THE ROBERTS RADIO CURRENT METER (*)

The Roberts Radio Current Meter is a recently developed instrument especially designed for measuring the direction and velocity of the current, of more than about 0.3 knot velocity, either at sea or in navigable waterways. The Current Meter system is such that the necessity of having attendant observers at the point of measurement is obviated, thus eliminating the cost and the danger in bad weather, of station vessels.

The apparatus comprises the Current Meter and a buoy of suitable design which houses a battery operated radio transmitter and antenna. From it is streamed the Roberts radio current meter, suspended below the buoy at the desired depth, and connected thereto by an electric cable. The meter aligns itself in the direction of current flow. Its impeller reacts to the flow, actuating an interior contacting mechanism controlled in part by a magnetic compass. Contacts so made are communicated to the buoy, where the radio transmitter is keyed to produce radio signals. These indicate the current direction and velocity. At a radio receiving station conveniently placed afloat or ashore, the radio signals are received, amplified and recorded by means of a chronograph tape.

Method of producing signals.

This depends upon a mechanism within the meter, consisting of two systems of contact points and a revolving contactor, all properly arranged relative to the vertical axis of a compass system.

One system of contact points, mounted on the compass, or sensitive element, is always oriented N magnetic. The other system is fixed relative to the meter, and is always oriented in the direction of current flow.

The revolving contactor, driven by the meter impeller, closes the contacts mounted on the compass at each cycle of operation. The regularly spaced radio signals so produced indicate the current velocity according to a rating table. These are *velocity signals.*

The contactor closes the other contacts, mounted on the meter frame, each second cycle only, creating a regular series of signals interspersed with the velocity signals. They may be distinguished therefrom by their double time interval. The instant of a signal of this latter series in the operating cycle depends upon the orientation of the meter. Its time relationship to the velocity signals, shown by its relative position on the chronograph record, indicates the current direction. Signals produced thus are called *direction signals.*

In other words, the directional relationship of the velocity contact (in the magnetic meridian) and the direction contact (in the direction of current) is translated into a time relationship by the sweep action of the revolving contactor. This is carried through the radio signals to the chronograph record, whence it is translated by the scaling process back to a directional relationship.

These signals when compared with a rating table give the velocity and direction of the current at the point of measurement. Several Current Meters may be operated at widely spaced points and a great advantage of the instrument is that their signals are taken at the same time, thus enabling a true comparison to be made.

The Current Meter housing, which is streamlined, is in two sections held together by screws at a gasketed connection. Struts situated at the forward end of the housing carry an impeller together with its bearings. The tail surfaces enable the Current Meter to stream with the current. The impeller is connected with the working mechanism by a magnetic drive and this mechanism consists of a revolving contactor and two sets of contacts all correctly arranged relative to the vertical axis of a compass system.

The impeller has four helicoidal brass blades and operates the working mechanism through the magnetic drive, this type being used instead of a mechanical one since it enables the meter to be hermetically sealed. The drive has two magnets, one connected to the impeller and the other to the inner mechanism.

(*) For more detailed information see pamphlet entitled : « Roberts Radio Current Meter Operating Manual » by Lieutenant-Commander Elliot B. Roberts, (U.S. Coast and Geodetic Survey, Washington, D.C.).

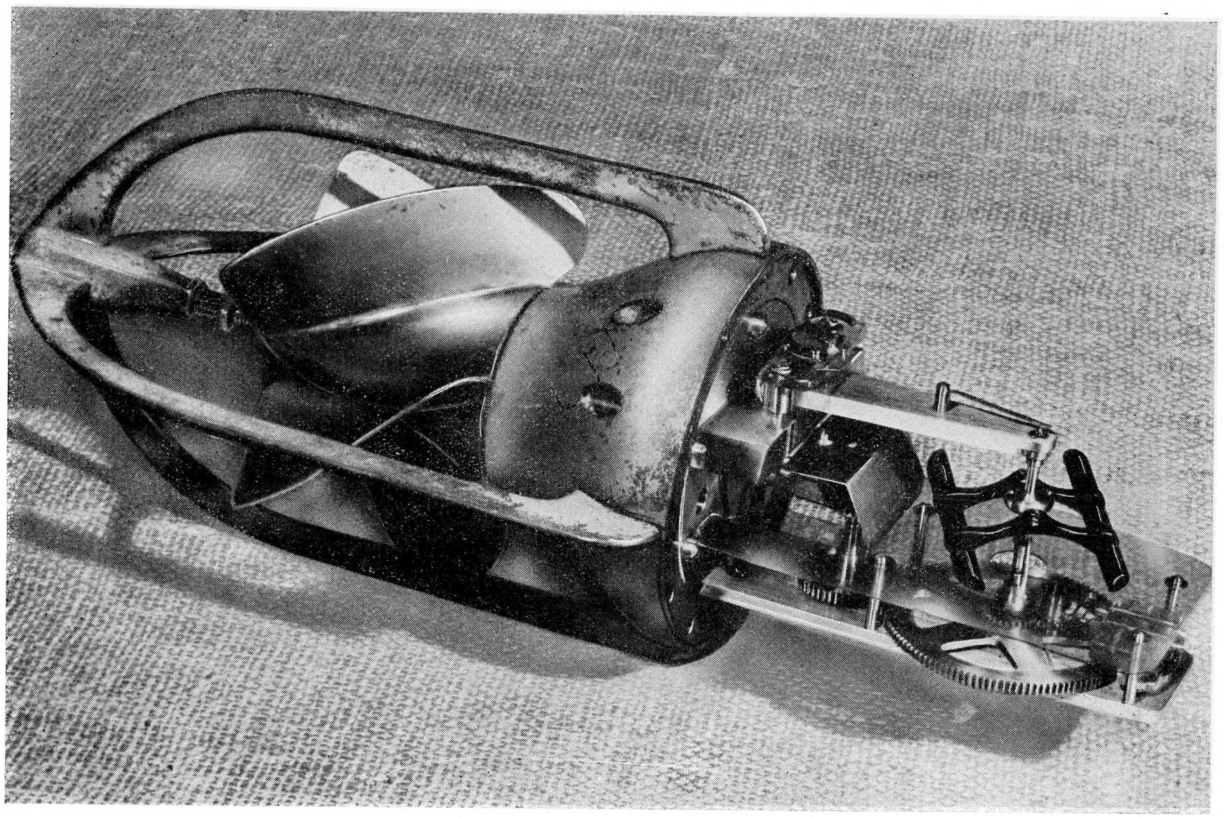

Fig. 1

Roberts Radio Current Meter : Impeller and Inner Mechanism.

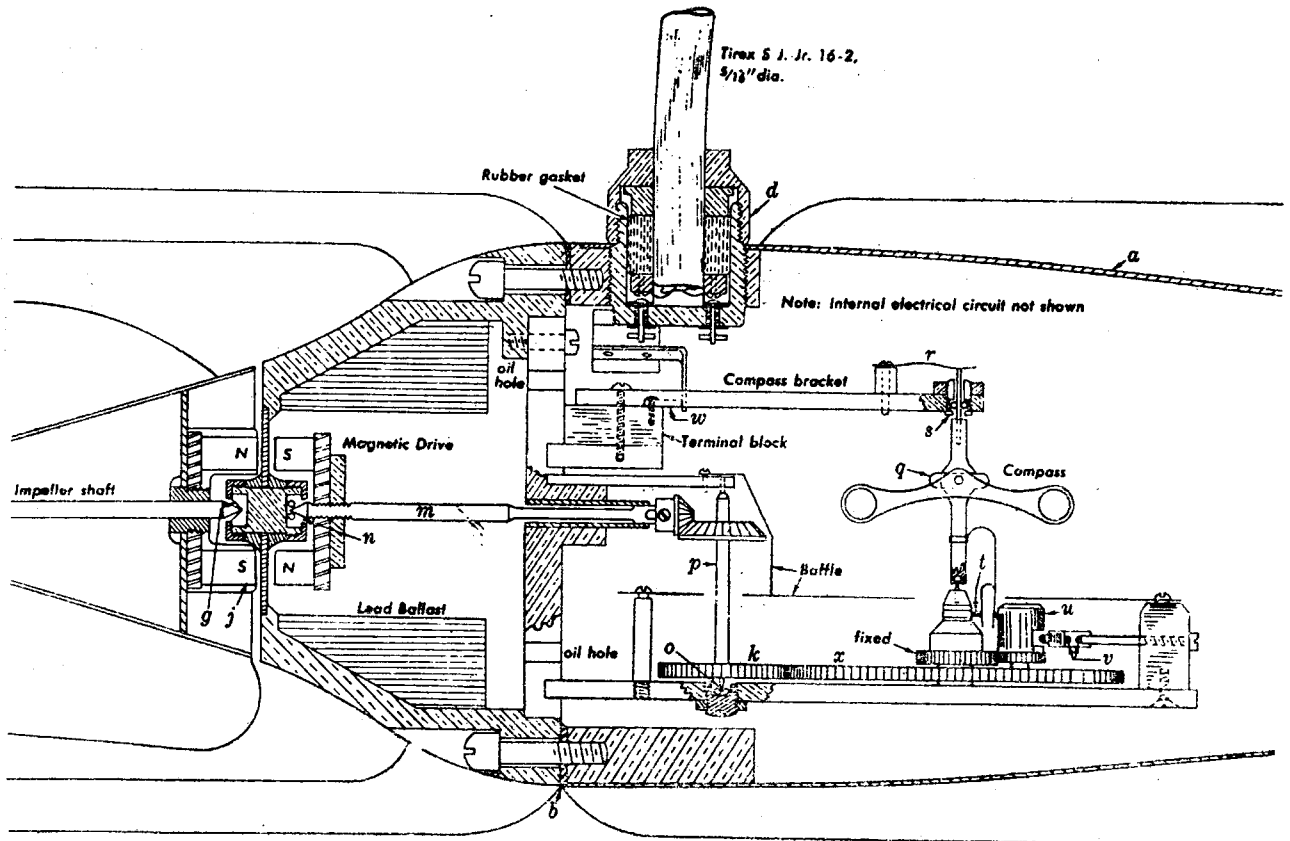

Fig. 2

Roberts Radio Current Meter : Sketch showing Mechanical Arrangement.

a) Housing (spun copper) ; b) Connection with 1/32" fiber gasket ; d) Water and Oil proof cable attachment fitting; g) Impeller bearings, lignum vitae; j) Case containing impeller part of magnetic drive; k) Transmission gear; m) Drive Shaft; n) Drive Shaft thrust bearing RMB P-7 (see text); o) Transmission spindle lower bearing, RMB C-T-4 (see text); p) Transmission spindle; q) Compass cardan ring; r) Spring contact clip; s) Compass upper guide bearing RMB R-L-410 (see text); t) Velocity contact point; u) Planetary contactor; v) Direction contact points ; w) Terminal block lugs; x) Base gear ; Lead Ballast; Rubber gasket; Tirex S J. Jr. 16-2 5/16" dia.; Note: Internal electrical circuit not shown; Magnetic Drive; Oil hole ; Compass Bracket ; Baffle ; Oil filled.

The magnetic drive (figs 1 and 2) consists of two identical parts, one attached to the impeller, and one to the working mechanism within the meter body. The impeller part is fully enclosed in a brass case (j). The parts consist of soft iron armatures, each holding six alnico magnets set in a parallel arrangement about the axis, with alternate S and N poles outward. These parts, mounted in operating position facing each other, align and hold strongly together. They comprise a nearly closed system of magnetic circuits so that there is little external field, and inappreciable compass deviation results.

A system of transmission gears gives motion to a revolving contactor. One set of contacts is mounted on a compass element and is oriented North Magnetic and another set is fixed relative to the meter, and is thus oriented in the direction of flow of the current. The revolving contactor translates the directional relationship of these two sets of contacts into a time relationship.

In use, the instrument is completely filled with light petroleum oil of low viscosity at working temperature and pressure. For use in moderate sea depths, a very light type of petroleum oil, such as aircraft instrument oil, or a light servo-liquid, is suitable. It is essential that no sensible increase in viscosity result from the pressures and temperatures to be encountered by the apparatus.

The buoy, pontoon shaped, is anchored at the desired station and the Current Meter suspended from it at the required depth, the two being connected by an electric cable.

At the receiving station, the chronograph should be an electrically driven type recording on paper tape. (Gaertner Scientific Corp., Chicago, III.). The tape is wax-coated, and the record is produced by scratching the wax, obviating need for ink pens. There should be two independently operated stylii.

The DC motor of the chronograph may be controlled by theostat to achieve speed as desired. Better uniformity of speed would be obtained by use of a synchronous motor with a gear shift to produce a selection of about three tape speeds between 1/2 cm. and 3 cm. per second.