FIG. 1 — Visual Indicator.

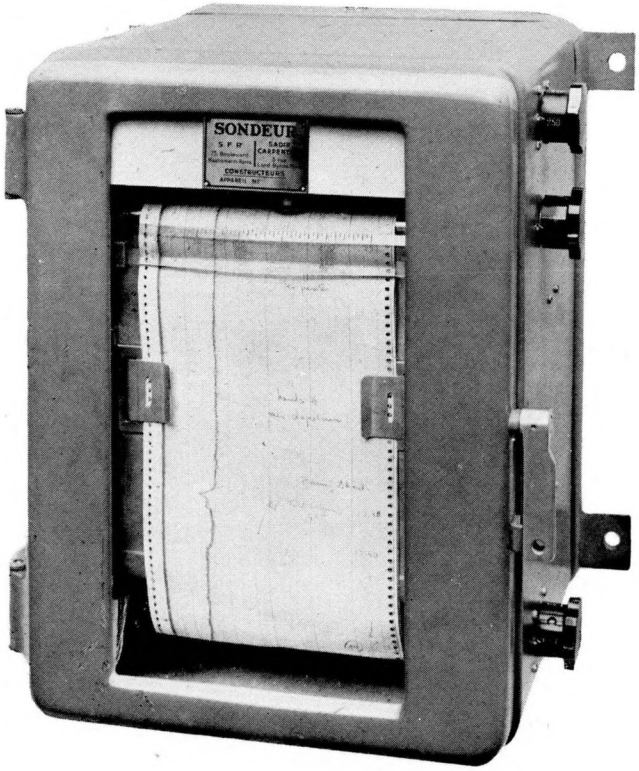

FIG. 2 — Recorder.

SFR-Carpentier 476 Sounding Machine.

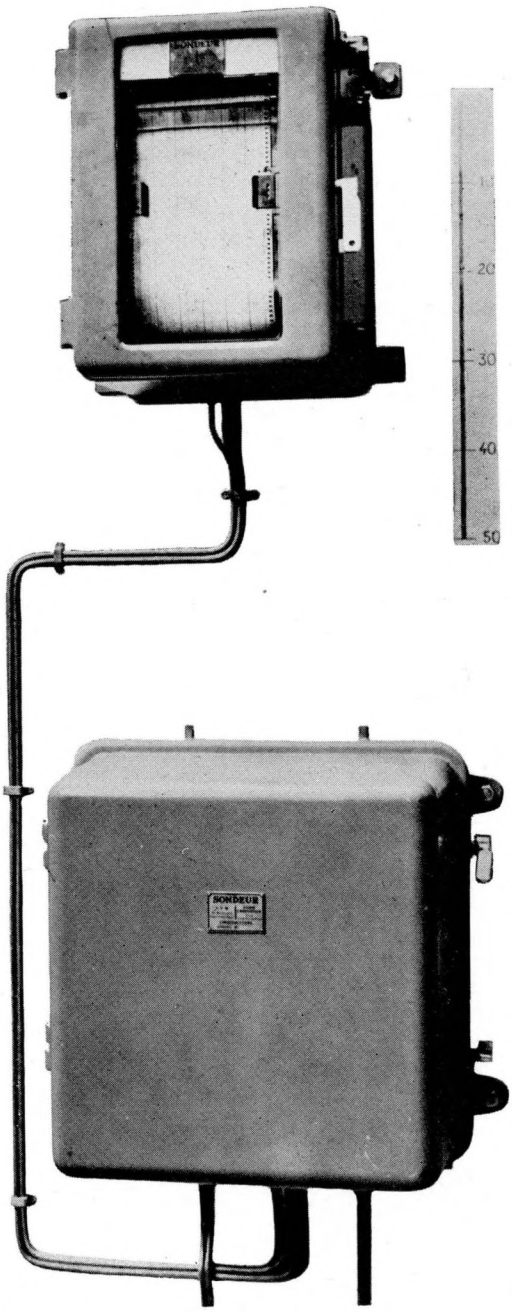

FIG. 3

SFR-Carpentier 476 magnetostriction Echo Sounder.

SFR-CARPENTIER 476 SOUNDING MACHINE.

(SOCIÉTÉ FRANÇAISE RADIO-ELECTRIQUE, 79, Bd HAUSSMANN, PARIS (VIII^{e}).)

GENERAL DESCRIPTION.

The SFR-CARPENTIER 476 Sounder is a magneto-striction ultrasonic sounding machine designed to give up to 850 metres, the depth of the sea-bottom or of a submerged obstacle : mine, wreck, fish-shoal, submarine, etc.

From the fact of its accuracy, its use is particularly indicated for safety of navigation, for fishery operations, scouring for wrecks and, more generally speaking, for the examination of submarine areas.

The vibration frequency selected is 15,000 periods per second ; the signal transmitted being thus an ultra-sound situated beyond the limit of audible frequencies, the working of the apparatus is silent and remains unaffected by aboardship parasitical noises which are almost invariably at audible frequencies.

The installation involves a certain number of distinct units enumerated below :

— a measuring apparatus, which may be either a visual indicator with circular dial or a recorder, or the two instruments.
With indications in metres or in fathoms on request.

— a radioelectric transmitter-receiver box.

— a transmitting base

— a feeding arrangement.

The measuring apparatus operates the starting "Mark", which provokes the oscillations of the radioelectric transmitter. The signal thus obtained is transformed by the magnetostriction transmitter base into an acoustic signal radiated in the water towards sea-bottom.

The magnetostriction receiving base, similar to the transmitting base, works in the opposite sense, i. e. transforms the sound echo into an electric signal amplified by the radioelectric receiver.

This amplified signal is directed to the visual-indicator or recorder measuring apparatus which indicates the value of the time interval between the start of the transmission and the return of the reflected wave. This interval being proportional to bottom depth, the apparatus is divided in metres or in fathoms, so that the reading indicates the depth directly. Only the measuring apparatus, which gives the indication of the depth, needs to be under the eyes of the operator. Thus all encumbrance of the bridge is reduced to a minimum.

Two variants of the sounding machine exist, differing solely in the measuring apparatus :

— sounder with visual indicator

— recording sounder.

The visual indicator is convenient for readings at a certain distance.

With regard to the recorder, while allowing of direct readings, it gives a continuous tracing, without deformation, of the submarine relief and is of particularly easy reading because of its rectilineal scale.

All grouped parts other than the measuring apparatus being identical for the two variants, the possibility of installing a mixed sounding machine, i.e.

an instrument including both visual indicator and recorder with a switch governing the action of either the one or the other as desired, has also been foreseen.

Relatively speaking, the equipment is not bulky, as is shown by the figures apportioned to each part or group of parts.

Feeding arrangement : $61 \times 15 \times 13$ c/m.	weight : 25 kgs.
Radioelectric transmitter-receiver : $49 \times 27 \times 52$ c/m.	" : 35 "
Visual indicator : $35 \times 34 \times 14$ c/m.	" : 6 "
Recorder unit : $39 \times 33 \times 27$ c/m.	" : 25 "

Transmitter or Receiver base :

Diameter : 32.5 c/m.

Height : Variable according to the rake of the hull (26 c/m. for a rake of 20°).

The visual indicator and the recorder, being like the transmitter-receiver absolutely silent, these instruments can be mounted without any inconvenience in places where silence is most necessary as, for instance, on the bridge.

With regard to the transmitter or receiver bases, these are normally mounted in containers fixed inside against the hull if it is in metal ; this does away with the necessity for putting the ship in dry dock while being equipped.

During the endurance trials made by the French Navy, gunfiring and grenade action at sea were resorted to. After those exercises the equipment continued to work perfectly, without the slightest irregularity having to be noted. It was, besides, the attention devoted to the question of solidity, which is of course a primordial quality for a shipborne equipment, which decided the adoption of magnetostriction transmitter and receiver bases. In this way one has at one's disposal extremely solid bases on which accidents caused by the deterioration of the quartz or by the latter becoming un fixed, need not be feared.

No adjustments are necessary for putting the machine in operation and maintenance is limited to greasing a few axes from time to time.

With regard to the mechanism of the recorder, it is mounted on a vertical axis round which it can rotate in such a way that it may be led to the exterior of its box without ceasing to function, which is particularly convenient for testing the working and for maintenance operations.

Considered from the radioelectric point of view, this sounding-machine also introduces some interesting innovations likely to improve the security of its working.

Firstly the start of the transmission "Mark" is obtained by liberating the transmission valve grids, i.e. by cutting off an insignificant current which acts without intermediary relays.

A second advantage arises from the fact that the transmission magnetostriction base is sollicited by a pure wave supplied by the transmitter and not, as in other sounders, by an electric shock, from which it results that the transmission power and frequency remain constant for the whole duration of the impulse, which is not the case for the damped oscillations obtained with shock-excited bases.

Lastly, special precautions have been taken to eliminate to the greatest possible degree parasites capable of jamming reception of the echoes.

The regulated feeding provided for does away with the necessity for employing accumulator batteries with charging board, which demand much time and attention and are costly to maintain.

I. — VISUAL INDICATOR.

The case of the visual indicator is cylindrical in form, the essential component of the latter being a shaft turning at constant speed operated by an electric motor fitted with a very delicate speed governor. For the accuracy of the measurements it is in fact necessary that revolution speed be as constant as possible.

A disc carrying a collector swept by a brush is fitted on the shaft ; the collector is interrupted on a narrow section of such a length that the brush requires one-thousandth of a second to cross it. It is the passage of the insulated sector under the brush that excites the transmission signal, as will be seen further on in the chapter relating to the radioelectric transmitter.

A neon valve which plays the rôle of luminous oscillograph is also mounted on the disc. When lit, this valve, situated behind a guard screen in which there is a radial slit, appears as a narrow luminous stroke directed according to one of the rays of the reading dial constituting the front of the apparatus (Figure 1).

The period of illumination of the valve is very brief, on the one hand at the instant of the transmission "Mark" and on the other, at the instant of arrival of the echo "Mark".

The apparatus is adjusted in such a way that the transmission "Mark" coincides with the passage of the neon valve opposite the zero division of the indicator. The angle through which the neon valve has turned when it lights up under the action of the echo, therefore measures the "echo time".

The circular dial may be divided, on request, either in metres or in fathoms.

According to the depth to be measured or according to the sensitivity desired, the instrument carries a dial with two distinct scales :

— *scale of* 0 *to* 100 *metres* corresponding to the external division in one hundred equal parts, the tenths only being marked, with the numbers 10,20, etc. up to 100 ; a small division therefore corresponds to 1 metre, which gives a very satisfactory accuracy and great ease of reading.

— *scale of* 0 *to* 800 *metres* corresponding to the exterior division of the dial in 80 equal parts, each division corresponding to 10 metres. Hundredths only are marked, by the numbers 100, 200, etc... up to 800.

To obtain this double sensitivity no arrangement for change of speed has been retained because of the mechanical complexity of solutions of this kind, which are generally the source of inaccuracies in the measurements.

Simply two concentric discs each carrying a neon valve are used instead of a single disc.

One of the discs turns at the same speed as the chronograph shaft and the luminous slit shows opposite the 0-800 metre division ; the other disc turns at 8 times the above-mentioned speed and the corresponding luminous slit appears opposite the 0-100 metre division.

A simple switch allows one or the other disc to be connected onto the electric arrangement which excites the illumination of the neon valve. Thus one or the other disc may be put in operation as desired, according to the depth to be examined.

When the approximate depth, say 325 metres, has been determined on the 0-800 scale, the scale 0-100 on which soundings will be recorded to the 25th division may be used, thus obtaining more sensitivity to changes of depths, a matter of great interest, notably for fishing : also the rhythm of soundings is multiplied by 8 which renders reading much easier and, in heavy swell, affords to some extent a better contact with sea-bottom.

The manœuvre of the switch is governed by the knob seen on the righthand side of the indicator (Figure 1). This is a 4 position knob marked by the inscriptions :

VEILLE (Off) — MARCHE (On) 100 m. : VEILLE (Off) — MARCHE(On) 800 m. ; it governs the putting in operation of the sounding machine. When it is in the position VEILLE (Off), the heating is branched onto the filaments of the transmitter - receiver valves ; but the high tension is not branched ; moreover the indicator motor does not rotate. When sounding operations are momentarily interrupted, this position allows the valves to maintain their heating and the apparatus to remain ready to function instantaneously without the slightest hitch, while at the same time consumption of the electric supply during the interruption of sounding is reduced. When the knob on one of the MARCHE (On) positions is operated, the instrument works on the corresponding scale : 100 m. or 800 m..

A second knob serves to regulate in just proportion the sensitivity of the reception.

For easier reading the indicator is completed by an exterior reglet, not shown on the figure. This reglet, turning around the axis of the indicator, may be orientated by the operator so as to place it on the mean division corresponding to the depth of the sounding in progress. Changes in depth are thus more easily followed and all risk of confusion with any possible parasite echo is eliminated.

II. — RECORDER.

a) Principle of the Recorder.

The recorder (Figure 2) carries a stylus moving at constant speed transversally in relation to a paper strip which itself moves longitudinally at slow speed. This strip is ruled longitudinally ; the lines correspond to equidistant depths marked in metres or in fathoms as desired.

When in transit before the zero line, the stylus itself liberates the transmission "Mark" and traces a mark on the paper. On the return of the echo the stylus, then at a distance from the zero division proportional to the depth of the obstacle, traces a second mark. The distance between the two marks gives the depth value which is read directly by using the transparent rule divided in metres or in fathoms which is placed in front of the sheet of paper.

Sounding to 850 metres have been provided for by the recorder.

Sounding frequency has been selected so as to be amply sufficient for navigation and fishing requirements and the speed of unrolling of the paper strip is such that a large number of records per millimetre are obtained, which gives perfectly continuous lines for the records as may be seen on Figures 4 & 5.

The useful width of the paper strip is 125 millimetres ; it corresponds to a depth of 250 metres.

For ease in reading the results, the paper strip carries stippled lines at intervals of 5 millimetres (which corresponds to 10 metres' depth) and continuous thicker lines at intervals of 25 millimetres which afford more visible marking points (they represent 50 metres'depths).

In installations where it is desired to read the sounding in fathoms, the speed of the stylus is increased in the relation 2/1.83 so that the scale of 125 millimetres corresponds to 125 fathoms. The interval between the stippled lines then represents 5-fathom depths and the interval between the thick lines represents 25-fathom depths.

The recorder has been arranged to work at depths up to 850 metres. To take soundings beyond 250 metres (the useful width of the paper strip), an electric device is used to put out of phase the trigger of the transmission Mark beforehand by a period of time determined in relation to the passage of the stylus opposite the zero division. A special arrangement has been provided to prevent any record on the paper strip of the out of phase transmission Marks and to differentiate, according to the value of the displacement, the record traced on the paper at the instant of the passage of the stylus in the vicinity of the zero division.

In this way four scales are available :

— Scale 0-250 metres :the starting Mark is recorded on the zero division ;

— Scale 200-450 metres : no record in the vicinity of the zero division ;

— Scale 400-650 metres : a small dash 2 millimetres in length is recorded on the margin before the zero division ;

— Scale 600-850 metres : two small dashes of 2 millimetres' length are recorded on the margin before the zero division.

The passage from one scale to another is instantaneously effected by manœuvring a switch.

b) Principle of the Recorder.

The recorder includes an exceedingly light cylindrical stem, in the form of a very fine needle, animated by a uniform-speed transversal alternative movement which, under the influence of an electro-magnet, lowers vertically and comes in contact with the recording strip.

The latter is constituted by a strongly tinted paper covered by a thin layer of a product on a paraffin basis giving the sheet a white colour. When a transmission mark or an echo mark liberates the working of the electro-magnet, the point of the stylus lowers and scratches the paraffined pellicule thus causing the coloured foundation to show, whereby absolutely clear-cut and visible traces are obtained. The nature of the paper and the use of the dry-point eliminates all difficulties inherent in the use of chemically-treated papers or ink styles.

There need no longer be feared, in fact, modifications to internal parts of the apparatus caused by chemically-treated papers, or the expansion and contraction that affect dampened papers. The irregularities and lack of clarity almost inseparable from ink recording instruments are likewise avoided.

Finally, it is unnecessary that any special precaution be taken either before or after use, and the conservation in good condition of the paper is unlimited.

The initial paper roll corresponds to about 50 hours' continuous working of the apparatus. Its insertion and replacement are extremely simple.

The recorder scale corresponds to 0.5 millimetres per metre of depth. In contrast to the arrangement adopted by almost the totality of recording sounders, the movement of the stylus is absolutely rectilineal so that measurement of the depth is recorded on the paper without the curved line having to be followed, either by means of the division marked on the sheet or of a simple decimetre. As a result, for a constant ship's speed, the profile of sea-bottom is obtained without deformation on an easily-determined scale.

In the same way the record gives a continuous profile without deformation of the submarine relief ; the slope of sea-bottom can thus be deduced from the slope of the curve and, up to a certain point, depth variations can be deduced from an examination of the strip on which may be read, through the recorder glass, a length corresponding to 27 minutes'preceding soundings.

Another advantage, springing both from this absence of deformation and the sensitiveness of the stylus, lies in the fact that, from the aspect alone of the recorded signals, an attentive observer can draw indications on the nature of the bottom.

c) Recording System.

The mechanical and electric units are grouped in a very solid, watertight metal box, in which no heating may be feared. It can be fixed on a bulkhead without any apparent fixative materiel ; where this method of fixation is impossible, two bars are supplied which bring the fixative holes to the outside of the coffer. The total weight of the recorder is about 25 kilogs.

This coffer is closed by means of a door occupying the entire surface of the front panel, articulated on two hinges situated left and kept closed by means of a bolt manœuvred by a handle situated on the right. This door is fitted with a large surface glass which offers the great advantage of having constantly before the eyes a length of paper corresponding to 30 minutes' sounding.

On the upper part, behind the glass, may be seen the stylus and a transparent divided rule used for direct reading of bottom depth ; this reading is equally possible by night for the apparatus is fitted with interior lighting consisting of two valves fixed to the inside of the door and giving diffused light. The divisions on the rule correspond respectively to each of the four recording scales.

On opening the door of the recorder, all useful data concerning the sounding (such as ships' position, route, time, etc) may be noted by means of a pencil or any sort of a point.

Most of the apparatus parts are fitted on a frame mounted on guide-blocks articulated on hinges to right.

When the door in front of the apparatus is opened, the mechanism may be extracted from the coffer without its ceasing to function, simply by making it rotate around an interior vertical axis situated towards the front. In this way the working of the instrument may be conveniently tested and cleaning and maintenance easily carried out.

The safety fuses protecting the installation are situated at the bottom of the coffer as well as a screw-driver and a special key ; a cavity behind the paper table contains an oil-can, a box of vaseline, a case of replacement brushes, etc...

The connecting cables, two in number, penetrate into the apparatus through two stuffing-boxes of the *Marine Nationale* type and join up to the terminals plate situated at the lower part of the apparatus.

The unrolling speed of the paper being 9 millimetres per minute and the length of the roll being about 21 metres, the duration of a roll of paper is in the vicinity of 39 hours.

All the manœuvring while in operation, reduced to a minimum, is done by means of the three knobs seen on the righthand side of the coffer (Figure 2).

A knob, divided from 1 to 10, permits the sensitivity of reception to be modified.

A 4-position knob, governs the change of scale and carries the marks 250, 450, 650, and 850 which indicate the scale in actual use.

A knob governs four positions shown by the indications "Marche" (On) "Veille"(Off) "Marche" et "Veille". The "Veille" positions hold the instrument ready to resume operations instantaneously on any interruption of sounding ; in fact, for those positions the heating of the radioelectric transmitter-receiver tubes is assured, without high tension being branched, and the recorder motor does not rotate, which does away with unnecessary consumption of electric power and recording paper.

Working of the apparatus

An electric motor with vertical axis fitted at its lower part with a speed governor assures the driving of all recorder parts through the intermediary of a speed-gear carried by the upper cheek of the motor.

The motor is adjusted for a speed of 3,017 revolutions per minute when results are given in metres and 3,298 revolutions per minute when results are given in fathoms.

The stylus is operated by a chain which gives it an alternative rectilineal movement ; the speed of the stylus is constant during the track corresponding to the useful width of the paper.

Two wheels fitted with needle-like points penetrating the perforations of the paper, driven by a *Vaucanson* chain assure the movement of the paper during the return period of the stylus towards the zero division. (Notes are made when the paper is at a stop).

Two drums over which different brushes sweep, permit the transmission of the "marks", the recording of the identification dashes on the scales and the prevention of recording during the return periods of the stylus.

A push-button permits testing of the proper working of the apparatus.

The initial adjustment of the recording of the starting mark in relation to the edge of the recording roll permits, if desired, indication on the paper either of the depth under the keel or the depth measured from the water-line.

III. — TRANSMISSION AND RECEIVING BASES.

The essential element of the Transmission and Receiving bases is a magneto-striction oscillator.

It is known that numerous magnetic materials have the property of varying in length when submitted to the action of a magnetic field and, the phenomenon being capable of acting in the contrary sense, of altering their magnetic condition when submitted to alternative elastic pressure.

By applying to a bar of nickel a magnetic field due to an alternative current of such frequency as to initiate the proper period of longitudinal oscillation of the bar, dilatations and contractions are obtained which permit pressures to develop. It is in this way that with a field of maximum force 50 gauss, variation amplitudes corresponding to a pressure of the order of 30 K/cm2 can be obtained.

This is the phenomenon which has received the name of magnetostriction. It offers a very attractive solution for the problem of submarine sounding, for it allows very durable metal oscillators particularly well adapted to sea-operations, to be substituted for the quartz oscillators, always fragile and subject to deterioration and to becoming unfixed.

The oscillator adopted by the SFR-CARPENTIER sounding machine is constituted in substance by a battery of thin nickel plates round which are wound spirals of conductor wire giving passage to the current meant to produce magnetisation. A circular metal piston fixed to the base of the nickel battery transmits the vibrations to the water with which it is in contact. A cylindrical hood arrangement insulates the other faces of the battery.

Oscillation frequency is 15,000 cycles per second.

A transmitter base (Figure 6) is constituted by seven analogous oscillators mounted on gear-case ; in this way better sensitivety is obtained in addition to greater directivity. It is known in fact that the greater the diameter of a

circular source, the less the demi-angle at the summit of the fundamental conical beam of sound emitted by the circular source.

The casing of the transmitter base is itself fixed on a very solid, watertight container which is applied to the hull exactly as a cupping glass would be. The container is fixed by direct soldering onto the hull or by means of iron bars and pegs soldered to the hull or even by a set of screw-jacks. The container holds a sheet of fresh water so that close connection may be maintained between the magnetostriction elements and the hull.

The preceding arrangement is suitable for steel hulls only. If one has to do with a wooden hull, it is necessary to pierce the hull and the casing of the transmitter base is then mounted on what is called the "pedestal" which allows the basic pistons of the oscillators to be put in direct contact with the sea. The same system of mounting may be adopted for metal ships where exceptionally high sensitivity is desired.

The receiver bases are identical with the transmitter bases and they function in the same way but in the opposite sense ; pressure introduced on the bases gives rise to currents in the spirals of wire surrounding the oscillators.

Receiver bases are mounted on the hull in exactly the same way as the transmitter bases. However, in the case of wooden hulls, in order to avoid piercing a second hole of large size in the hull a receiver base comprising only one oscillator may be used. In fact the sensitivity is amply sufficient given that the two bases, transmitter and receiver, are in direct contact with the sea.

The hole to be pierced in such a case for the receiver base has a diameter of only 90 millimetres.

It should be noted that the connecting cables of the two bases to the transmitter-receiver possess a junction-box each, one of which, that which is relative to the receiver base, contains a pass-band filter for the elimination of parasites.

IV. — RADIOELECTRIC TRANSMITTER-RECEIVER.

Details of the equipment (Figures 8 & 9).

The transmitter-receiver unit is contained in a very strong watertight metal coffer which is fitted on a bulkhead by four elastic supports. The coffer is formed of three principal parts :

— the body of the coffer carrying the fixation supports, the cable terminals and the bolts for closing the cover.

— the frame, on which the electric parts are fitted, which is mounted on hinges to the right and kept in position on the body of the coffer by two permanent screws situated on the lefthand side.

— the cover, which extends over the whole, is articulated on hinges to the left and maintained closed on the righthand side by the two bolts inset in the body of the coffer. A rubber joint ensures watertightness.

By this special arrangement all parts are rendered easily accessible for the purposes of maintenance, adjustment and repair as shown on Figure (9).

The connecting cables penetrate into the apparatus by four stuffing boxes situated on the lower part and are connected to the terminals plate carried by the body of the coffer. The cables going from this terminals plate to the frame are so arranged that the rotation of the frame cannot deteriorate them.

The weight of the equipment is about 35 kilogs.

The complete electric diagram of the radioelectric transmitter-receiver unit is composed of three distinct parts :

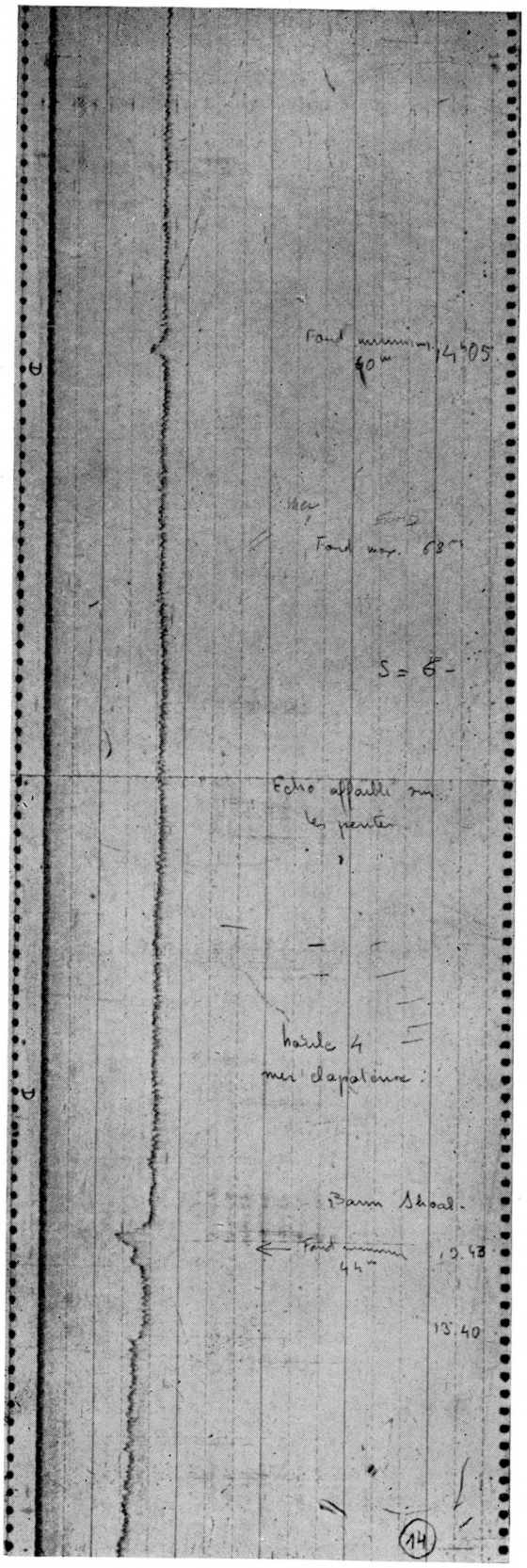

FIG. 4
Soundings in bad weather.

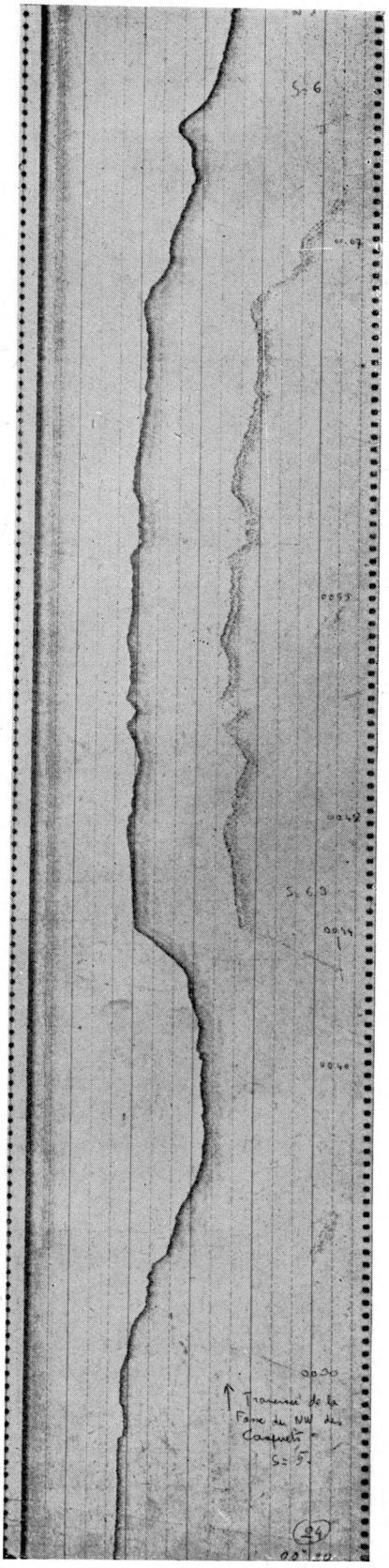

FIG. 5
Soundings off the Casquets.

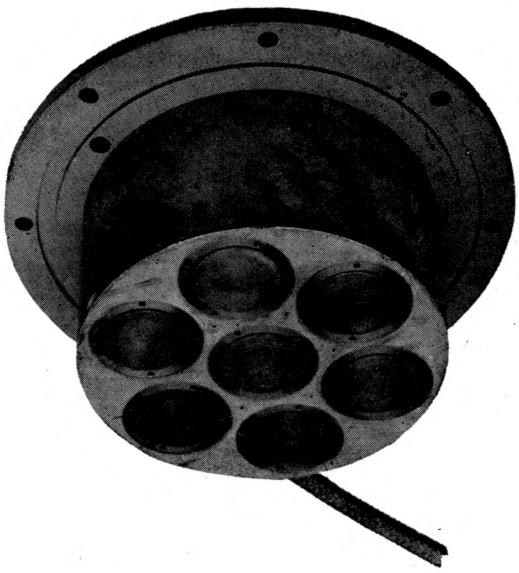

FIG. 6 — Transmitter Base.

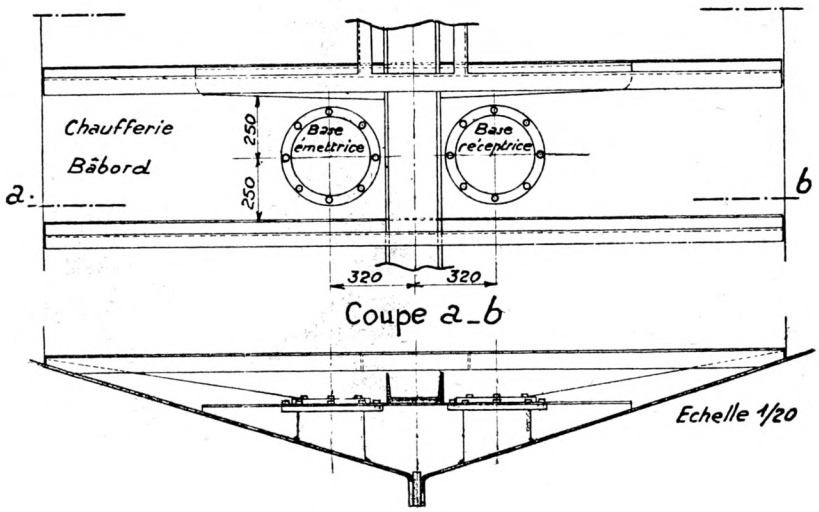

FIG. 7 — Mounting of Bases in ballast tank.

— the transmitter,
— the receiver,
— the HT rectifier and transformer.

RADIOELECTRIC TRANSMITTER.

Monitoring Amplifier stage.

The Monitoring Amplifier stage is equipped with two type EL 32 penthode tubes fitted symmetrically.

The oscillatory circuit consists of an iron coil self, a fixed capacity and an adjustable condenser which permits the frequency of the monitor stage to be adjusted at the factory exactly on the frequency of the transmitter base magnetostriction oscillators.

The self also includes two other coils symmetrically mounted : the secondary acting on the monitor valve grids in opposite phasing with the plates and the tertiary acting on the amplifying stage.

Between the start-off "marks" the monitor valve grids are blocked by a polarisation tension of—70 volts, applied to the middle point of the grid self and originating from the visual indicator or recorder transmission collector. At the instant of the interruption induced by the passage of the insulated sector of the collector during 1/1000th second, the valves EL 32 oscillate and the grids are automatically polarised by an escape resistance.

The current cut to induce the transmission "mark" is therefore insignificant. As has already been emphasized, this arrangement, contrary to the solution adopted in the majority of sounding-machines, where the triggering of the signal is produced by bringing into play a very considerable current, constitutes a distinct advantage in favour of the SFR-CARPENTIER sounder.

The amplifying stage includes 2 penthode valves type EL 39 mounted symmetrically and working in class C. The governing grids of those valves are put in motion by the tertiary of the pilot transformer. The polarisation of—50 volts is applied to the middle point of this transformer, well disconnected by a large condenser which supplies grid current for the duration of the "mark".

The plates are charged by an aperiodic lowering transformer which adapts the working impedance of the valves to that of the transmitter base.

The secondary coil of this transformer transmits the signal of issue of the amplifying stage to the magnetostriction transmission base by means of a two-conductor transmission cable under reinforced rubber. The transport of feeble resistance energy may be effected on the greatest lengths likely to be encountered on vessels.

During the "mark" the tension plate is supplied by a large condenser.

It should be noted that, between the "marks" there is no plate or grid screen current either in the pilot or in the amplifier.

All feeding of the monitoring stage as of the power stage is supplied during the brief duration of the "mark" by the discharge of the large-capacity condensers which serve as reservoirs ; this assures an instantaneous power maximum, prevents reaction on the other circuits and regularises the output of the sources.

At the terminals of the secondary of the charge transformer of the amplifying valves, the power of the "marks" is about 150 Watts, say 150 volts in 150 Ohms.

This power is applied to the transmitter base through a condenser that compounds the self of this latter and a two-conductor cable the characteristic impedance of which is in the vicinity of 150 Ohms, so as to allow the use of any length of cable whatsoever. The preceding, by allowing the bases to be placed at an appreciable distance from the transmitter-receiver, constitutes a very substantial advantage. Numerous sounding systems at present being used necessitate short connections between the bases and the transmitter-receiver which means that in general the latter must be placed at the bottom of a hold or some other place difficult of access.

With reference to the excitation of the base, it is supplied through a filter composed of two selfs and two condensers by the 24-volts direct current which assures the heating of the filaments.

RADIOELECTRIC RECEIVER.

The electric signal given by the magnetostriction receiver base is transmitted to the receiver by a cable of characteristic impedance in the vicinity of 150 Ohms to the primary of a step-up transformer.

The receiver constitutes an amplifier equipped with four penthode valves.

Through the intermediary of an aperiodic step-up transformer, the electric signal received strikes against the control grid of the adjustable gradient type EF 39 valve which constitutes the first amplifier stage.

The plate oscillating circuit is composed of an iron-coil self, a fixed condenser and an adjustable condenser by which the circuit is tuned to the frequency of 15,000 cycles per second.

This first valve is capacity-coupled to the succeeding valve, adjustable gradient type EF 39 (Z 302), which constitutes the second aperiodic resistance amplifier stage.

The control grids of the two EF 39 valves are polarised by means of a volume potentiometer situated in the measuring apparatus and manœuvred by the sensitivity control knob. This potentiometer allows the polarisation tension to be modified thus assuring the adjustment of the receiver amplifier.

The second EF 39 valve is capacity-coupled to the succeeding fixed gradient type EF 36 valve constituting the third aperiodic resistance amplifier stage. The outgoing signal of this stage is transmitted to the detector by the intermediary of a condenser.

The detector is constituted by two dry rectifiers, mounted as tension duplicators, which transform the signal received into a direct positive continuous pulse striking against the control grid of the power stage.

The power stage equipped with a type EL 33 valve, amplifies the impulse received from the detector and transmits it to the measuring apparatus.

The positive detection signal is sent to the grid of a valve which, at rest, is blocked by a polarisation tension of—50 volts. The valve then oscillates, its output being received on an aperiodic transformer.

The current thus obtained is used to light the neon valve of the visual indicator or for putting in action the recorder stylus, according to the one or other of the installations in operation at the time. In this way, by its proper functioning the receiver eliminates the parasites the intensity of which is not sufficient to unlock the grid of the final oscillator.

In addition, the rôle of the pass band filter contained in the junction box of the transmitter base cable mentioned in Chapter III, is to eliminate parasites beyond the useful reception band.

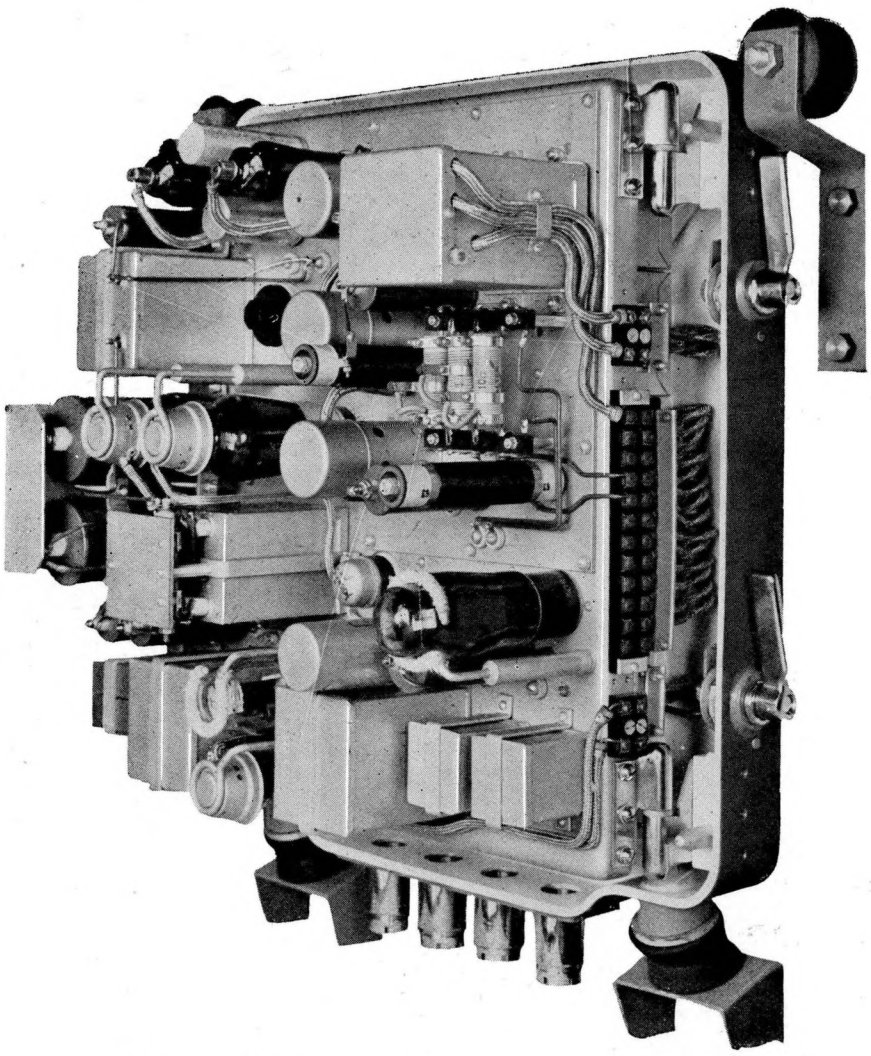

FIG. 8 — SFR-Carpentier Transmitter-Receiver (cover removed).

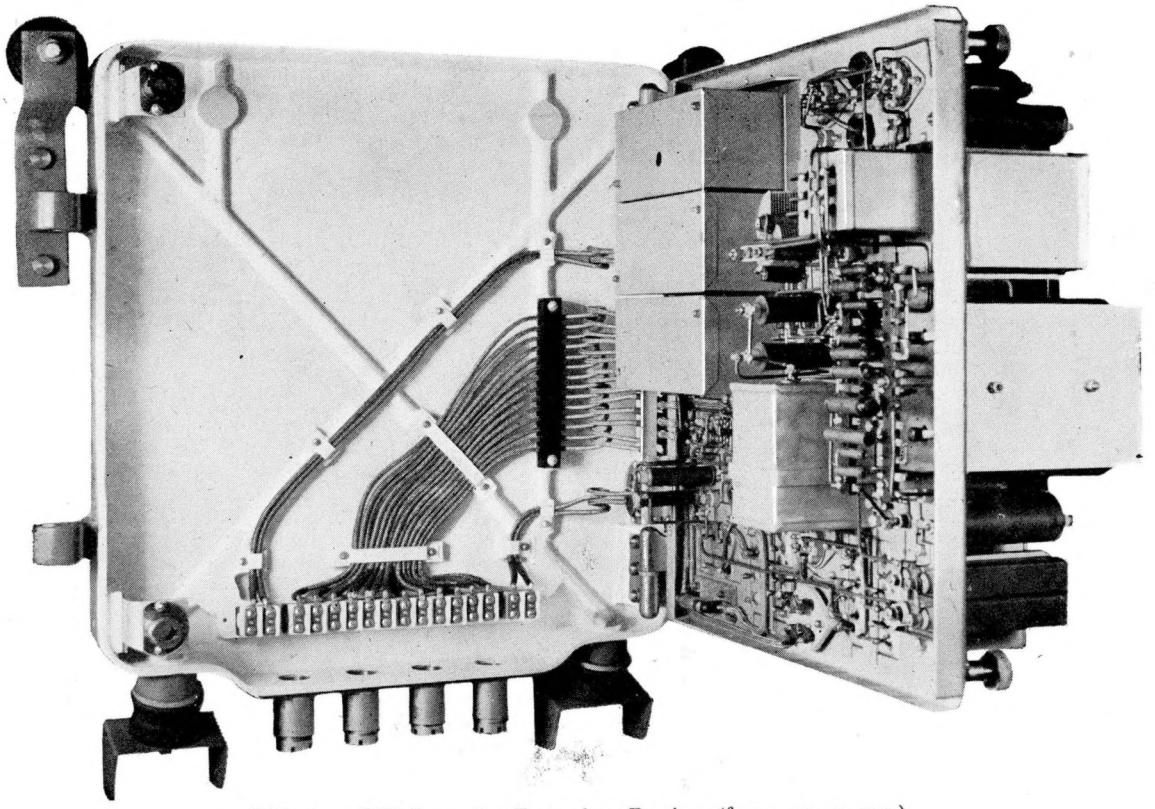

FIG. 9 — SFR-Carpentier Transmitter-Receiver (frame swung open).

From the above it is seen that the elimination of parasites has been carried to a degree rarely achieved.

V. — FEEDING.

Heating of valves.

Suitable groups in parallel series permit the feeding of the transmitter and receiver valve filaments under a tension of 6.3 volts. The initial feed current is supplied either by the ship's sector 24 volts or by a 24 volt generator.

Rectification and transformation group.

This group is fed with single-phased alternative current, 50 volts 600 pps by the feed group ; it supplies the necessary continuous high tensions to the transmitter and receiver.

A safety-fuse F 101 is inserted in the feed circuit.

Three valves are included in this group :

The 6 H 6 type valve supplies the high tension of 100 V.

The 5 Y 3 G B type valve supplies the 300 V. high tension.

The 879 type valve supplies a 700 V. tension which placed in series with the preceding 300 V. tension, produces the 1.000 volt high tension feeding the plates of the transmitter power stage only.

The feed arrangement includes a convertor group with an automatic adjustment motor, fed by the ship's current of 24, 110 or 220 volts $\pm$ 10% (approx.), which drives a generator supplying 24 volts direct current, feeding directly :

— the motor of the visual indicator or recorder, and assuring heating of the filaments of the transmitter and receiver valves by passing through the transmitter base and its blockage selfs.

— in addition, the motor drives an alternator supplying 50 volts 600 cycles which is transformed and rectified so as to obtain :

— 500/700 volts for the anode feeding of the valves fitted in the transmitter power stage ;

— 300 volts for the anode feeding of all the other valves and the feeding of the grid-screens of all valves without exception.

The advantage of this feeding is to do away with the accumulator batteries along with their charging plates, and consequently not only to eliminate costly installations but also to suppress recharging and maintenance operations. One ship's mains with storage lead battery allows the generator to be done away with ; in this case the mains will insure the same feeding as above.

In addition, currents adjusted to the different stages of tension can be used ; these contribute to increasing the accuracy of the measurements and to the sure functioning of the sounding machine.

The maximum power to be taken from the ship's mains is 200 volts.

The whole installation may be fitted up by means of ordinary cable with rubber-insulated wire covering. However, the cables connecting the transmitter and receiver to the junction boxes might be covered in lead thus increasing the security of working.