FOXBORO LIQUID LEVEL GAUGES FOR OPEN VESSELS[1]

NOTE BY DIRECTING COMMITTEE

The Hydrographic Office of a State Member has lately acquired from the Foxboro-Yoxall Limited a Liquid Level Gauge for the purpose of recording tides.

A description of this instrument follows.

Comments from the Hydrographic Office concerned will be furnished as soon as effective tests in actual use in maintaining tidal records have been completed.

The instrument was originally designed and was primarily used for the measurement of liquid level in bore holes, reservoirs, storage tanks, etc. and, in fact, in any vessel which is open to atmosphere. By the very nature of its design it lends itself to use in the recording of tide fluctuations.

Foxboro Liquid Level Indicating Gauges operate on exactly the same system as the Recording Gauges, reading in inches, feet, pounds, gallons, per cent or any other unit of volume or weight. They can be installed at locations easily observable by the operating force and will aid greatly in efficient operation. Furnished in 6", 8", 10" and 12" sizes, the dials are specially designed for easy reading.

Foxboro Liquid Level Recording Gauges for open vessels furnish accurate and permanent records of depth and volume. They are supplied in ranges up to a pressure equivalent to 150 lbs per square inch, and may be calibrated in any units of measurement. The standard round-form, dust-proof case is finished in dull black lacquer and combines utility and sturdiness with symmetry, and makes a neat durable housing which perfectly protects the movement from dust and moisture.

The operation of the instrument depends on the use of a slack rubber diaphragm which is housed in a bronze box and is immersed in the liquid below the lowest level which is to be measured. The hydrostatic head over this diaphragm is transmitted to the instrument by means of fine bore copper capillary tubing and this head is measured and either indicated or recorded on a suitable instrument. Our standard for recorders are 12" circular charts and these may be supplied with either 24-hour or 7-day rotation as may be required.

The pressure at any point in an open tank or body of liquid is a measure of the height of liquid above that point. The Foxboro Liquid Level Gauge is built upon that fact.

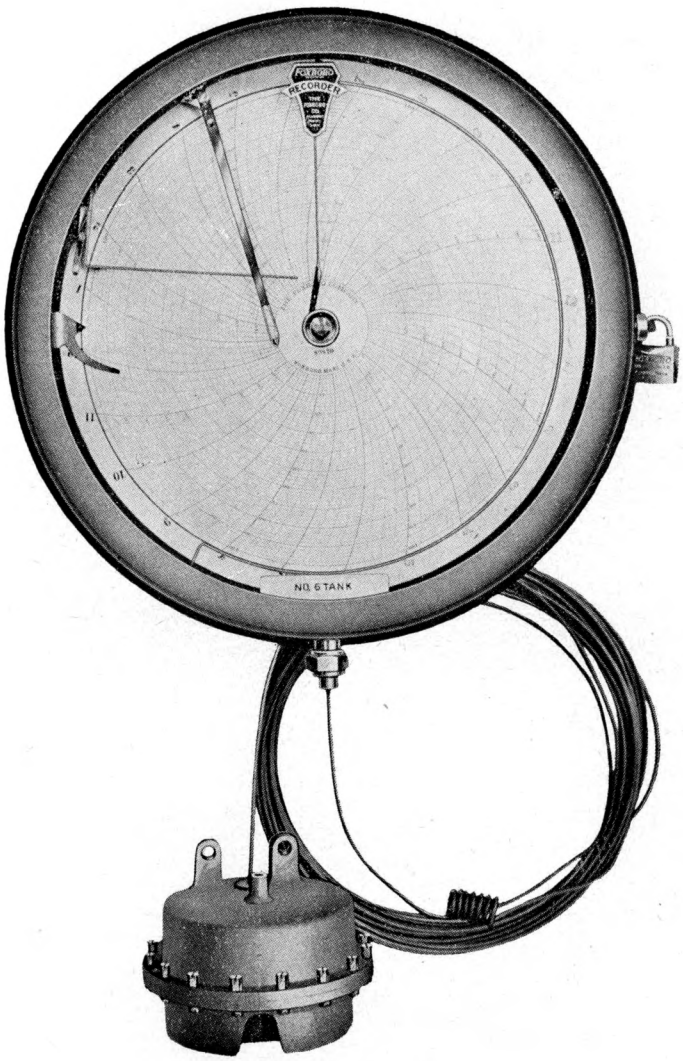
An air-filled system is used to eliminate gauge elevation correction. This system makes it possible to place the instrument at any location within 500 feet of the body of liquid to be measured, but greater lengths of connecting tubing can be accommodated in special circumstances.

The reading of the instrument is not affected by the area exposed to liquid pressure, but it is directly affected by specific gravity and must be calibrated for the liquid in question. Almost every kind of liquid used commercially is being measured by Foxboro Liquid Level Gauges. They are just as successful in flowing and turbulent liquids as in calm liquids.

The bronze air chamber is sealed from the liquid, in which it is submerged, by a patented rubber diaphragm the shape of which permits a great deal of expansion and contraction of air in the system without creating any restraint. The purpose of the diaphragm is to prevent condensation in the tubing and the absorption of air in the liquid.

The pressure caused by the column of liquid compresses the entire air system equivalent to the actual liquid head. The variations in level, actuating the movement, cause the recording pen or indicating pointer to move to the position (on a chart or dial) corresponding to the level of the liquid. Regardless of the particular problem of measurement, the indicating or recording mechanism may be located wherever it can be read most conveniently.

(1) Foxboro-Yoxall Limited, Lombard Road, Merton, London, S.W.19.



Foxboro Gauge.

The diaphragm box is made in two sections, inserted between which is a diaphragm of rubber, special oil-resisting rubber, Duprene, or other composition depending largely on the application. The two sections are held together by sixteen Everdur screws. Diaphragm boxes are usually of acid resisting bronze that is resistant to the chemical action of most liquids, and they are tinned on the inside of the upper section. As an additional protection, bronze diaphragm boxes can be lead wiped. Special cast-iron or stainless steel boxes are furnished for use with acids corrosive to bronze. For chlorine applications the boxes are coated inside and out with silver. The upper section of all diaphragm boxes is carefully tested for leaks as it must be absolutely air-tight.

The patented diaphragm is securely clamped between the two flanges of the box. A positive air-tight joint is assured by the carefully machined and serrated faces on the flanges. A milled slot permits the insertion of a screwdriver for separating the flanges when removing the diaphragm. The flange on the diaphragm extends only to the bolt ring, thus eliminating any danger of pulling or crinkling.

The capillary connecting tube, which enters the top flange, is extended into the diaphragm box and reversed so that its open end faces away from the diaphragm. This eliminates the possibility of the tube becoming sealed by the diaphragm. Outside the box the tubing is supported for several inches by a loop of heavy bronze wire to protect the capillary against kinks near the joint.

To work satisfactorily, an instrument of the liquid level type must be absolutely free from leaks. The weakest spot has always been at the necessary joint in the connecting tube of the case of the instrument. A special form of union was designed which absolutely insures a permanently tight joint.

The diaphragm box of the Standard rigid type for use at temperatures below 150° F., is attached rigidly to a wooden or metal support which, in turn, is attached to some support on the sea bed. These instruments are capable of a high degree of accuracy in reading, the pressure movement being accurate to within half of one per cent of full scale range. They are used in streams, tidewater, forebays, tailraces, and other rapidly moving, or agitated liquids which will not attack rubber, Duprene and bronze.

Care must be exercised to have the diaphragm box level, and the tubing held to the plank by staples.

THE ACTUATING MOVEMENTS

To assure accurate, dependable measurement under various conditions three different actuating springs have been designed.

The Diaphragm Spring.—On depths up to and including 18 feet of water (or its equivalent), a unique Bronze Diaphragm Spring Movement is used. The movement is a series of metal diaphragms built up in the form of a bellows with small coiled springs on one side. This construction produces maximum motion with a minimum number of diaphragms. Consequently, the movement is more compact, more sensitive to level changes and more rugged than any other type.

The motion of the diaphragm spring is transmitted to the pen by simple levers connected by a patented phosphor bronze wire link to give a three-point bearing which prevents lost motion and friction.

The Spiral Spring.—On depths from 18 1/2 feet of water to 34 feet, the Bronze Spiral Spring Movement is used. This type of movement offers more power per ounce change of pressure than the helical spring and less power than the diaphragm spring. Compact and rugged in construction, it is not easily injured by ordinary overranges. Because of its shape a large number of convolutions can be wound in a small space. With this construction it is possible to obtain the necessary angular motion with relatively heavy-walled tubing.

The Helical Spring.—Where the depths to be measured are equivalent to 35 feet of water, or more, a Helical Spring Movement is used. This is a special alloy bronze tube wound into helical form. Combined with experienced drawing, tempering and selection of alloys, this design insures freedom from set and hysteresis.

A patented connecting strip, flexible to the radial expansion of the spring, transmits the motion of the helical directly to the pen arm without distortion or undue friction. All unnecessary strains have been eliminated.

CLOCKS

The clock is the power motor of a recording instrument. It revolves the chart at a definite speed. Dependability under all conditions is, therefore, an essential quality, for failure of the clock means inaccurate or incomplete records. All Foxboro Clock Movements are interchangeable—they fit the same case drillings and are applicable to all recorders.

Spring-Wound Clock.—The five-column construction gives as nearly perfect alignment between back and front plates as is mechanically possible. The entire clock movement is enclosed in a nickel finished, dust-tight, brass box, through the cover of which the clock spindle, winding spindle, regulator, lever, and starter extend. This cover has a small window that enables the operator to see whether the clock is running. Clocks are furnished to give one revolution in 15 and 30 minutes, in 1, 2, 3, 4, 6, 8, 12, 48, 72 hours, and 7 days. The standard movement is one revolution in 12 or 24 hours.

For out-of-door service or wherever instruments are installed subject to extreme heat or cold, and for 7-day service, a special movement is furnished with eleven-jewelled Swiss Escapement. It is so finely constructed that it can be regulated to the accuracy of a watch.

Two-speed clocks are available which permit changing the speed of rotation by shifting gears. They are supplied in 7 day-24 hour combination and 24 hour-24 minute combination.

Warren Telechron Clock.—The Warren Telechron Motor Clock requires no winding, no attention at all except oiling and cleaning about once every three years. It can be supplied to operate on 110 or 220 volts, 25, 50 or 60 cycles; to give one chart revolution in 12 hours, 24 hours, or 7 days. Fluctuations in voltage do not impair their time-keeping qualities. As long as the frequency of the circuit is constant an accurate clock will result.

D.C. Impulse Clock.—Standard minute impulse clocks can be furnished to operate in series or multiple with other electric clocks in the plant, according to the type of system installed.

Electric Motor-Wound Clocks.—These clocks should be used on unregulated circuits. A standard escapement governs the speed. The clock spring will drive the clock for two hours beyond current failure. Available only for 105 to 125 volts; 50 to 60 cycles A.C. On other voltages a transformer is necessary.

HUMITEX CHARTS

for Liquid Level Gauges

The reliability of a chart is of tremendous importance. If it is not accurately drawn and punched, it will destroy the value of the most perfectly designed recorder.

Foxboro Humitex Chart Paper is made on paper machines controlled by Foxboro-Atlantic Verigraphs. It is delivered to us at a guaranteed uniform relative humidity. In the Foxboro Chart Printing Department an air-conditioning system maintains the relative humidity at exactly the same percentage. Thus at no moment can the paper expand or contract, and the highest accuracy in chart printing is assured. All Foxboro Charts are alike in quality. Records made on them can be compared with confidence in their accuracy.

After a careful investigation of colors in combination we have found that a soft tone of brown on cream-tinted paper is the most restful to the eye, especially when studying charts, and that it combines best with different colors of recording inks. Foxboro Humitex Charts are now, therefore, being printed in brown ink.

Foxboro Liquid Level Charts are made in three sizes—8", 10" and 12"— and can be used for any units of measurement. The electrotypes from which the charts are printed are made from wax-process plates that insure absolute accuracy and ease of reading. This ease of reading is greatly increased by the scale length.

Some users prefer to install instruments in protection cases and to meet that preference the wood protection case has been designed. For service where excessive moisture, fumes, rain or dust prevail, a Waterproof Aluminum Case can be furnished which is tight under all conditions except submersion.

Submersible Case.—For the occasional service where a Gauge may be actually submerged, a 12 in. Submersible Case is used. The case has binding bolts and wing nuts which draw the ring down on a tubular rubber gasket and hold it firmly in position. An air vent releases the pressure caused by the tight closing of the door.

The recorder is fitted with a stainless steel pen lifter operating automatically when the door is opened. The pen arm can be disconnected and replaced without disturbing the instrument. A stainless iron time set pointer enables the operator to set the time at the widest time section of the chart. The recorded chart is set and centrated automatically and is held firmly in place by a pull button. The Humitex chart rests on an aluminum disk held firmly in place on three pillars.