July 2, 1935. J. A. HARTLEY 2,006,549

HYDROMETER

Filed March 5, 1934 2 Sheets-Sheet 1

Fig. 1.

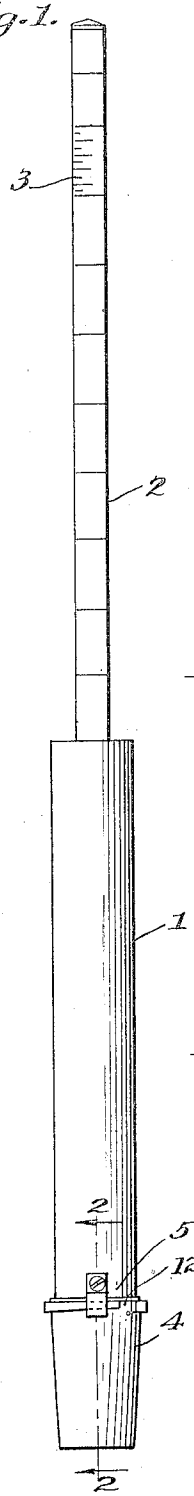


Fig. 2.

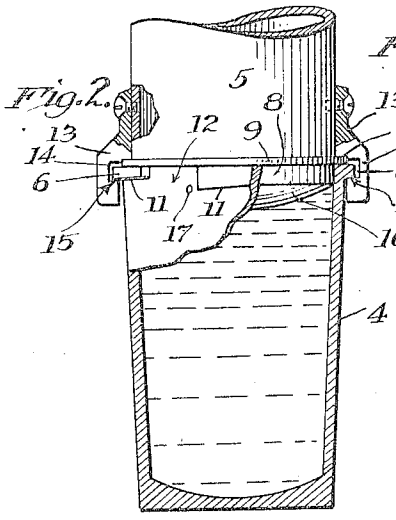


Fig. 6.

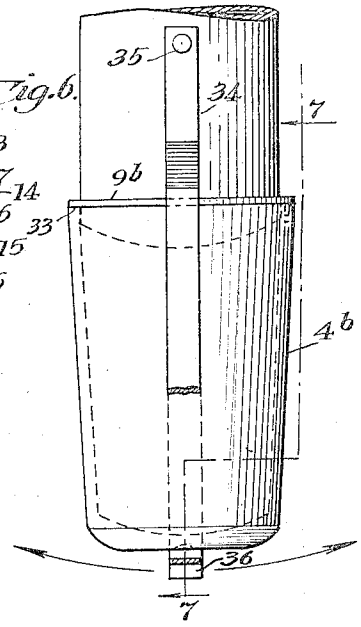


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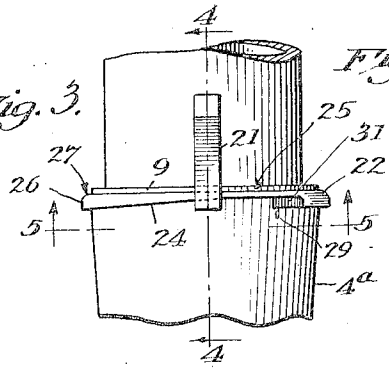


Fig. 7.

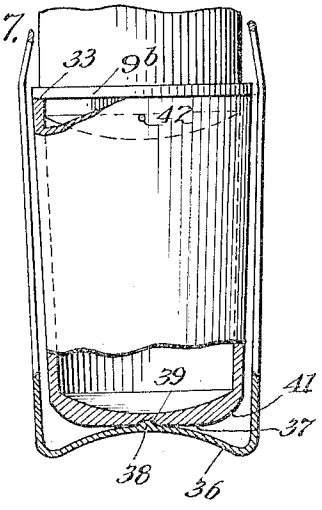


Fig. 4.

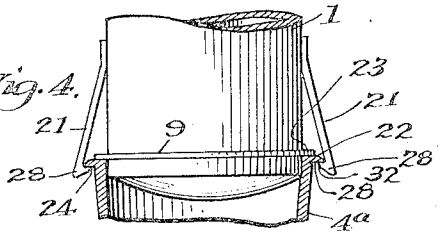
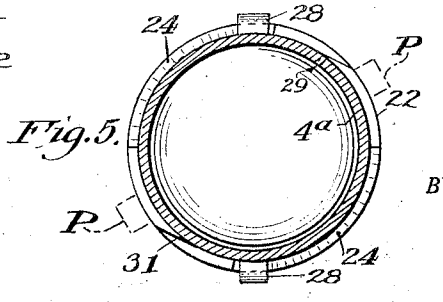


Fig. 5.



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Fig. 8.

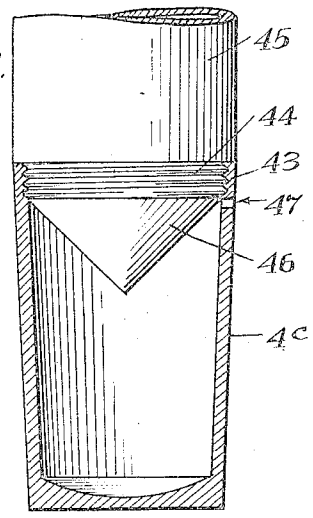


Fig. 9.

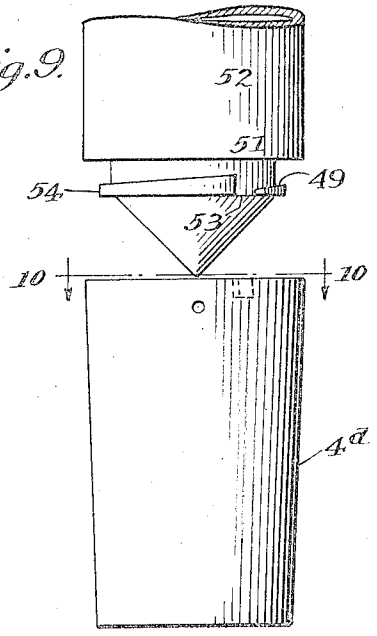


Fig. 11.

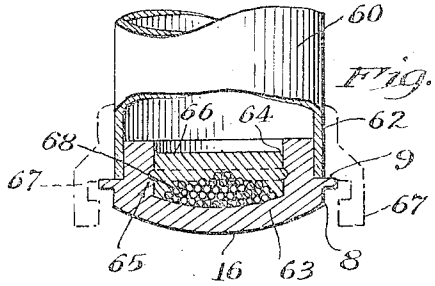


Fig. 10.

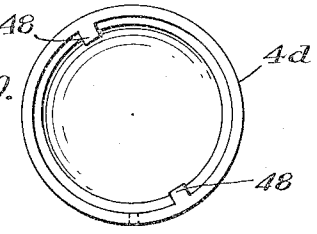
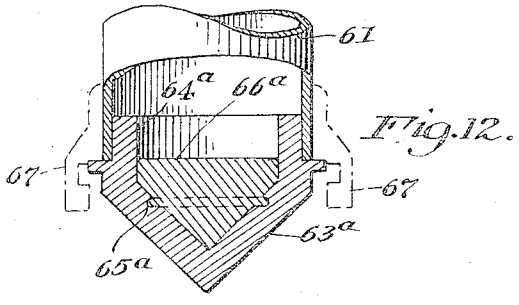


Fig. 12.



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UNITED STATES PATENT OFFICE

2,006,549

HYDROMETER

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Application March 5, 1934, Serial No. 714,072

5 Claims. (Cl. 265—45)

This invention relates to hydrometers for determining the specific gravity of fluid materials, and pertains particularly to hydrometers of the type comprising a buoyant hydrometer body member and a fluid container adapted to be secured to the lower end of said hydrometer body member, whereby the assembled fluid container and hydrometer body member act as a weighted hydrometer which may be immersed in a suitable fluid of known specific gravity, and the density or specific gravity of the fluid present in said container determined by noting the depth to which said hydrometer sinks.

One of the principal objects of the present invention is to provide a hydrometer of the character set forth having a removable container portion adapted for secure and rigid attachment to a buoyant hydrometer body member.

A further object of the invention is to provide a hydrometer having a removable container portion, whereby said container portion may be quickly and easily removed from the body of said hydrometer, filled with the fluid to be weighed, and quickly and securely attached to said hydrometer body. A further object of the invention is to provide a hydrometer of the type described, having a removable container portion adapted to be secured to the body of the hydrometer in such manner as to provide a sample receptacle or container of constant volume.

A further object of the invention is to provide a hydrometer of the above described type, in which the lower end of the hydrometer body member serves as a closure means for the fluid container when said container is secured thereto.

A further object of the invention is to provide a hydrometer comprising a buoyant body member and a removable container member adapted for attachment thereto adjacent the lower end thereof, said buoyant body member being provided with an advantageous form of ballast means whereby said hydrometer is caused to persist in an upright position when floated by immersion in a suitable fluid.

The device of the present invention may comprise, essentially, a buoyant body member preferably of vertically elongated shape, a cup-shaped fluid container having an open upper end, and means for rigidly but detachably securing said container to the lower end of said hydrometer body member in position such that the lower end of the hydrometer body member serves as closure means for the upper end of said fluid container. According to a preferred embodiment of the invention, the sample receptacle portion of the device is provided with means for securing the same to the body portion of the hydrometer in a quick and facile manner, whereby the time required for the assembly of the hydrometer is a minimum while insuring a positive attachment of the two portions of the device.

The hydrometer is preferably weighted at its lower end so that it will tend to assume an upright position when immersed in a suitable fluid medium, and this weighting is preferably accomplished by providing ballast means rigidly secured within the lower end portion of the hydrometer. According to a preferred embodiment of the invention, the hydrometer body member is preferably provided with an internal recess extending to a position adjacent the lower end wall thereof, and the ballast means comprises a solidified body of fusible metal preferably having a plurality of small heavy metal balls such as lead shot or the like incorporated therein and held in place by such solidified metal body, said solidified metal body being rigidly held in position by engagement with suitable shoulder means on the interior wall of said hydrometer body member.

Other objects of the invention will be brought out in the following description of a preferred embodiment and certain advantageous modifications of the invention, or will be apparent therefrom.

The attached drawings show the preferred embodiment of the invention, together with advantageous modifications thereof, and referring thereto:

Fig. 1 is a small scale side elevation of a complete hydrometer of the present invention, provided with one form of attachment means for securing the sample receptacle to the buoyant body of the hydrometer;

Fig. 2 is a detail thereof taken on line 2—2 in Fig. 1, on an enlarged scale;

Fig. 3 is a broken-away side elevation of a modified form of the invention, showing an alternative form of securing means.

Fig. 4 is a sectional view taken on line 4—4 of Fig. 3;

Fig. 5 is a transverse section thereof taken on line 5—5 of Fig. 3;

Fig. 6 is a view of the lower end of a hydrometer provided with an alternative form of receptacle attachment means;

Fig. 7 is a similar view taken at right angles thereto, substantially along line 7—7 in Fig. 6;

Fig. 8 is a view of the lower end of a hydrometer according to the present invention, provided

with an alternative means for securing the sample receptacle to the hydrometer body;

Fig. 9 is a side elevation of the lower end of a further modification of the invention, showing the sample receptacle in position to be engaged by the hydrometer body;

Fig. 10 is a sectional view thereof taken on line 10—10 in Fig. 9;

Fig. 11 is a partly sectional broken away view of the lower end of the buoyant body member provided for the hydrometer of the present invention, showing the manner of disposition of ballast means therein; and

Fig. 12 is a view corresponding to Fig. 11, showing a modified form of ballast means.

The hydrometer of the present invention may comprise a buoyant body member 1 provided with a stem 2 which may be provided with suitable scale markings 3, and a sample receptacle 4 secured to the lower end 5 of the body portion 1 in any suitable manner. As shown in Figs. 1 and 2, the sample receptacle 4 may comprise a cup-shaped member having its upper end open and provided with a rim portion 6 having an upper face 7, and the lower portion of the body member 1 is preferably provided with a downwardly extending portion 8 adapted to fit within the upper end of the member 4 and is preferably also provided with an annular flange 9 adapted to engage the face 7 of rim 6. In order to secure the member 4 in position with the face 7 in positive engagement with the flange 9, the rim 6 may comprise a pair of outwardly projecting semi-circular flanges each having a downwardly inclined cam surface 11 and each circumferentially spaced from the other to define a slot or passage 12. The body member 1 may be provided with two diametrically opposed lugs 13 adapted to extend downwardly over the upper end of the member 4 through the slots or passages 12, and these lugs may be provided with notches 14 into which the cam-surfaced rim portions 6 of the member 4 may be passed by a rotational movement of said member 4 with respect to the hydrometer body member 1, the lower faces 15 of the notches 14 engaging the cam surfaces 11, whereby upon forceful rotation of said member 4 with respect to the body member 1 the upper face 7 of the rim portion 6 of the cup member 4 will be brought into forceful engagement with the downward face of the flange 9 on the portion 5.

In the use of the present device, the member 4 is filled to the top with the material to be weighed, which may consist of a mud or other fluid material, and the lower portion 8 of the body member 1 is forced downwardly into the filled cup into position to close the upper end thereof. This lower portion 8 is preferably provided with a projecting portion 16 of smooth contour, whereby the fluid in the upper portion of said cup may be forced outwardly toward the side portions of said cup and displaced. In order to provide for displacement of surplus fluid after the portion 8 has entered the open end of the cup 4, a small extrusion hole may be provided as at 17, whereby the fluid displaced by the portions 8 and 16 of the body member 1 may be forced outwardly of the device. The hole 17 is preferably disposed adjacent the upper end of the cup 4, and, particularly, this hole is disposed immediately adjacent the uppermost level assumed by liquid when the closure means is in full closing position. The member 4 is forced toward the member 1, with the lugs 13 opposite the passages 12 until the slots 14 have come opposite the rim portions 6, whereupon the member 4 may be rotated relative to the body member 1 in a right-hand direction and the cam surface of said portions 6 engaged by said lugs, whereupon the cup will be brought into engagement with the flange 9 and a definite volume defined within the member 4. Any fluid which has been forced from the cup over the rim 6 and from the hole 17 may then be wiped from the surface of the device, and the device lowered into a suitable receptacle filled with a suitable fluid such as water, the material within the receptacle 4 serving to weight the lower end of the device and cause the same to persist in an upright position. Dependent upon the weight of material in said receptacle, the stem portion 2 of the hydrometer will be lowered into the displaced fluid to a point dependent upon such weight, and it will be appreciated that suitable graduations may be provided on said stem portion as at 3 to indicate directly the density or specific weight of the material in the receptacle, according to the well known construction of such forms of apparatus.

Figs. 3 to 5 show a modified form of attachment means, in which the lugs 13 shown in the first-described form of the invention are replaced by spring clips 21, and the rim portion 6 of the cup or receptacle 4a is formed as a continuous rim 22 provided with an upper face 23 adapted for engagement with the flange 9 on the body member 1. The lower surface of the rim 22 is formed in part as two cam surfaces 24 extending from a portion of said rim having a relatively small axial depth, as at 25, downwardly of the face 23 toward a portion of said rim having a relatively large axial depth, as at 26. To assemble the cup and body portions of the device, the ends of the spring clips 21 are forced downwardly over the rounded edge 27 of the rim portion 22 whereby the hook portions 28 of the spring clips 21 are caused to slip past the said rim at the small portion 25, whereupon the cup member may be rotated so that the cam surface 24 is forced into contact with the hooks 28, and the cup member drawn forcefully into engagement with the flange 9. A hole 29 may be provided corresponding to the hole 17 above-described, whereby extrusion of fluid contained in the cup member is provided for during the attaching procedure. In order to provide for easy removal of the cup from engagement by the spring clips 21, a portion of the rim portions 22 may be provided with an outwardly sloped rim or cam surface 31 in position to engage the inner surface 32 of the hook portion 28 of the spring clips 21 whereby, upon rotation of the cup member 4a in a direction opposite the direction of movement required for tightening said cup on the body portion 1, said cam surfaces 31 will engage said inner surfaces 32 of said clips and cause said clips to be forced outwardly over the outer rim surface to a position such as shown in dot-dash lines at P in Fig. 5, permitting the cup member 4a to be quickly withdrawn from the body member 1. The manner of use of this modification of the device is comparable to the above-described manner or use of the first form of invention.

According to the modification shown in Figs. 6 and 7, the cup member 4b may be provided with a plain upper rim 33 adapted to be engaged by the flange 9b on the body member 1, and the cup member may be held in place by a stirrup 34 pivotally secured to the body member 1 as at 35 and having a lower spring portion 36 adapted to

engage the lower end 37 of the cup member 4b and force the same into engagement with the body portion 1 of the hydrometer. The spring portion 36 of the stirrup 34 may be provided with a projection 38 adapted to engage a suitable depression 39 in the bottom wall 37 of the cup member, in order to position said stirrup with respect to said cup member, and the corner portions of the bottom of the cup member 4b may be rounded as at 41 to facilitate placement of the stirrup over the bottom of said cup member. Extrusion hole 42 may be provided within the cup member 4b, comparable to the holes 29 and 17 above-described. This form of the invention provides for a very quick and easy removal of the cup member from the body portion of the device, by displacing the stirrup from engagement with the bottom of said cup member by manual pressure. This form of device may be used in the above-described manner to weigh a fixed volume of fluid placed within the cup member 4b.

The modification shown in Fig. 8 may comprise a cup member 4c provided with a threaded upper end 43 adapted for threaded engagement with the lower end 44 of the body portion 45 of the hydrometer, said body portion of the hydrometer being provided with a portion 46 extending downwardly from the threaded portion 44 into the receptacle 4c, corresponding to the portion 16 above-described and said receptacle 4c is preferably provided with an extrusion hole located at the base of the portion 46 as at 47 for extrusion of fluid from the receptacle 4c during the time said receptacle is being screwed in place on the body portion 45.

The form of device shown in Figs. 9 and 10 corresponds to the form of device shown in Figs. 1 and 2 with the exception that the cam surfaces and lugs are provided in a relatively reversed relation as compared with the first described form of the invention. Thus, diametrically disposed lugs 48 may be provided adjacent the upper end of a cup-shaped receptacle 4d, adapted to engage cam surfaces 49 disposed on the lower end 51 of the body portion 52 of the hydrometer, suitable passages 53 corresponding to the passages 12 in Figs. 1 and 2 being provided between the two cams 54 provided with the cam surfaces 49.

In Figs. 11 and 12 I have shown the lower end portions, numbered respectively 60 and 61, of two forms of hydrometer, which show both the construction of the end wall of the buoyant body member of the hydrometer and the method employed for securing a ballast member within the lower end portion of the device. While a construction of this type is considered preferable, it will be understood that the desired weighting of the hydrometer at its lower end may be obtained by providing the necessary weight in the cup member instead of in the body member. Referring to Fig. 11, the lower end portion 60 of the buoyant body member is shown as comprising a tube 62 within which is inserted a plug member 63 which may define the lower wall of the hydrometer body. The above-mentioned flange 9 may be formed in this plug member as shown, if desired, if a locking construction such as shown in Figs. 1 through 7 is employed, though it will be appreciated that the lower end of the hydrometer may be formed as shown in Fig. 8 or 9, in which case the plug member 63 may be suitably modified. The plug member 63 is shown as provided with an interior recess 64 within which is formed a suitable shoulder means such as an annular groove or the like 65, and the ballast member, which may be formed of an easily fusible metal such as lead or a lead alloy, is cast into the recess 64 as at 66 so that it may flow into the groove 65 and thus interlock, upon solidification, with the plug 63. The form shown in Fig. 11 corresponds generally to the lower end of the device as shown in Fig. 2, and the lower surface of the plug 63 is shown as provided with surfaces 8 and 16 as shown in said Fig. 2. Suitable locking means such as lugs of the type shown at 13 in Fig. 2 are shown in dot-dash lines at 67 to indicate a type of locking means which may be employed though it will be appreciated that locking means of the type shown in Figs. 3 to 5, 6 and 7, 8 or 9 and 10 may be employed if desired.

The ballast member 66 may be placed in its recess 64 by providing a removable upper end for the hydrometer body member, dropping pieces of fusible metal, such as "Wood's Metal" into the recess, before the hydrometer body member is completely assembled, and after a sufficient amount of such metal has been put in place, the hydrometer may be heated to a sufficient temperature to melt the pieces of fusible metal and produce a unitary ballast member. In order to facilitate the attainment of the requisite weight of ballast, I prefer to drop in enough fusible metal to provide a ballast member of such size as to engage the shoulder means 65 when melted, and to then drop in a suitable number of small heavy metal pellets, such as lead shot, as shown in 68, until the desired weight has been attained, after which the hydrometer is heated, as by immersion in a suitable heated liquid, to a sufficient temperature to fuse the fusible metal around the heavy metal pellets. The hydrometer is then allowed to cool to cause solidification of the fused metal in engagement with the shoulder means 65, with the heavy metal pellets embedded therein.

The form shown in Fig. 12 compares generally to the form shown in Fig. 11 with the exception that the plug member 63a is provided with a conical bottom surface corresponding to the showing at 46 in Fig. 8, and the interior recess 64a is shaped somewhat in conformity to the outline of the plug. The ballast member 66a is shown in place within the portion 64a and secured therewithin through the agency of a suitable groove 65a. This ballast member may be formed in substantially the same manner as above described, and may, if desired, be provided with heavy metal pellets embedded therein, as shown in Fig. 11.

With reference to Figs. 2 and 11, and Figs. 8 and 12, it will be appreciated that the convex portion 16 may be substituted for the downwardly directed conical portion 46, or vice versa, in any of the forms of the invention. The particular function of this portion of the device is to insure that the available volume of the cup or sample receptacle is filled to capacity with the fluid under test when the receptacle is in place on the hydrometer body member, and any desired configuration may be imparted to such portion provided that it is such as to crowd into the fluid contained in the receptacle and displace such portion of the fluid as is present in said receptacle over and above the above-mentioned capacity. In both of the specific examples above-mentioned, such projecting portion slopes upwardly and outwardly from adjacent the axial center thereof toward the side walls of the sample receptacle, preferably to a level adjacent the level defined by the

upper edge of the extrusion holes 17 or 47 when the receptacle is in fully secured position, so as to provide for extrusion of any excess fluid through said hole.

I claim:

1. A hydrometer comprising: an elongated buoyant body member; a plug member closing the lower end of said body member; a cup-shaped sample receptacle having an open upper end; attachment means on said body member adjacent the closed lower end thereof adapted to engage said receptacle and position the same in secure attachment to said body member with said plug member closing said upper end of said receptacle; a recess in said plug member at the side thereof away from said closed lower end of said body member; and ballast means secured to said plug member and disposed within said recess.

2. A hydrometer comprising: an elongated buoyant body having a lower end wall and an interior recess adjacent said lower end wall, said recess being provided with annular shoulder means; a ballast member comprising a body of solidified fusible metal positioned within said recess in engagement with said shoulder means; a sample receptacle; and means for securing said sample receptacle to said body at the lower end thereof.

3. A hydrometer comprising: an elongated buoyant body member having a lower end wall; a cup-shaped sample receptacle having an open upper end and adapted to receive a fluid for test and provided with an extrusion hole adjacent the upper edge thereof; and means for rigidly but detachably securing said receptacle to the lower end of said body member in a fixed position with said lower end wall closing the upper end of said receptacle, said lower end wall being of such shape as to project downwardy within said sample receptacle and being inclined upwardly and outwardly from its central portion to its periphery at a level adjacent the upper edge of said extrusion hole.

4. A hydrometer comprising: an elongated buoyant body having a closed lower end; a sample receptacle provided with a side wall and an open upper end having an internal diameter slightly greater than the outside diameter of the lower end portion of said body; and cooperating attachment means on said body and said receptacle for rigidly securing said receptacle to said body in position with the upper end of said receptacle surrounding said lower end portion of said body, said receptacle having an extrusion opening in the side wall thereof adjacent the upper end thereof positioned to provide free access from the interior of said receptacle to the exterior thereof during movement of said body and said receptacle into said rigidly secured position.

5. The invention set forth in claim 4, said cooperating attachment means comprising relatively rotatable shoulder means on said lower end portion of said body and on said receptacle, one of said shoulder means defining an inclined cam surface positioned for engagement by the other of said shoulder means to cause movement of said body and said receptacle toward one another and into said rigidly secured position upon relative rotation thereof.

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