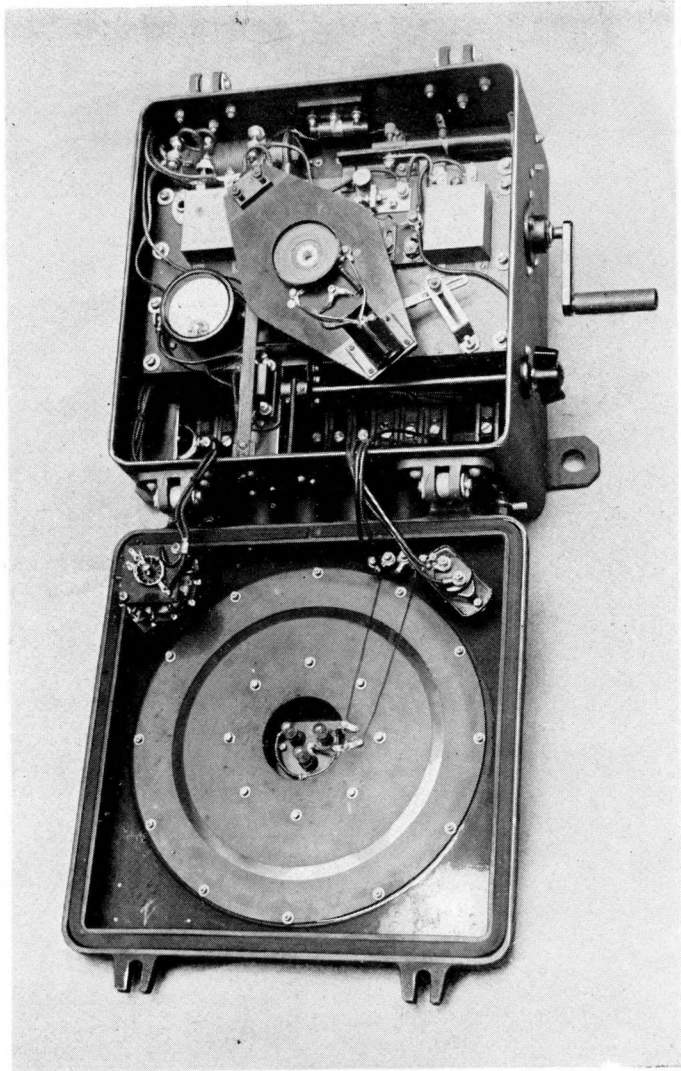


Fig. 6
Indicator (type 418) open.



Fig. 7

Indicator (type 420) with double reading scale.

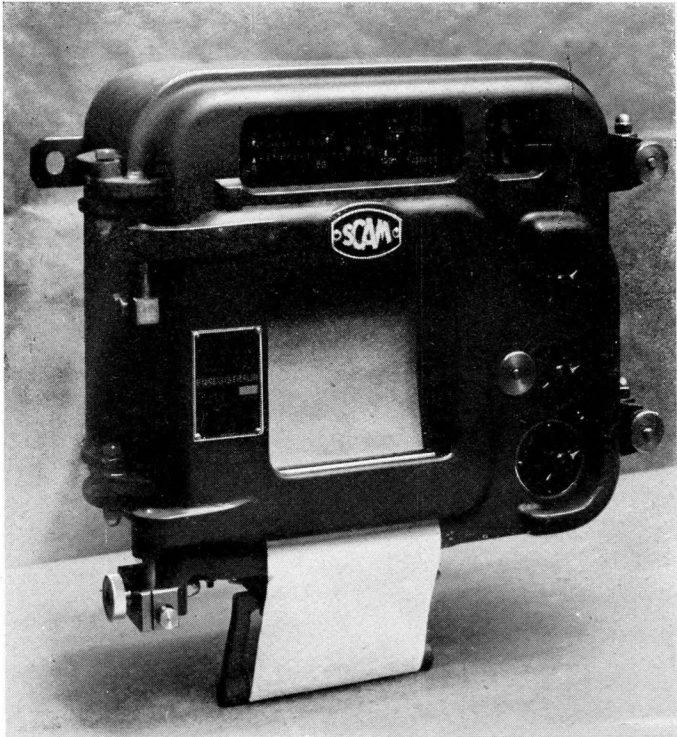


Fig. 8
Recorder-indicator (type 419).

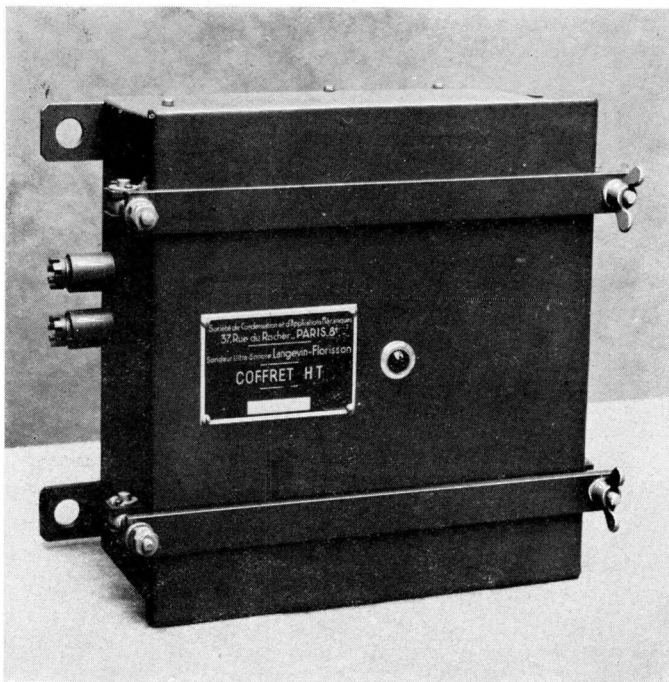


Fig. 9
Coffer H.T. closed up.

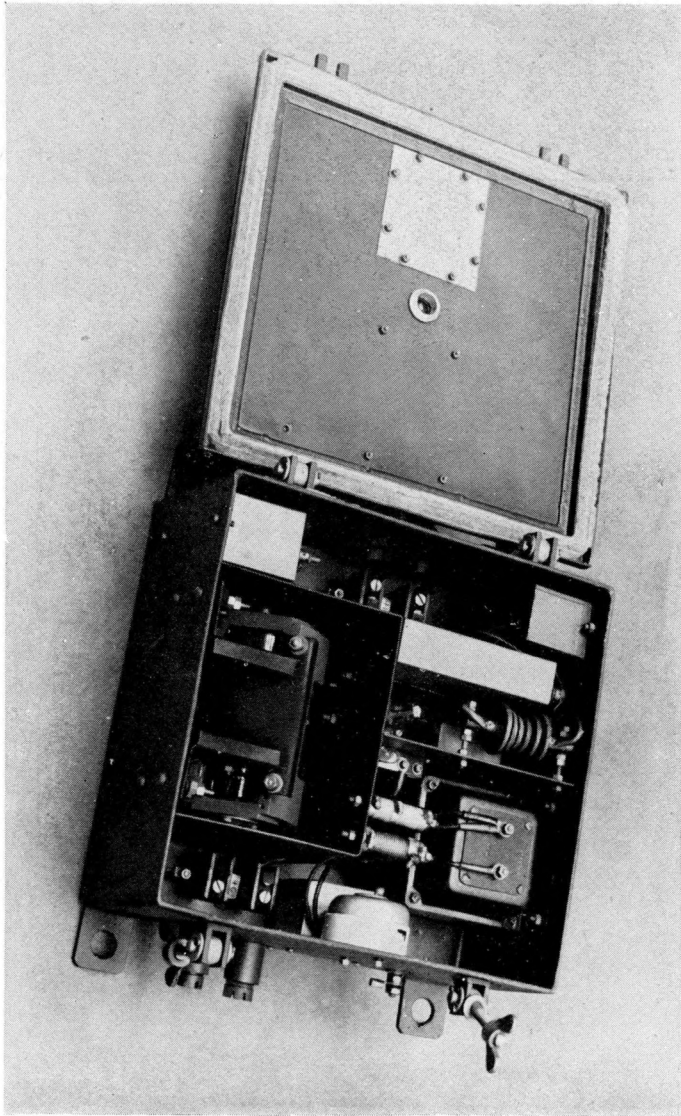


Fig. 10
Coffer H.T. open.

a) *When the sea-bottom is flat or slightly sloping*, the duration of the reflected wave train (echo) is equal to that of the incidence wave train (transmission). Consequently, a flat or very slightly sloping bottom is shown on the dial by a single, thin echo line.

b) *With a sea-bottom very much sloping but even*, the reflected wave train is "spread in time" and the echo, while being less intense, other conditions being equal, has a longer duration than that of the transmission; the echo spot line is less luminous and larger.

c) *When the sea-bottom is sloping and irregular*, the reflected wave train is prolonged and presents intensity maxima corresponding to the horizontal planes tangent to the "troughs" and to the "crests" of the bottom. Such bottom therefore appears on the dial as a large echo, streaked with more luminous lines.

d) *When the sea-bottom shows pronounced irregularities, (inequalities):* submarine cliffs, wrecks, etc., the principal horizontal planes of the bottom irregularity produce separate echoes. Consequently, echoes with multiple lines are noted on the dial. The intervals of the lines show the relative vertical distances of the principal planes to the bottom inequality.

e) When the bottom shows a thick soft-mud layer, (in harbours or at river entrances, etc...) two echoes are occasionally observed: one due to the mud surface, the other produced by the hard bottom, so that the thickness of the mud layer may be determined by means of the sounding apparatus.

420-type indicator. — This indicator differs from the preceding in that it possesses an electric motor and two sounding scales 0-60 and 0-600 metres (diameters 152 and 228 mm. (6 and 9 in.) respectively). The electric motor fitted with SGD patent electric speed control, sets in motion two coaxial discs, turning behind the dials, each bearing a type-4 neon bulb. The inner disc which is directly connected on the motor axis makes 750/minute revolutions and permits an accurate reading of small depths on the 0-60 dial (25 soundings per 4 seconds). The other disc, set in motion by a demultiplication ratio 1/10th permits the reading of the depth-indication on the 0-600 m. dial (5 soundings per 4 seconds), also soundings in depths greater than 600 metres (328 fathoms): the dial is fully divided, as for the 418-type indicator, and shows no divisional interruption.

A switch is provided for instantaneously connecting the receiver either to the 0-60 dial indicating-bulb or to the 0-600 dial bulb.

The same arrangement in watertight alpac casing is used in the 420-type indicator, also indirect lighting of the dials for night work. The distribution has been specially studied with a view to facilitating access to the various inner parts.

Figure 7 shows the external view of the 420-type indicator.

Recording indicator 419-type (fig. 8). — As compared with the former recording model, this apparatus brings a large number of important improvements. At the lower part of the apparatus is found an electrolytical recorder using the SCAM marine-type paper strip 152 mm. (6 in.) wide. The motion of the stylus is rectangular and uniform; this is obtained by means of a SGD patent arrangement consisting of an endless chain running between two lateral cogwheels. One of the links of this chain is fitted with a pin setting in motion the cradle supporting the stylus by means of a vertical slide. By this means an alternative continuous and silent motion of the sliding carriage is obtained.

At the upper part and behind the chain is a 12-volt driving electric motor fitted with the same electric regulator as the 420-type indicator (see above). A system of 4 star-shaped interruptors with a switch workable from the exterior on the front, permits the instantaneous passing from one registering scale to another: 0-200 m., 200-400 m., 400-600 m., 600-800 m.: (437 fathoms). The scale used is shown by a luminous index and by means of a special mark on the electrolytical paper.

The paper container, which is very easily charged, is situated at the back of the recording table. The stylus travels to-and-fro at the upper part of the window so that a large part of the recording strip may be observed. When the recorder is running, the paper strip issues from the apparatus through a special door in front fitted with a window protecting the moistened strip. When not in use, this door slips towards the bottom and completely shuts the container.

At the upper part is situated a *luminous indicator* the alternative movement of which is rectilinear and uniform. A type-4 neon lamp is carried by the recorder carriage and coincides with the vertical passing through the stylus point so as to match laterally the indicator divisions with those of the recorder.

The reading scale is divided from 0 to 200 m. (109 fathoms). As with the recorder, soundings may be taken from 200 to 400 m. (219 fathoms), from 400 to 600 m. (328 fathoms) and from 600 to 800 m. (437 fathoms). A switch situated on the front permits an instantaneous change from the indicating to the recording system or conversely.

A third handle is fitted for controlling the sensitivity. Inner bulbs provide for the lighting of the recording strip, also for the indirect lighting of the indicator-plexiglas scale.

The apparatus is fitted in a watertight coffer with swinging alpac front face supporting the mechanism. This construction facilitates access to the different parts, which is very convenient for maintenance.

The smaller dimensions of this apparatus, equally suitable as luminous indicator and as recording instrument, will be noticed. The paper is delivered moistened and ready for use in lengths of 27.40 m. (90 feet), thus allowing about 45 hours' sounding operations.

Electric-power sources. — The new sounding apparatus as described introduces an important new feature, i.e. the use of a single 12-volt accumulator battery which feeds low tension circuits, transmission, bulb filaments, lighting of dials and also a special box so-called "Coffret HT" providing about 250-volt anode tension. This eliminates the use of clumsy and costly high-tension dry cells. The 12-volt battery consists generally of 2 automobile 6-volt blocks and may be charged by the direct current of the ship's mains. This arrangement ensures a long autonomy of the sounding apparatus in connection with the mains which is of the highest value in cases of breakdown or accident.

Coffret HT. — This coffer (figure 9) contains in its lower part (see figure 10 for open apparatus), a small 12-volt—250-volt rotating convertor starting automatically when the indicator or recorder-indicator is switched on. A red "warning" bulb carried on the front indicates that the apparatus is in use. At the upper part may be seen the HF and LF filters for input and output; these have been carefully studied for the prevention of parasite induction.

Mains box (Coffret de Réseau)—This box, figure 11 provides for the connection between the 110-volt or 220-volt continuous current of the ship's mains, the 12-volt battery and the indicator or recording-indicator. It includes (figure 12) a "charge-on-off" inverter situated at the right-hand side of the box, a connecting and disconnecting piece which prevents the battery from discharging in the mains in case of lack of tension in the latter; a voltmeter carried on the front for ascertaining the mains' tension and lastly, a general break-circuit for the installation completed by a charging resistance the dimension of which varies according to the mains' tension and the 12-volt battery capacity; the installation is fixed on the bulkhead in the vicinity of the mains' coffer.

Echoscope. (Portable Surveying Sounding Machine).—The new echoscope has the same dimensions and outward appearance as the echoscope familiar to Hydrographic Engineers but includes important improvements doing away with several inconveniences pointed out by users. The list of these improvements is as follows :—

The impermeability of the new echoscope (which henceforth contains a drying device) is assured by an accurate mounting of door joints and the use of hinges that may be regulated. All the controls through the container are fitted with stuffing-boxes. The resonance control is led to the exterior and protected, when in use, by a watertight cover. The apparatus is fitted with a multiple watertight plug for battery and anode tension suitable for immediate setting-up. The same is the case for the plug of the projector cable. The amplifier is of a new model consisting of three penthode bulbs of easy access and quickly dismantled. The sensitivity control acts upon an inner potentiometer of grid polarisation of entrance valve. The oscillograph coil is fitted with thicker wire so as to render this part robust. The zero control (projector depth) is fitted on the outside near the reading scale (in the former apparatus it was necessary to open the door before difficult access to the regulating screw could be attained, which was inconvenient and brought about the penetration of moisture into the apparatus). The starting device remains the same but the stop-cog has been improved. The protecting low-tension break-circuit is fitted with a calibrated fuse instantaneously set-up. The electric connection between the oscillograph and the amplifier has been studied anew and this has led to a notable improvement in the precision of the transmitting and echo teeth. The clockwork has been retained on account of its simplicity and the absence of parasites, but its fixings have been reinforced by means of a welded steel base. The axis of the winding-up crank is fitted into a watertight stuffing-box; the dismantling of the clockwork has been made easier; an index showing the winding-up has been provided fitted with a break to prevent

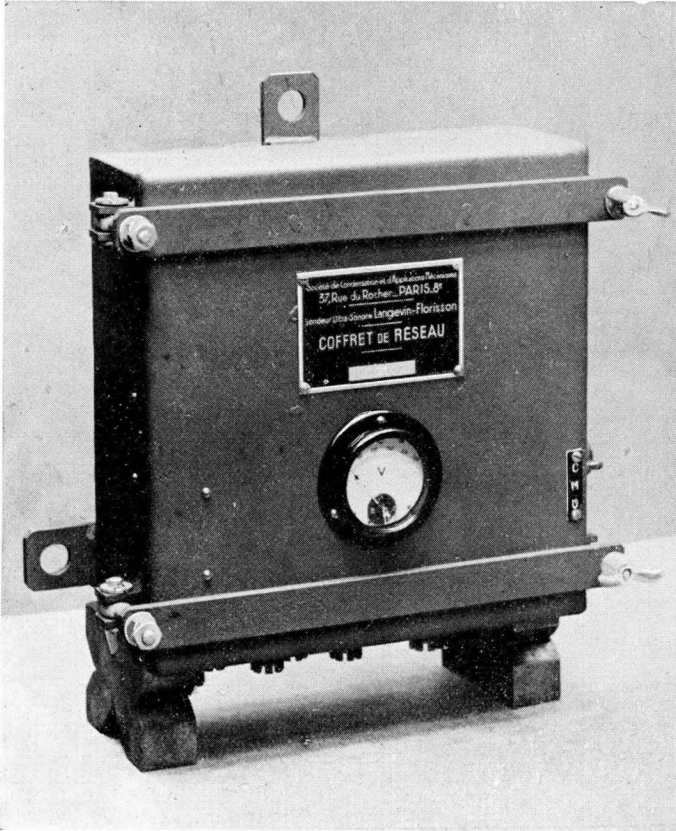


Fig. 11
Mains coffer closed up.

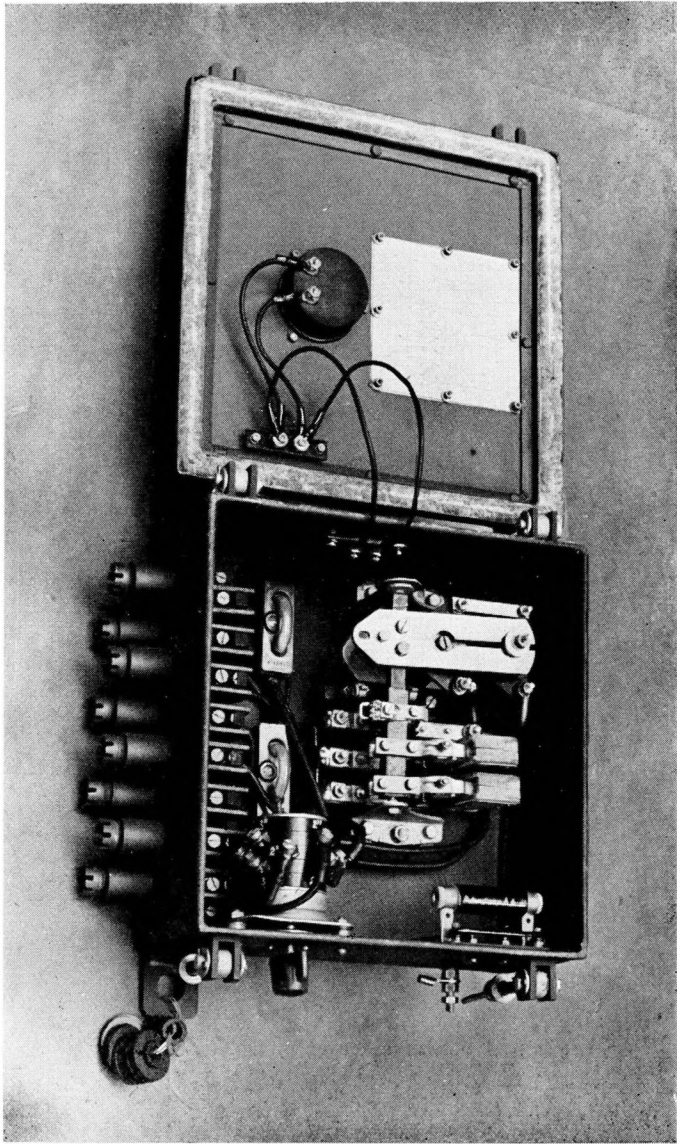


Fig. 12
Mains coffer open.

readings being made when there is a diminution of speed of the clockwork. The variable transmission condenser is of a much stronger type, with larger blade-intervals. The scale for night operations is lighted by a blue bulb. The general supply of the sounding apparatus is obtained by a single accumulator battery, 6-volt, 50-100 amperes of the automobile starter type. The anode tension is provided by means of the "Coffret HT", which coffer contains a small 250 volt generator with LF and HF filters at the entrance and at the exit in order to avoid every kind of parasite. This watertight "Coffret HT" is provided with an external starting interruptor and a red bulb. It contains the HT circuit-breaking device and a quick-branching impermeable plug for the instantaneous connection with the battery on the one hand and, on the other hand, with the echoscope. The transmission tension has been doubled (electric power multiplied by 4).

Improvement in the transmitting power and in the receiving sensitivity are also obtained by substituting S.32 projector for the former S.23 projector. The S.32 projector, with which the "pasty" glue is used and which has an immovable inner plate and watertight joint of the "stuffing-box" type, has a useful perimeter of 14 cm. (5 1/2 in.) as against 10 cm. in the former model. Its frequency is in the neighbourhood of 52,300 per second as against 65,200 for the S.23. The frequency has been thus lowered in order to maintain for the apparatus the same directional power. The projector is clamped to the same projector-carrier tube as before; however, the latter is fitted with a kind of improved watertight cable, with protection by a more practical metallic tube.

The new echoscope may be fitted either with the 9-60 m. (33 fathoms) divisions as in the former model or with the 0-30 m. (16.5 fathoms) divisions, the latter being better adapted for work in estuaries, harbours and rivers.

