The soundings per minute on this instrument are brought up to a high figure of 16.4 in spite of the large depths in order to obtain as many echoes per minute as possible. Plates XXVII & XXVIII show the inside and outside of a typical 0 - 3000 fathoms electrolytic recorder for deep sea soundings. The particular instrument shown in the figure however has only three ranges 0 - 150, 0 - 1500, and 1500 - 3000 fathoms. The soundings on this instrument were only 7.6 per minute. It will be appreciated therefore that the new design giving five ranges and increased sounding per minute up to 16.4 is a definite improvement over the model shown in the figures. Typical reports on the 3000 fathoms deep sea ranges are shown on Pl. XXV, and it will be observed from these records that a very decided contour of the ocean bed is obtainable even at full speed on a Cable Ship at ranges of 1000 to 2500 fathoms.

## IV. THE ATLAS ECHOLOT

High Frequency Type.

MANUFACTURED BY THE ATLAS-WERKE AKTIENGESELLSCHAFT, BREMEN.

The ATLAS echo sounder of the high frequency type manufactured by the Atlas-Werke of Bremen makes use of the principle of the ultra-sonic waves for the measurement of the depth, produced by sounding apparatus based on the principle of magnetic contraction (magnetostriction). The sound waves are radiated in the shape of a cone and are directed towards the bottom, whence they return to the vessel after reflection in the form of an echo. The depths are determined entirely automatically, and the depth indications in metres and fathoms are shown by means of a luminous red point at the corresponding position on the circular depth scale of the apparatus.

Normally, the indicating apparatus is provided with two scales; the standard model of the Echolot for high frequency for navigational purposes is equipped with an inner scale running from 0 to 100 metres and an outer scale from 0 to 1000 metres.

The depth indications succeed each other at an extremely rapid rate; on the 100 metres scale there are 7.5 soundings per second. The observer cannot separate out the individual depth indications; he sees only a permanent line which follows the slightest variations in depth somewhat like an indicating pointer. On the outer scale the depth indications succeed each other at a proportionately slower pace. It is possible also to read off on the inner scale depths which exceed the range of the scale divisions, provided one assures oneself of the actual sounding by switching on, for a short time, the other circuit to obtain temporary readings on the outer scale. For instance, if one has found depths on the outer scale of, say 385 metres, after switching to the inner scale of 0 to 100 metres a reading of 85 metres will be obtained.

The accuracy with which the depths can be obtained depends naturally upon the range of the measurements. It is evident that on the scale of 0 to 1000 metres the accuracy cannot be as great as on the scale up to 100 metres since the divisions of the former scale are much closer. Generally speaking, the accuracy of reading on the scale of 0 to 100 metres is plus/minus 25 cm.

Since the transmitter and receiver are placed at a short distance from each other, it is possible to measure also very small depths beneath the keel. Generally speaking, one can measure depths under the keel from one metre upwards.

Owing to the large periphery of the scale, the readings may be effected at a distance from the apparatus, so that the observer is not under the necessity of approaching the apparatus closely each time a reading is desired.

### *PRINCIPLE OF THE ECHOLOT:*

This is explained with the aid of Figure 21. The straight neon tube (*h*) is inserted radially in the disk which is turned by the motor (*a*) at a constant speed behind the fixed scale (*g*) showing metres and fathoms. The centrifugal governor (*b*) either cuts in or out the series resistance of the induction circuit, thus assuring an exact number of turns with the necessary regularity, independent of the voltage fluctuation in the supply mains. On the gear axis (*c*) is also inserted a sliding contact (*d*) which, each time the neon tube passes the zero on the scale, discharges a condenser (*l*) into the windings of the magnetostriction oscillator (*f*), from which is sent out an impulse of short duration into the water. This short wave impulse reaches the ocean bottom, is reflected, and arrives at the vessel where it impinges upon the magnetostriction tuned oscillator (*k*). This, acting as a receiver, transforms the sound waves into electrical oscil-

lations. The latter are amplified by an amplifier (*i*) such that the neon tube (*h*) is instantaneously illuminated by a flash. The disk carrying the neon tube has turned through a predetermined angle during the time which has elapsed while the sound wave covered the distance from the ship to the bottom and back. The scale of depths is calibrated in metres and fathoms in accordance with the velocity of sound waves in sea water and therefore the depth of water in that locality may be read off directly on the scale at the place where the red line appears.

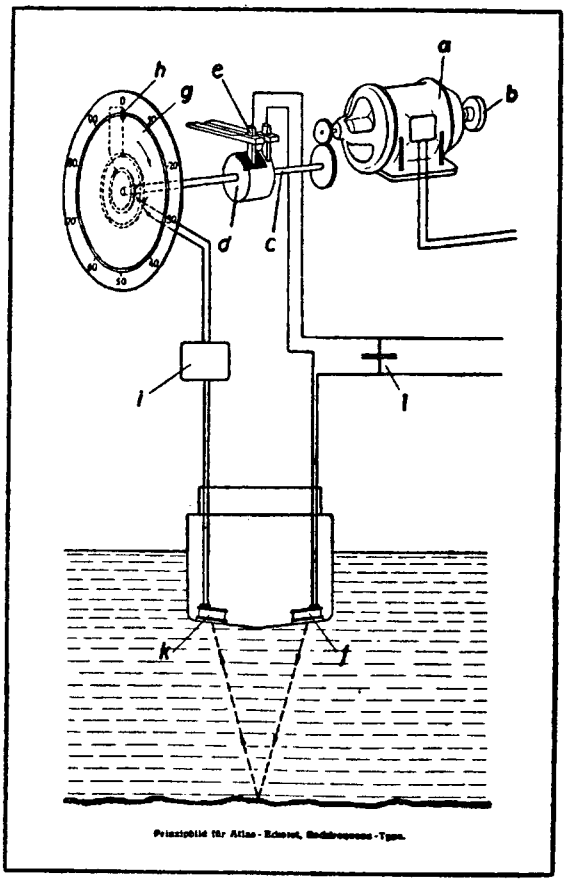



FIG. 21.

*DESCRIPTION OF THE VARIOUS PARTS.*

The Atlas-Werke Echolot is composed of the following parts:

1. The depth-indicating apparatus.
2. The transformer — direct current to alternating current.
3. The connection box.
4. The two magnetostriction oscillators, one of which acts as a transmitter and the other as receiver.
5. The amplifier.

1. *The Depth-indicating Apparatus.* (Plate XXIX)

The depth-indicating apparatus comprises a motor which drives through a gear train an indicating disk rotating at constant speed. The motor is provided with a centrifugal governor which maintains a constant speed of rotation under normal fluctuations of as much as 10 % in the voltage in the supply mains. The accuracy of the soundings depends in fact, primarily upon the constancy of the revolutions of the motor. The voltage in the supply mains can be read on the voltmeter.

On the outer edge of the disk, in a straight mortice, is inserted the neon tube, which passes over the circular scale. On the axis of the indicating disk, is the disk interrupter, which

at each passage of the neon tube through the scale zero, causes the relay of the transmitter (described later) to function.

For the range of 0 to 100 metres, the indicating disk makes 7.5 revolutions per second: equal to the number of soundings effected. For the outer scale, which has a range up to 1000 metres, a second neon tube is attached to a concentric disk.

By means of the interrupter attached to the indicating apparatus, one may switch as desired from the outer to the inner scale. The apparatus is fed by the ship's supply mains.

2. *The Transformer. — Direct to Alternating Current:*

This furnishes the alternating current for the installation, namely:

The alternating current supply for the amplifier and the current necessary to feed the transmitter (this current must be lowered and rectified).

When there is on board ship both alternating and direct current supply, there is no need for the transformer. Under these conditions the two currents are fed to the apparatus through a special switch by means of which the currents may be turned on or off.

3. *The Connection Box:* (Plate XXX)

This serves for the production and connection of the high tension necessary for the magneto striction transmitter. It contains a rectifier for the high tension current in which the high tension alternating current furnished by the transformer (or the current taken from the ship's mains) may be stepped up and rectified — together with a relay and a high tension condenser. The condenser is continually charged by the high tension rectifier and is discharged through the windings of the transmitter by means of the relay interrupter of the indicating apparatus each time the neon tube passes the scale zero. The interrupter relay must operate with great precision in order that accurate soundings may be obtained.

4. *The Magnetostriction Oscillators:* (Plate XXX)

The transmitter and receiver are identical in construction and consist essentially of a bundle of nickel strips which have an appropriate shape and about which a conducting wire is wound. In order to create sound waves, use is made of a property of the nickel of contracting in a magnetic field, that is, of effecting oscillations under the action of electro-magnetic energy. In the receiver, the susceptibility of the nickel to magnetic contraction is used to convert the sound waves into electric oscillations. These produce in the windings of the receiver small alternating voltages which, amplified in the amplifier, are then led to the indicating apparatus where the depth is indicated.

*Arrangement of the Apparatus in the Double Bottoms:*

The magnetostriction oscillators are normally mounted in a compartment adapted for this purpose in the structure of the vessel — usually so arranged that the same couple is placed symmetrically to starboard and to port, 1 metre on each side of the central longitudinal of the ship, so that the transmitter is about 2 metres distant from the receiver. The caissons are of two types: in one type the caisson is separated from the water by a thin membrane and is filled with oil or water, which transmits to the external body of water the vibrations engendered above the membrane of the caisson (Type of enclosed oscillator). In the second type the oscillators are placed in open caissons having their radiating surface inserted directly in the ship's hull plating, so that the oscillations are transmitted directly to the outer body of water. (Open type of oscillator).

The mounting of the oscillators in the hull, as compared to mounting in the closed caisson, offers certain advantages in transmission of the sound wave to the external body of water. In certain special cases the oscillators may be mounted thus without cutting into the hull plating, i. e. they may be adapted to the interior of the outer skin. This method of mounting, however, suffers from the disadvantage that the sound wave lacks somewhat in intensity due to its double passage through the outer hull plating, and consequently the range of the Echolot is diminished.

5. *Amplifier:*

The impulses captured by the receiver are led to the amplifier to be stepped up. The exit tube of the amplifier is a special tube and engenders a very strong current which is led through a transformer to the neon tube of the indicating apparatus. Further there is a small regulating dial by means of which one can vary the amplification so that good reception is obtained at all

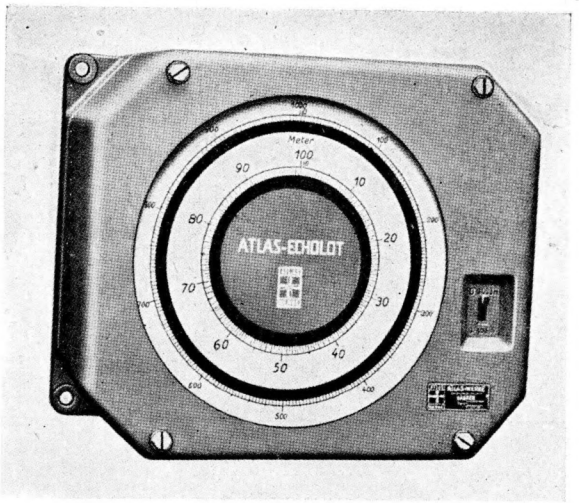
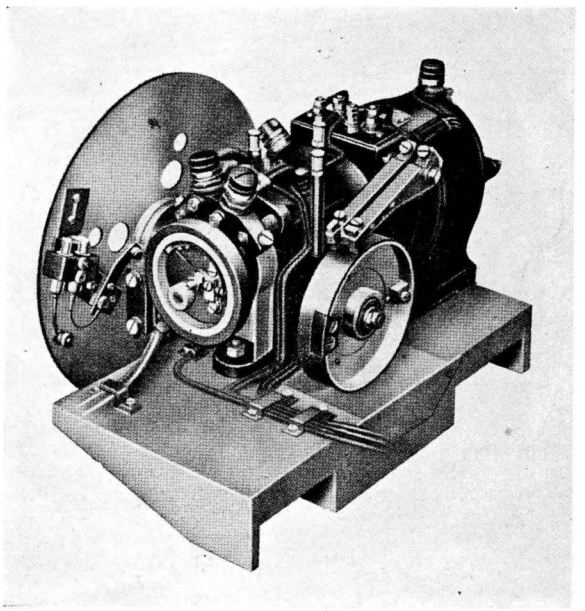



PLANCHE XXIX
PLATE XXIX.

*Indicateur (petit modèle)*

Depth Indicating device (small type).

Atlas ECHOLOT.



*Console de moteur, cadran indicateur, régulateur et interrupteur de commande*

Motor bed-plate with indicating dial, speed governor and control switch.

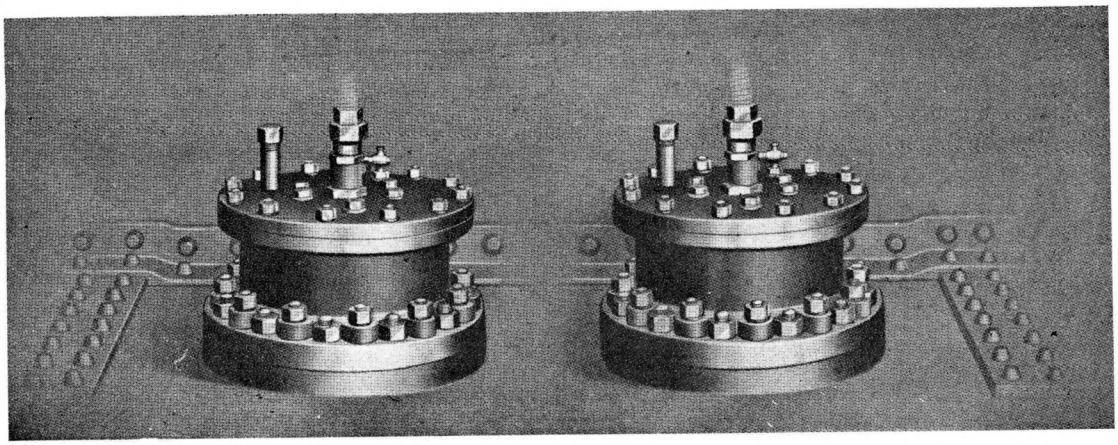
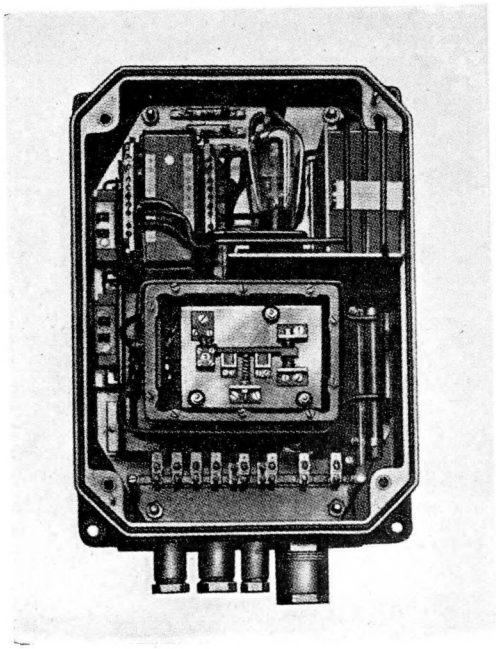


PLANCHE XXX
PLATE XXX.

Atlas ECHOLOT

*Emetteur et Récepteur à haute fréquence*

High frequency transmitter & receiver.



Atlas ECHOLOT.

*Boîte des connexions (ouverte)*

Connection Box (open).

depths. A second regulating dial is for the purpose of varying the grid voltage of the last tube, and consequently the sensitivity of the indication. The voltage necessary for the operation of the amplifier is taken from the ship's mains.

*CARE IN OPERATION OF THE ECHOLOT :*

All parts of the apparatus for sounding are so arranged as to be visible and easily accessible after opening the box. The care required is limited to the oiling and greasing of the moving parts and an occasional replacement of one of the tubes in the amplifier.

*INSTALLATION OF THE ECHOLOT EQUIPMENT :*

As far as possible the installation should be made in one of the existing cofferdams in such a manner that changes in the ship's structure are few and slight. It is only necessary to cut two small openings in the hull in which are inserted the caissons of the transmitter and receiver. The connection box is placed near the indicating apparatus and the amplifier is located in the chart house. It is essential that the amplifier should be readily accessible since it is provided with a regulating dial.

*GENERAL REMARKS :*

The Echolot Apparatus of the high frequency type which has just been described is of the type which comes primarily into consideration for the needs of navigation and is used on passenger steamers, freighters, as well as on tankers, fishing vessels and men-of-war. The dimensions and speed of the vessels concerned have no influence on the results obtained with the Echolot, since the Echolot functions with accuracy and impeccably even under the difficult conditions encountered aboard men-of-war, for instance, where the speed may reach as much as 35 knots and more.

For the needs of hydrography and other special purposes, the construction of the High Frequency Echolot is on the whole the same ; one may, however, in that case take into consideration the particular desiderata such as, for instance, other ranges of depth or the adaptation of a recording indicator (echograph) for depth.

With regard to the use of the high frequency echolot for hydrography, the experience obtained with the apparatus has shown that it is now possible to execute extensive surveys in a small fraction of the time which was formerly required with the old methods then in use.

*GRAPHICAL RECORDING :*

For the graphic recording of the depths, one may attach the Atlas Echograph to the indicating apparatus and obtain thus an indication of the depth in two ways, i. e. by the optical method and the graphic method.

The Echolot is in use in a great number of Hydrographic Services executing hydrographic surveys, and many surveying ships have been equipped with the High Frequency Echolot.

Commander SAABYE of the Danish Navy has published in the *Tidsskrift for Søvaesen*, Copenhagen, June 1936, an article reporting the results obtained in Denmark with the Atlas sounding apparatus.