C. — THE NEW ULTRA SONIC SOUNDERS AND THEIR USE IN HYDROGRAPHY.

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Readers of the *Hydrographic Review* are acquainted with the ultra-sonic sounders based on the Langevin-Chilowsky system (*Hydrographic Review*, Vol. III, N° 2, July 1926, pages 75 to 87 ; Vol. V, N° 2, Nov. 1928, pages 107 to 120). These appliances contain three essential parts, the *quartz ultra-sonic projector*, the *emitter-receiver* and the apparatus for controlling the emitter-receiver and for measuring the echo interval. This last appliance may be either a Touly neon lamp *Indicator*, a Florisson *Optical Analyser* or a Marti smoked paper *Recorder*.

THE OPTICAL ANALYSER.

The Langevin-Florisson Sounder with analyser, of the more usual type, takes a sounding every second. Its scale is graduated from 0 to 375 metres (205 fms.). One millimetre (.039 in.) on the scale represents 2 metres (6.6. ft) of water. At each sounding a luminous spot makes a "tooth" which corresponds to the emission signal and another which corresponds to the echo (Fig. 1). As the point of initiation of the emission "tooth" appears opposite the zero of the scale (or, more accurately, opposite the graduation which corresponds to the draught of the vessel) the vertical depth at the position of the vessel is read off opposite the point of initiation of the echo "tooth".

The constant-speed motor, which is necessary in order that the spot of light should move along the scale at a rigorously constant speed, is a 20 pole phonic motor driven by a current the frequency of which is 40 (*viz.* continuous current from a battery, interrupted periodically by means of a maintained tuning-fork or a ticker).

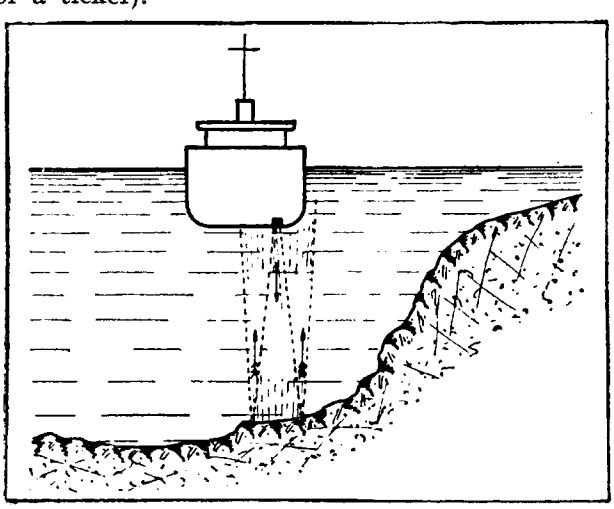

Fig. 2.

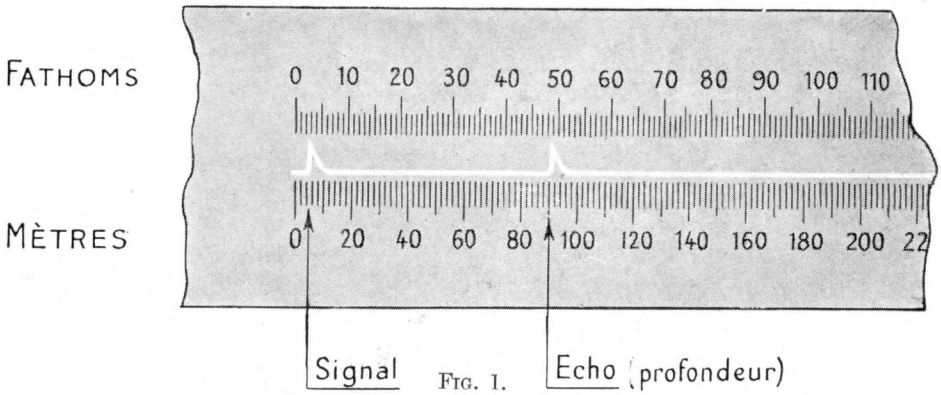
FATHOMS
0 10 20 30 40 50 60 70 80 90 100 110
MÈTRES
0 20 40 60 80 100 120 140 160 180 200 22
Signal
Echo (profondeur)

FIG. 1.

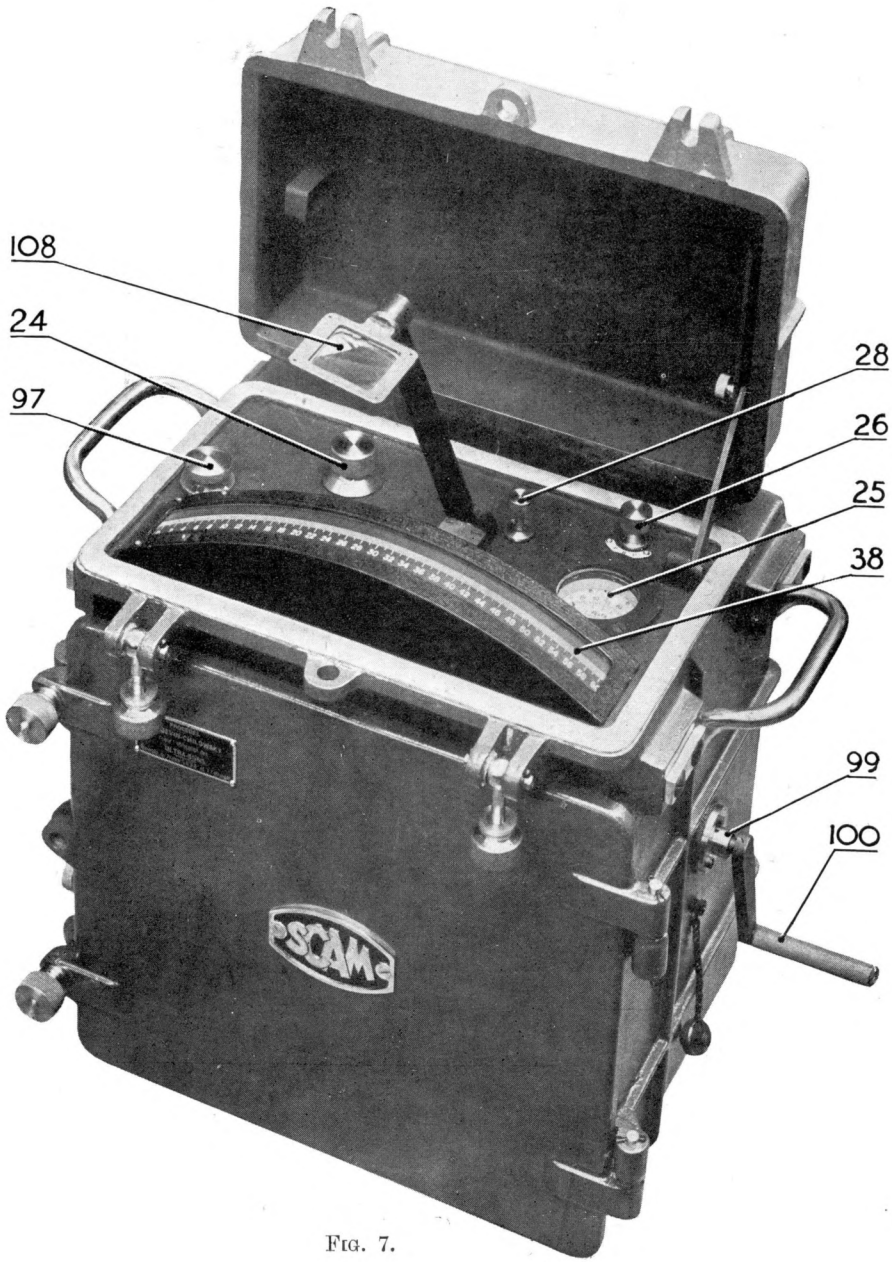
108
24
97
28
26
25
38
99
100
SCAMS

FIG. 7.

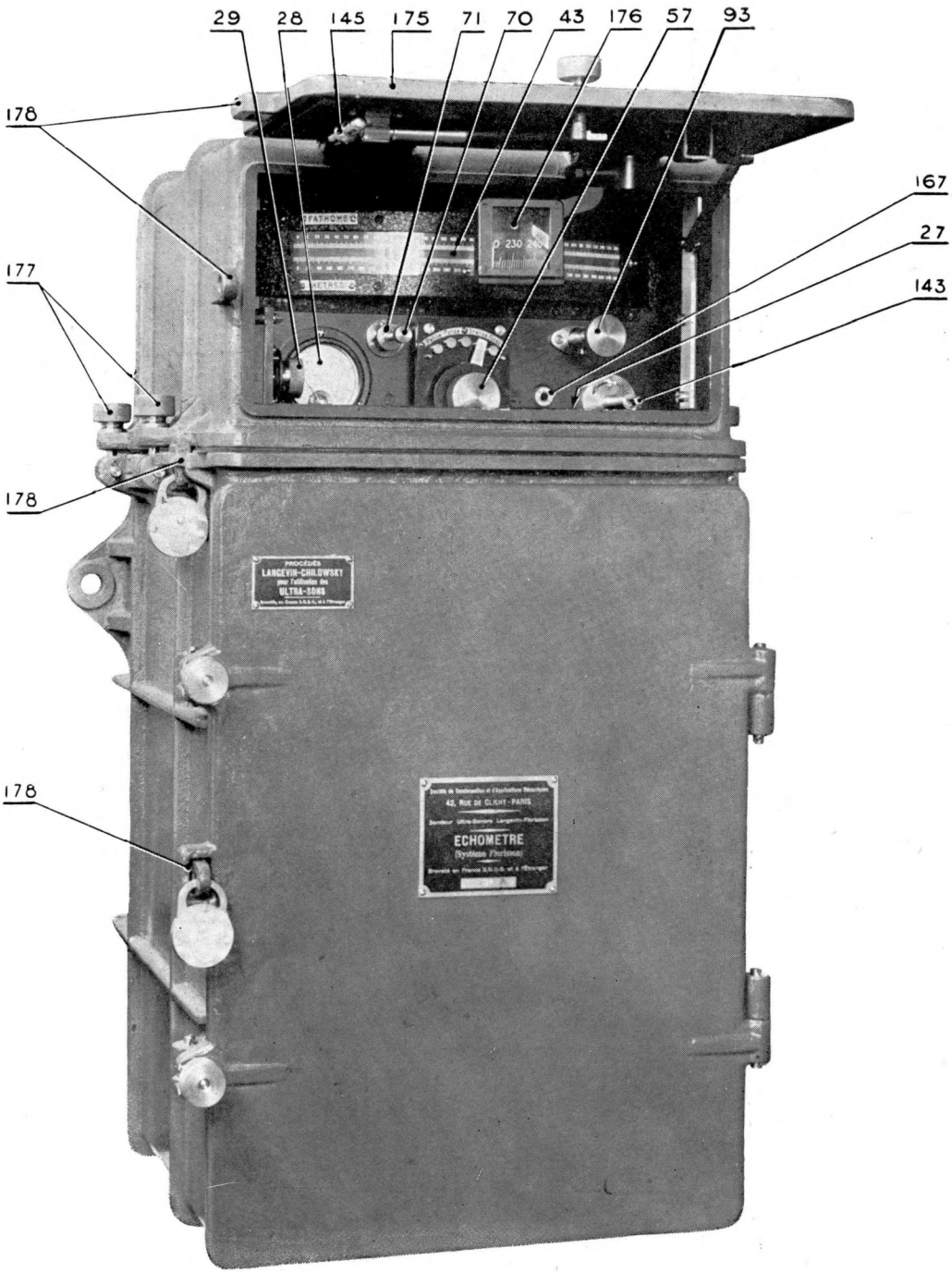
29
28
145
175
71
70
43
176
57
93
178
167
27
143
177
178
178
FATHOMÈTRE
METRES
PROCÉDÉS
LANGEVIN-CHILOWSKY
ULTRA-SONS
42, RUE DE CLICHY - PARIS
ECHOMETRE
(Système Florisson)

FIG. 4.

The great advantages of ultra-sonics in sounding will now be briefly summarised. Ultra-sounds are propagated in a relatively narrow pencil at right angles to the emitting face of the quartz projector. By installing the projector so that its emitting face lies in a horizontal plane when the ship is on an even keel the taking of *vertical* soundings is ensured (Fig. 2). By using sonic waves, which are propagated spherically, the apparatus records the echo from the nearest point of the bottom (Fig. 3). Obviously, in most cases, this will give the vertical depth, but with uneven or sloping bottom the appliance will record, not the vertical depth, but the distance to a nearer part of, or obstacle on, the bottom, and the user cannot be aware of this.

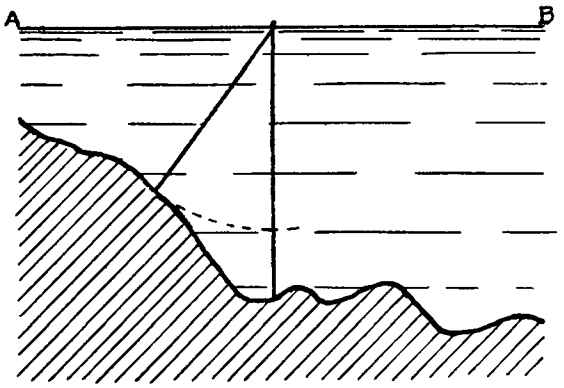

FIG. 3.

Ultra-sonic sounders with analysers have the additional advantage of *recording the emission signal at each sounding*, thus permitting the observer to make sure that there is no time error in the level of the departure of the emission signal. Besides, the soundings are automatically and *periodically repeated*. The observer can thus rapidly check his readings and easily distinguish the echo from the bottom from the "false echoes" produced by parasitic water noises which occur in certain circumstances at sea (in bad weather). Finally, "oscilloscopic" or "oscillographic" analysis gives some indication of the *nature of the bottom* by the shape of the echo "tooth" (e.g. a double "tooth" over a wreck or a rock, etc.).

The ultra-sonic sounder with the MARTI recorder is used by many ships, liners, surveying vessels, etc. In ships of medium or small tonnage and for trawlers, in which it is of the greatest importance to know the depth of water at any moment, the sounder with an optical indicator is used for preference, for this does not entail keeping the apparatus at work continuously as is the case with the recorder. But the appliances have been much too bulky for small vessels and thus the makers have sought to reduce the bulk and, at the same time, to simplify the working as far as possible.

Naturally the idea was conceived of grouping the emitter, the receiver and the analyser within a single case. But it was impossible, in such case, to retain an electric motor for this would produce inadmissible parasitic induction in the highly sensitive amplifier. Consequently recourse was had to a

clockwork movement. It is true that this has the slight disadvantage that it has to be wound up by hand, but it has very much simplified the apparatus.

THE LANGEVIN-FLORISSON ECHOMETER.

The new instrument made by the Société de Condensation et d'Applications Mécaniques and named *Echometer* has its emitter-receiver and the analyser all within a single cast metal case.

The sounder consists of the echometer with its batteries (a 4 v. 100 A.H. accumulator with recharging apparatus attached, and an 80 v. dry battery) and the quartz projector fixed in the bottom of the ship. Fig. 4 shows the exterior appearance of the Echometer. The number 43 indicates the scale on which readings are made and this is usually graduated from 0 to 660 metres (361 fms.). The magnifying glass 176 makes the "teeth" more easy to distinguish. The starting and stopping of the apparatus is worked by the plug 93, and 143 is the winding stem of the movement; the rheostat 57 controls resistances in the oscillograph circuit thus making it possible to reduce its sensitiveness in shoal water and the milled head 71 governs the height of the lumi-

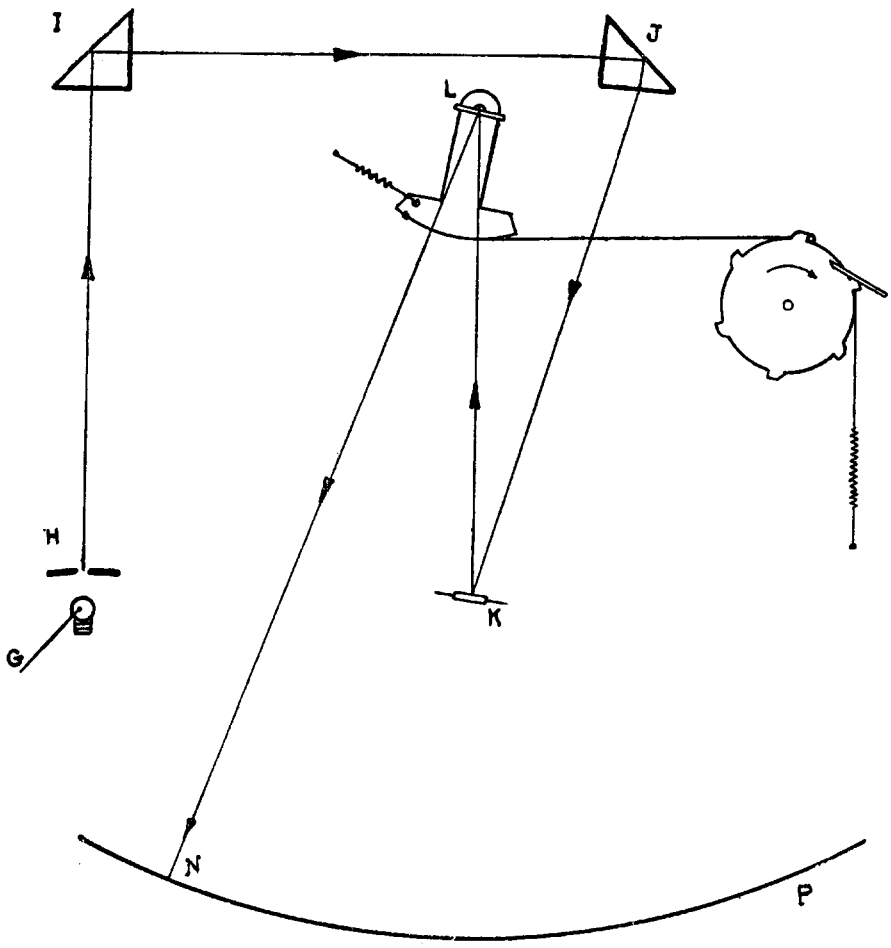

FIG. 5.

nous spot. In the 660 metre model soundings are taken automatically every 7/6 second.

The various interior parts of the Echometer will not be described but the principle of the optical system of the appliance will now be examined.

Fig. 5 shows a diagrammatic arrangement of the upper part of the apparatus as seen from above, the lid being removed. The graduated scale is marked *P*. A diaphragm *H* is brightly illuminated by an electric lamp *G*. The pencil of light is reflected by two prisms *I* and *J*, then by the mirror *K* of the oscillograph and finally by a plane mirror *L*. A small, sharp and brilliant image *N* (the spot) of the diaphragm *H* is thus produced on the scale. The mirror *L* is not fixed but swings at a constant angular velocity about the axis *L* and thus the spot traverses the scale at a constant velocity from left to right. When the spot has completed its run, the swinging mirror *L* comes sharply back to its initial position bringing the spot back to the zero of the graduation after each sounding.

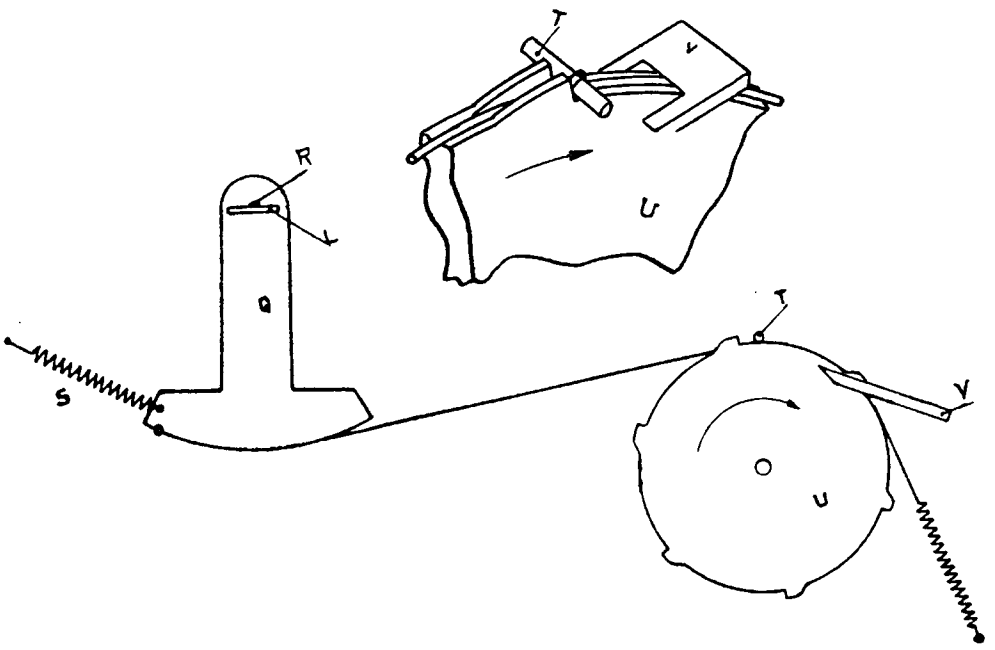

FIG. 6.

Fig. 6 shows the mechanism which causes the displacement of the spot *N* at a constant velocity along the scale *P*. The mirror *L* is attached to a sector *Q* which can move about the vertical axis *R*. A steel wire, stretched by the spring *S*, is provided with a small bar *T* at right angles to the wire. The ratchet-wheel *U* revolves, by clock-work (not shown), at a rigorously constant speed. A tooth of the ratchet-wheel catches the bar *T* and carries it with it thus causing the mirror *L* to turn about the axis *R* at a constant speed. This motion continues until the ends of the bar *T* reach the inclined fork *V* which lies astride the ratchet-wheel *U*. This throws the bar clear of the tooth and, owing to the action of the springs shown, the sector *Q* springs

back until it reaches a stop (not shown). Owing to this the spot is brought very sharply back to the zero of the scale graduation. The cycle is repeated as soon as the next ratchet tooth catches the bar.

An appliance (not shown), which causes the ultra-sonic emission when the spot passes the zero of the scale, is attached on to the sector *Q*.

Fig. 1 shows the appearance of the scale when a sounding is taken in 90 metres of water. The shoalest legible sounding with this type of scale is from 3 to 4 metres (10 to 13 feet).

The Echometer is a valuable navigational instrument for all classes of vessels (cruisers, torpedo vessels, submarines, liners, tramps, trawlers, etc.) and may be used with advantage for hydrographic work.

THE LANGEVIN-FLORISSON ECHOSCOPE.

The Echometer will not allow soundings of less than 3 to 4 metres (10 to 13 feet) to be taken and, besides, depths up to about 50 metres (27 fms.) are, in many cases, those of the greatest interest when surveying. The Société de Condensation et d'Applications Mécaniques has just produced a new type of small sounder for shallow water, *viz.* the ultra-sonic sounder with *Echoscope* (Fig. 7).

This instrument is contained in a cast metal case of very small dimensions and has, at the top, a scale graduated from 0 to 60 metres (32 3/4 fms.). One metre (1/2 fm.) of water is represented by 5 mm. (0.2 in.). Soundings are taken each 10/11 of a second. As in the Echometer, the observer can see the emission "tooth" and it may be so adjusted that the initial point of this "tooth" lies opposite the point on the graduation which corresponds to the depth of the projector. The spot of light moves at a constant speed along the scale and, as before, the echo "tooth" is observed and the depth is read off at the initial point of this "tooth". Fig. 8 gives the appearance of the scale when a sounding of 8.20 metres (27 ft.) is taken. Soundings may be obtained from 1.20 metres (4 ft.) of water under the projector down to 20 to 50 metres (11 to 27 fms.) according to the nature of the bottom.

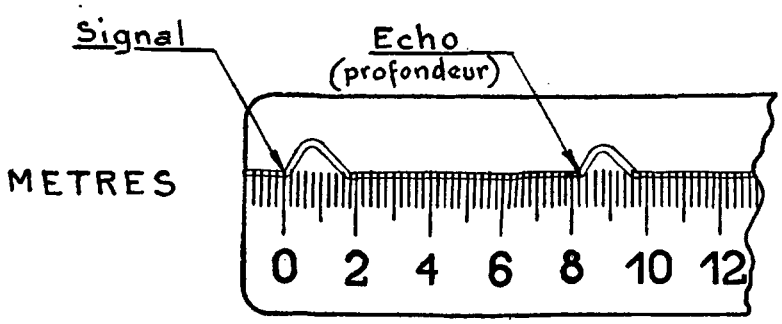

FIG. 8

Fig. 9 represents the course of the luminous pencil in the analyser (in a vertical plane). A diaphragm 71 is brightly illuminated by the electric lamp 73 with reflector 77. The pencil is reflected by the mirror 39 of the oscillograph and again by the spherical mirror 36 which turns at a constant speed

about the axis 37. The scale 38 being centred on this axis, the spot moves along the scale at a constant speed.

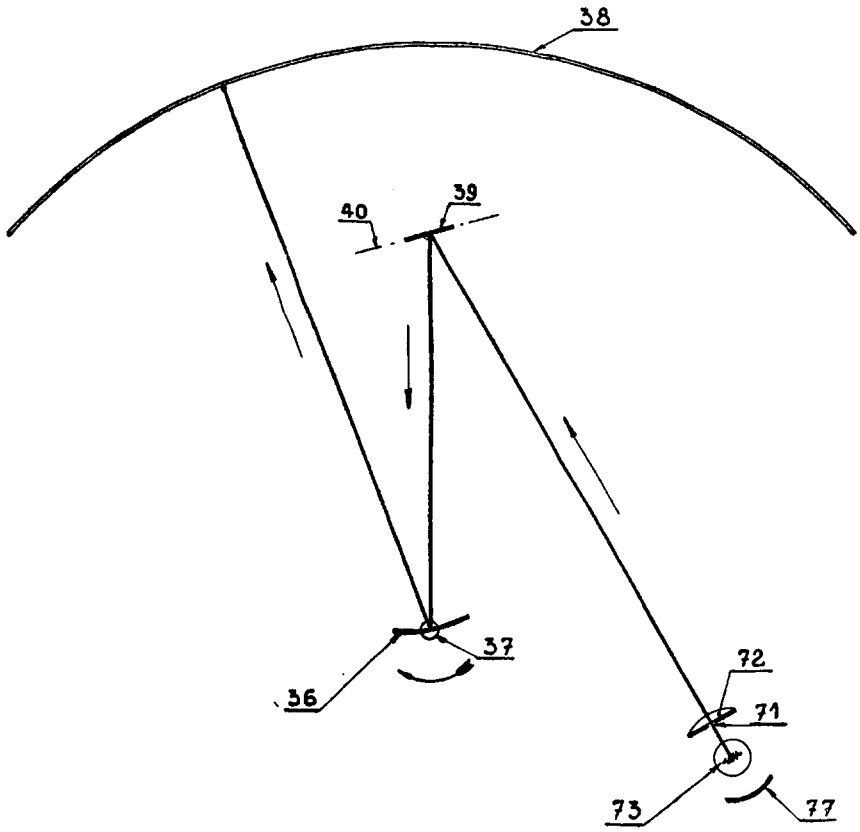

FIG. 9.

The amplifier has 5 valves but a switch allows 3 valves only to be used for depths of less than 5 metres (16 ft.). The relative error of the soundings is less than 1 %, and the absolute error in reading off, which may increase the relative error, is less than 20 centimetres (8 ins.).

The Echoscope, like the Echometer, may be secured to a bulkhead (it then becomes the *mural* model) and the projector is permanently attached to a base which is bolted to the hull. But a *portable* model, provided with handles for lifting and rubber feet, can also be made. The projector is portable also and is attached to the lower end of a watertight tube and thus can be immersed at any point along the ship's side.

The whole Sounder weighs but some 50 kilogrammes (1 cwt) and can easily be fitted into a boat in fifteen minutes. The projector is connected to the Echoscope by two cables protected by a flexible metallic tube.

The portable Echoscope is destined to be of the greatest service in coastal hydrographic surveys, the supervision of estuaries of ports, canals, etc. and it is certainly a valuable and remarkable step forward in the rapid and accurate determination of lesser depths.

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