" OTTBORO " TIDE GAUGE

by the Canadian Hydrographic Service

The " Ottboro " tide gauge is a portable tide and water level recorder issued to hydrographic field parties.

General

The pressure at any fixed point below the surface of the sea is proportional to the height of the water surface above the point; the changes in pressure as the surface rises and falls consequently provide a means of measuring the rise and fall of the tide or water level.

In the pressure type gauge, the vertical movement of the water level is recorded by a change of pressure actuating a submerged rubber diaphragm joined by capillary tubing to a pressure-sensitive element. This element is connected by linkage to a pen assembly which traces the vertical oscillations of the water level in the form of a curve on a moving sheet of graph paper.

Development

The Tides and Water Levels Section of the Canadian Hydrographic Service combined two basic tide gauges, the " Ott " and " Foxboro " into one unit and named it " Ottboro ". The pressure assembly and pen mechanism of the " Foxboro " are incorporated with the paper drive mechanism and casin of the " Ott ".

Area of Use

The " Ottboro " was primarily developed for use by hydrographic field parties and more specifically for areas where the coastal formation is such that the establishment of a float gauge would be difficult or impossible and costly in time and labour.

Description

The gauge consists of a diaphragm box complete with a diaphragm, capillary tubing, pressure elements, a pen assembly and paper drive mechanism.

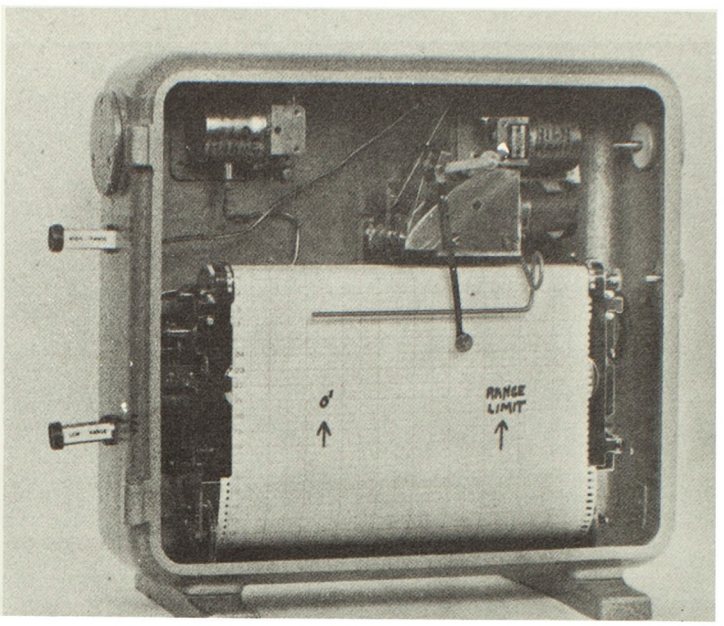

FIG. 1. — Recorder in case, door removed for clarity.

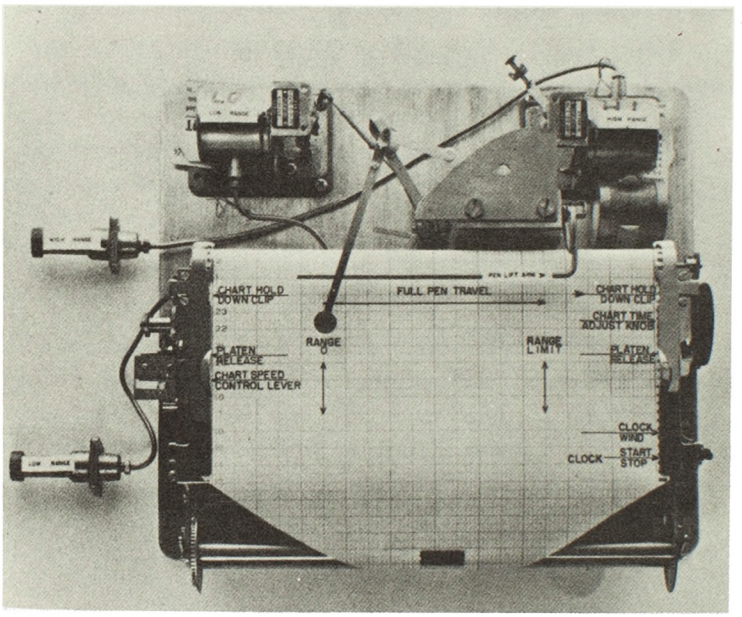

FIG. 2. — Recorder removed from case. Chart drive information and range limits.

Diaphragm Assembly

The diaphragm box is a two section brass cylinder 5 inches in diameter by 3 ½ inches in height. An adjustable opening is provided in the lower section, — in areas of considerable marine traffic or heavy wave action and where silting is not present the opening should be set at minimum but where an appreciable amount of silting is liable to occur the opening

should be set at maximum. A synthetic rubber diaphragm sits in the lower section with the edges of the diaphragm firmly clamped between the flanges of the upper and lower sections of the box which causes an airtight seal between the diaphragm and upper section. The upper section of the box houses one end of the capillary tubing which connects the diaphragm box to the pressure element in the recorder. The box is provided with a lug in which holes are drilled so that the unit can be secured firmly to a wooden mounting bracket (supplied) for the installation of the diaphragm box at a selected site.

Capillary Tubing

The diaphragm is joined to the pressure element in the recorder by plastic covered capillary tubing. The diaphragm box is issued with a length of capillary tubing fitted to form an airtight seal between the box and tubing — this connection is made by the manufacturer and it can be expected to be a tight seal. The connection between the tubing and pressure element or between lengths of tubing is made by a union joint and to make this joint completely airtight, a special washer (supplied) is to be used in the connection. When making the fastening between the tubing and recorder, or between lengths of tubing, two wrenches should be used, one on the nut and the other across the flats of the union. The connection should be made taut but not overly tight; care should be taken to prevent damage to the solder joint between the tubing and union. The maximum distance between recorder and diaphragm is 400 feet when the standard tubing of .080 inches inside diameter is used. This distance can be increased to 1 000 feet with the use of special tubing with an inside diameter of .040 inches. The special tubing is marked by red paint and the number 4 stamped on the union nut. The joints in the tubing are the most likely places at which leakage of air might occur so they should be inspected after an interval of 30 minutes and again, if feasible, after 24 hours from the time of original connection. If, for any reason, air escapes from the system after the gauge has been installed, any increase of pressure on the rubber diaphragm will cause it to move inwards and expel air until the diaphragm becomes inverted. When this occurs, the air in the system will be at barometric pressure and the recorder will not register. A certain amount of care should be taken when handling the tubing; it should never be kinked, no sharp turns should be used, metal cleats of proper size should be used for securing it during installation, it should be protected from traffic and it should not be used to lift or lower the diaphragm box. The tubing should be installed out of the direct rays of the sun as much as possible; therefore, when it is necessary to have the tubing run across a drying foreshore, it should be covered or buried if practicable.

The Pressure Element

Two bellows type pressure elements are fitted in each recorder to provide a two range selection for each gauge. The two union connections for the elements are on the left end of the recorder and are so positioned

that the upper one is always for the element of the higher range. To assist in making the correct connection between the capillary tubing and the pressure element, each union is colour coded to correspond with the colour code used on the elements as stated below.

Range	*Colour*
0-10 ft	Black
0-20 ft	Red
0-30 ft	Orange
0-40 ft	Yellow
0-50 ft	White

Each pressure element has been calibrated to within two percent of its range, therefore, no adjustment to an element is permitted in the field. The possibility of a pressure element failing to operate properly is very remote, but if it should happen, the hydrographer is advised to use the second element on the recorder, if suitable for range, and to order a complete recorder replacement. Although over-range protection is provided on each pressure element, care must be taken to assure that the range of an element is not exceeded. Should the range of an element be over-run, the recorded heights beyond the range would appear as a straight line and would not be the true height of the water level.

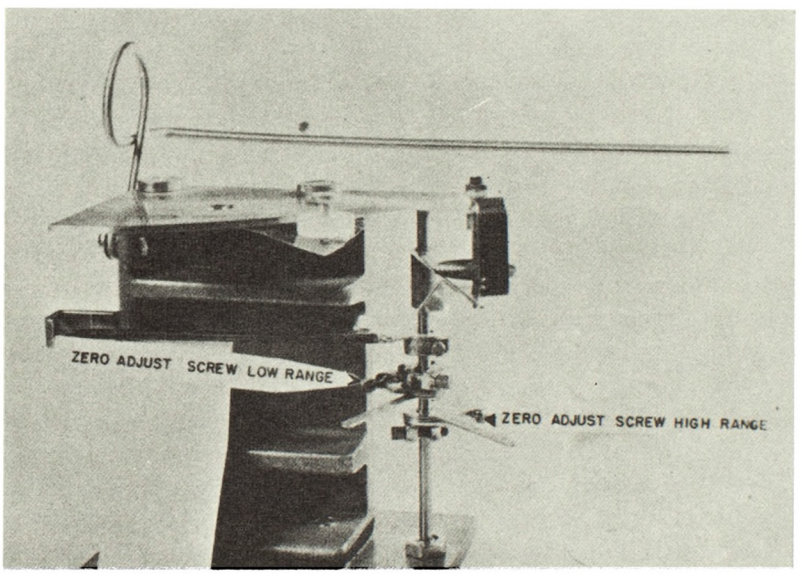

FIG. 3. — Cam bracket, showing pen lifting arm, pen drive shaft and zero adjust screws.

Pen Assembly and Linkage

The short movement of the bellows in the pressure element, caused by a change of pressure on the diaphragm, is expanded by linkage to the pen assembly. Two linkage arms are supplied with each recorder, one for each pressure element fitted and are correspondingly scaled, adjusted and colour coded to match an element. The pen assembly is provided with a

height adjustment of approximately three inches of paper width. This adjustment is made by turning a micrometer screw, situated on the pen drive shaft bracket where the element linkage connects. This is the only adjustment required in the field. The pen assembly has compound shafting and a cam arrangement to convert an arcing movement into a straight line. The linkage arm clips at one end to the pressure element drive arm and at the other end to the pen drive arm. The arms have multiple holes but only the holes not painted are to be used when connecting a linkage arm. Only one arm is to be connected at a time, therefore, a storage clip for the extra arm is provided on the door flange. The pen and ink reservoir is supplied as a single unit and it should be fitted in the *lower* of two holes in the pen arm. The pen arm clips into position on the recording assembly. A lifting arm for the pen is fitted so that the pen may be raised clear of the paper when changing or removing sections of the graph. Only the special ink supplied should be used — any other ink will not flow freely through the small opening of the pen. It is recommended that the pen and reservoir be cleaned at least once a month.

The Paper Drive

The paper is driven by a hand-wound clockwork mechanism. Although the clock will operate for 28 days when fully wound, it is preferable that it be wound regularly once a week. The clock is provided with a positive stop which prevents overwinding but the mechanism feels tight even when the clock is run down, therefore, it should be wound until a definite resistance is felt in the winding. The regulator for the clock is of the " Advance-Retard " type, that is, if the clock is operating slow, the regulator should be moved in the direction of the letter " A " and vice versa. The " Start-Stop " lever for the clock is positioned near the lower right corner of the recorder and it should be in the " UP " position for the clock to operate. The selection lever for two paper speeds, 20-10 mm/h is located midway on the left side of the paper drive assembly. The recommended paper speed for normal use in the field is 10 mm/h — the hourly time intervals printed on the chart paper are synchronized to this speed. It is possible for the selection lever to be moved to a neutral position during transit of the recorder, therefore, it should be inspected for proper gear mesh when the recorder is installed.

The Recording Paper

The recording paper for the " Ottboro " is identical to the " Ott " recording paper and is supplied in rolls 35 feet long by 10.6 inches wide. Both edges of the paper are perforated to fit over paper drive sprockets. These perforations use up 0.6 inches of the paper width and the remaining 10 inches are divided into 100 equal divisions. Each division represents two tenths of a foot of vertical tide or water level movement when the recorder is set for a ten foot range and proportionally for other range settings. The " Ottboro " utilizes only a 5 inch section of the paper which lies between the two dashed lines in the central portion of the graph. The length of the

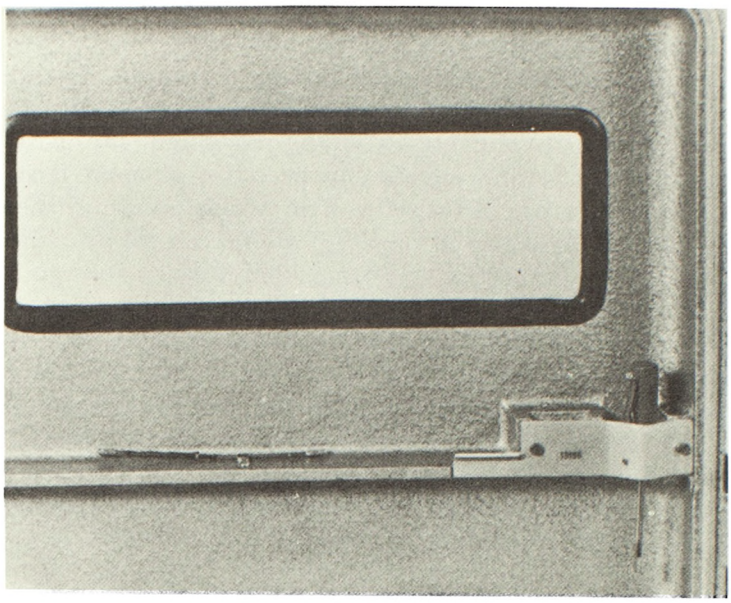

FIG. 4. — Interior of door, showing spare linkage held by clip and screwdriver for zero adjust.

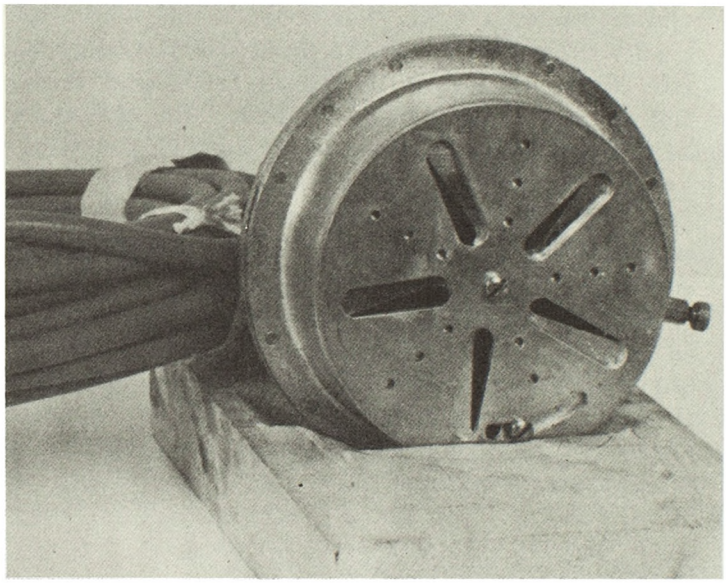

FIG. 5. — Diaphragm box, showing adjustable bottom plate and lock screw.

paper is divided into divisions of two tenth inches with each division representing one half hour time interval when the paper speed is set at 10 mm/h. The hourly time intervals printed along the left edge of the paper are synchronized to this paper speed. A paper length indicator, in the form of a dashed, diagonal line which runs from right to left, appears on the graph when 11 days' supply of paper remains on the roll.

Silica Gel

The recorder is constructed as airtight as possible and to dehydrate the air in the instrument a silica gel cartridge is fitted. Each recorder is supplied with two cartridges so that when one is in use the other may be regenerated. Silica gel, in the process of taking up moisture from the surrounding air, turns from blue to pink in colour. After it has become pink, it has lost its dessicating property and must be replaced. The cartridge can be regenerated by heating it to a temperature of 120-130 degrees centigrade (250-265 fahrenheit). Completion of the regenerating process is indicated by the reappearance of the blue colour. It is advisable to regularly inspect the cartridge in the instrument and replace if necessary.

Lubrication

No lubrication is required by the field officer. Should a recorder be required for an area of below freezing temperature it can be " winterized " with special lubrication, with prior notice.

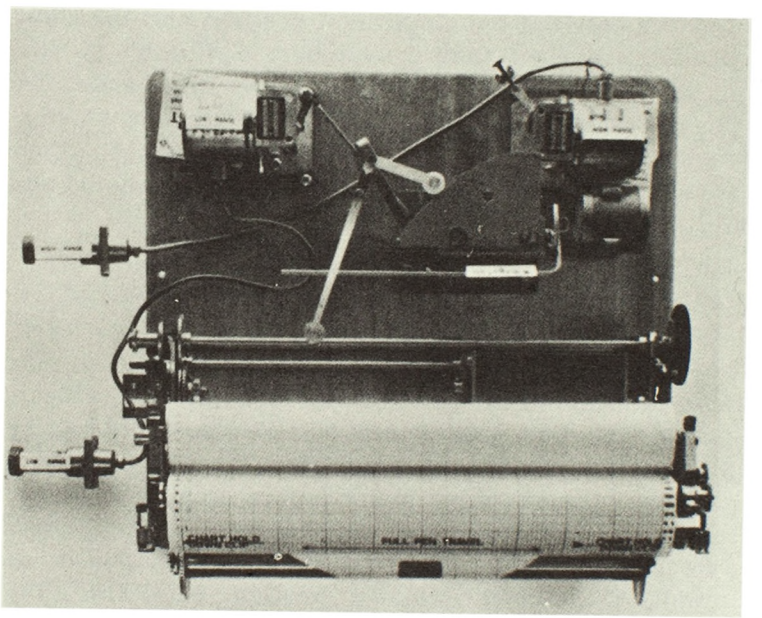

FIG. 6. — Recorder out of case, to show position of chart feed roll.

Installation of the Gauge

Although the " Ottboro " was designed primarily for areas where it would be impractical to install a float type tide recorder, the " Ottboro " can be readily established on a wharf or other permanent structure. It is expected that nearly all temporary gauging stations will use the pressure type tide recorder in the future.

When No Wharf is Available

Some means of anchoring the diaphragm in sufficient water to record the tides and a location for the recorder unit must be considered when installing the instrument. The hydrographer is advised to examine the survey area thoroughly, at low water, for a suitable location for the tide recording equipment. The area selected for the diaphragm head should, if possible, be sheltered from storms, have a fairly level bottom, be relatively close to shore, be adjacent to the sounding area and be fully open to the tides. Because the distances between the diaphragm and the recorder unit can be as much as 400 feet with standard equipment, and in extreme cases, with special tubing and a specially calibrated recorder, this distance can be extended to 1 000 feet, there is considerable leeway available when selecting the site for the equipment.

A stone filled crib with length and width dimensions considerably greater than height — a single wooden stake or pole driven firmly into the sea bed and fitted with wire guys to anchors — a wooden tripod with ends pointed for penetration and some means of anchorage fitted — have been used successfully for positioning the diaphragm.

If the distance between the diaphragm position and the shore is within the limits of the length of tubing available, a suitable location for the recorder unit must be established on shore above high water. The recorder is sensitive to vibration, therefore, a stable platform and shelter should be built for the unit. If the location for the diaphragm is not sufficiently close to shore, a wooden tower for the recorder must be constructed and anchored in open water.

Before installing the gauge, the tidal range for the area should be ascertained and the recorder set for that range. Where chart datum is known, relative to a local bench mark, the height of sea level should be determined by levelling prior to placing the diaphragm box into position. The diaphragm box should then be secured in a depth of water one or two feet below datum; this will prevent any loss of records should the tide fall below datum. If chart datum is unknown, then the best time for positioning the diaphragm box is about three hours before or after high or low water when the sea is near its mean level (semi-diurnal tides). The diaphragm should then be placed in such a depth of water that the pen on the recorder is near the middle of the height scale on the diagram. *NOTE* : The tide staff is usually established simultaneously with or prior to the tide gauge, therefore, the water level readings on the tide staff would provide a ready reference when positioning the diaphragm.

For the purpose of an illustration, let it be assumed that : the location for the diaphragm box and recorder has been selected, the recorder is secured in a level position in a shelter on a stable platform, a stone filled crib has been constructed for the diaphragm box and that a tide staff has been established in the immediate vicinity. Then the procedure for installing the gauge is as follows :

(1) Set the choke on the diaphragm box at a suitable opening.

(2) Secure the diaphragm box to the mounting bracket with the lag screws provided.
(3) Secure the bracket and box to the crib with brass screws. The opening of the diaphragm box should face downwards and be fastened so that in its final position it will be 3 to 6 inches from the sea bed.
(4) Uncoil and lay along the beach the capillary tubing connected to the diaphragm box — this will prevent kinks from forming in the tubing. Similar precautions should be given to any extra lengths of tubing required.
(5) Connect the lengths of tubing together and connect the final end of the tubing to the recorder. Special washers are provided for use between the connections but only *ONE* washer should be used at each join. When making the connections, two wrenches should be used, one on the nut and the other on the flats of the union. The connections should be set up taut.
(6) Load the recorder with paper.
(7) Install the pen assembly, complete with ink.
(8) Wind and start the clock.
(9) Transport the crib, complete with diaphragm head in position, to its selected site and lower it to the sea bed. Do not permit any sharp turns or kinks to develop in the capillary tubing during this operation.
(10) If possible, cover or bury any tubing that would be exposed on the shore. Any surplus tubing should be lightly coiled and lashed under the recorder shelter out of the direct rays of the sun.
(11) Set the pen at the desired height and time on the diagram.
(12) Complete the comparison form.
(13) Close and secure the recorder and shelter.

NOTE : The installation should be inspected after an interval of 30 minutes and, if possible, again after 24 hours.
The position of the crib and diaphragm should be marked with a buoy.

When a Wharf is Available

For the purpose of an illustration let it be assumed that : the recorder is secured in a level position in a shelter on a stable platform on the wharf, a tide staff has been established in the immediate vicinity of the wharf and that a suitable piling of the wharf has been selected for the installation of the diaphragm. Then the procedure for installing the gauge is as follows :

(1) Set the choke on the diaphragm box at a suitable opening.
(2) Secure the diaphragm box to the mounting bracket with the lag screws provided.
(3) Secure the bracket and box to a length of 2×6. The opening of the diaphragm box should face downwards.
(4) Uncoil and lay along the wharf the capillary tubing connected to the diaphragm box — this will prevent kinks from forming in the tubing. Similar precautions should be given to any extra lengths of tubing required.

(5) Connect the lengths of tubing and the final end of the tubing to the recorder. Special washers are provided for use between the connections but only *ONE* washer should be used at each join. When making the connections, two wrenches should be used, one on the nut and the other across the flats of the union. The connections should be set up taut. If the recorder and the diaphragm box are separated by a considerable distance, the capillary tubing should be secured underneath or along some protected portion of the wharf with metal cleats.
(6) Load the recorder with paper.
(7) Install the pen assembly complete with ink.
(8) Wind and start the clock.
(9) Lower the piece of 2 × 6 timber complete with diaphragm into the water until the recording on the graph is at the desired height. Use the tide staff as a guide.
(10) Secure the 2 × 6 timber to the piling. Any fastenings in the immediate vicinity of the diaphragm box should be made with brass screws.
(11) Any surplus tubing should be lightly coiled and lashed under the recorder shelter or other protected location out of the direct rays of the sun.
(12) Set the pen at the desired height and time on the diagram.
(13) Complete the comparison form.
(14) Close and secure the recorder and shelter.

NOTE : The installation should be inspected after an interval of 30 minutes and, if feasible, again after 24 hours.