THE BRILLIE TIDE-GAUGE

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The tide-recording instruments manufactured by the Brillié Brothers' workshops are of two types according to the maximum level changes to be measured. Both are floating tide-gauges and their only difference is the size of their various component parts. A number of home and overseas ports use one or other of these types of gauges, and the Navy Hydrographic Service itself has procured several for its survey groups.

In addition to the tide-gauges as such, which we shall go into in more detail further on, the Brillié workshops also construct remote-control indicators or recorders which are not really designed for tidal studies in particular, but which can, if necessary, also be used for this purpose (1). Some information will be given about them in the second part of this article.

TIDE-GAUGES

General description (see Plate I).

There are no unusual features to the Brillié tide-gauges. The vertical movements of a float counter-balanced by a counterweight are transmitted by means of a mechanical reduction system to a stylus which moves along the generatrix of a uniformly-revolving cylinder. The winch which supports the float-counterweight combination, and the case of the recorder, are both mounted on a very rigid angle-iron and flat-bar frame to which the winch bearing and the recorder case are bolted and to which the end of the counterweight wire can also be fixed should it be necessary for it to be rigged in order to reduce its movement. The recorder is kept in a water-tight, cast-iron case closed in front by a glass or plexiglass pane. To simplify the alignment of the shafts, which has to be effected as carefully as possible when assembling the instrument, the winch and recorder shafts are only coupled by a chuck.

The float.

Both types of tide-gauge contain exactly the same kind of float, i.e. made of copper in sphero-conic form with a diameter of 30 cm. An aperture allows for the addition or removal of ballast in order to maintain the water-line constantly at the narrow, cylindrical part of the float. As is seen, the solution adopted is therefore that of the broad float which allows for the winch to be worked with greater power but which has the disadvantage of increasing the space required for the shaft.

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(1) The « limnimeter » section of all these instruments (i.e. the float, winch, counterweight and frame) is moreover exactly the same as that in the tide-gauges.

Reducing device.

The two types of gauges allow for the recording of maximum level changes of 20 and 4 metres on diagram sheets of 50 and 20 cm. height respectively.

In order to draw the greatest advantage from these diagram-sheet dimensions in terms of the levels to be measured, both these types of tide-gauge contain three reduction ratios which are easily set by means of two levers.

In terms of reduction ratio, the following maximum ranges can be obtained :

	Ratio	Range
Large Type :	(1/10	5 m.
	(1/20	10 m.
	(1/40	20 m.
Small Type :	(1/5	1 m.
	(1/10	2 m.
	(1/20	4 m.

Plate I shows both models, and with the information that has been given regarding the height of the recording cylinders, it should be easy to visualize their size.

Method of inscription.

After reduction, the movement of the winch is transmitted to a drum on which is wound the wire which controls the movement of the stylus carriage. A roller-compensator ensures that this wire is maintained at constant tension whatever the temperature. On one side of the carriage is a regulating index which moves along a vertical rule divided into three scales which correspond to the three reduction ratios of the instrument; on the other side is the inscribing stylus holder in the form of either an eversharp pencil with black or fuchsin leads, or a ball-point pen. The leads give a reliable recording but need to be frequently sharpened if thickening of the lines is to be avoided; the ball-point pen gives a fine and even line but unfortunately does not work with 100% reliability. In either case, the inscribing mechanism is the part of the tide-gauge which needs the most careful supervision if satisfactory operation is to be maintained.

The diagram sheets for the inscriptions are of rectangular, glossy paper, squared off in terms of time and height and measuring 72×50 cm. and 36×20 cm. for the large and small models respectively. They are wound on the recording cylinder where they are kept in place by a spring ruler (see Plate III, on the scale of 1/1).

Action of the cylinder.

The cylinder's action mechanism allows for two speeds which correspond to either one revolution every 24 hours or one every 7 days. It is possible to switch very easily from one to the other by means of a sliding pinion.

Usually the action mechanism works through the impetus of a master-clock based on the well-known principles of the Brillié electric clocks, thus ensuring complete precision of movement of the cylinder. This system is well suited to fixed installations where it is possible to shelter the master-clock and the batteries

PLATE 1

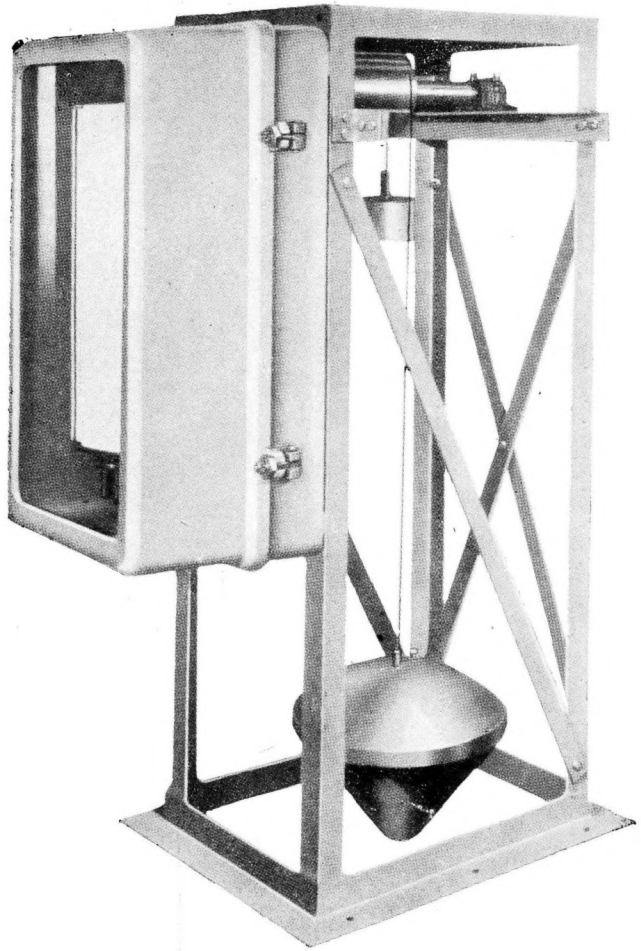


Fig. 1.
Model 2 A Tide-Gauge
Complete apparatus in working order.

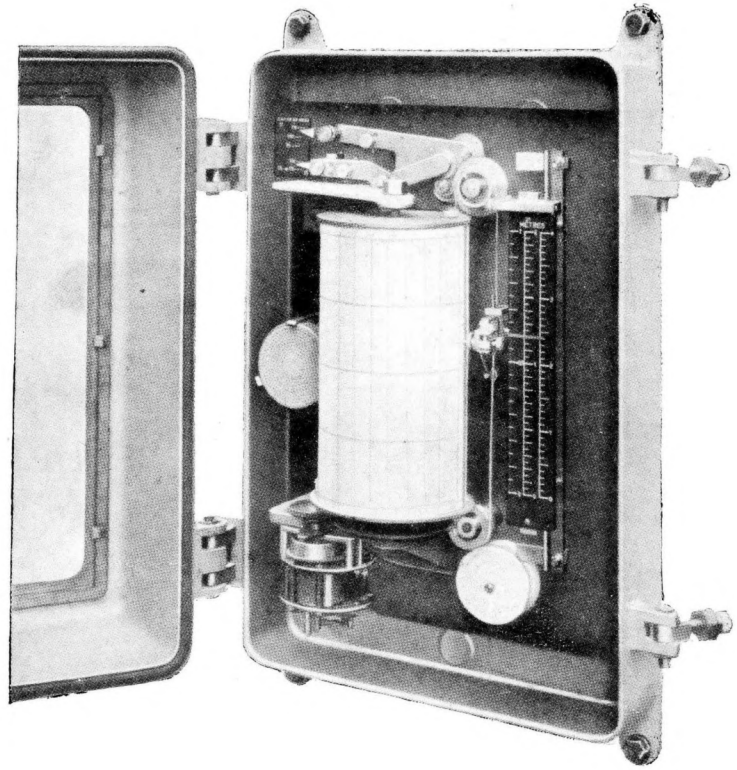


Fig. 2.
Model 2 C Tide-Gauge.
Case open and showing details of recording mechanism.

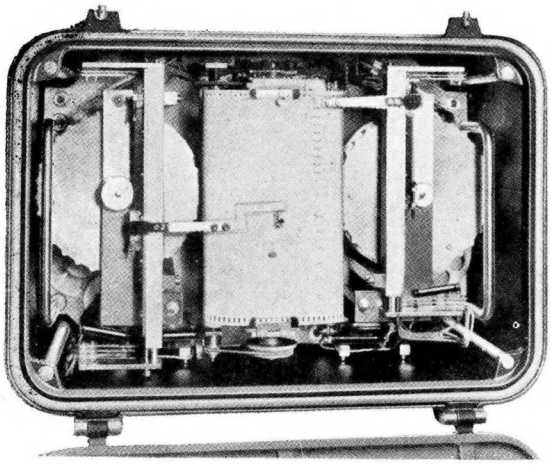


Fig. 3.
Binary « Limnimeter » recorder.

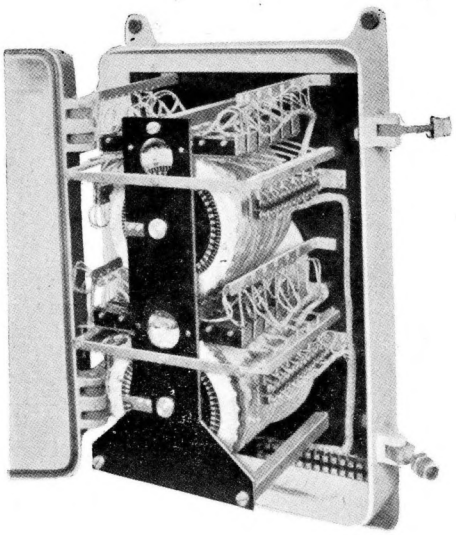


Fig. 4.
Binary « Limnimeter » (binary translator).

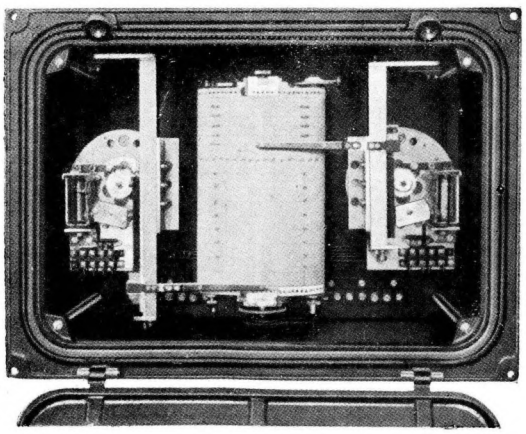


Fig. 5.
Type A transmitter (recorder).

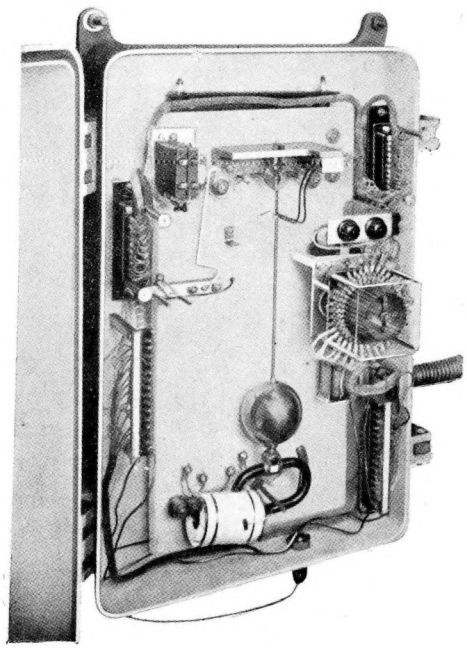
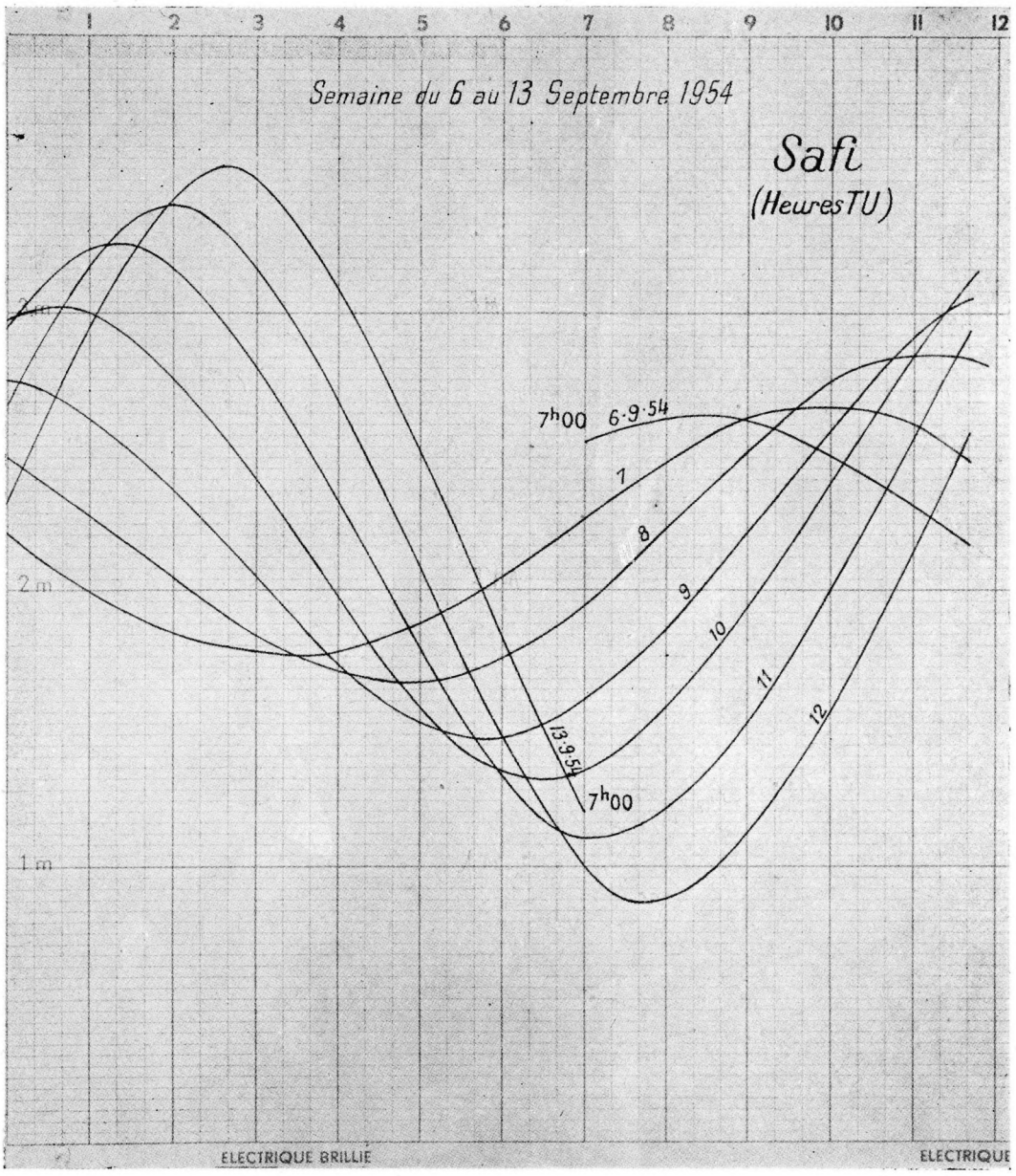


Fig. 6.
Binary « Limnimeter » (transmitter or receiver selector and its regulator).



Section of recording sheet of Model 2 C.

PLATE III

at a reasonable distance from the tide-gauge and if there is no danger of the electric fittings being subjected to excessively severe atmospheric conditions (1).

This system has the added advantage of enabling several tide-gauges to be actuated simultaneously by the same clock if they are not set up too far from one another.

However, for tide recording during limited periods of time in the colonies and in areas where there are no well-sheltered, fixed installations (which is often the case on hydrographic surveys), the tide-gauges can be furnished with a mechanical action of about 15 days' duration. Obviously, accuracy will be slightly less than with the master-clock and a certain amount of supervision will be required if a perfect recording is to be obtained, but it is just as convenient to operate.

Maintenance.

The Brillié tide-gauges give entire satisfaction if they are correctly looked after. The paintwork has to be carefully checked, as well as the drying cartridges in the case. The mechanical components have to be lightly oiled and protected with a suitable product, a silicone vaseline being recommended by the Brillié firm.

Under these conditions, it is generally possible to obtain an accuracy to within a few centimetres in height of tide, if the water in the shaft is sufficiently calm, and to within a few minutes in time, in the case of recordings by mechanical action. The time accuracy is even better when the instrument is run by a master-clock.

REMOTE-CONTROL INDICATORS AND RECORDERS

The Brillié workshops produce several very different types of remote-control recorders or indicators. Their measuring devices, as mentioned above, are based on float systems which are identical with those of the tide-gauges. A description of three of these is given below.

(1) One of these indicators (Type D) transmits the movements of the float to one or more receivers by means of positive or negative electric impulses according to whether the level rises or falls. One impulse corresponds to a fixed variation in the level of the water (e.g. 1 cm.) and moves the stylus a corresponding suitable amount. This arrangement is simple but does not make for much accuracy (about 5 to 10 cm.). Furthermore, the necessity of using a multi-conductor line (4 if the battery is near the receiver) with a certain amount of loss limits the maximum transmission range to short distances.

As an example, mention should be made of the erection by this method in the estuary of the Loire of a large-diameter, luminous indicator showing navigators the height of the water.

(2) Another system (Type A) works in a similar fashion but carries out a discontinuous series of absolute measurements taken at fixed intervals of time, such as every 5 minutes, from a lower level taken as the datum. The number of impulses (in this case, the impulses do not need to be polarized) is proportional to the height of water to be transmitted. The advantage of this process lies in the fact that only

(1) For example, it was possible, at the « Falaise des Fonds » Lighthouse in the Seine estuary, to install a tide-gauge connected by a 300-meter-long, lead-covered, submarine cable toits clock which was inside the lighthouse itself.

2 lines are required, thus enabling the range to be increased and the accumulation of random errors (which limits the accuracy of Type D) to be avoided. In particular, as the instrument does not work « connected », unexcepted stoppage does not necessitate a new adjustment of the inscriber. On the other hand, the level curve is not traced continuously but has to be obtained by joining the ends of the vertical strokes drawn by the stylus. Plate II, Fig.5, shows the recorder of a dual-measurement instrument of this type.

(3) A third type of remote-control level transmitter is designed on a different working principle to record with great accuracy and at what can be considerable distances (several dozen kilometres) level differences which can also be considerable (e.g. river levels, dam levels, etc.)... and this with only a two-conductor line (1). The recording is carried out, as described in the preceding type, by a series of discontinuous measurements of absolute values, but the transmission principle is quite different in that the result of the measurement is transformed by a « binary translator » device into a number of the base-2 system obtained by the position of a line of contacts (0 if the contact is open, 1 if it is closed). The message is formed by this number which the transmission system transfers to a line of contacts in the receiver, the line being identical with that of the binary translator. Another device, called the « decimal translator », then actuates the mobile reading or recording equipment. Briefly, these various devices operate as follows :

The binary translator (Plate II, Fig. 4) is formed by a set of cams actuated by the winch of the float by means of a gear-train, each cam actuating one of the contacts in the line. Transmission occurs on a single line by exploring all the contacts in succession, and for this purpose both the transmitter and the receiver have two identical selectors explored synchronously by a brush. The studs of the transmitter's selector are connected with the contacts of the binary translator; those of the receiver's selector to the contacts maintaining the relays, the relays themselves actuating a line of inverser contacts. To ensure synchronization of exploration for each measurement, the selectors are actuated by identical balance regulators which are sufficiently accurate for the purpose and are synchronously set in motion by electric clutches mounted in series on the No. 1 contact circuit. The decimal translator has a set of cams which is similar to those of the binary translator, is set in motion by an electric motor, and actuates the inscriber or the indicator mechanically. The cams actuate a line of inverser contacts connected with the corresponding relay contacts of the receiver, all the lines being connected with the motor power supply in such a way as to cut it off when the two lines of contacts are in the same position, i.e., when the set of cams of the receiver is in the same position as that of the transmitter. Actually, to avoid the inconvenience of duration of contact and gear action, it has been so arranged that the falling into place of the receiver cams should always occur in the same direction (e.g. upwards). At the end of the measurement, the last stud actuates a cut-off relay which disconnects the maintenance contacts and causes the line of relays to drop.

Plate II shows certain parts of one of the dual-measurement apparatus of this type which enables level differences of more than 60 metres to be transmitted to within 1 cm.

(1) Or possibly even by radio-electric transmission.