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(54) **Multi-purpose sensor/detector for fluid**

(57) A multi-purpose capacitive sensor/detector comprises a dielectric tube 1 on the outside of which are provided substantially semi-circumferential electrode coatings 2, 3 which form the plates of a capacitor. The value of capacitance is dependent on fluid characteristics within the tube. The sensor/detector may be arranged in different configurations to defect fluid pollution, fluid level, fluid flow, fluid pressure etc. The capacitor is connected as part of a tuned circuit of a stable oscillator the frequency of which varies according to the fluid parameter being measured. Instead of the coatings forming a capacitor they may form an inductor.

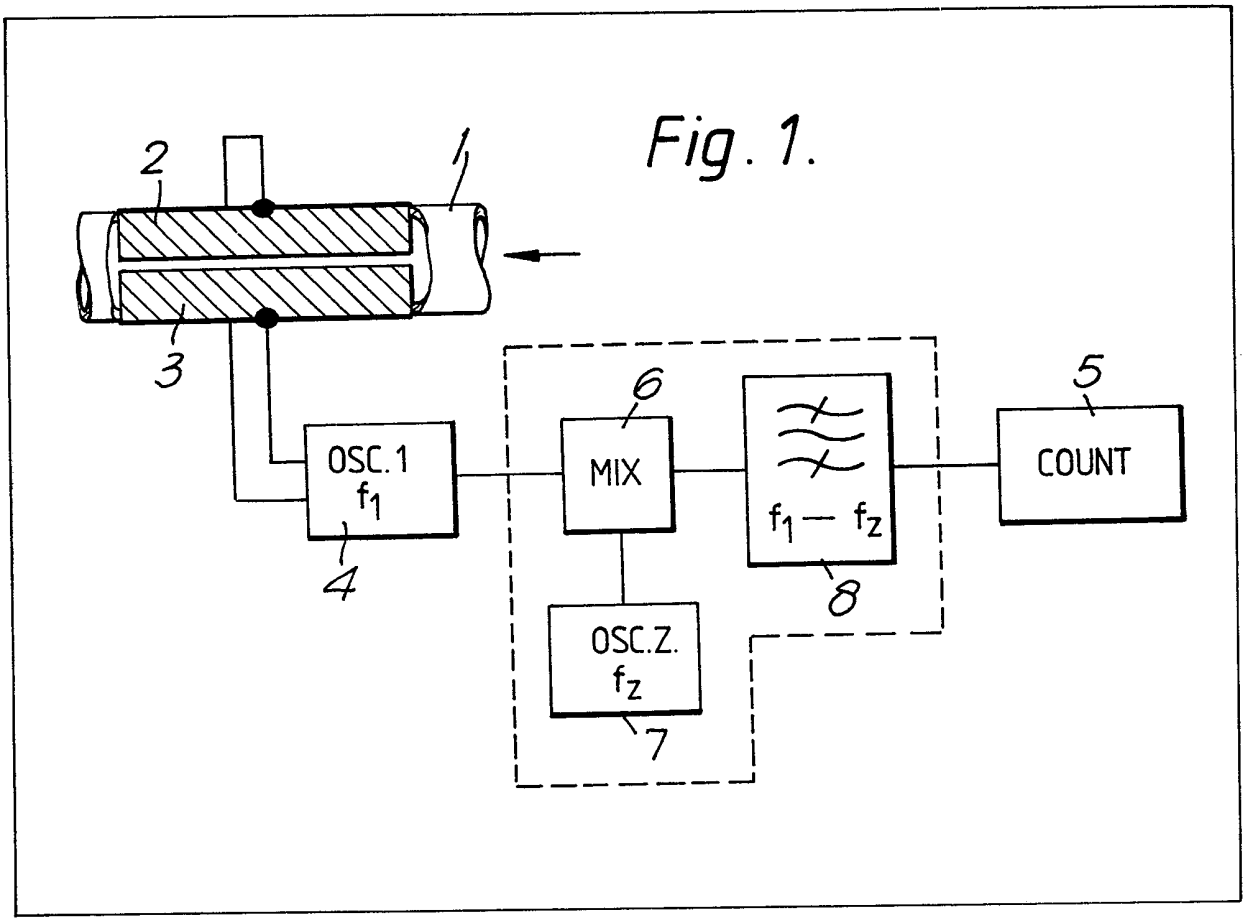

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Fig. 1.

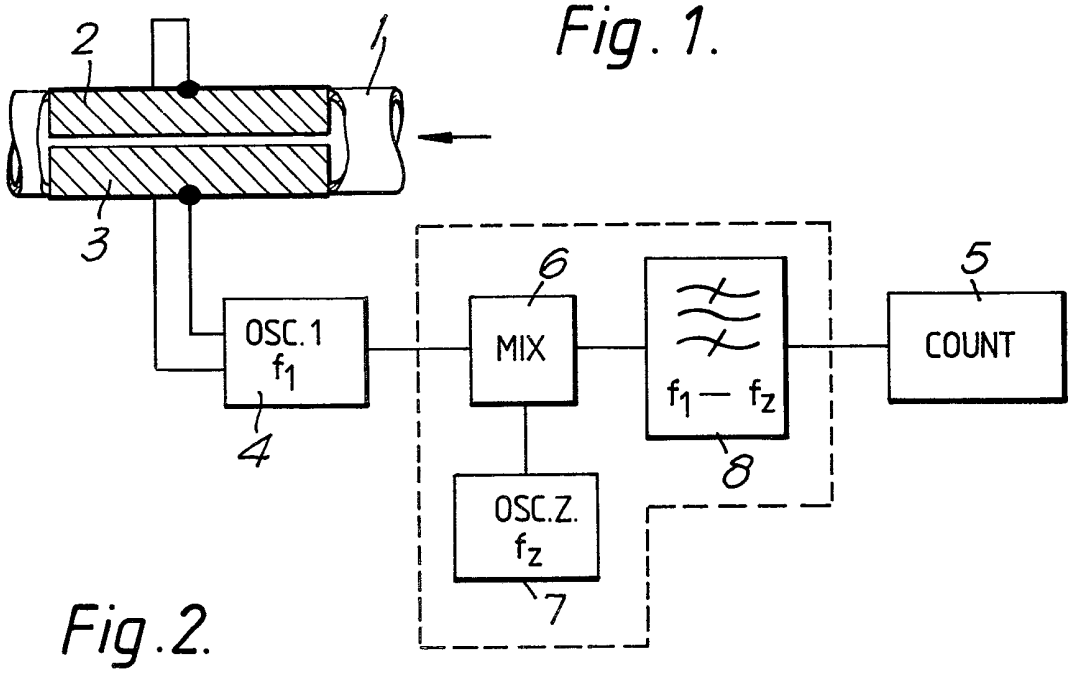


Fig. 2.

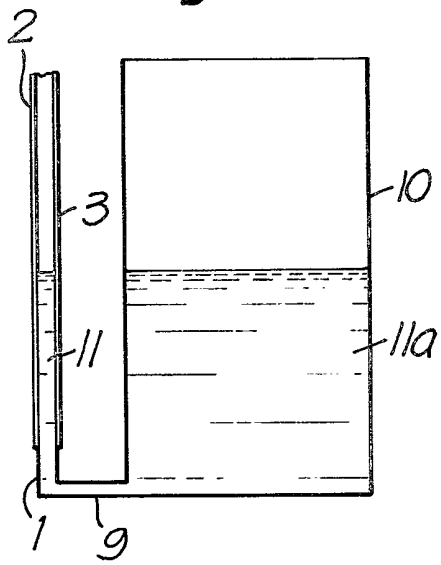


Fig. 3.

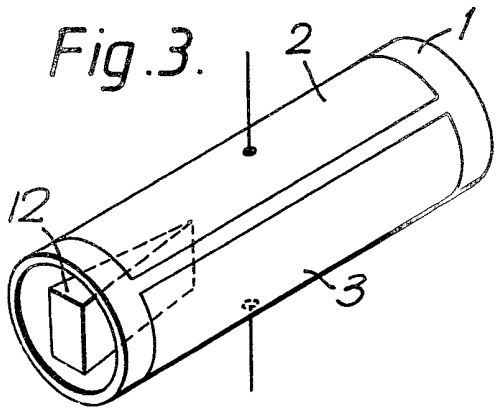
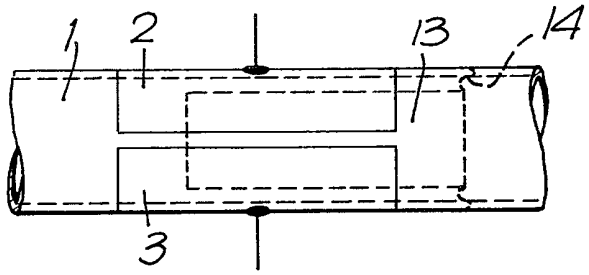


Fig. 4.



SPECIFICATION

Multi-purpose sensor/detector for fluid

This invention relates to a multi-purpose sensor/detector for use in a variety of fluid measurement applications, e.g. level, flow, pressure, pollution etc measurement.

Hitherto it has been common practice to use special purpose sensor devices for specific fluid measurement requirements. For example, for fluid level measurement it is common to use a float operated sensor. For fluid flow measurement it is known to use ultrasonic devices. For measuring fluid pressure diaphragm mounted piezoelectric devices have been proposed.

According to the present invention there is provided a multi-purpose sensor/detector arrangement comprising a tubular substrate of dielectric material provided with one or more electrode coatings extending substantially around the circumference of the tubular substrate, the coatings being adapted to form an electrical component the electrical characteristic of which is variable dependent on the presence of liquid in or flowing through the tubular substrate.

Embodiments of the invention will now be described with reference to the accompanying drawings, in which:-

Fig. 1 illustrates a basic arrangement for the measurement of water-in-oil pollution,

Fig. 2 illustrates an arrangement for liquid level sensing,

Fig. 3 illustrates an arrangement for liquid flow sensing, and

Fig. 4 illustrates an arrangement for liquid pressure sensing.

All the arrangements illustrated make use of a basic sensor/detector element comprising a length of dielectric tube 1, e.g. glass, on the outside of which are deposited two substantially similar semi-circumferential electrode coatings 2, 3. The two electrodes constitute the plates of a capacitor which can form part of a tuned circuit of a stable oscillator. Liquid present in or passing through the tube will vary the capacitance of the capacitor and therefore the frequency of the oscillator.

In the arrangement of Fig. 1 the electrodes 2, 3 are connected in the tuned circuit of stable oscillator 4, whose frequency is f_1. The oscillator frequency is determined by a frequency counter 5. Alternatively, the output of the oscillator can be fed to a pulse counter or other additional signal processing circuit as required. In order to enhance the accuracy and resolution of the basic arrangement of Fig. 1 the output of the oscillator can first be applied to a mixer circuit 6 where it is mixed with an offset frequency f_z from a local oscillator 7. The resultant beat frequency f_{1-z} is extracted by a filter 8 and it is this beat frequency which is applied to the frequency or pulse counter 5. The presence of water droplets in oil flowing through the tube 1 causes the capcitance between electrodes 2 and 3 to change.

In the level sensing arrangement of Fig. 2 the vertical tube 1 with its electrode coatings 2, 3 is in fluid connection 9 with a tank or reservoir 10. The level of the fluid 11 in the tube 1 corresponds with the level of fluid 11a in the tank 10. As the level varies so will the capacitance between the electrode coatings change.

In the arrangements shown in Fig. 3 a vortex generating wedge 12 is introduced into the tube 1 such that fluid flowing through the tube creates vortices within the volume bounded by the electrode coatings 2, 3. The capacitance between the electrode coatings varies according to the size and number of the vortices which in turn depend on the flow rate.

Fig. 4 shows an arrangement for measuring pressure, in which a high permitivity slug 13 is supported by a single bellows 14 (or a double bellows, and is moved more or less into a coupling with the capacitor electrdes 2, 3. The arrangement may be designed to measure either single or differential pressure.

All the above examples are for capacitive sensing of the fluid in the tube. An alternative is to form a single coating in the shape of a helical winding around the tube. This forms an inductive winding the self-inductance of which is variable dependent on the characteristics of the fluid in the tube. Again, this sensor can be incorporated in the tuned circuit of an oscillator whereby the frequency of the oscillator is varied in accordance with the inductance.

CLAIMS

1. A multi-purpose sensor/detector arrangement comprising a tubular substrate of dielectric material provided with one or more electrode coatings extending substantially around the circumference of the tubular substrate, the coatings being adapted to form an electrical component the electrical characteristic of which is variable dependent on the presence of liquid in or flowing through the tubular substrate.

2. An arrangement according to claim 1 wherein the tubular substrate of dielectric material is provided with a pair of similar opposing electrode coatings each extending substantially around half the circumference of the tubular substrate, the two coatings being electrically isolated one from the other whereby together they form the plates of a capacitor within which fluid may be present.

3. An arrangement according to claim 1 including an oscillator having a tuned circuit of which the capacitor is a component of major significance.

4. An arrangement according to claim 1 or 2 wherein the two coatings are applied to the outer surface of a cylindrical tube.

5. An arrangement according to claim 3 wherein the tube is glass.

6. An arrangement according to any preceding claim wherein the tube has positioned therein a vortex generating body to generate vortices in a fluid flowing through the capacitor.

7. An arrangement according to any one of claims 1-4 wherein the tube has positioned therein a high permittivity magnetic slug extending partway into the capacitor, said slug being axially movable by a bellows in response to fluid pressure in the tube.

8. An arrangement according to claim 2 or any claim dependent thereon including a second oscillator having a different frequency to the first mentioned oscillator, means for mixing the outputs of the two oscillators and means for filtering the difference frequency output of the mixing means.

9. A method of monitoring a distinctive feature of a fluid in a tube dielectric material wherein the outside of the tube is provided with an electric circuit component the electrical characteristic of which is variable dependent on the presence of the distinctive feature, the component forming part of a resonant circuit controlling the frequency of an oscillator whereby the oscillator frequency is a measure of the distinctive feature of the fluid within the tube.

10. A method according to claim 8 wherein the electric component is a capacitor.

11. A method according to claim 8 wherein the electric component is an inductor.

12. A method according to claim 10 wherein the resonant circuit includes a capacitance provided by a pair of similar opposing electric coatings each extending substantially around half the circumference of a dielectric tube within which the fluid may be present.

13. A method according to claim 11 wherein the inductor and the capacitor are formed adjacent one another on the same dielectric tube.

14. A method of monitoring a distinctive feature of a fluid substantially as hereinbefore described.

15. A multi-purpose sensor/detector arrangement substantially as described with reference to the accompanying drawings.

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