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SEWAGE OPEN FLOW METER

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This invention relates to the measurement of the rate of flow of liquids and more particularly refers to apparatus for sensing and transmitting an electrical signal for indicating the rate of flow of water or sewage through open flow measuring devices, such as flumes, and open flow nozzles.

The measurement of flow of water under free flowing conditions through open channels, sewers or partially filled pipes is commonly accomplished by means of weirs or flumes. The rate of flow of water through such devices is a function of the depth or head of the water upstream from the weir or throat of the flume. Any suitable means, such as a measuring stick, may be used to measure the head of water and the rate of flow calculated from this information, or the scale on the measuring stick may be a direct indication of the rate of flow.

When it is desired to use a float to automatically and continuously sense the level of the surface of the water for the purpose of continuously indicating the rate of flow of the water through the weir or flume, the general practice has been to provide a stilling well adjacent the flume but connected to the flow channel at the level of the bottom of the flume or weir notch so that the level of the still water in the well is the same as that upstream from the flume or weir so that the level of the water in the stilling well indicates the rate of flow through the measuring device. A float resting upon the surface of the water in the stilling well, not being subjected to the horizontal movement of the flowing stream of water, may then be connected to suitable mechanisms which indicate the rate of flow or transmit an electrical signal responsive to the level of the float.

Although heretofore almost universally employed, the stilling well expedient has the inherent disadvantages of substantial construction and maintenance costs and additional space requirements. When metering sediment-bearing water, and particularly sewage, it is necessary to provide means for periodically flushing out the stilling well with clean water. This equipment and necessary maintenance further increase the cost of building and operating the stilling well.

The principal object of the invention is to provide an apparatus for measuring the rate of flow of water in open flow measuring systems which apparatus is simple, accurate over long periods of use, and inexpensive to install and operate. A novel feature of the apparatus resides in the fact that it measures the level of the flowing stream of water directly in the stream and without the interposition of a stilling well.

A further object of the the invention is to provide continuously operating measuring apparatus which is not adversely affected by the presence of floating debris in the water. Another object is to provide such measuring apparatus which can readily be adapted for the measurement of the rate of flow of water over a very wide range. Still another object is to provide such apparatus which provides an electrical signal suitable for use in telemetering systems. Other objects and advantages of the invention will become apparent from the following detailed description thereof in conjunction with the accompanying drawings wherein—

FIG. 1 is a plan view of a Parshall flume showing the measuring apparatus of the present invention mounted thereon;

FIG. 2 is a vertical sectional view of the flume and measuring apparatus shown in FIG. 1 and taken at the line 2—2 thereof;

FIG. 3 is an enlarged vertical sectional view of the sensing and transmitting apparatus taken at the lines 3—3 of FIGS. 1 and 4;

FIG. 4 is a cross-sectional view taken at the line 4—4 of FIG. 3;

FIG. 5 is a schematic electrical wiring diagram of the transmitter, receiver, and indicating and/or recording device;

FIG. 6 is a perspective view of the measuring apparatus using an open flow nozzle, and

FIG. 7 is a side view of the assembly of FIG. 6 on a much smaller scale.

Referring to FIG. 1, a Parshall flume is shown by way of example of a suitable channel-type open flow measuring device. As used herein, the term "channel-type open flow measuring device" means a flow measuring device wherein the flowing sewage is conducted through an open flume, such as a Parshall flume or open flow nozzle, wherein the entire body of sewage flows continuously as a stream and the level of the sewage for flow measurement purposes is measured by sensing the level of the stream at an appropriate point as it flows through the open flume. This Parshall flume, shown by way of example, has a converging section 1, a throat section 2, and a diverging section 3. A beam 4 is mounted across the top of the entrance to the flume and fastened at each end to the flume walls and a housing 5 containing the measuring mechanism is mounted thereunder, supported by the beam. A spherical float 8 is fastened to the free end of a float arm 7 which is connected to a pivot shaft 6 mounted in housing 5.

As is shown in FIGS. 1 and 2, the measuring apparatus is oriented with the float 8 downstream from the pivot 6 of the float arm, the float being located approximately at the crest of the stream of water 8*a* for properly sensing the level of the water in the flume. Desirably, a small depression 8*b* is provided in the bottom of the flume to accommodate float 8 for zero flow calibration purposes. Since float 8 rides upon the surface of the flow stream, the position of float arm 7, and therefore the rotational position of pivot shaft 6, is responsive to the depth of the water at the location of the float in the flume.

Housing 5 encloses the mechanical and electrical components of the meter transmitter. The pivot shaft 6 is supported on anti-friction bearings 19 and 20 supported by suitable structure in the housing. The arrangement and nature of the bearings are such that the shaft 6 turns readily with movement of float arm 7 and in keeping with the elevation of float 8 as it rests upon the surface of the flowing stream of water. A counterweight 10*a* is adjustably mounted in pivot shaft 6 by means of shaft 9 which threads into a diametral hole in pivot shaft 6, a lock nut 9*a* being provided to lock the counter-weight assembly in the desired position. The purpose of the adjustable counter-weight is to adjust the depth of immersion of float 8 in the water of the flowing stream. This adjustment is somewhat critical in that it is desirable that the float arm assembly have sufficient weight to follow faithfully the level of the surface of the flowing stream while, at the same time, the float is immersed no more than necessary so that floating debris will readily pass under the float. The adjustment may be made by increasing or decreasing the length of the counter-weight arm, shaft 9, by turning the counterweight assembly in the threaded hole in shaft 6. Once adjusted for a particular apparatus, particularly the float and float arm assembly, it is generally unnecessary to alter the adjustment.

In order to translate the position of the float into a usable electrical signal that may then be transmitted to