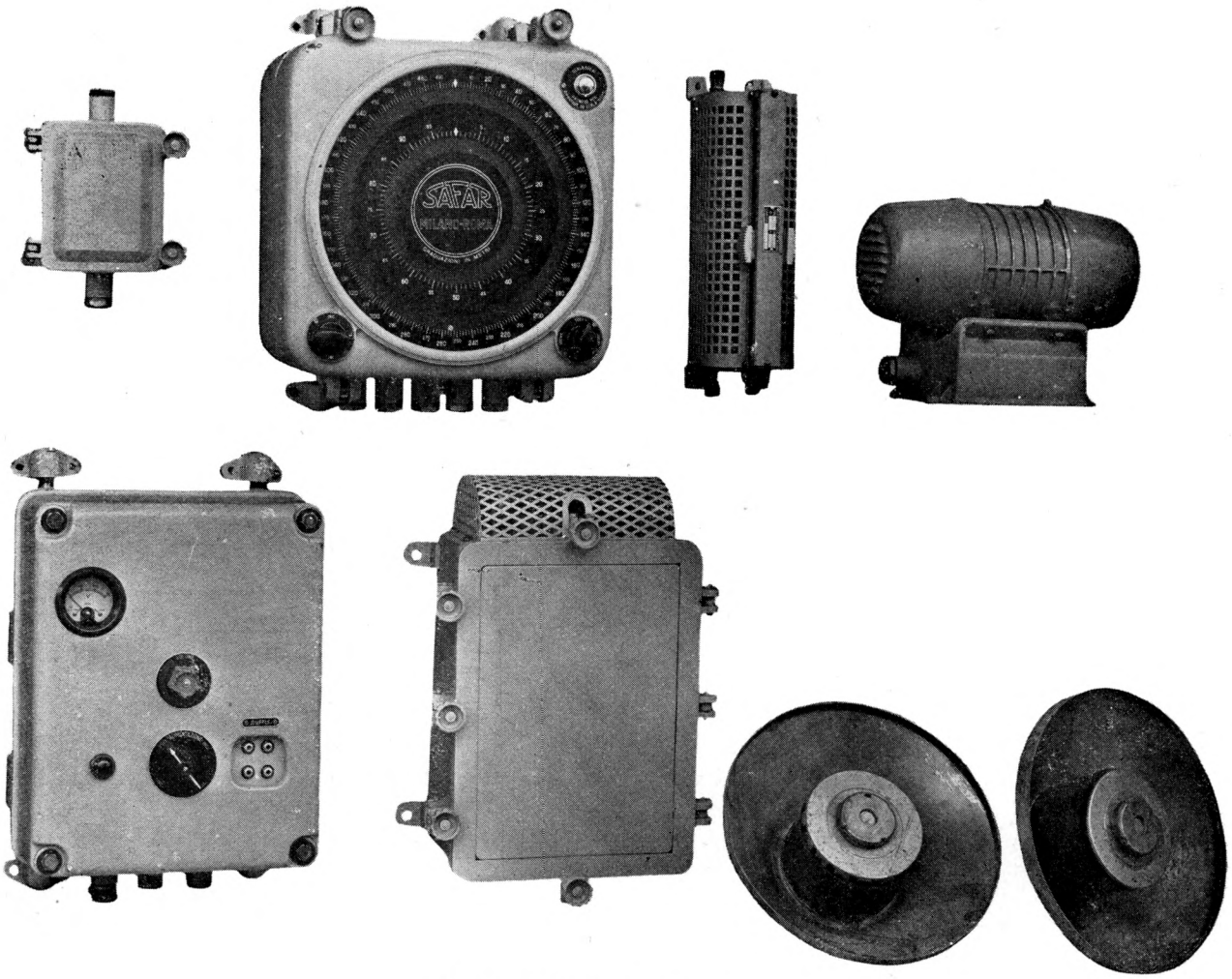

SAFAR — Deep sea echo-sounder.

THE S.A.F.A.R. (*)
ULTRASONIC ECHO-SOUNDING INSTRUMENTS.

The Firm S.A.F.A.R., Milan, specialises in the construction of ultrasonic echo-sounding apparatus and at present supplies three models :—

The *R.47 apparatus* for average depths (up to 500 metres), ship's model with optical indicator ;

Deep-sea echo-sounder (up to 5,000 metres) comprising the optical indicator up to 500 metres and a recording unit from 0 to 5,000 metres, surveying vessel type ;

Shallow-water echo-sounder (up to 50 metres) operating on accumulators, fitted with graphical recorded only, surveying boat type.

The *R.47 echo-sounder* is planned for operating either by 110 volt electrical current or 24 volt accumulator battery.

General characteristics of the S.A.F.A.R. instruments.

For the transmission of ultrasonic signals, all those instruments make use of nickel-alloy (nickel-silver) magneto-striction rings. The deep-sea and average depth apparatus are fitted with a torus-shaped nucleus consisting of a pile of lamellae transmitting radial waves which are reflected towards the bottom by means of a conical reflector; these waves are transmitted to sea-water through a metallic membrane attached to the ship's hull.

The nucleus and the conical reflector are sheated in a casing filled with distilled water. The nucleus operates by permanent magnetization renewed for time to time by the passage in the coil of a 110 volt or 24 volt main's current.

For shallow-water instruments the pile consists of lashes rolled in cylindrical form and vibrating longitudinally.

For each type of apparatus the alternative current acting on the nucleus is provided by the instantaneous discharge of a special condenser which is charged during the intervals of inactivity by the feed transmitting circuit.

A transmission relay enables the condenser to be charged by insertion in the feed circuit or to be discharged on the nucleus. This relay is controlled either by the optical indicator or by the recording unit by means of a special cam which provokes the discharge of the condenser on the transmitting nucleus at the moment when the optical indicator, or the stylus of the recorder, indicates the depth zero.

For shallow-water instrument there is no relay; the transmission signal is governed by a contact connected to the drum bearing the recorder stylus.

For reception, the transmitters are not used, but identical apparatus tuned on the same frequency.

For average and deep-sea echo-sounders for large ships, the receiver and the transmitter are mounted in pairs in symmetry with the keel at distances of 3 to 4 metres apart so as to avoid the influence of the transmitter on the receiver; and also in the most favourable position for avoiding repercussions on the membrane.

In the shallow-water type the receiver and the transmitter are fitted into a fish-shaped casing a few decimetres apart from each other.

After the receiver, a reception amplifier is connected which differs according to the type of apparatus and which transmits the impulses either to the optical indicator for the first two categories of apparatus or to the recorder for the second and third categories.

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Deep-sea sounding permits also of the reception by ear of the impulses which, by the transformation of the ultrasonic frequency into sonic frequency, may be gathered by means of an ear-phone.

The optical indicators carry two concentric scales; one for depths up to 100 metres, the other for depths up to 500 metres. This unit includes a small motor acting by means of a gearing on two concentric aluminium disks of different radius; the outer disk rotates at the rate of 90 r.p.m., the inner at 450 r.p.m., corresponding to 0.67 sec. and 0.133 sec. per revolution. Each disk is provided with a slit, behind which is fixed a small neon lamp which shows a red light when the amplifier transmits a signal.

In front of these two rotating disks is fixed a transparent plate on which are drawn two concentric scales : one divided 0 to 100 metres (inner scale), the other 0 to 500 metres. The disk rotating at the rate of 450 r.p.m. corresponds to the inner scale; the other to the outer scale. On the axes of these rotating disks are secured the above-mentioned cams controlling the transmission of impulse when the lamp passes in front of the zero of the scale.

A switch establishes the working scale of the apparatus. If the 100-metre scale is inserted in the circuit, the impulses start every 0.133 sec., and the lamp which lights up on receiving the echo is that of the inner disk, thus enabling the depth to be read on the inner scale. If the 500-metre scale is inserted, the impulses are produced every 0.67 sec., and the depth is read on the outer scale. The neon lamp is sufficiently powerful to permit the reading to be made at a few metres' distance.

The recorders, which differ on the two instruments, are of the usual type having a metallic point recording on the paper strip with iodide of potash and which liberates the iodine each time the current passes through, leaving a brown trace on the recording sheet.

R.47 echo-sounder (110 volt d.c.).

The equipment consists of the following units :—

Magneto-striction ultrasonic transmitter similar to the description given above. In order to maintain at constant level the distilled water which fills up the inner part of the cylinders containing the magneto-striction cores, the casing is in communication with a small charging-tank containing distilled water and placed about 2 metres above the transmitters. The water from this tank reaches the transmitter through a small pipe fitted with a tap.

Magneto-striction ultrasonic receiver.—Similar to transmitter.

Reception amplifier: consists of a panel in cast silumin on which all the elements of the circuit are mounted. These elements consists of five three-stage amplification valves, a gas valve and a rectifying valve. The total amplification is about 135 decibels, 17 400 Hz. On the front part of the cover is the control of volume, allowing an adjustment of 60 decibels. This panel is mounted by antivibration elastic suspension.

Optical depth indicator: is of the type already described.

Transmission feed: consists of the condencer and relay in container.

The condenser charge is made through a survolter.

The survolter: is fed by the ship's mains (110 volt d.c.) and provides the secondary with 800 volts d.c.—0.1 ampere for charging the transmission condenser. It is also this survolter which, by means of two collectors blocks placed on the low-tension side, provides a tension of about 60 volt a.c. (50 - 55 cycles) which feeds the receiving amplifier by means of a tension stabiliser.

Manœuvre panel : Consists of a silumin base closed by a cover in the same metal and containing a high tension stabiliser and high tension filter as well as all fuses necessary for the equipment. On the cover is a voltmeter showing the main's tension, a rheostat for adjustment of tension and the four-position interruptor: an ESCL (escluso - out of circuit); two marked AVV (avviamento - On); an INC (incluso - branched).

Amplifier diversion container : used for connecting the non-flexible electric wires from the various parts of the equipment with the flexible wires reaching the amplifier. Mounted by elastic suspension.

Connecting-unit casing : consists of a container inside which is operated the connection between the wire running from the magneto-striction receiver nucleus and the wire protected by metallic tubing to the amplifier branch box.

R.47 echo-sounder (24 volt).

Similar to the preceding except that the feed is operated at low voltage. Instead of the survolter there are an alternator and a H.T. feed-unit.

The alternator : is fed by a 24-volt accumulator current (d.c.) and provides the secondary with tension of about 220 volt a.c., passing to H.T. feed-unit. The receiving amplifier is fed with the same current through an auto-transformer and a current stabiliser.

The H.T. feed : consists of H.T. transformer and 836 valve which supplies the 800 volt d.c. tension, 0.1 ampere, necessary for the condenser of the transmission feed, by means of a filter (condenser and impedance).

Deep-sea 110 volt d.c. echo-sounder.

Consists of the following units :—

Magneto-striction ultrasonic transmitter : already described, with reserve tank for distilled water.

Magneto-striction ultrasonic receiver : Similar to transmitter.

Transmitter feed-unit: is fixed on a silumin panel protected by steel-plate cover. The feed-unit consists of a mercury-vapor rectifier providing High Tension of charging the condenser which, in turn, feeds the transmitter core. The various controls are fitted on the front panel.

Control panel : is formed by a silumin base protected by a steel cover. It contains the general switch fuses and the distributors for the ship's main direct current and alternative current from the electrical converter unit. A voltmeter is included for checking the tension in the mains.

Transmitting relay : controls the discharge of the transmitter condenser.

Charging capacity : Transmission condenser controlled by relay.

Electrical convertor unit : consists of a 110 volts d.c. motor and a generator providing alternative current 220 volts 50 Hz, which is directed to the control panel for distribution.

Receiving amplifier : is fixed on a silumin panel protected by a cover of the metal, the whole by antivibration elastic suspension. On the front part are fixed the controls for the adjustment of volume, the general switch, the " indicator-recorder " commutator and the plug for the ear-phone echo reception. The valve amplifier has four-stage amplification for change of frequency transforming the ultrasonic into audible signals. The total amplification is about 130 decibels, 15 300 Hz.

By means of this commutator the signal may be directed to the recording unit through a rectifying circuit or towards the optical indicator by a thyratron circuit.

Amplifier-feed unit : is formed by a valve rectifier and supplies 230 volt d.c. tension and 6.3 volt a.c. for feeding the amplifier valves.

Optical indicator : is of the model already described.

Recording unit : A rotating axis operated by a 110 volts d.c. motor fitted with speed control, acts on the drum governing the carriage which bears the recording stylus, the system for mouving on the paper strip, the transmission of signals cam and the cam for time-recording on the paper.

The recording unit possesses three metric scales : 0 - 500; 0 - 2,500 and 2,500 - 5,000. The passing from the first to the second scale is effected by an electro-magnetic change of speed. The change from the second to the third scale is obtained by means of the same speed; only the angular lag between the beginning of the run of the carriage and the start of the signals is changed; this is achieved by change of the transmission of signal cam. The signals themselves are made by three cams wedged onto the drum axis governing the recording stylus. The two cams corresponding to the 0-500 m. and the 0-2,500 m. scales are situated in phase each other and transmit the signal when the stylus crosses zero. The third cam has a lag of 180° with reference to the first two and corresponds to the 2,500 - 5,000 m. scale.

A second stylus governed by a fourth cam shows a trace every minute which forms a division for counting time.

For the 0-500 m. scale the to-and-fro run is made in 1.33 sec.; for the other two scales the run is made in 6.66 sec. The whole system in enclosed in a silumin container on the cover of which is a window protected by glass, through which the working of the recording unit may be observed.

Shallow-water 24 volt d.c. echo-sounder.

This instrument works on an accumulator battery providing 24 volt, 150 amperes, current, sufficient for 24 hours' operations; it consists of the following units :—

Casing: of elongated fish shape, containing the transmitter and the receiver; 1 metre in length, 25 centimetres in width, flattened in the lower part and subdivided transversally into 5 compartments. The transmitter and the receiver are lodged in the second and fourth compartments; they consist of two magneto-striction cores of the type already described, immerged in fresh water. Compartments 1, 3 and 5 are filled with air; they act as air-chambers in order to give to the system a slightly positive buoyancy. Two stanchions fix the whole container under the hull of the boat.

Recording unit : contains all the elements necessary for recording and for the transmission of signals, except the receiving amplifier. Transmission is obtained by means of the discharge of a condenser which is itself charged by a survolter supplying 450 volt d.c. The charge of the condenser is governed, as previously mentioned, by a contact forming part of the drum which carries the recording stylus.

A small motor fitted with a speed adjutment part, drives the drum carrying the recording stylus and the cylinders which guide the paper strip.

There are two recording scales : one for 0-25 m. depths, the other for 0-50 m. depths. For the first scale the paper unrolls at a speed of 2.2 cm. per minute and soundings are made at the rhythm of 400 per minute. For the second scale the paper unrolls 1.1 cm. per minute and soundings are made at the rhythm of 200 per minute.

There are two recording stylus; the first shows a series of dashes every five minutes (or 10 minutes for the 0-50 m. scale); the other at intervals of 30 seconds (or 15 seconds), to obtain the continuous marking of the meter scale and the time scale.

In addition a push device permits the recording of particular marks for reference on the paper strip and with an electrode pen notes can be made on the sheet.

Receiving amplifier : includes two-stage valve amplification. The latter stage feeds the stylus through a copper oxide rectifier.