March 29, 1955 J. J. FERRIER ET AL 2,704,891

APPARATUS FOR GAUGING THE POSITION OF LIQUID LEVELS (OR INTERFACES) IN VESSELS

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Fig. 3.

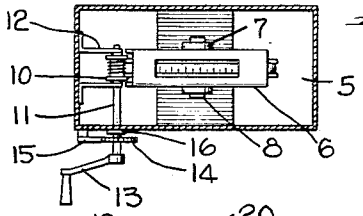


Fig. 1.

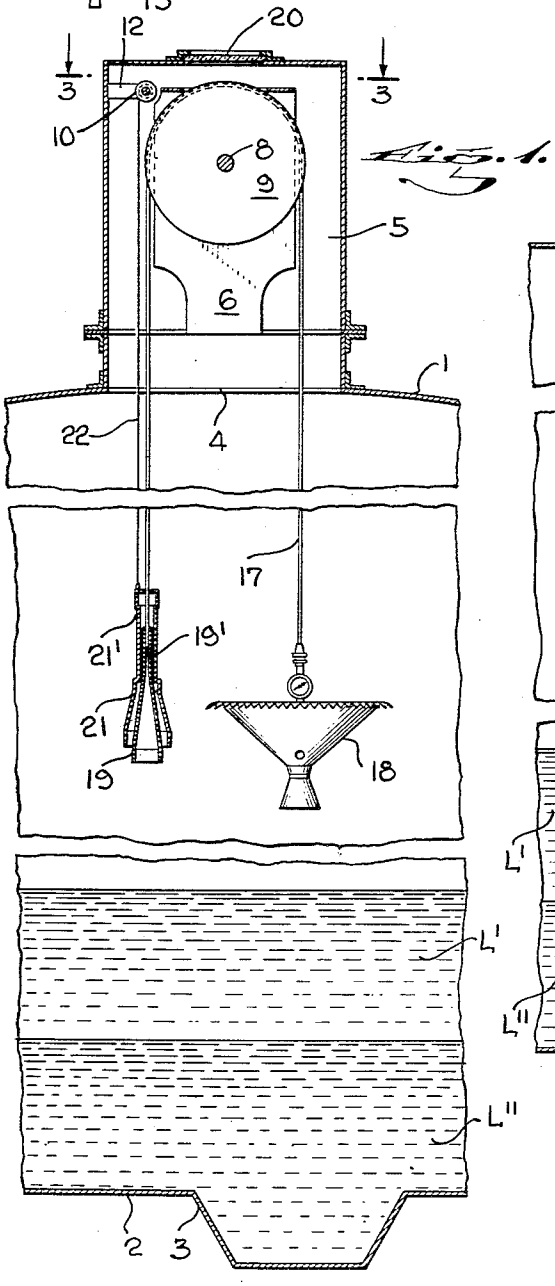
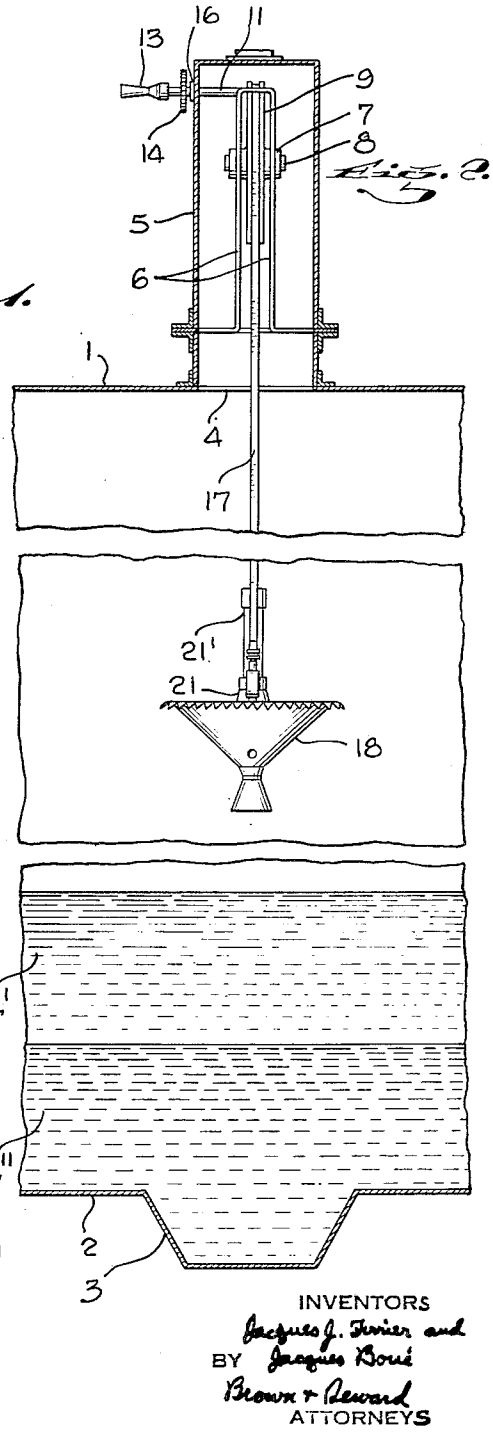


Fig. 2.



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Fig. 4.

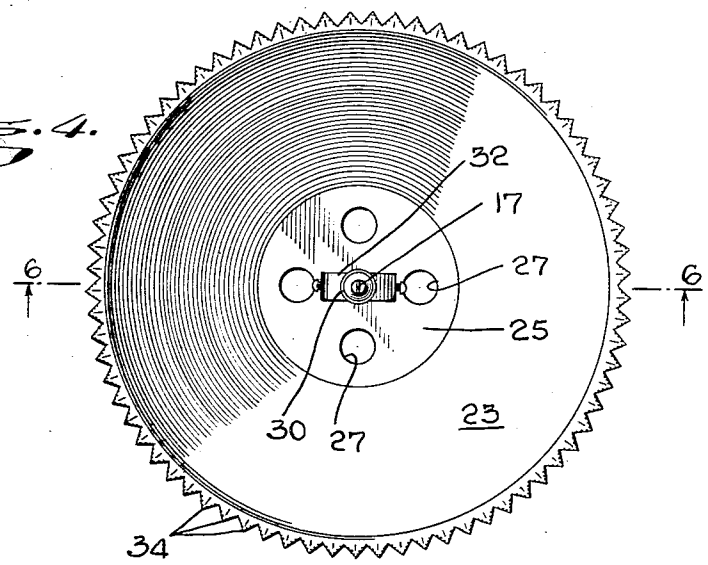


Fig. 5.

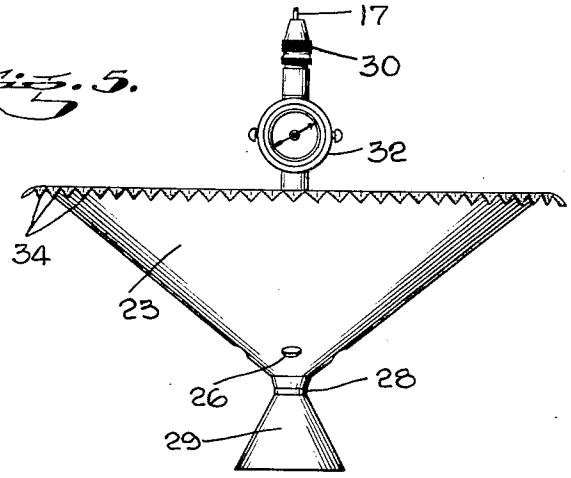
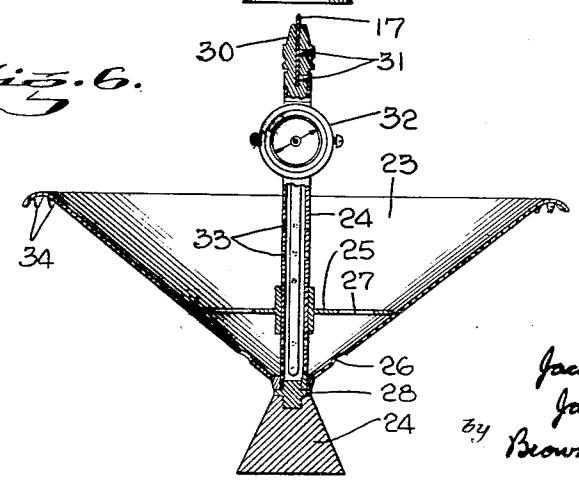


Fig. 6.



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APPARATUS FOR GAUGING THE POSITION OF LIQUID LEVELS (OR INTERFACES) IN VESSELS

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Application January 5, 1952, Serial No. 265,169

3 Claims. (Cl. 33—126.5)

This invention relates to an apparatus for gauging the position of liquid levels (or interfaces) in vessels, such as open or closed tanks.

An object of the invention is to make possible such gauging in a single operation even though the tank contains two or more layers of non-miscible liquids.

Another object is to provide an apparatus of great simplicity, accuracy and efficiency.

A further object is to provide a gauging apparatus which can readily be used in connection with closed tanks, including those in which the pressure is greater or less than atmospheric.

Another object is to provide certain improvements in the form, construction and arrangement of the several parts by which the above named and other objects may effectively be attained.

A practical embodiment of the invention is shown in the accompanying drawings, in which:

Fig. 1 represents an elevation of the apparatus installed in a tank, certain parts being in section and parts of the tank being broken away;

Fig. 2 represents a similar view taken at a right angle to the view of Fig. 1;

Fig. 3 represents a detail horizontal section, taken on the line III—III of Fig. 1;

Fig. 4 represents a top plan view of the cone;

Fig. 5 represents an elevation of the cone, and

Fig. 6 represents a vertical axial section of the cone.

Referring to the drawings, the apparatus is shown as being installed in a tank having a top wall **1** and a bottom wall **2**; the latter may be provided with a small well **3** for a purpose described below. The tank may be cylindrical, spherical, rectangular or any other desired shape, and is shown as being partly filled with two immiscible liquids L' and L''. The top wall **1** is provided with an opening **4** over which is mounted a cupola **5** containing a pair of upright supports **6, 6**, shown as being secured to the sides of the cupola. In the supports **6, 6** is journaled (on suitable bearings **7, 7**) the shaft **8** of the main pulley **9**, the rim of which is flat with small flanges.

An auxiliary pulley or spool **10** is fixed on a shaft **11**, which is journaled in supports **12, 12** and projects out through the wall of the cupola. On the outer end of the shaft **11** are fixed a hand crank **13** and a ratchet wheel **14**, the latter being adapted to be engaged by a releasable pawl **15**. A gas-tight packing gland **16** of any suitable type may be provided, if necessary, where the shaft **11** passes through the wall of the cupola.

The main pulley **9** is designed to carry a flat tape **17** on one end of which is attached the cone assembly **18** and the other end of which is secured to the main counter-weight **19**. The tape **17** is calibrated with markings indicative of the vertical position of the cone, and a gas-tight window **20** in the top of the cupola permits observation of these markings as the tape passes over the top of the main pulley. The window **20** may be a magnifying lens, if desired, and is normally provided with an index line for comparison with the calibrations on the tape.

The main counter-weight **19**, shown as being conical with an upwardly projecting stem **19'**, is somewhat lighter than the cone assembly **18**. An auxiliary counter-weight **21**, shown as being a hollow frusto-cone with an upwardly projecting tubular part **21'**, is fitted loosely around the weight **19** and stem **19'** and is independently supported by a cable or cord **22** secured to the spool **10** and capable of being wound thereon when the crank **13** is turned. The counter-weight **21** is heavy enough so that the total weight of the main and auxiliary counter-weights exceeds that of the cone assembly **18**. For example, with a cone assembly weighing 3.21 kg., the main counter-weight **19** may weigh 1.78 kg. and the auxiliary counter-weight **21** may weigh 3.33 kg. (or, in any event, more than 1.43 kg.). The tape **17** may conveniently be metallic, with known coefficients of thermal expansion and tensile elongation, and the cord **22** may be of "Nylon" or the like with a diameter of approximately one millimeter.

The cone assembly **18** includes an inverted conical float member **23** mounted at its apex on a vertical tube **24**. The member **23** is braced in proper position by means of the disc **25**, which fits on the tube **24** with its periphery resting against the inner surface of the member **23**. The float member is provided, near its apex, with one or more perforations **26** and the disc **25** is provided with the larger perforations **27**. A plug **28** is screwed or otherwise fastened in the bottom end of the tube **24** and a flat bottomed solid shoe **29** is screwed onto the lower end of the plug **28**. The upper end of the tube **24** is secured to a slotted member **30** and one end of the tape **17** is fastened in this member, as by means of set-screws **31**. As shown in Figs. 4, 5 and 6, the upper part of the tube **24** is enlarged to accommodate a thermometer dial **32**, the bulb of the thermometer extending down through the tube almost to the plug **28** and the tube being provided with perforations **33** at various levels from its bottom up to the vicinity of the dial **32**. The provision of the thermometer is expressly made optional; when it is omitted the tube **24** need not be perforated, or the parts **24, 28** and **30** may be formed, in an obvious manner, as a single solid bar.

A particular feature of the float member **23** is the provision of an outwardly and downwardly curved fluted edge formed by the triangular projections **34**, each of which has a sharp lower point and saw-tooth edges extending up to the circular base line which corresponds to the highest part of the edge.

In operation, assuming that the counter-weights **19** and **21** are in their lowest position and the cone assembly **18** is in its highest position in a tank containing one or more liquids the level of which is to be measured, the operator turns the crank **13** and steadily winds up the cord **22** on the spool **10**. This lifts directly the counter-weight **21** and the main counter-weight **19** rises with it, due to the pull on the tape **17** exerted by the weight of the cone assembly **18** (which exceeds that of the counter-weight **19**, as explained above). As the counter-weights rise the cone assembly descends, eventually reaching the level of the liquid. The shoe **29** will enter the liquid with little perceptible change in tension on the cord **22**, but when the float member **23** enters the liquid it tends to float thereon while the liquid enters through the perforations **26** and **27**, allowing it to sink gradually; at this stage the load on the cord **22** increases sharply as the operator takes a few extra turns on the crank to lift the auxiliary counter-weight **21** out of contact with the weight **19** by a distance of about 15 inches (i. e., approximately the vertical depth of the float member), and then locks the crank-shaft **11** by means of the pawl and ratchet **14, 15**. The operator then observes, through the window **20**, the slow passage of the tape **17** (corresponding to the gradual sinking of the float member) and is able to note precisely the height of the liquid level by observing the instant at which the tape starts to move more rapidly, this being the instant when the highest point of the edge of the float member passes through the liquid surface. The precision of this observation is assured by the fact that the fluted edge of the float member eliminates any surface tension or capillary effects which might cause the member to cease floating at a level lower or higher than the true liquid level. After the float member moves below the liquid level its further descent draws the weight **19** up against the weight **21** and all motion is stopped.

If a second level is to be measured (e. g., the interface between liquids L' and L'') the steady winding up of the card **22** is continued until the motion of the float member is slowed by immersion in the lower heavier

liquid, when the observation procedure may be repeated as described above. Whenever necessary or desired, the winding may be continued until the shoe **29** touches the bottom of the tank (or bottom of the well **3**) in order to establish or confirm the zero reference level. The true heights (and volumes) of the liquid or liquids in the tank can readily be formulated from the surface level readings thus obtained. In case there is danger that solid material may collect on the bottom of the tank and prevent the flat shoe **29** from resting evenly thereon, the shoe may be made in the form of a tripod, for improved average accuracy in determining the zero reference level.

The cone assembly will normally be permitted to rest on the bottom, with the counter-weight **21** supported only by its cord **22**, so that there will be as little tension as possible on the measuring tape **17** and so that the zero reference level can be re-checked immediately before each measurement of the liquid level or levels. When such a measurement is to be made, the pawl is moved away from the ratchet and the crank handle is turned in the reverse direction, permitting the combined counter-weights to descend and to lift the cone assembly out of the liquid, where it is held long enough for the liquid to drain out; the measurement then proceeds as previously described. If the thermometer is used and the operator wishes to know the temperature of the liquid in the tank, the cone assembly is lifted all the way to the top of the tank so that the reading on the dial **32** can be observed through a second window (not shown) in the side of the cupola.

The well **3** in the bottom of the tank need only be large enough to accommodate the cone assembly **18**, since it is intended to make possible the measurement of liquid levels all the way to the bottom of the tank, disregarding only the small quantity of liquid contained in the well.

It will be appreciated that the control of the lifting and lowering operation by means of the crank and small spool makes it possible to lower the cone assembly into the liquid as gently as necessary, without splashing or forming ripples which might sway the apparatus and interfere with the accuracy of the gauging. The cone assembly descends at all times in a perfectly vertical line, with no need for guide wires or the like. The construction and handling of the apparatus can be simplified and the weight reduced by making the cone and other appropriate parts of plastic material.

What we claim is:

1. In an apparatus of the character described, a float member comprising a hollow conical body having its apex at the bottom, said body being provided with one or more perforations near its apex and having an outwardly and downwardly turned fluted upper edge.

2. A float member according to claim 1 in which the flutings are in the form of triangular projections having sharp points and saw-tooth side edges, the bases of said projections lying substantially in the circular line corresponding to the highest part of the edge.

3. A float member according to claim 1 which includes a weighted shoe secured to, and projecting below, the apex of the conical body.

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