may be considered constant and correct. The frequency of the fork is 1,025 cycles per second and the dial and motor speeds are arranged for a velocity of 820 fathoms, or approximately 1,500 metres per second.

It would be useless of course to maintain the indicator at a constant speed if there were variations in the time the signal is emitted, due to changes in any mechanical means of sending the signal. The signal is therefore sent by a beam of light acting upon a photoelectric tube, the impulse of which is amplified to operate the transmitting tubes to send the signal. When the echoes return, they generate a small voltage in this same transceiver so that no error is introduced by sending on one instrument and receiving on another. The echo is amplified sufficiently to produce a flash of light in a Neon tube which is bent in a circle and installed back of a thin disc rotated by the synchronous motor. In front of the rotating disc is a glass scale through which shines the light of the Neon tube through a narrow radial slot in the disc. The duration of the flash in the Neon tube is not over two-millionths of a second so that the scale is illuminated by a red line at the depth indicated. Over a flat bottom the flashes of light are so frequent and steady that the slot can be examined by a magnifying glass even under this test it appears sharp-edged and stationary. When the ship anchors over a flat bottom, the indicated depth will change, due to the change of tide or motion of the vessel.

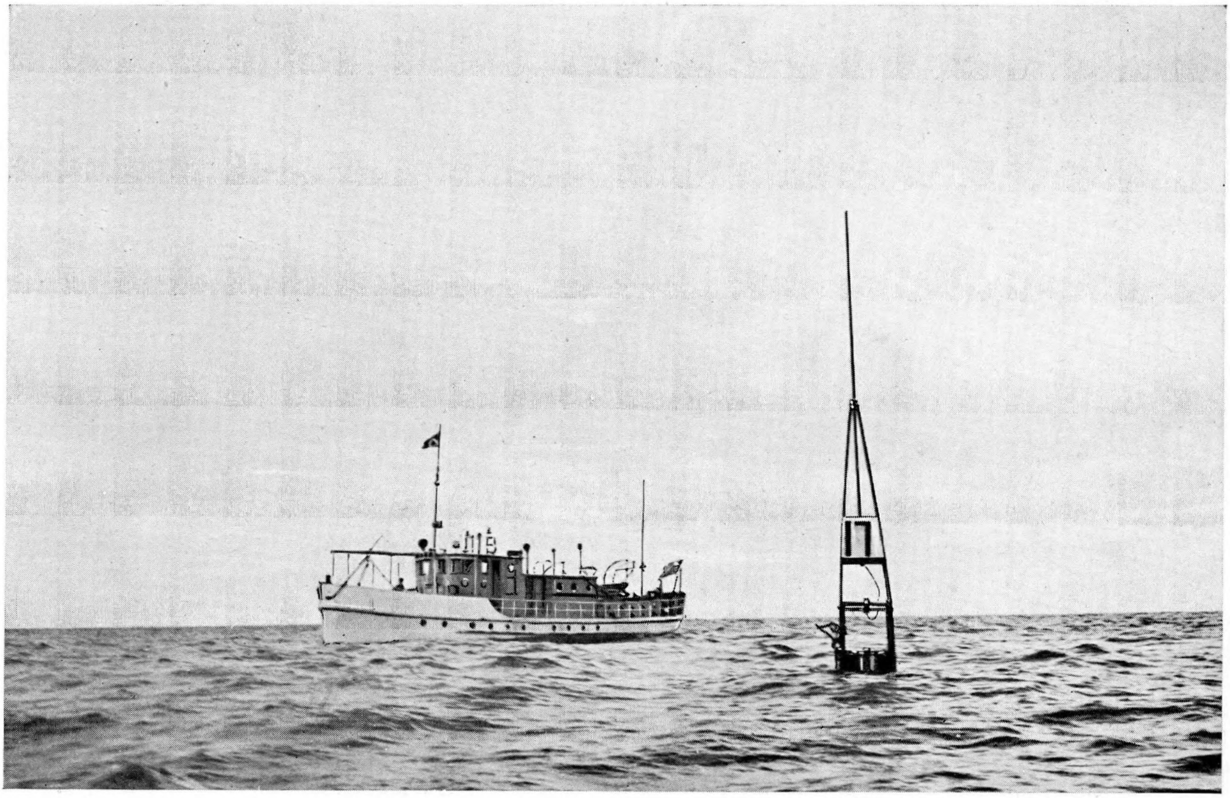
For shoal depths, the indicator is graduated to 20 fathoms and 20 soundings per second are given. As an example of a recent accomplishment of this instrument, 552 square miles of hydrography was executed off the Gulf coast of Louisiana on a sheet which had 550 crossings in the system of sounding lines. There were no crossings differing by more than one foot. The maximum depth sounded was 75 feet and the minimum was 23 feet.

II. *SONO - RADIO - BUOY.* *

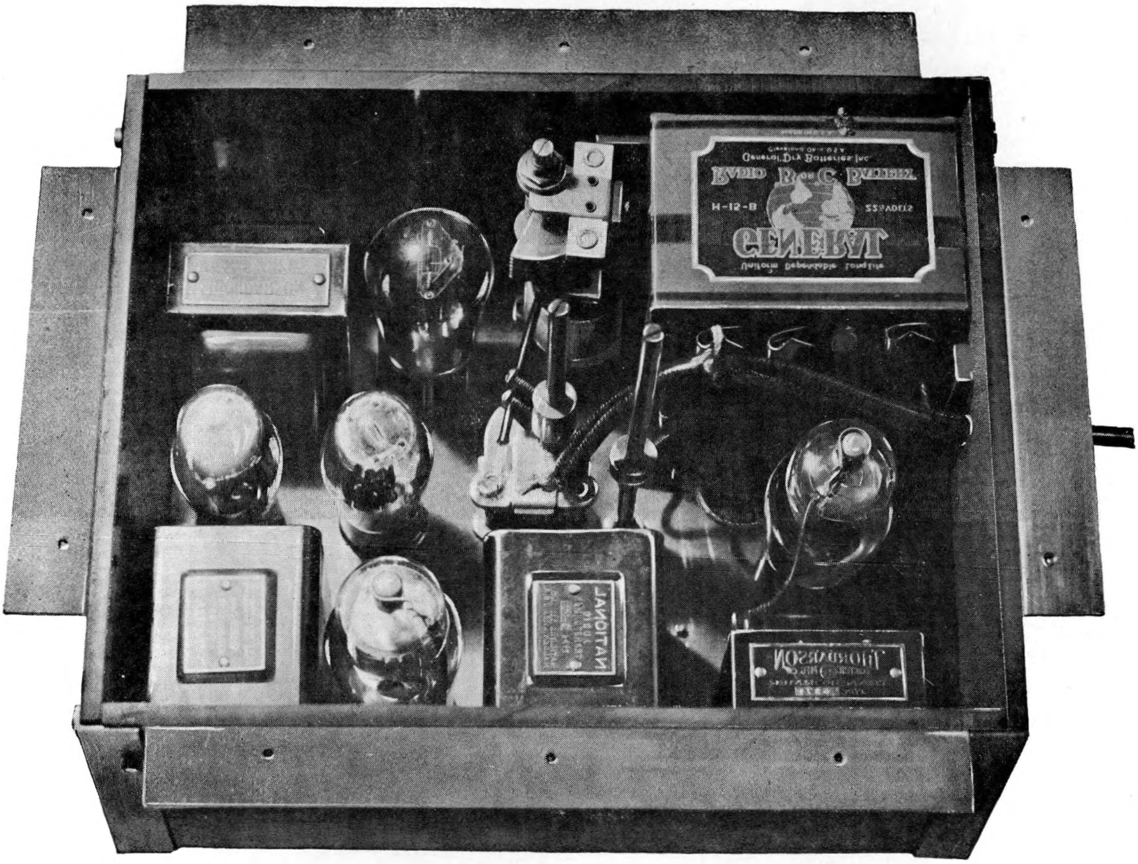
These excellent crossings of sounding lines were due also to the strength of horizontal control which was available. In this particular case, a combination of taut wire traverse and radio acoustic ranging was used.

Because of the shallow coastal plains on the Atlantic and Gulf coasts, the sound from the bomb explosions will not reach shore hydrophones as on the Pacific Coast, making necessary the use of station ships for radio and acoustic stations. This constitutes a hazard for the personnel at sea at great distances from a harbour of refuge because, for economic reasons, it is necessary to keep these units small in size. In an effort to remedy this menace the U.S. Coast and Geodetic Survey has recently developed a buoy to replace these small station vessels. It is automatic in operation. During the summer of 1936, these buoys were used for the first time in actual R.A.R. work. Although their performance is not yet quite up to that which has been experienced in the use of station vessels, they have given every promise of completely eliminating station vessels possibly this present season.

(*) See details further on.



Sono-Radio Buoy. — *Bouée Radio-Sonore.*



Sono-Radio-Buoy. Transmission-Receiving-Mechanism.

Bouée Radio-Sonore. Mécanisme réception-émission.

A maximum distance of 38 miles was reached in one case last season with sono-radio-buoys. As this was in the relatively shoal water of the Gulf of Mexico, it is expected that much better performance will be found in deeper and colder water. The buoys used for the Atlantic coastal work were built from ordinary commercial oil drums and are quite inexpensive. The audio and radio units are shown in the photograph.

Another party on the Pacific coast for experimental purposes has built a similar unit but much smaller and lighter. This buoy has not yet been used in actual service to any great extent, but it is shown here to illustrate the variation in ideas which are obtained from a group of engineers who have been trained in the same work for many years. The Pacific coast buoy, complete with antenna, batteries, and equipment, can be lifted by one man. This is a decided advantage in handling. It appears quite rugged, and if it satisfies the other conditions of stability and reliable operation, it may be more desirable than a heavier unit. The total weight of the large buoy is approximately 750 pounds, without anchor gear.

III. *RADIO ACOUSTIC RANGING.*

The decrease in cost of offshore hydrography in the United States has been due not alone to echo sounding and Radio Acoustic Ranging development. It is also largely due to the taut wire apparatus for areas such as the coastal shelves, which are found on the Atlantic coast of the United States of America and other continents of the world. This device was brought to my attention at the last Conference by Admiral Edgell and it has been used in conjunction with radio acoustic ranging methods very successfully. It may be conservatively stated that the two purchased for $ 1000 each have saved us $ 200,000 in the five years and in addition has increased the accuracy of our offshore control.

An extract from the report of the Commanding Officer of the Ship *Oceanographer* will serve to indicate the increase in economy largely due to development in these methods.

Cost of hydrography per mile of sounding line :

Year	Cost per mile
1933	$ 20.03
1934	16.20
1935	12.20
1936	8.62

These costs per mile are based on the operating expenses of the ship and are thought to be the best criterion for estimates or other comparison of costs.

Several plates showing the work which was accomplished during the past summer (1936) by the U. S. Coast and Geodetic Survey using these methods are shown here.

The results of the experiments on the velocity of sound in sea water which were carried out by the ships PIONEER and GUIDE, in January, 1935,