suitable indicating, recording and/or control apparatus, an electrical induction coil 15, arranged within a coil housing 15*a*, is mounted from and within the housing by means of a suitable threaded pipe or tubing 16 and nuts threaded thereon. The electrical characteristics of this coil will be described hereinafter. The coil is mounted in vertical position and a core 10 of iron or other suitable electrical core material is arranged at its axis, being guided for vertical movement in the coil by a guiding disk 21 and connected with pivot shaft 6 through rod 14 and arm 13. The arm 13 is affixed in shaft 6 and extends radially therefrom, being coupled to vertical core rod 14 at 13*a* with sufficient play to permit vertical movement of the rod and core assembly following movement of arm 13 with pivot shaft 6. Desirably, a stop 11 is provided to limit movement of counter-weight arm 9, and thus rotation of pivot shaft 6 and movement of core arm 13, to avoid damage to the core operating mechanism. As shown, this stop may be part of the casting which forms housing 5. A bushing 17 provides a central opening which serves as a guide-way for core rod 14.

Electrical conductors 15*b*, connecting with the respective end and midpoint terminals of coil 15, may be brought out, as shown, from the middle portion of the coil housing and pass through tubular support 16 for connection with related metering apparatus.

A schematic wiring diagram showing the relationship of coil 15 with associated equipment is shown in FIG. 5. An alternating voltage is applied from the supply line to the respective end terminals of the transmitter coil 15 and also to the end terminals of a receiver coil 22 which may be identical to coil 15. The supply line also furnishes current for an amplifier 23. The midpoint terminals of coils 15 and 22 are respectively connected to amplifier input terminals 33 and 34. The output terminals 35 and 36 of amplifier 23 are connected to servo-motor 29 which drives a cam 27 by means of a shaft indicated at 28. The servo-motor-cam shaft may also be extended, or otherwise connected, to a meter indicator 30, or other recording or control mechanism for indicating, recording, or otherwise manifesting the rate of flow of water through the flume measuring device.

A core 24 within receiver coil 22 is mechanically coupled by means of a rod indicated at 25 with one end of cam follower arm 26 which is suitably mounted for pivoting about an axis 37 and is provided with a suitable cam follower 26*a* which engages cam 27.

The arrangement forms an alternating current impedance bridge consisting of legs *a*, *b*, *c*, and *d*. This bridge is employed to operate the receiving apparatus in such a way that changes in the level of the flowing stream of water or sewage are immediately reflected in the receiver. With the coils 15 and 22 energized by current from the line supply, the potential at midpoint terminal 31 of transmitter coil 15 will be equal to the potential at midpoint terminal 32 of receiver coil 22 when the impedance ratio a/b is equal to the impedance ratio c/d. This condition obtains when cores 10 and 24 are at corresponding locations within their respective coils. Input to the amplifier is then zero and actuating voltage applied to the servo-motor from amplifier output terminals 35 and 36 is also zero and the servo-motor is inactive. Any change in the level of float 8 and corresponding angular position of shaft 6 which may rotate between limiting positions indicated by the full line and dotted line positions of the counter-balance assembly in FIG. 3 results in corresponding movement of core 10 as it is driven by the float assembly, changing the impedance ratio a/b resulting in a difference in potential at terminals 31 and 32 and corresponding input to the amplifier which supplies a corresponding current to the servo-motor to turn cam 27 in a direction to alter the position of core 24 within coil 22 to that at which the impedance ratios of the respective cores again become equal so that amplifier input is reduced to zero and the servo-motor stops. In this way, changes in the level of the water are continuously manifested at the indicating mechanism 30 as the apparatus operates to continuously re-establish balance of the impedance bridge as the float assembly tends to cause a condition of unbalance.

The manner in which the apparatus is calibrated will be readily understood. The water gates at the flume may be closed to stop the flow of water therethrough and permit float 8 to rest in the depression 8*b*. At this position of the float assembly, indicated in dotted lines in FIG. 2, and solid line in FIG. 3, the core of the transmitter coil is at its highest position within coil 15. The receiver cam mechanism is arranged with core 24 at its uppermost position within receiver coil 2 and the indicator 30 is set at zero when the impedance bridge is balanced. The scale of the indicating or recording instrument will then depend upon the length of float arm 7 since a given change in water level will produce a greater degree of rotation of the pivot shaft 6 with a shorter arm. The length of the float arm used will depend upon the range of water levels to be measured, a greater range requiring a longer float arm to avoid appreciable error due to the movement of the float 8 in an arc about the pivot shaft. A very important advantage of the apparatus of the invention resides in its ready adaptability to an extreme range of rates of flow, nothing more being necessary than adjustment of the counterweight to properly counterbalance a longer float arm to measure a greater range of water levels. By proper choice of flume and length of float arm, it is possible to use the same transmitter apparatus to measure flows ranging from sixty gallons per minute to thirty-four thousand gallons per minute.

The greatest single advantage of the apparatus herein described resides in the elimination of the stilling well with its attendant costs and operational requirements. It is admirably suited for use in connection with a telemetering system. The spherical shape of the float is greatly to be preferred over other shapes since it has been found that floating debris, such as is encountered in the measurement of sewage, readily passes under the spherical float, especially when immersion is adjusted to about ¾ inch. The floating solids do not affect accuracy of measurement, although such debris may register as small "pips" on the chart of a recording instrument, information obtainable from the presence of such pips being itself of value for certain purposes. The housing is made watertight and no damage is caused by flooding of the flume and consequent immersion of the housing in the water. Almost no maintenance service is required by the transmitter apparatus.

Although the exemplary embodiment of the invention has been particularly described for use with Parshall flumes, such as those described in United States Department of Agriculture Circular No. 843, dated May 1950, it can be used with open flow nozzles and other types of open flow measuring devices. The flow measuring apparatus using an open flow nozzle is illustrated in FIGS. 6 and 7. The open flow nozzle 38, as such, is a well-known primary flow measurement device. As with similar devices, the rate of flow of liquid through the open flow nozzle is a function of the depth of the liquid in the nozzle. In the illustration of FIGS. 6 and 7, nozzle 38 is connected by suitable means, as flange 39, to a pipe carrying the liquid and meter housing 5 is mounted on the nozzle with the float arm 7, which is connected with the pivot shaft 6, located in the vertical axial plane of the nozzle so that float 8 rests upon the surface of the flowing liquid 8*a* to register the depth thereof in the manner and for the purposes hereinabove described in connection with the Parshall flume.

It may also be used for the measurement of liquid level for purposes other than rate of flow measurement.

Invention is claimed as follows:

1. Apparatus for measuring the rate of flow of a gravity flowing stream of sewage comprising a channel-type open