SCAM SOUNDERS

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Readers of the International Hydrographic Review are well acquainted with ultrasonic sounding equipment based on the Langevin-Chilowsky process. 1917 was the year in which Langevin, resorting to both theory and experimentation, devised the elements of his celebrated vibrating triad (or sandwich), consisting of a piezo-electric quartz mosaic stuck between two steel plates—which is the basic feature of quartz ultrasonic sounders. In October 1920 the staff of the French Navy laboratories at Toulon carried out the first ultrasonic line of soundings (approximately 50 soundings in 25 minutes).

The Langevin-Florisson ultrasonic sounder equipped with an optical analyser was created at Toulon in 1921. The first continuous line of soundings was obtained with this instrument from aboard the *Ville d'Ys* in April 1922. At about the same period, Marti, a hydrographic engineer of the French Hydrographic Office, obtained the first continuous sounding record by using a strip of smoked paper.

A set of Langevin-Florisson ultrasonic sounding equipment basically consists of the following:

(a) Ultrasonic projector.

(b) Transceiver.

(c) Depth reading apparatus — optical indicator or paper recorder.

(d) Power supply and electric protective gear. Specifications of existing Scam sounding equipment appear below (1).

ULTRASONIC PROJECTOR. — Quartz projectors invariably use the vibrating triad. The steel plates (outer plate in direct contact with sea and inner insulated plate connected with transceiver) are cemented to the piezo-electric quartz mosaic. The inner plate is firmly held in place by insulating shims. By these means and the use of improved joints, extreme ruggedness of the projector is achieved.

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(1) French and foreign patents.

Scam at present uses the following piezo-electric projectors:

Type	Useful diam.	Actual diam.	Height	Weight	Natural frequency	Approx. range	Sounder	Use
	mm.	mm.	mm. (minus clamp)	Kg	Hz	m.		
S.32	140	180	90	8	53.200	300	Echoscope	Hydrography
S.24	220	370	110	49	37.500	800	Sounders	All uses steel ships
S.30	220	268	110	38	37.500	800	418, 419,	All uses wooden ships
S.34	310	400	177	100	29.150	2000	420 and cathodic analyser	submarines Greater depths Hydrography Cable ships

Figures 1 and 2 show the most frequently used types: S.24 and S.30.

When the projector is set up in the hull, it is important to bear in mind that the transmitting surface should cause no discontinuity in the outside plating in order that « sea noise » produced by eddies may be avoided, especially in

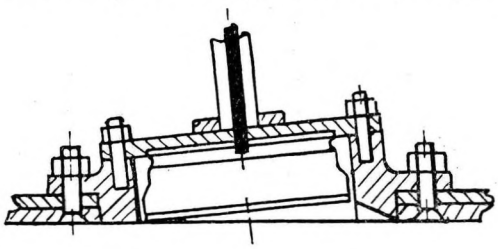

Fig. 3. — Normal mounting of S.24 Projector
(Iron ship with flat or slightly sloping bottom).

the case of fast ships. Figure 3 shows a standard mounting of an S. 24 projector in a ship with a horizontal or slightly inclined bottom. The S. 30 projector, which

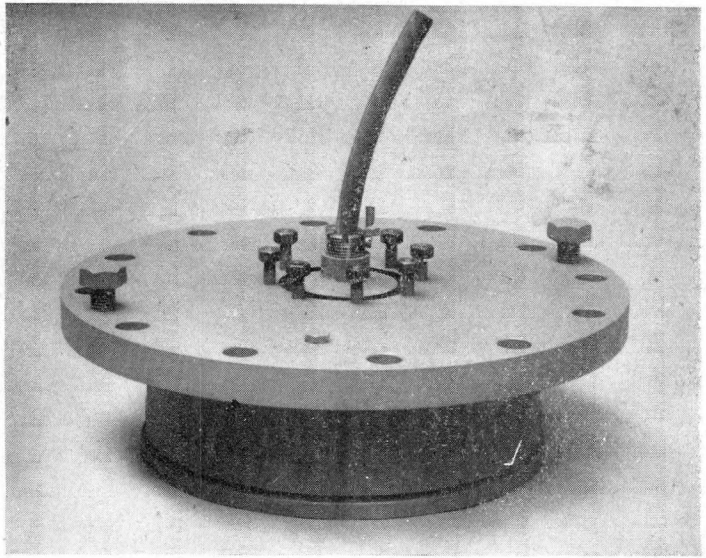

Fig. 1. — S.24 Projector.

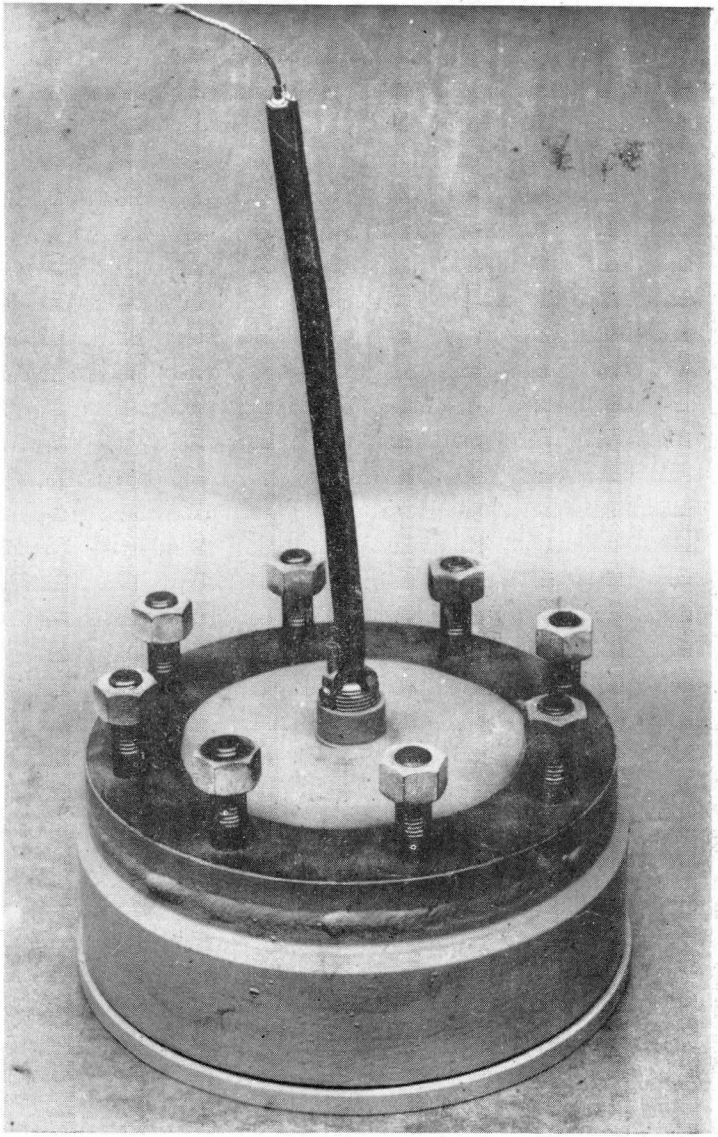

Fig. 2 . — S.30 Projector.

is exactly like the S. 24 model except that the upper clamping plate is missing, is mainly used in wooden vessels (especially fishing craft). Figure 4 shows a method for installing the projector on board ship.

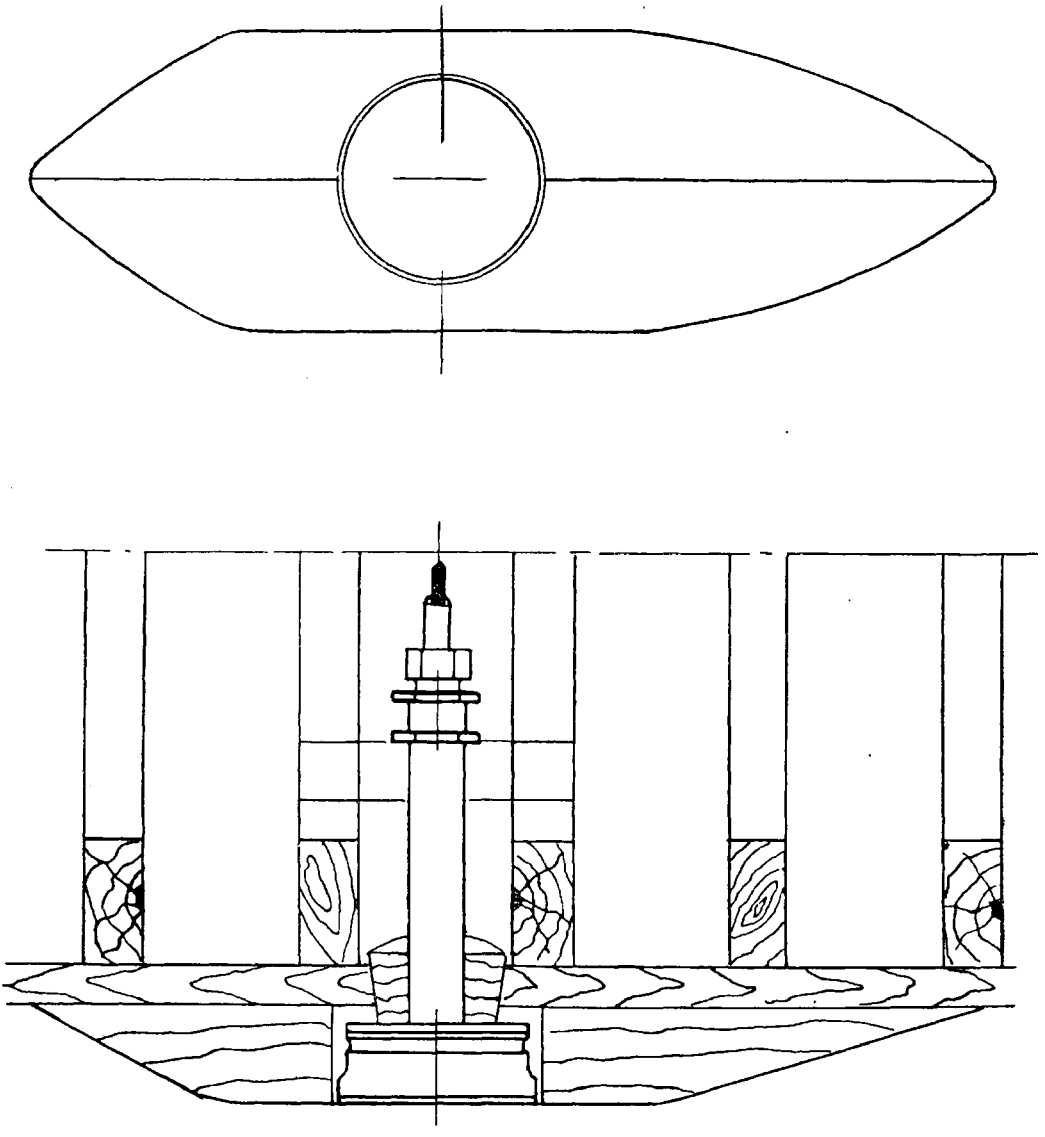

Fig. 4. — Mounting of S.30 Projector (Wooden ship).

In the case of ships with an inclined hull and slight draught, experience has shown that better results are obtained with a semi-projecting assembly such as illustrated in Figure 5.

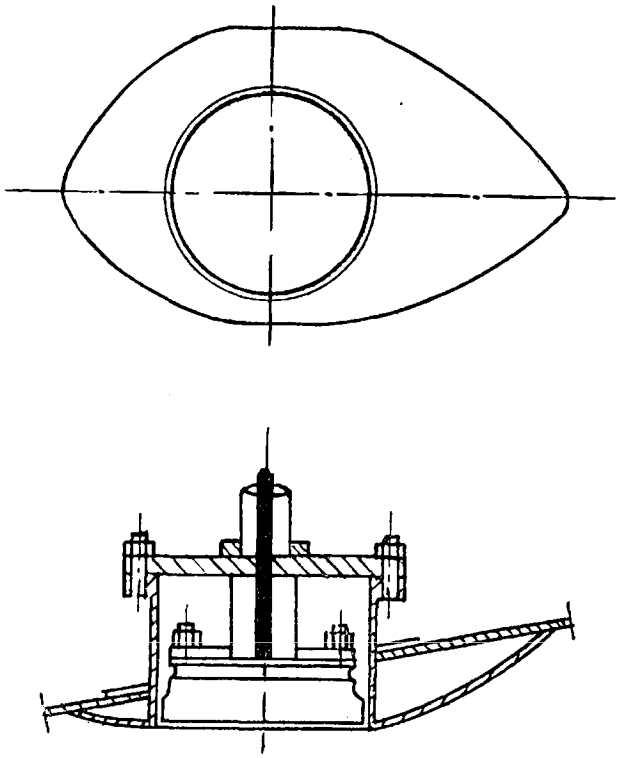

Fig. 5. — Half raised mounting of S.24 Projector
(Iron ship with sloping hull - Trawler).

TRANSCEIVER. — This instrument, normally in a closed compartment, is located near the projector in the bottom part of the ship. The parts used for transmission are in the lower section of the instrument. Through its primary circuit an induction coil receives a current impulse supplied by the battery and periodically induced by a circuit-breaker of the depth reading apparatus. The secondary circuit supplies power to the spark circuit, consisting of a condenser in parallel with the terminals of the secondary circuit, and of a double spark gap and spark coil in series connection. The oscillating circuit of the projector is formed by an induction coil coupled with the spark circuit, and by the capacitance of the projector and projector line.

The upper section contains the receiver, consisting of an amplifier with four pentode tubes. Sensitivity control is achieved by means of a potentiometer, which is located in the depth-reading instrument (indicator or recorder) and polarizes a variable-mutual conductance tube.

It will be observed that the projector is in constant connection with the amplifier. The transmitted signal and echo are displayed at each sounding.

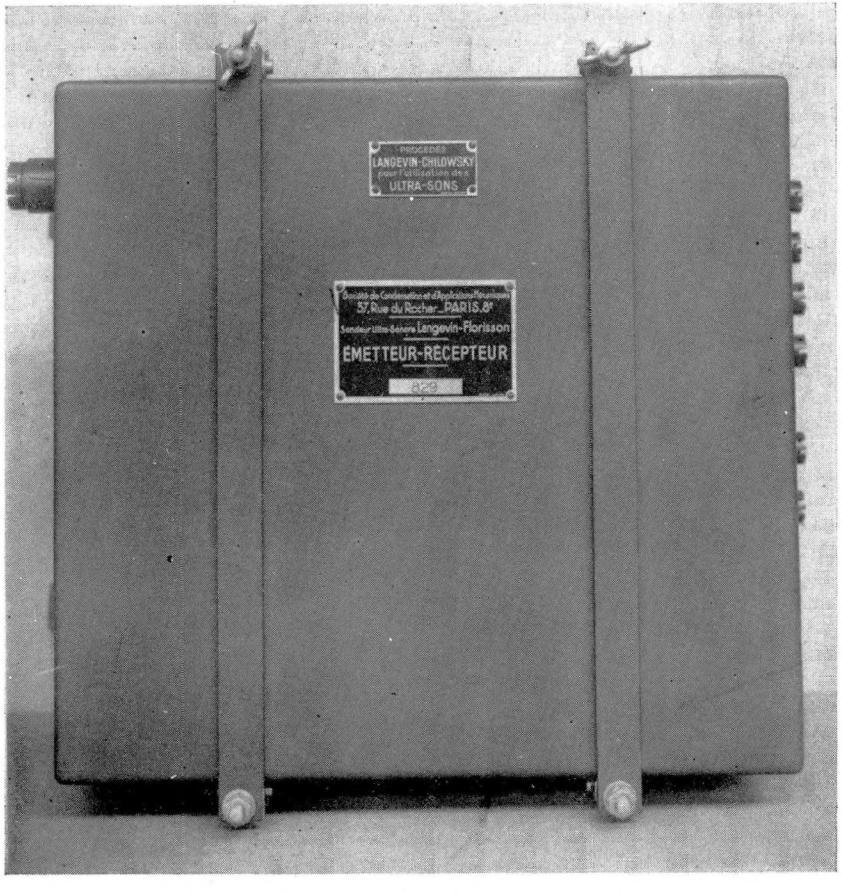

Fig. 6. — Transmitter-Receiver, Type 015 (Closed).

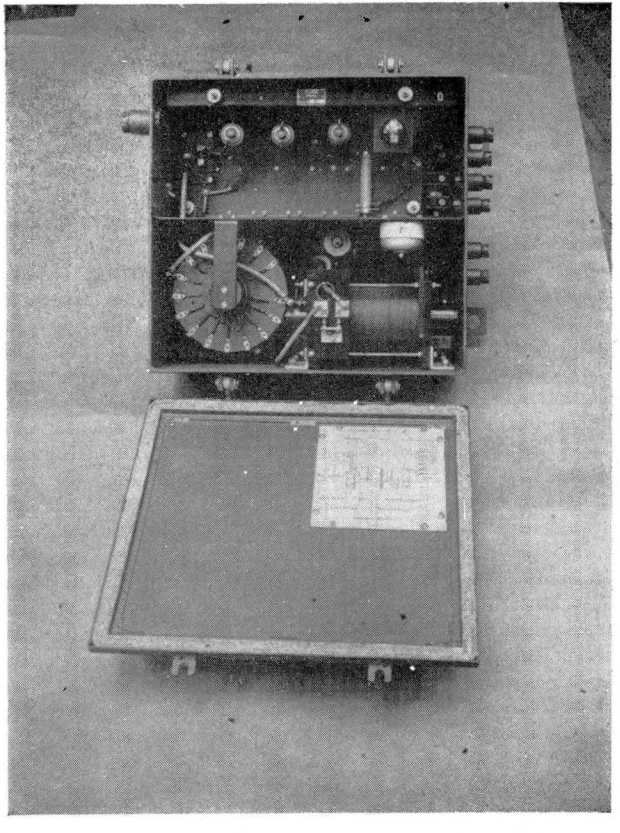

Fig. 7. — Transmitter-Receiver, Type 015 (Open).

Fig. 8. — Indicator, Type 418.

Fig. 9. — Indicator, Type 420.

Each time a break in the current from the battery occurs, a single spark appears in the double spark gap, giving rise in the oscillating circuit of the projector to a single train of damped electric oscillations. The projector immediately translates the latter into a damped ultrasonic elastic wave train, and the projector remaining in connection with the amplifier can receive the echo immediately thereafter. The echo is translated into a current impulse which is amplified by the receiver and actuates the depth reading apparatus.

The same type of transceiver (015) is used for projectors S. 32, S. 24, S. 30 and S. 34, indicators 418 and 420, indicator-recorderr 419 (and the cathodic analyser). The spark circuit coils must be changed, however, as this circuit must be accurately tuned to the natural frequency of the projector being used. This tuning process takes place on board before the sounder goes into operation.

The different type of transceiver used in the echoscope will be described later.

Weight of 015 transceiver	27 kg.
Space requirement: Width	481 mm.
Height	416 »
Depth	270 »

Figures 6 and 7 show the appearance of the instrument when open and closed.

Type 418 INDICATOR. — A shaft actuated at a constant rate of speed by clockwork carries the transmission cam and a revolving arm bearing the neon indicator lamp. This lamp moves close behind the transparent circular window of the graduated dial. When it lights up a red luminous radial mark appears on the dial. The transmission cam is fixed to the shaft in such a way that the break inducing the ultrasonic transmission occurs when the neon lamp is opposite zero on the dial (or rather opposite the number corresponding to the draught of the projector on the vessel involved). The neon lamp is connected to the anode circuit of the last amplifying stage.

When the indicator is operating, each impulse corresponding to transmissions lights the lamp and a red mark appears at the origin of the scale. The echo impulse then occurring (following « echo time » t, in ratio to the depth sounded) induces a second luminous mark, whose angular distance from the mark on transmission measures the depth. As the shaft revolves at a constant set speed and the dial is directly graduated for depth, the observer reads off the depth sounded opposite the luminous echo trace.

Indicator 418 is run by a clockwork mechanism wound by hand with a crank. Running time between crankings is about 10 minutes. The sounder supplies 15 soundings in 8 seconds. The dial is scaled from 0 to 400 m. As the connection between the amplifier and the oscillating circuit connected with the projector is never broken, even during transmission, no dead reading interval occurs on the dial. As a result, the display of an echo involving a depth between 400 and 800 metres occurs, with regard to a given transmission, while the neon lamp is travelling around the dial for the second time, and so on. The indicator thus enables the reading of depths up to the limit of visible echo reception corresponding to the type of projector used and receiver sensitivity control. A push-button switch on the lower right side of the dial enables switching off the transmission, thus facilitating readings of depths above 400 metres.

Figure 8 shows the appearance of the instrument. At the right is the crank for winding, at the lower left is the sensitivity control (polarization potentiometer), and at the lower right is the push-button for switching off the transmission. The main on-off control is located on the right side of the indicator, below the crank. It controls the braking of the clockwork mechanism and the sounder's main switch.

The dial may be observed at night time by means of a subdued indirect lighting arrangement.

Weight of Indicator 418	26 kg.
Space requirement: Width	432 mm.
Height	394 »
Depth	226 »

Type 420 INDICATOR (Fig. 9). — This type, instead of being run by clockwork, has an electric motor. There are two scales: 0 to 60 m., and 0 to 600 m. The electric motor, equipped with an electric speed controller (S.G.D.G. patent) (1), actuates two coaxial discs revolving behind the dials and each carrying a type 4 neon lamp. The inner disc, which is directly fixed to the motor shaft, makes 750 revolutions per minute and enables shallow depths to be read off with accuracy on the 0-60 m. dial (25 soundings every four seconds). The other disc, operating by means of a 1/10 reduction gear, is for 0-600 m. dial-readings. The dial, as in Indicator 418, involves no break of continuity.

A switch enables the reeceiver to be connected immediately with the indicator lamp of the 0-60 m. dial or 0-600 m. dial.

The 420 Indicator has the same tight alpax cabinet arrangement and indirect lighting of dials for night-work. Special pains have been taken with the design to provide easy access to the inner mechanism.

Figure 9 shows the outward appearance of Indicator 420.

Weight of Indicator 420	23 kg.
Space requirement: Width	438 mm.
Height	452 »
Depth	281 »

RECORDER-INDICATOR 419-B. — The lower part of this instrument contains an electrolytic recorder in which a roll of 152 mm. Marine-type Scam paper is used. Motion of the stylus is uniform and rectilinear, and is obtained through a patented (2) endless chain device travelling over two lateral sprockets. One of the chain links is equipped with a dog actuating the stylus-carrier along a vertical slide. A continuous and silent alternating motion of the moving element is thus obtained.

The 12-volt electric driving motor located in the upper section behind the chain.

The end of the stylus slides along the paper during the recording period from left to right, and is automatically lifted from the paper during its return.

(1) SGDG : without government guarantee.
(2) SGDG patent.

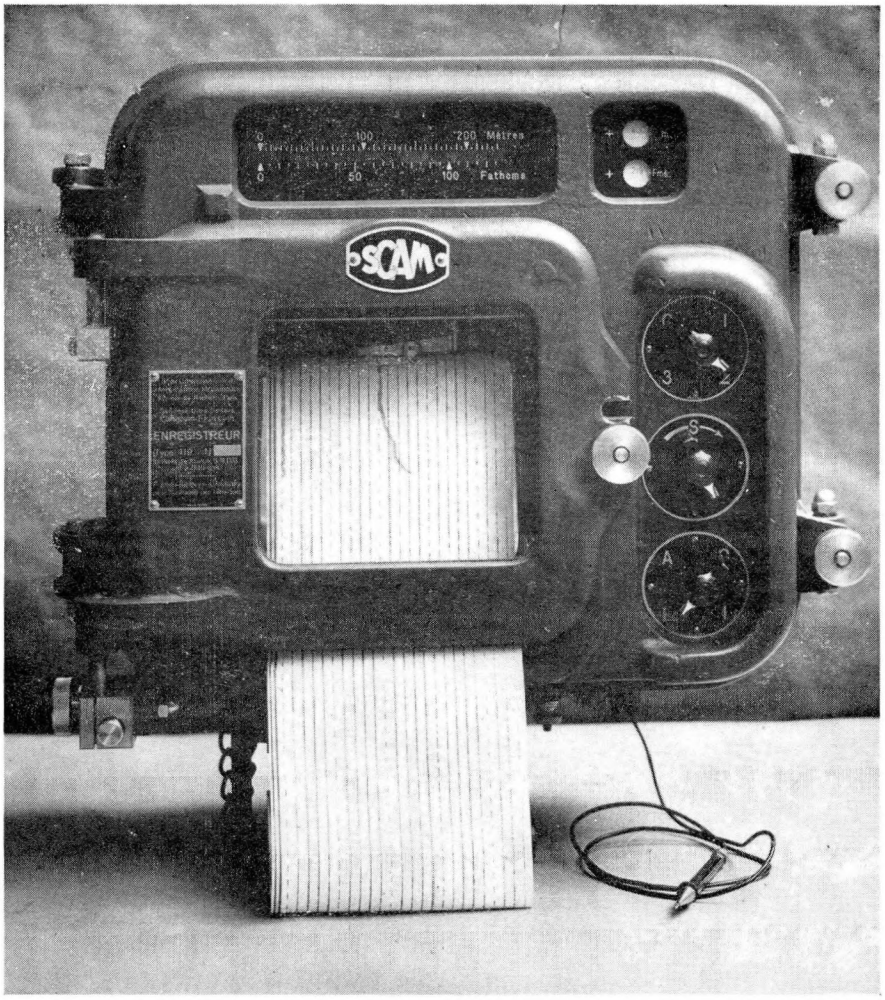

Fig. 10. — Recorder-Indicator 419-B.

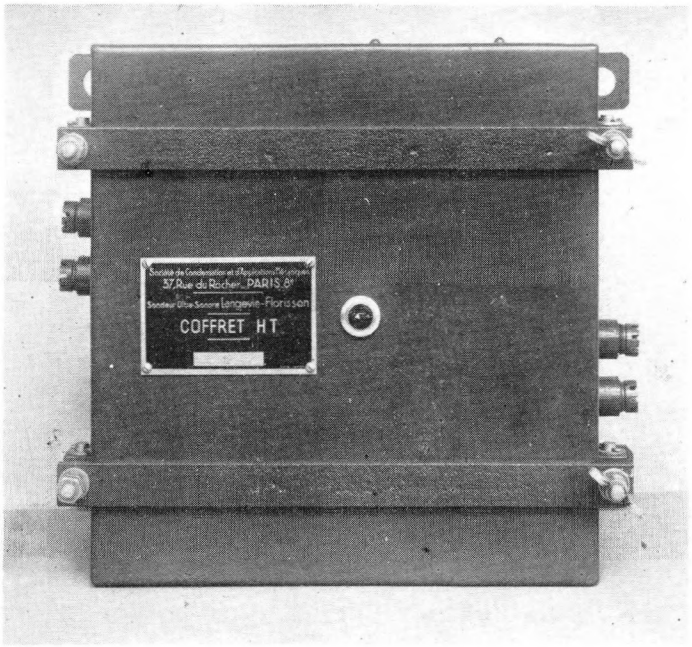

Fig. 11. — HT Cabinet.

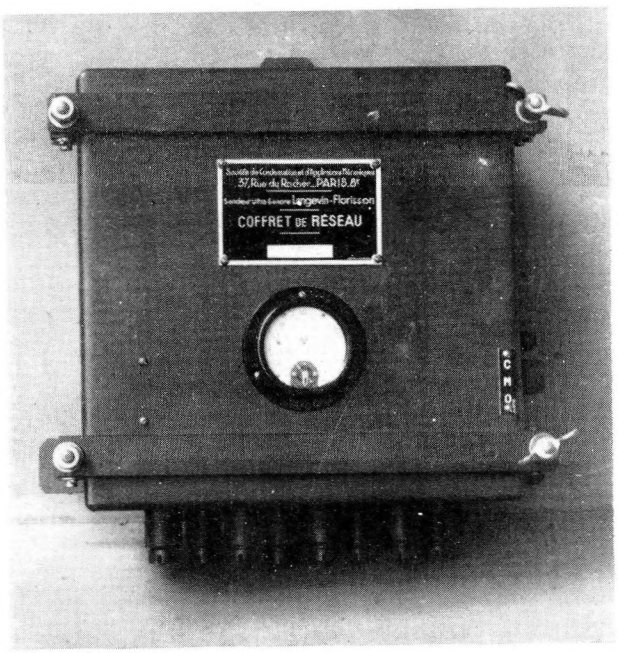

Fig. 12. — Mains Cabinet.

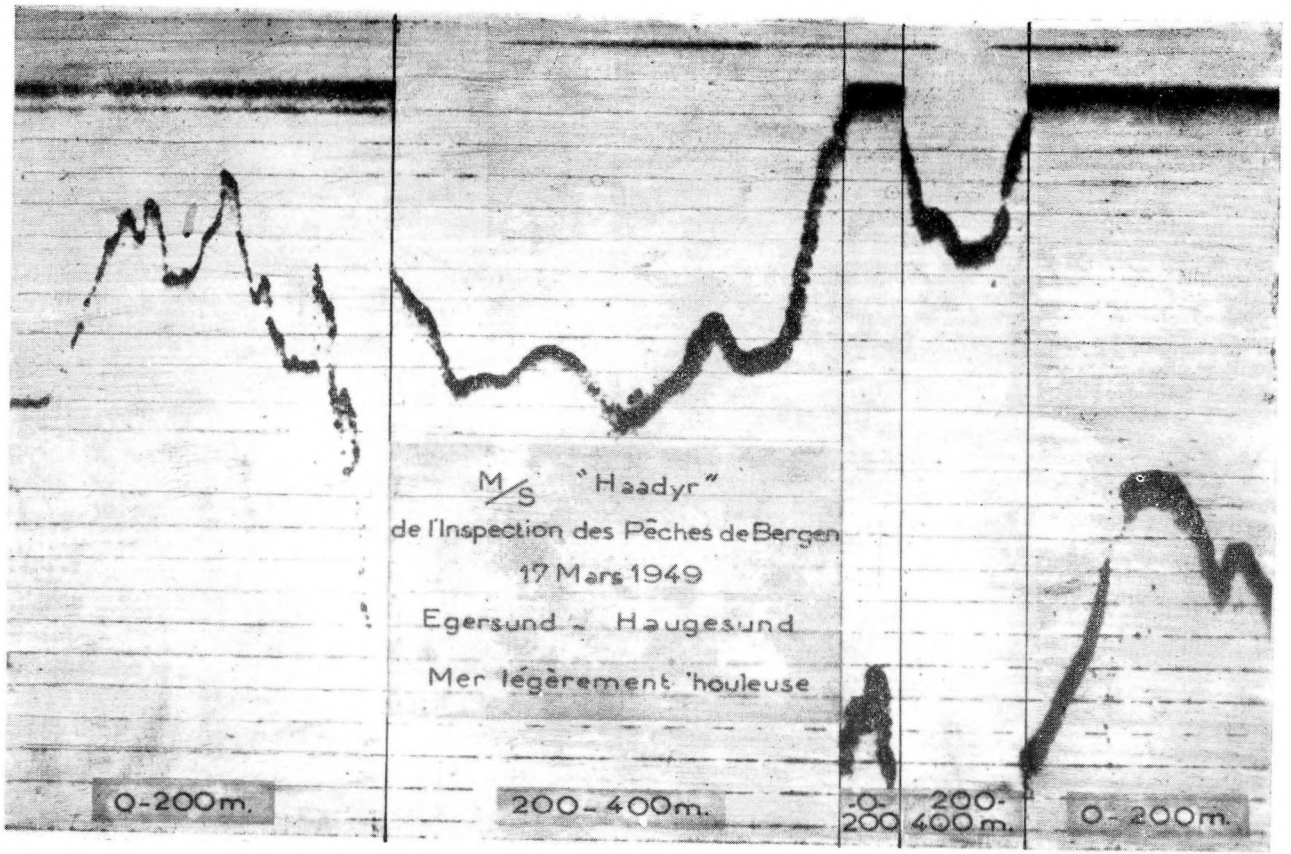

Fig. 13. — Recording of very uneven bottom taken on board a trawler (electrolytic paper).

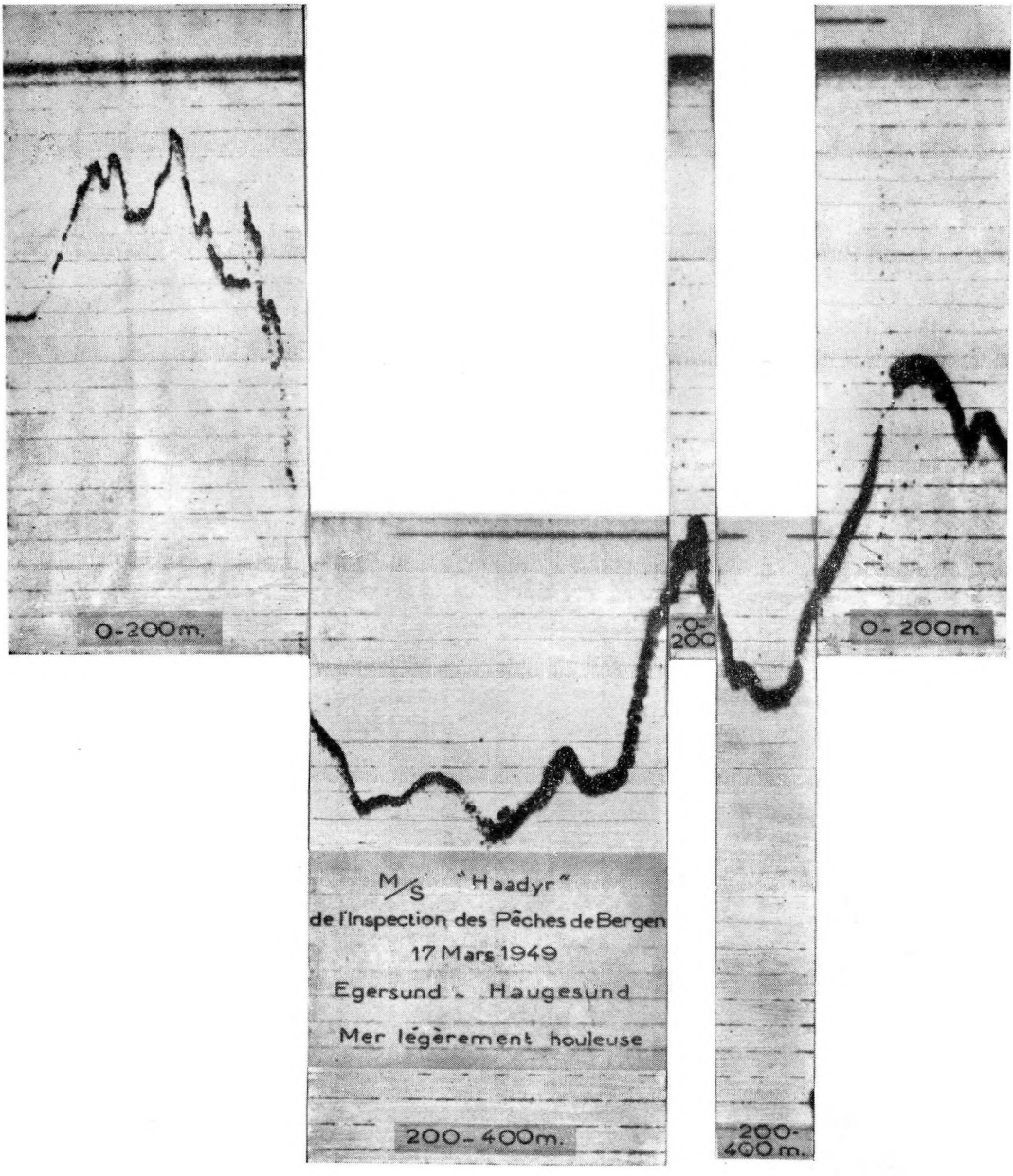

Fig. 14. — Same recording as in Fig. 13 but with phasing in the 200-400 metre zone.

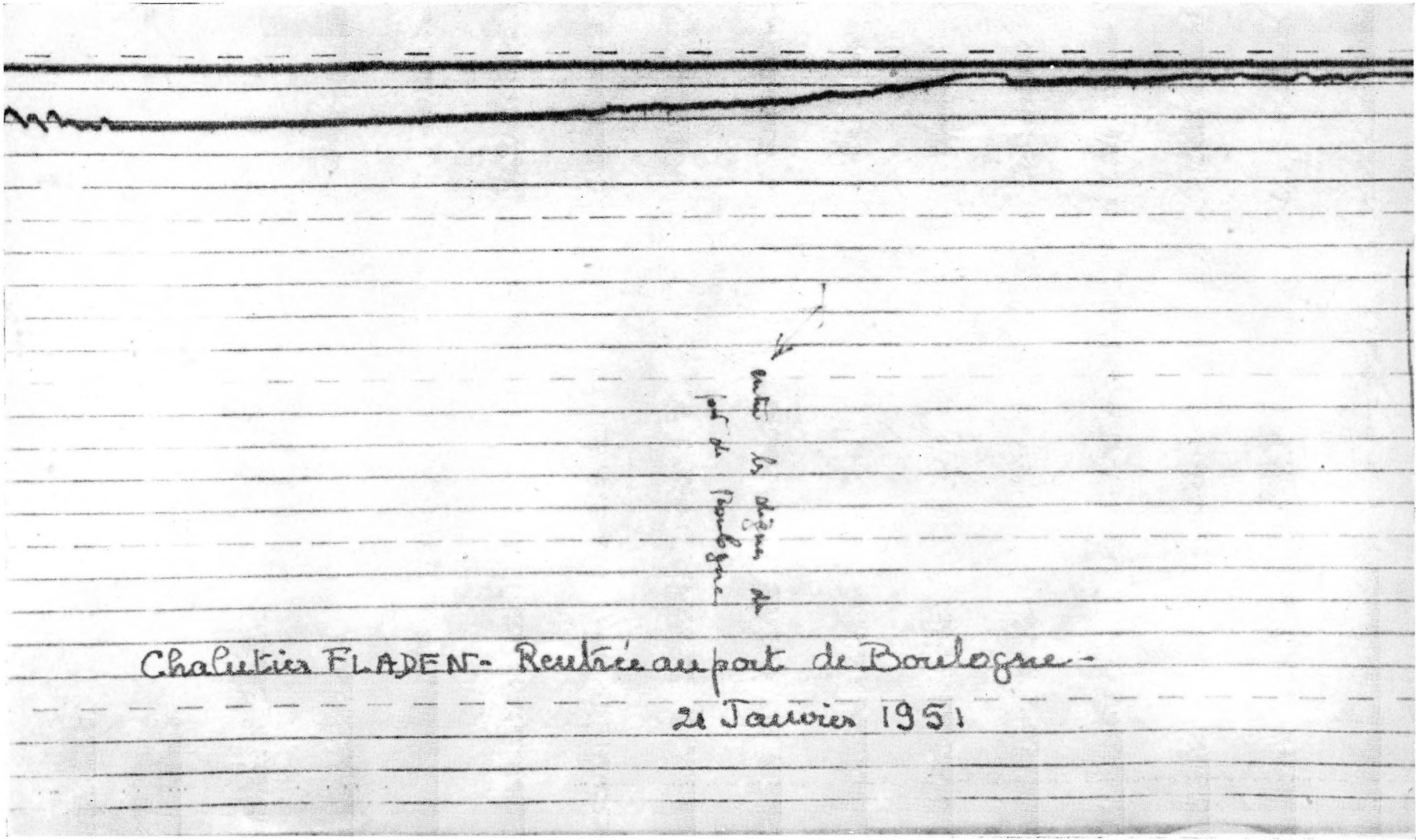

Fig. 15. — Recording with 419 Sounder in shallow water (electrolytic paper).

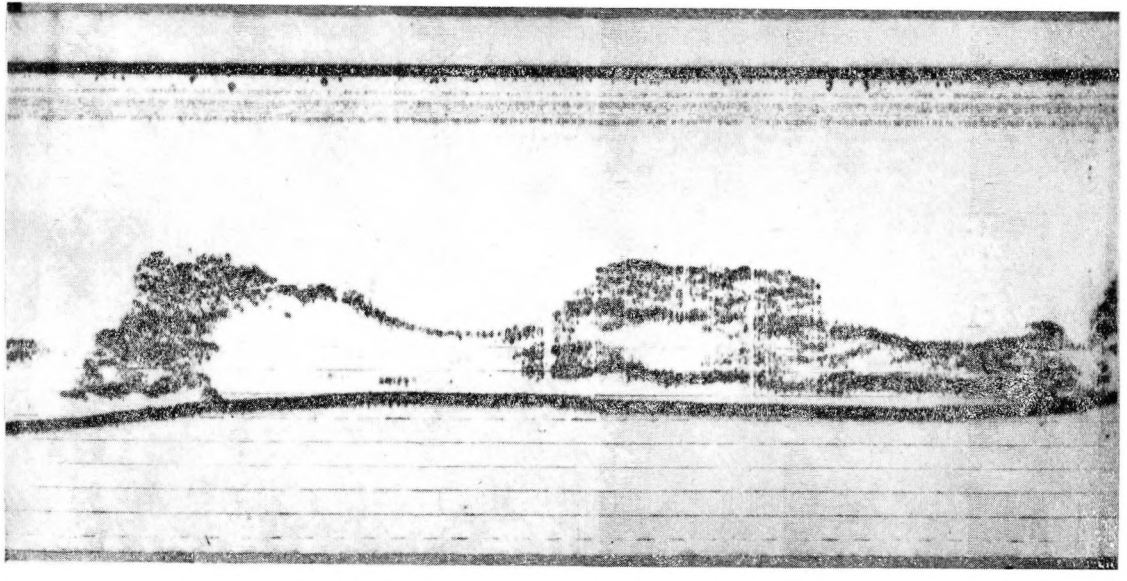

Fig. 16. — Echoes from a school of fish (electrolytic paper).

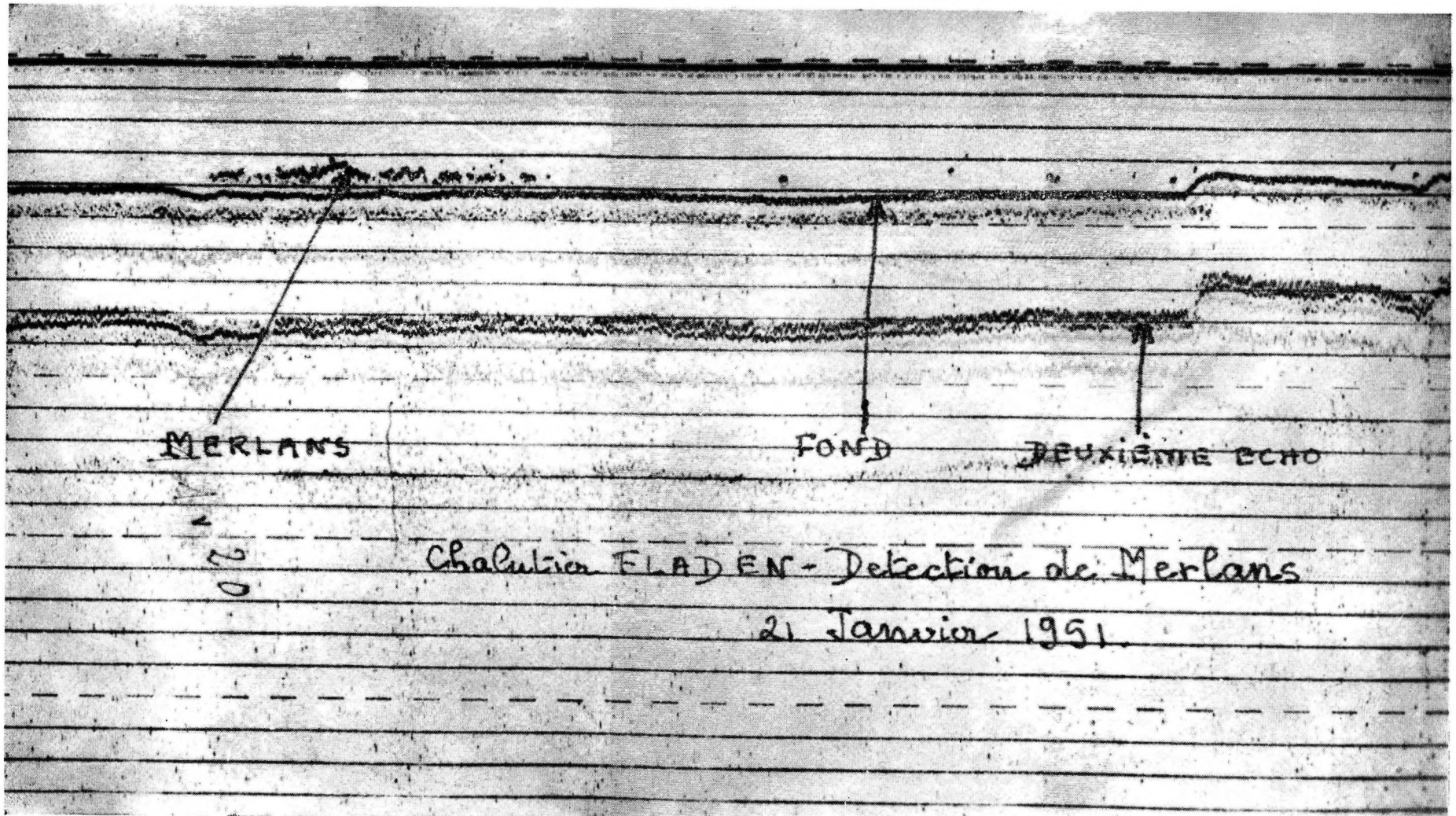

Fig. 17. — Echoes from whiting (electrolytic paper).

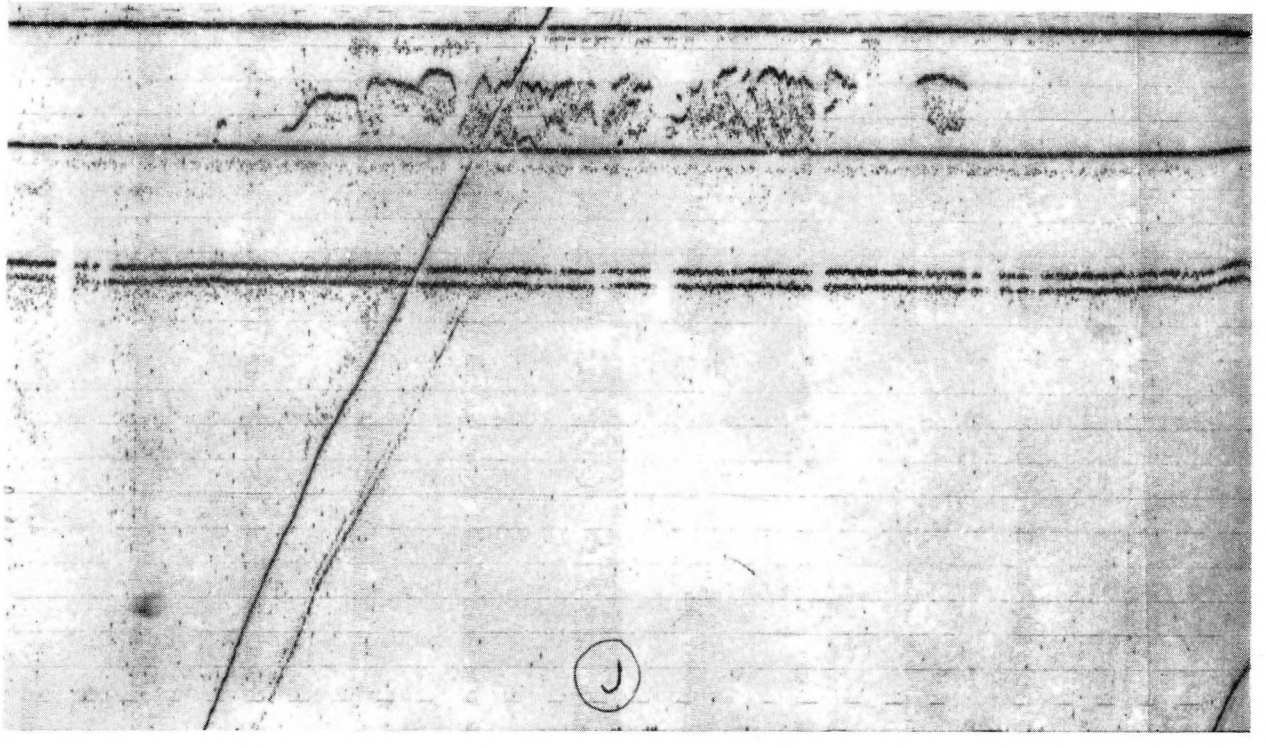

Fig. 18. — Echoes from a school of fish (dry paper).

At the beginning of the sounding stroke, a circuit-breaker actuates the ultrasonic transmission, which causes a short impulse to occur in the amplifier output circuit. This current, passing from the stylus to a metal roller, passes through the electrolytic paper and leaves a brown mark on the roll.

Shortly after transmission, the echo reflected from the bottom induces a second impulse leaving a second brown mark on the roll.

This process recurs each time the stylus moves. As the roll unwinds very slowly, the recorded brown marks partially overlap. Impulses transmitted at constant intervals line up along a vertical straight line (scale : 0-200 m.), and the echoes form a line showing the bottom profile. The lefthand edge of this latter trailing brown line indicates the depth.

To make readings easier, a cylinder with projecting discs bearing down upon the recording paper reproduces the equidistant divisions of a scale in metres (or in fathoms, if so desired).

This process of electrolytically inscribing parallel straight lines at the time of recording enables avoidance of errors that might possibly result from variations in the width of the paper induced by moisture and drying.

The paper container, which can easily be loaded, is located behind the inscription plate. The stylus moves behind the upper section of the window, through which a large recorded area may be observed. When the recorder is in operation, the paper roll emerges from the instrument through a slot located at the base of a glass door in front protecting the damp roll. When not in operation, the door can be shifted downwards, closing the case completely.

The light indicator, which has a uniform rectilinear alternating motion, is located in the upper section. The recorder's carrier carries a neon lamp vertically opposite the end of the stylus, in such a way that a transverse match of the graduations of the indicator and recorder are obtained.

The reading scale is graduated from 0 to 200 m. As with the recorder, from 200 to 400 metres and from 400 to 600 metres may be sounded. A switch on the front of the instrument enables an immediate change-over from indicator operation to recorder operation. A third switch is for sensitivity control. Lamps in the instrument light up the recorded section of the roll and ensure the indirect lighting of the plexiglass scale of the indicator.

The instrument is contained in a tight cabinet with a swivelling Alpax front that carries the mechanism. This design provides easy access to the various parts and considerably facilitates maintenance operations.

The restricted space taken up by this instrument, which can be used as a luminous indicator as well as a recorder, should be noted. The paper is delivered wet and ready for use in rolls 27.4 metres long, good for about 45 hours of sounding. The unwinding speed of the paper is about 1 cm. per minute.

Figure 10 shows the appearence of the instrument.

Weight of Recorder-Indicator 419-B	37 kg.
Space requirement : Width	490 mm.
Height	510 »
Depth	270 »

POWER-SUPPLY. — An important innovation in the sounders just described is the use of a single 12-volt storage battery feeding the low-voltage, transmission, lamp filament and dial-lighting circuits, as well as a special « HT » box supplying the anode voltage of about 250 volts. The 12-volt battery usually consists of two 6-volt motor vehicle units and is charged through the ship's mains direct current. This arrangement enables the sounder to be independent of the mains over a long period, which in case of a break-down or accident is of considerable value.

HT BOX. — The lower part of this box contains a small 12 V-250 V rotary converter, which starts automatically when the indicator or recorder-indicator goes into operation. A red control light in front shows when the instrument is in operation.

The input and output HF and LF filtering elements, which have been carefully designed to eliminate parasitic inducton, may be seen above.

Weight of HT box	.....	12 kg.
Space requirement : Width	.....	306 mm.
Height	.....	358 »
Depth	.....	173 »

MAINS BOX. — The mains box (Fig. 12) connects the 110 V or 220 V direct current of the ship's mains, 12 V battery, and indicator or recorder-indicator. It contains a « charge-on-off » reversing switch located on the left side of the box, a switch preventing the battery from discharging into the mains in case of voltage loss in the latter, a voltmeter in front for checking the mains voltage, and the general cut-out switches of the assembly, which is completed by a load-resistor of a size consistent with the mains voltage and capacity of the 12 V battery, located on the bulkhead near the mains box.

Weight of mains box	.....	11 kg.
Space requirement : Width	.....	340 mm.
Height	.....	307 »
Depth	.....	170 »

Figures 13 and 14 show a fairly curious strip obtained on board the MV. *Haadyr*, Bergen Fisheries Inspection, with a 419 electrolytic paper recorder. The observer had to shift the transmission several times in order to allow for the extremely irregular and distinctive profile of the depths off the Norwegian coast. Figure 13 shows the strip obtained, with no alteration beyond the vertical line separating records of the 0-200 m. area from those of the 0-400 m. area. Figure 14 shows the same strip with the 200-400 m. sections in their appropriate location. The practically vertical edge in the first 0-200 m. section will be observed, as in about 15 seconds the depth increased from 120 m. to 260 m. The instrument nevertheless recorded a few echoes from this extremely steep surface.

RECORDING PAPER. — The electrolytic paper referred to in the section describing the 419-B recorder-indicator is remarkably sensitive. Supplied in a damp condition and ready for use in air-tight metal boxes, it is highiy servi-

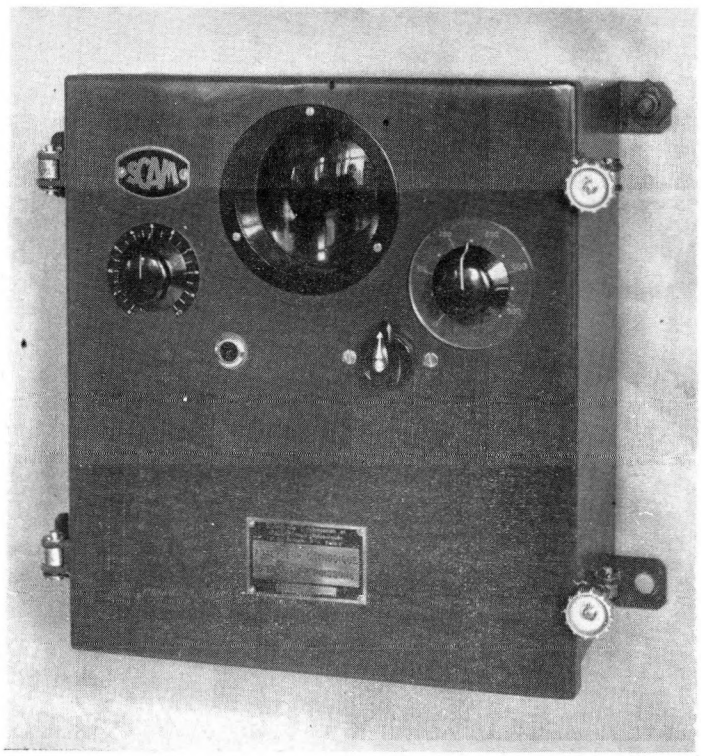

Fig. 19. — Cathodic analyzer.

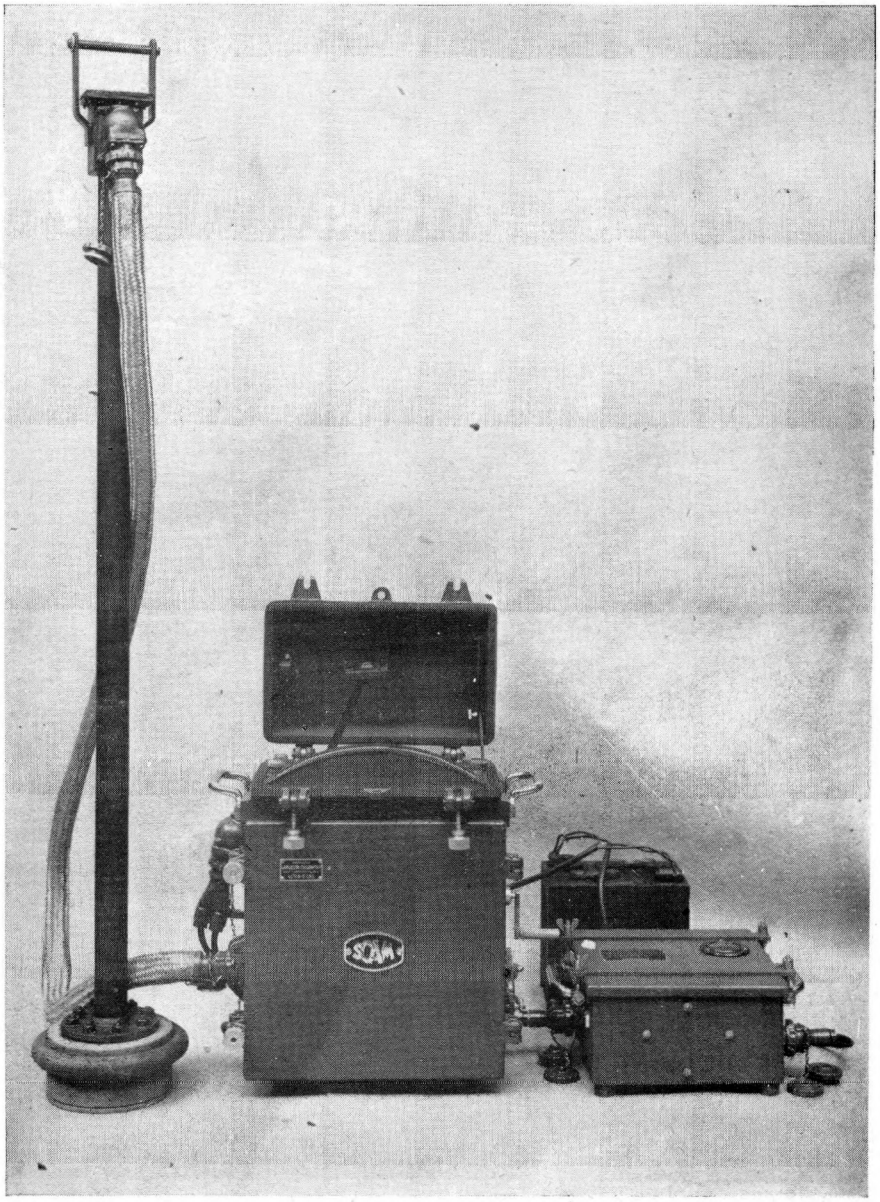

Fig. 20. — Echoscope.

ceable. The recordings on the strips, however, have the disadvantage of eventually tending to fade.

A dry paper intensively treated with graphite, which gives it a greyish-black colour and conductivity, has been in use for a number of years. A thin white film has been laid over the surface of the paper. When the end of the stylus, which gently rubs over the white film, receives a brief high-voltage impulse from the amplifier, the film burns through, and a black mark appears.

To facilitate depth-readings, a cylinder with projecting discs, suitably inked and pressed down against the roll, reproduces the even divisions of a metre (or fathom) scale. This cylinder is located on the uppermost part of the roll behind the graduated scale. Behind the cylinder is the ink-roller, which is pressed against the former by springs.

Each roll of paper is 20 m. long, enabling approximately 33 hours of soundings to be taken.

Fine recordings are obtained with this paper, and no special precautions are required for its preservation. It is extremely probable that it will come into general use.

419-B recorders can easily be adapted for use with dry paper.

Figure 15 shows a recording obtained with electrolytic paper on the trawler *Fladen* of soundings in extremely shallow water (the distance between two consecutive horizontal lines is equal to 10 m. of water).

The 419-B sounder and its extremely sensitive amplifier have given excellent results in the detection of fish. Figure 16 shows a recording of large shoals of fish. The clear echoes obtained from the various layers of the shoal will be noted.

Figure 17 shows an electrolytic paper record of echoes obtained from whiting.

Figure 18 is a reproduction of a fine echo record obtained from a shoal of fish by means of dry paper. The additional echo represented by a double line (reflection on the ship's hull and on the sea surface) appearing below the bottom echo line will be noted. The two oblique lines should be disregarded: the sounder recorded signals transmitted by the echo sounder of a trawler nearby and the corresponding bottom echoes.

CATHODIC ANALYSER. — The possibility of analysing echoes obtained in greater detail may occasionally prove desirable, such as in the more accurate determination of the height of a shoal of fish above a flat bottom.

A « cathodic analyser » of ultrasonic echoes was designed and built for this purpose, supplying a detailed picture on a screen of part of the area sounded, magnified 8 times. Figure 19 shows the appearance of the instrument. The front panel, swinging on lateral hinges, carries the electric equipment, which greatly facilitates inspection and maintenance of the instrument. A vertical cathodic tube shows the current impulses produced by the echoes on the cathode screen. A 45° mirror and a large magnifying lens supply a larger and extremely bright picture of the screen. The mirror swings on a central horizontal axis, enabling the user when inspecting the instrument to check its operation with the front panel open.

The instrument is used in conjunction with sounder 419. It can be set up by means of a simple connection arrangement with a sounder already in operation. On the front panel may be seen:

— the circular observation lens,
— the starting switch,
— the sensitivity control,
— the depth of observation control.

The analyser enables examination of a 25-metre layer selected at any depth between 4 m. and 575 m. Owing to the thickness of this layer there is no danger of the ship's vertical motion causing a shoal of fish under observation to disappear from view.

The cathodic analyser (known as a *pescamire* in fishing circles) is set up near the recorder in the deckhouse or chart room. A small converter unit supplies the necessary alternating current when there is no recorder available.

Weight of cathodic analyser	.....	28 kg.
Space requirement: Width	.....	452 mm.
Height	.....	428 »
Depth	.....	214 »
Weight of converter	.....	7 kg.
Space requirement: Width	.....	258 mm.
Height	.....	200 »
Depth	.....	115 »

ECHOSCOPE. — The Langevin-Florisson sounder equipped with an echoscope is a moderate-sized sounder enabling precise soundings to be taken at shallow depths. It consists of:

— The echoscope proper, containing the transceiver with a 3-valve amplifier in a watertight box, and the optical analyser with a Dubois electromagnetic oscillograph.

— An HT box.
— A 6 V storage battery.
— An S. 32 projector.

The latter may be connected to the end of a removable tube made fast vertically alongside the craft, or carried in a vertical tube fitted inside the craft, or mounted like the S. 24 projector.

The echoscope has a scale 30 cm. long graduated from 0 to 60 m. (or from 0 to 30 m.). Transmission takes place every 10/11 ths of a second (or every 5/11 ths of a second). A spotlight travels periodically over the scale and shows two peaks: one corresponding to the transmitted signal and the other to the echo. The depth is read off opposite the beginning of the second peak. Soundings can be taken beyond 1.20 m. beneath the surface of the projector with an accuracy of 10 cm.

The constant rate of travel of the spotlight is obtained by means of a clock mechanism wound by hand, ensuring 12-minute (or 6-minute) operation between

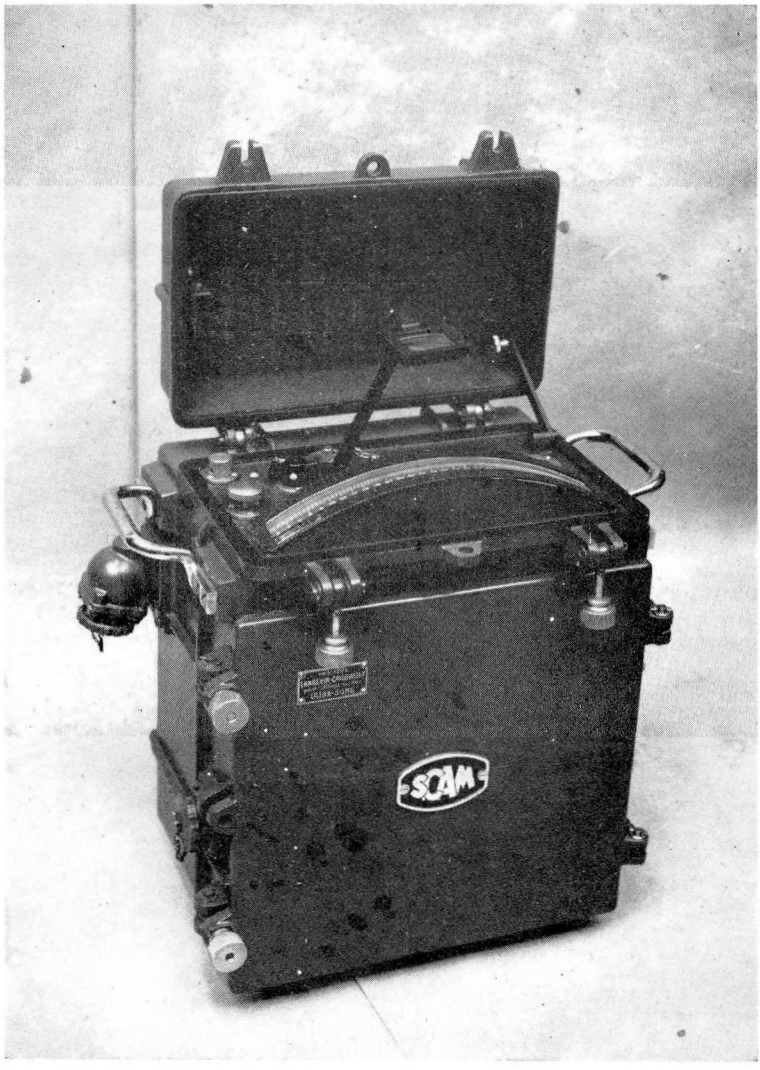

Fig. 21. — Sounding unit with Echoscope
(Portable type).

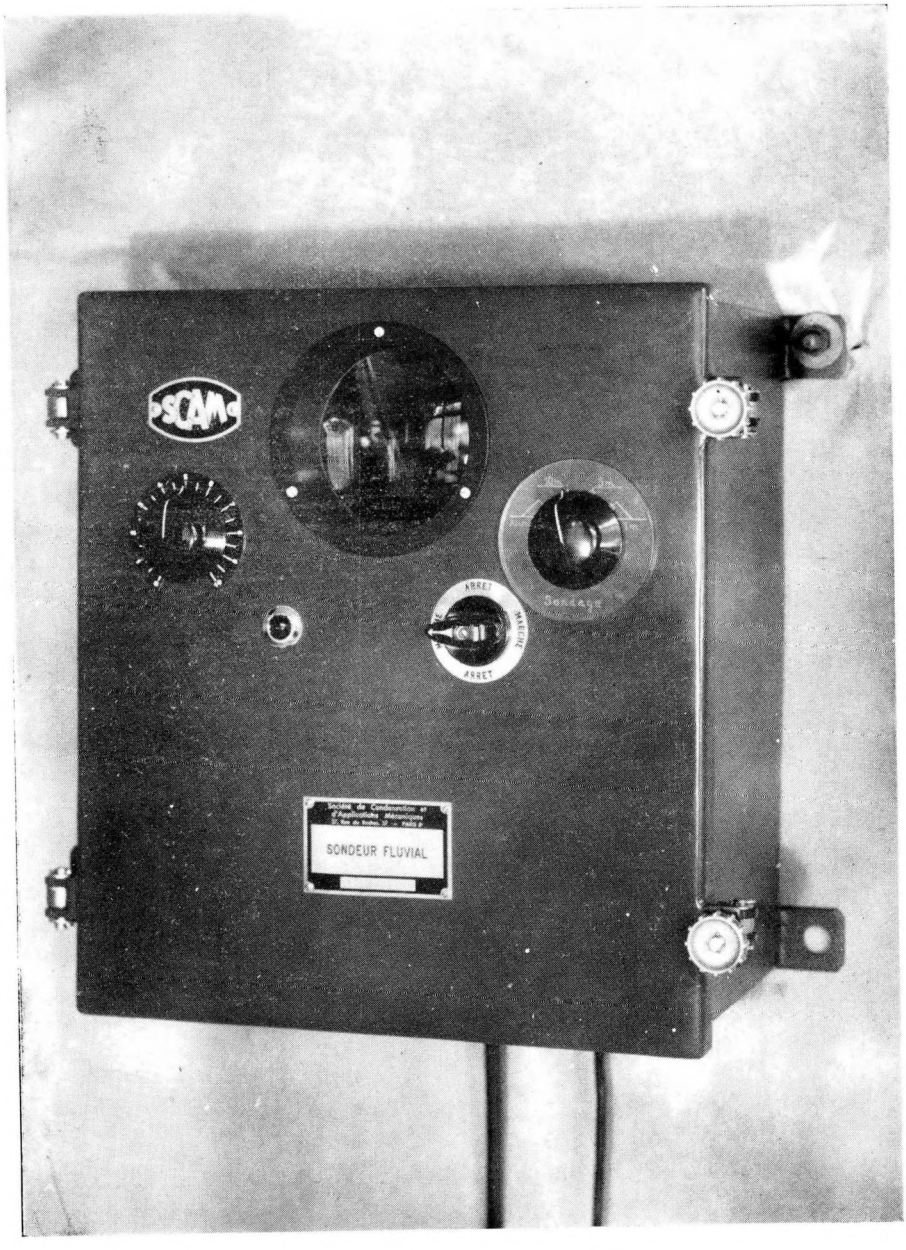

Fig. 22. — River echo sounder.

windings. The instrument is equipped with a winding indicator. A blue light is provided for night operaton.

The HT box contains a 250 V generator, with input and output LF and HF filters to eliminate all types of interference.

Figure 20 shows the echoscope in operation. The lens for easier reading will be observed. Figure 21 shows a portable type echoscope sounding unit.

Space requirement of HT box :	Width	387 mm.
	Height	308 »
	Depth	206 »
Space requirement of echoscope :	Width	573 mm.
	Height	516 »
	Depth	320 »
Weight of echoscope		59 kg.
Weight of portable echoscope sounding unit		113 kg.

RIVER SOUNDER. — This recently developed sounder is designed for river navigation, but may also be used in the hydrographic surveying of canals, roadsteads, harbours, etc. It consists of three separate units :

(1) The *Indicator* (Figure 22), set up in the deckhouse against a bulkhead or on a console, within full view of the man at the wheel.

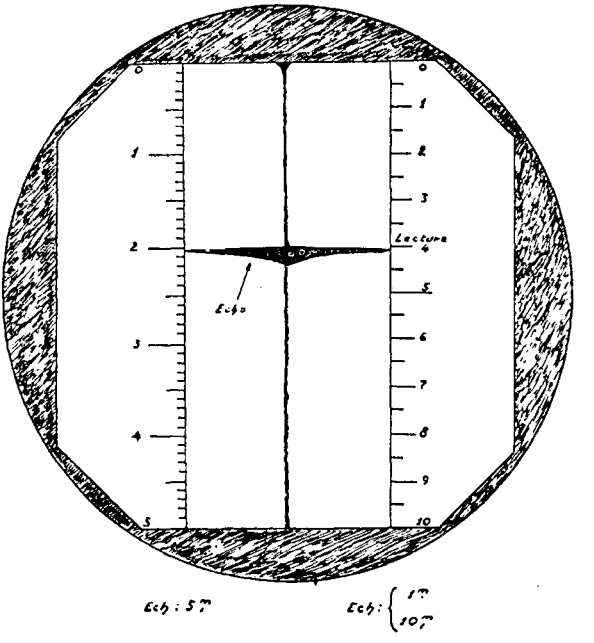

Fig. 23

The following controls appear on the front panel:

— An on-off switch.

— A sensitivity control.

— A 0 to 1 m., 0 to 5 m., 0 to 10 m. scale switch.

The front panel, which is also equipped with a circular observation screen, swings on lateral hinges, providing easy access for adjustment and maintenance purposes to the various parts of the equipment located on the inner wall.

(2) The *Projector* transmitting the impulses and receiving the echoes is a watertight metal cylinder 66 mm. in diameter. Its lower surface, consisting of a sheet of quartz, is in direct contact with the water.

The projector is assembled on a base bolted to the hull, through which a hole has first been drilled. The base, which is of a special shape, is freeze-proof, and includes a valve enabling the projector to be taken down while afloat, is usually set up in the axis of the ship on one of the flat plates and in a compartment near the bow.

The transmitting surface of the projector is about 10 cm. away from the inner edge of the base in order that possible shocks may be avoided.

The projector is connected with the indicator by a single cable that may be as long as 120 m. if required.

(3) The *Converter* of the power supply. Its weight is small and it takes up little space. It transforms the direct current from the ship's mains and supplies the sounder with alternating current.

This type of sounder is remarkably simple to operate. The screen, located within easy view of the helmsman, supplies a continuous depth display. The echo appears as a bright green mark, and its position on the depth scales can be read off with ease.

	Indicator	Projector and base	Converter
Weight ..... kg.	28	20	5
Space requirement: Height ..... mm.	430	250	300
Width ..... »	420	180	200
Depth ..... »	240	180	120