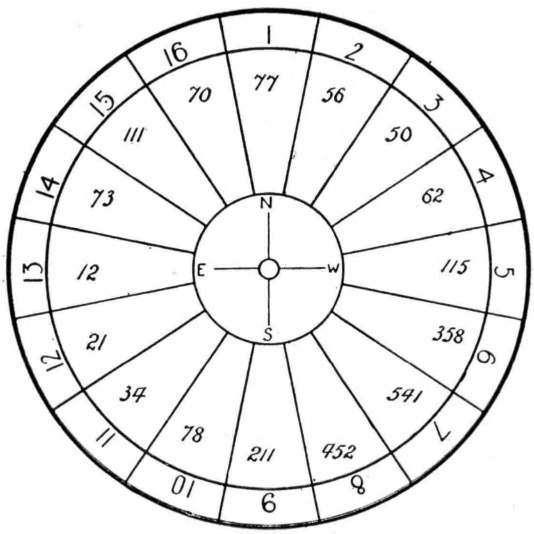
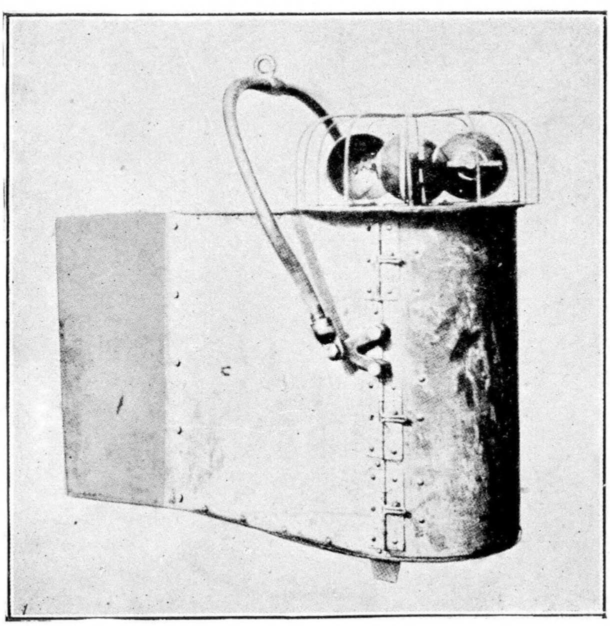
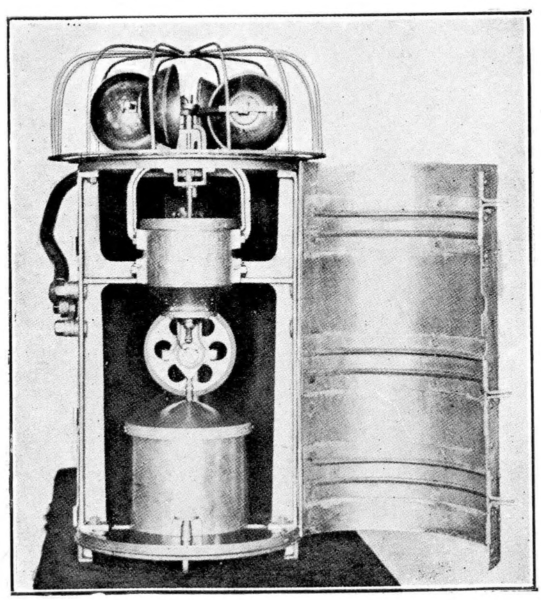
Carruthers Drift Indicator — Indicateur de Courant Carruthers







THE FLOW OF WATER THROUGH THE STRAITS OF DOVER AS GAUGED BY CONTINUOUS CURRENT METER OBSERVATIONS AT THE VARNE LIGHT-VESSEL.

(50°56' N. — 1°17' E.)

PART I.

METHODS EMPLOYED, WITH A PRELIMINARY SURVEY OF THE RESULTS.

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by J. N. CARRUTHERS, D. Sc.

NATURALIST ON THE STAFF OF THE MINISTRY OF AGRICULTURE AND FISHERIES.

Fishery Investigations. Series II, Vol. XI, N° 1, 8°, 110 pages, 14 Fig.

Published by *His Majesty's Stationery Office, London* 1928. Price 10s. 0d. Net.

This memoir deals with the mechanism and the results obtained with a drift indicator which Dr. J. N. CARRUTHERS has designed on the principle of the Ekman current meter, but which can be left working for 3 days or more, even in the roughest weather.

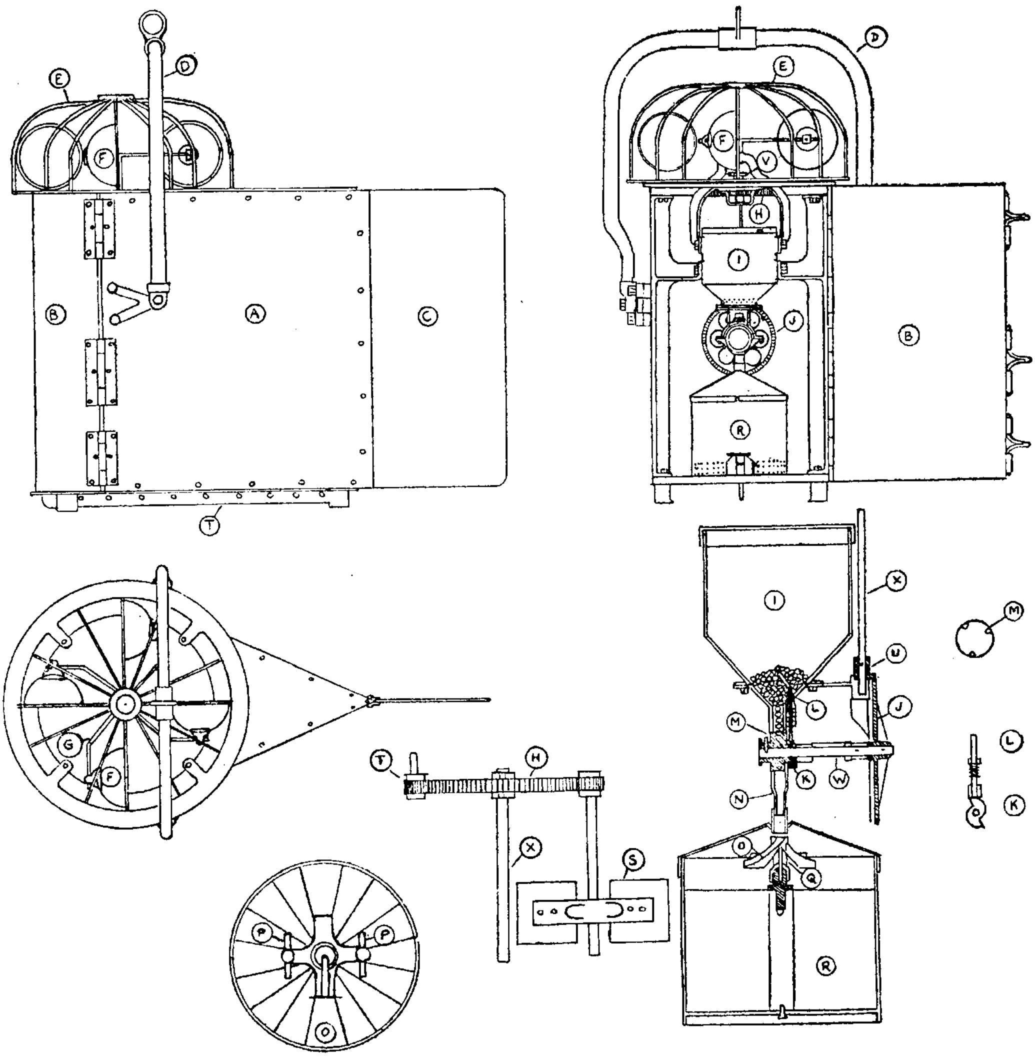
THE CARRUTHERS DRIFT INDICATOR.

This new current measuring instrument embodies certain features of the Robinson nemometer and makes use of the very ingenious direction recording mechanism due to EKMAN, and well known to all users of the Ekman current meter.

The "Drift Indicator" is an instrument designed to tell what the movements of water are past a fixed spot, such as a light vessel. When the instrument is lowered into the sea, suitably suspended, the force of the tidal streams causes a set of cups to rotate. There is an arrangement whereby the number of revolutions made by the cups during any desired period of observation can be ascertained. It is also possible to tell—by using a special type of compass— how many miles of water have passed the ship in each of the directions towards which the tidal streams may flow. As the cups rotate they drive certain spindles through a suitable gearing. One of these spindles (the lower fore and aft one) carries at its forward end either a dropping wheel or a dropping ball, which acts as follows:—The wheel or ball, as the case may be, has holes in it and each of these can just accommodate one of the small phosphor bronze balls, of which a considerable quantity is loaded into the hopper of the instrument. This hopper "thins out" and the balls rest upon the wheel or ball. Consequently when the wheel or ball is turned round on a horizontal spindle, the holes in it gather balls from the hopper, carry them round, and finally drop them below. As the balls fall they do so on to a specially shaped compass needle device. This compass has a runway on its north-seeking end which allows the balls to roll down into a receiving box. This box is divided radially into small equal angular spaces which are numbered 1 to 16. The presence of balls in the compartment on the instrument brought inboard, indicates that the current was, at the time the balls dropped. flowing in that direction represented by the compartments concerned. Thus a ball in the compartment marked *N* means that the current was at one time flowing North, and so on.

The gearing allows for one revolution of the dropping ball, or wheel, for every hundred revolutions of the cup. The following description of the Wheel Type of Drift Indicator was given by H. J. CARROOD, in an article by J. N. CARRUTHERS, and appeared in the *Journal du Conseil*, Vol. I N° 2, May 1926.

The Drift Indicator as delivered from the manufacturers (Messrs. ELLIOTT and GARROOD Limited of Beccles, Suffolk) weights about 56 lbs. = 29.5 kilos).



DESCRIPTION OF THE DRIFT INDICATOR.

"The Drift Indicator consists of a prime mover *SF* driving through gearing *H* and *J* a shot dropping wheel *M* ; a shot hopper *I*; a magnet shot distributor *O* and a shot receiver *R*; the whole being assembled on a framework covered with sheet brass, the covering being extended to form a rudder *C*, which keeps the Indicator in the stream. The prime mover *F*, consisting of four cups each mounted on a separate arm of a spider, rotates through gearing a shot dropping wheel *M*, this wheel taking shots from the shot hopper *I* above, and dropping them on to the centre of a magnet *O* of special shape, one side of which provides a runway for the shots. The shot drops from the magnet into the receiving box *R* below, this box being divided radially by thin partitions into equal angular spaces. These spaces are numbered and thus record the direction in which the Indicator is pointing at the time of dropping each shot.

The driving cups *F*, which are driven by the tidal pressure of the water are adjustable outward from, or inward to, the centre of their respective arms, and are held in position on the arms by clamping screws. The pinion *T* on the lower part of the first driving spindle engages with a spur a wheel *H*, this part of the gearing giving a ratio of reduction in speed of 10 to 1.

At the bottom of the second driving spindle *X*, is fixed a bevel pinion *U*, the spur wheel *H* being fixed to the upper end of the spindle. The bevel pinion *U* engages with a crown wheel *J* which is fixed to a horizontal shaft *W*. At the opposite end of the shaft *W* is fixed the shot dropping wheel *M*.

The bevel gear *U* and *J* again give a ratio of reduction of speed of 10 to 1, so making the over-all ratio of reduction of driving cups to shot wheel 100 to 1, *i.e.*, the driving cups *F*, make 100 revolutions to one revolution of the shot dropping wheel *M*.

Three shot dropping wheels are provided, one wheel having one shot recess only on its periphery, one with two recesses and one with three recesses.

By using these respective wheels the number of shots dropped per 100 revolutions of the driving cups may be one, two or three.

The shot hopper consists of a plain cylinder inside with a conical bottom, the apex of which continues into a rectangular shaped slot which extends downwards on to the shot dropping wheel.

A disturbing rod *L*, projects into the hopper at its lower part and is operated by a cam *K* formed on the shot dropping wheel. The rod is evenly raised and suddenly dropped by means of the cam and a returning spring, so disturbing the shots at the bottom of the hopper and by preventing the shots jamming, ensures that they fall into the rectangular slot at the bottom and on to the wheel.

A pawl and pawl race *V* situated below the driving cups and operating on the first spindle prevents the rotation of the cups in a reverse direction, and consequently ensures the rotation of the cam *K* in one direction only. This prevents the disturbing rod *L* being jammed against the sharp rise on the cam, which would occur if the direction of rotation of the cam were reversed.

The magnet comprises a magnet *O* and two steel magnetised rods the latter being held on the magnet holder by clamping screws. The top centre of the magnet holder is in the form of a cup and a runway for the shot extends from this cup to the edge of the holder. An agate centre is provided in the bottom centre of the holder and the whole magnet is mounted on a needle pointed pivot held in the shot receiver *R*.

A "flyer" driven off the spin wheel *H* and rotating in water at the same speed as the driving cups, provides the necessary damping action to smooth out slight and sudden variations in the strength of the current driving the cups. This flyer may be taken out of gear if considered unnecessary at any time before lowering the indicator. The whole indicator is suspended by the sling *D*, balance being maintained by lead weights, which may be suspended from any position in a "fore and aft" direction on the balancing bar.

As the result of experience, modifications have been made in the above instrument. These are described in "Fishery Investigations Series II. Vol. XI N° 1 1928 by J. N. CARRUTHERS, D. Sc. and are as follows :

a) "Instead of a narrow wheel with holes in its rim, the dropping part of the instrument nowconsists of a brass ball which performs the same work. This has allowed the delivery end of the hopper to be wider, consequently there is not the same chance of the balls jamming and spoiling the results.

b) A new type vulcanite compass has been designed in order to avoid the necessity of coating the steel magnets with preservative. It is less than half the weight of the old one; consequently when a long observation is being made, there will be less chance of the pivot being burred. The compass consists of two tubes closed at the ends by screw-in-caps and borne on a carriage which has a sapphire underneath for pivoting purposes.

c) The device for preventing jamming of the balls has been improved.

METHOD OF USING THE INSTRUMENT.

Usually a boom is swung out and the instrument lowered to the required depth by a 2 1/2" Manilla rope, over a suitable block which is hung from a spring, the latter to absorb any shock from the vessel pitching. Into one end of this rope a brass thimble is spliced, which is shackled to the swing handle of the instrument. No iron shackles or thimbles must be used. Before lowering, tow lead sinkers are hung from the balancing bar, so that the instrument balances when suspended.

When the instrument is brought inboard after concluding an observation, the receiving box is withdrawn, the lid removed, and a pouring-out disc placed in position on top of the compartments. The balls are then poured out of each compartment, and counted, and the numbers entered on a record sheet.

The use of ordinary traverse tables enables one easily to resolve the values (numbers of balls) along the four cardinal directions, and to find the magnitude and direction of the residual current, if the "mileage value" of the balls is known.

RESULTS OBTAINED AT THE VARNE LIGHT-VESSEL.

The preliminary survey of the results has been chiefly concerned to set down the extremes of experience regarding the flow of water, and to make appropriate qualitative studies of the associated meteorological conditions. Thus the occasion when the usual E.N.E. going flow was most strong and that when it was most pronouncedly reversed has been studied closely. There have also been studied in some detail such records as relate to other special conditions such as unusually high tides, and other records have been discussed which exhibit features of special interest as a set across the Straits.

The main aim in reporting upon the records was to arrive at a clear idea as to the relative importance, in point of frequency and mileage, of the customary E.N.E. going flow and the occasional W.S.W. going flow. They have been able to set down definite information in this connection (in so far as the period of experimentation permits) and to work out mean values of the daily rate of flow for individual calendar months, for seasons and for a whole year.

The two extremes of experience were as follows:

(1) A flow of 16.8 miles a day from Channel to North Sea, and

(2) A flow of 11.9 miles a day from North Sea to Channel.

The authors have a record which shows that the Flood Stream can run 10.98 miles and that it can at strength attain a speed of 2-9 knots. On this occasion the corresponding Ebb Stream ran for as little as 2-6 miles.

Another record shows that the Ebb Stream can run 8-6 miles and that it can at strength attain a speed of 2-24 knots. On this occasion the corresponding Flood Stream ran for as little as 2-6 miles.

It has been noticed that the distribution of wind and pressure as set forth in the synoptic charts issued by the Meteorological Office has a very obvious and informative bearing upon the currents registered in Dover Straits.

Mean values of the daily rate of flow of water for individual calendar months, for seasons, and for a whole year have been calculated at Varne light vessel for a depth of 6 fathoms and it has been noticed: (*a*) that with the exception of December, the flow from Channel to North Sea was least in summer months and that it gained in strength in winter months; (*b*) summer "comes out" as being pronouncedly the season of weakest-flow, whereas autumn has the greatest flow.

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