Dec. 29, 1931. J. L. HODGSON 1,838,399

SPECIFIC GRAVITY INDICATOR OR RECORDER

Filed Jan. 28, 1931 4 Sheets-Sheet 1

Fig. 1.

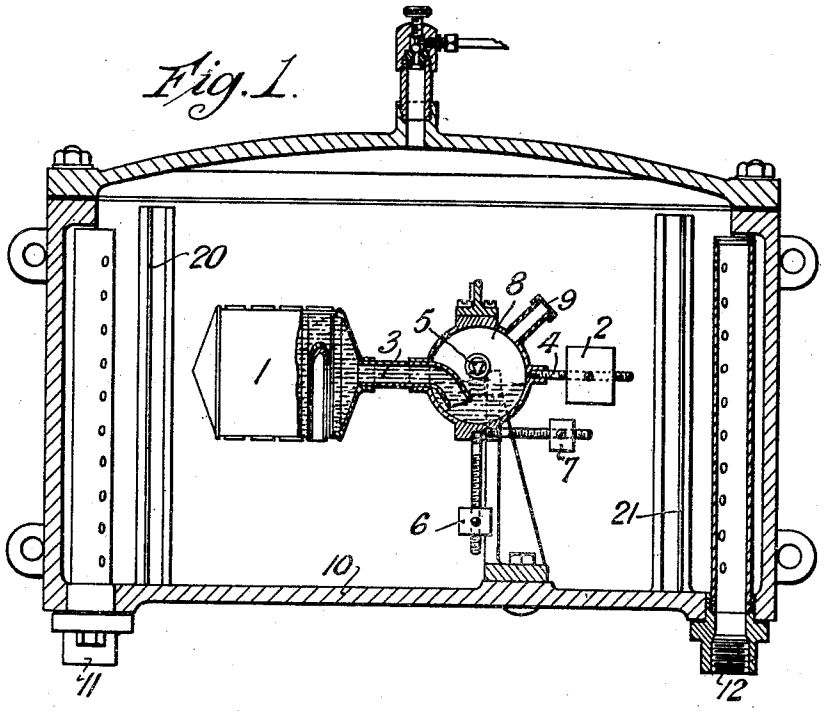


Fig. 2.

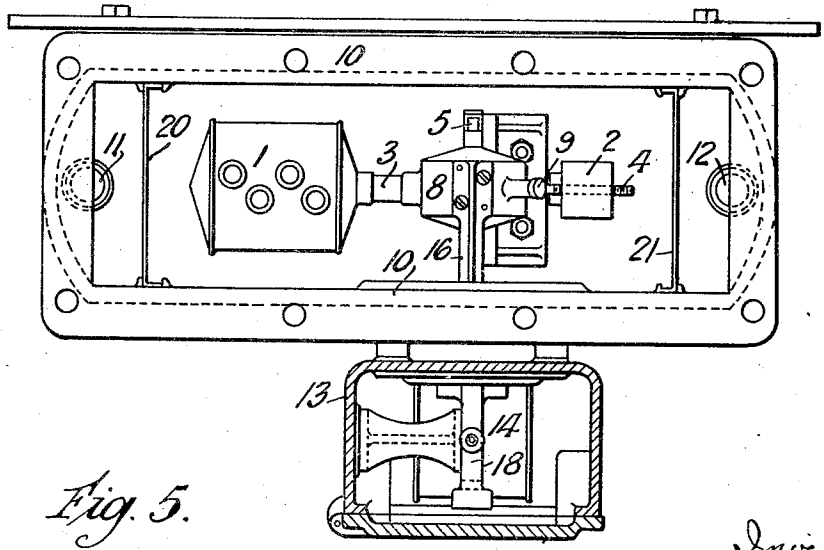
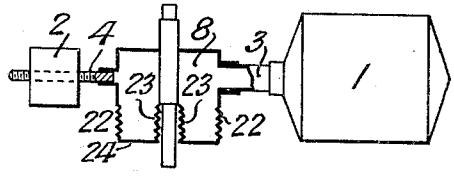


Fig. 5.



Inventor
John L. Hodgson,
By his Attorneys,
Baldwin & Wight

Dec. 29, 1931. J. L. HODGSON 1,838,399

SPECIFIC GRAVITY INDICATOR OR RECORDER

Filed Jan. 28, 1931 4 Sheets-Sheet 2

Fig. 3.

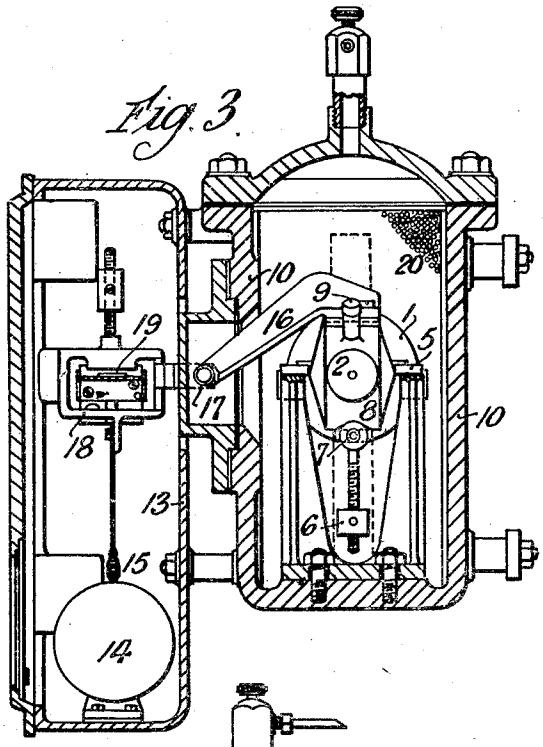
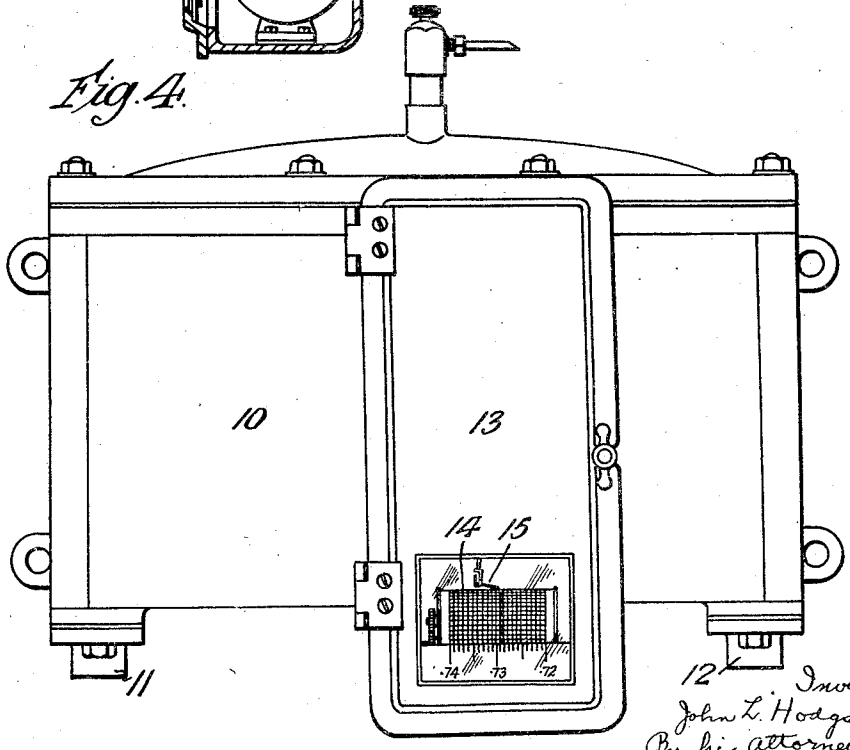


Fig. 4.



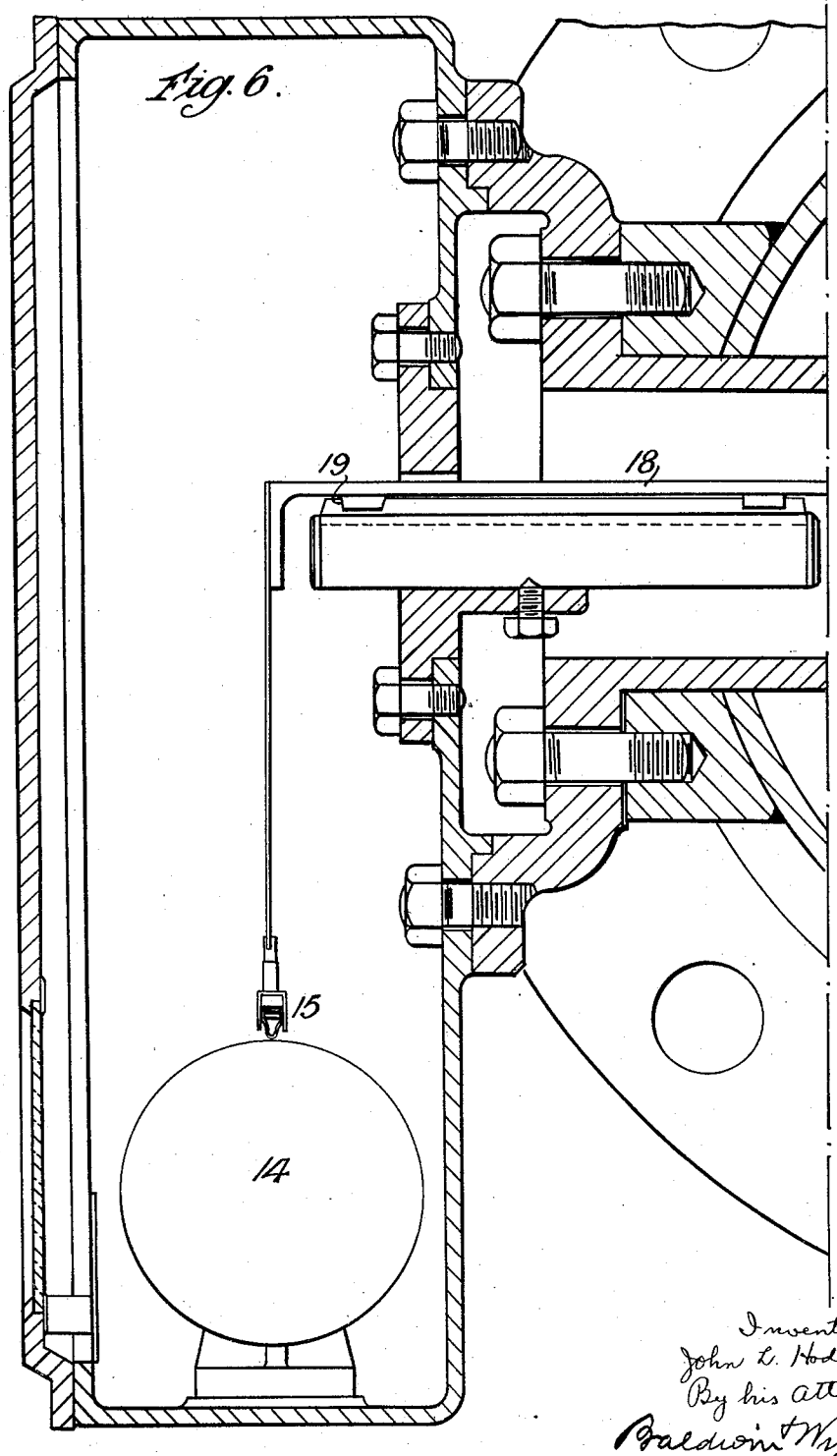
Inventor
John L. Hodgson.
By his attorneys.
Baldwin & Wight

Dec. 29, 1931. J. L. HODGSON 1,838,399

SPECIFIC GRAVITY INDICATOR OR RECORDER

Filed Jan. 28, 1931 4 Sheets-Sheet 3

Fig. 6.



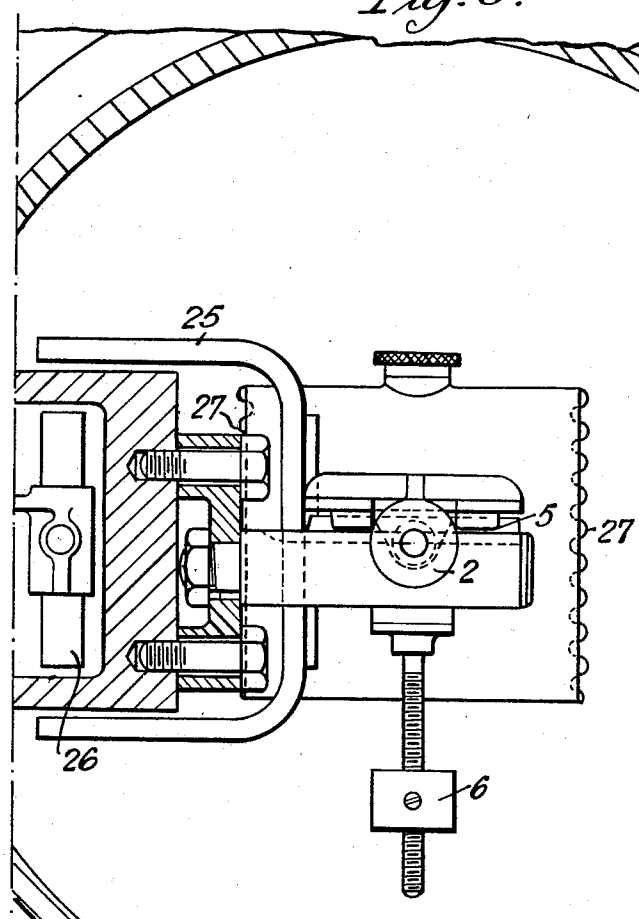
Inventor
John L. Hodgson,
By his attorneys,
Baldwin & Wright

Dec. 29, 1931. J. L. HODGSON 1,838,399

SPECIFIC GRAVITY INDICATOR OR RECORDER

Filed Jan. 28, 1931 4 Sheets-Sheet 4

Fig. 6.a



Inventor
John L. Hodgson.
By his attorneys,
Baldwin & Wight

Patented Dec. 29, 1931

1,838,399

UNITED STATES PATENT OFFICE

JOHN LAWRENCE HODGSON, OF LUTON, ENGLAND, ASSIGNOR TO GEORGE KENT, LIMITED, OF LONDON, ENGLAND

SPECIFIC GRAVITY INDICATOR OR RECORDER

Application filed January 28, 1931, Serial No. 511,827, and in Great Britain December 5, 1929.

The present invention relates to devices suitable for indicating or recording variations in the specific gravity of a fluid passing in a pipe.

The invention is illustrated in the accompanying drawings in which Figure 1 is a vertical sectional elevation, Figure 2 a plan view partly in section with the top cover plate removed, Figure 3 an end sectional elevation and Figure 4 a front elevation. Figure 5 is a diagrammatic view of a modification, and Figures 6 and 6[a], to be jointly considered, are left hand and right hand portions, respectively, of a sectional elevation of a further modification.

Referring more particularly to Figures 1–4, 1, 2 are displacers of widely different weights per unit volume, but of approximately equal weights, the displacer 1 being that of smaller weight per unit volume and being made hollow. The displacers are secured to two opposite arms 3, 4 forming a beam which is pivotally mounted about a knife edge 5 and whose position is controlled by a pendulum weight 6. An adjusting weight 7 is provided which is so adjusted that when the displacers are immersed in liquid of the mean specific gravity to be indicated or recorded, there will be no deflection from the mean position, i. e. the pendulum weight will hang vertically. If the liquid in which the displacers are immersed is now replaced by a liquid of lower specific gravity, the arm carrying the displacer 1 will descend, owing to its greater loss of buoyancy. The amount that it will descend will depend upon the size and the position of the controlling pendulum weight, so that a definite deflection will be obtained for each specific gravity of the liquid in which the beam carrying the two displacers and the controlling weight is immersed.

As an apparatus constructed as above would show a deflection due to a fall in the specific gravity of the liquid in which the displacers were immersed due to any rise in temperature of that liquid, the following means are provided to render the indications of the apparatus unaffected by such changes of temperature.

The hollow displacer 1 is filled with liquid of the same coefficient of expansion as the liquid whose specific gravity it is desired to indicate or record. The arm 3 carrying this displacer is also made hollow, and communicates with a closed cylindrical chamber 8 whose centre is at the centre of rotation of the knife edge 5 which carries the beam with its two displacers and pendulum control weight. The tubular arm carrying the large displacer 1 is bent downwards into this closed cylindrical cavity which is partially filled with liquid so that the end of this tubular arm is always sealed by the liquid, the beam being adjusted for balance by means of the adjusting weights. A suitable filling plug 9 is arranged on the periphery of the circular chamber. So long as the coefficients of expansion of the liquids inside and outside the displacer are substantially equal, changes in the common temperature of these liquids will not appreciably affect the balance of the beam as an amount of liquid whose weight is equal to the loss of buoyancy of the displacer 1 will expand into the central cylindrical chamber 8 where it produces no moment about the knife edge since the pivot means 5 are at the volumetric or symmetrical center of the vessel 8. The apparatus is therefore compensated for changes in the specific gravity of the liquid in which the displacers are immersed, due to variations from the mean temperature at which the zero of the beam was adjusted by means of the adjusting weights.

If the adjusting and controlling weights are made of different materials their expansions must be suitably compensated.

The error due to the loss of buoyancy with fall of specific gravity with rise of temperature of the liquid in which the controlling

pendulum weight is immersed is a small fraction of 1 per cent over any reasonable range of temperature, and therefore it does not generally require compensation. A compensation can, however, be effected by fitting above the pivotal axis of the arm 3 a volume the moment of whose buoyancy is equal to that of the controlling pendulum weight, but whose weight is much less.

The apparatus above described is located within a chamber in a casing 10 having inlet and outlet connections 11, 12 for the liquid whose specific gravity is to be measured. Secured to the casing is a second casing 13 containing a chart 14 over which moves a pen 15. The pen is operated by the movement of the beam through a bracket 16 which is secured to the beam and to an extension 17 of a frame 18 carrying the pen and having a knife edge pivot 19.

Baffles 20, 21 are arranged in the chamber to enable the liquid therein to be continually exchanged without causing any deflection of the balance arm.

In the modification shown in Figure 5, the displacer 1, hollow arm 3 and central chamber 8 are completely filled with liquid, and in order to allow the temperature compensation to be obtained, the central chamber is extensible to accommodate an increase in volume of the liquid, due to temperature rise. To effect this, one (or both) of the ends of the chamber is closed by concentric flexible tubes 22, 23 and an annular plate 24. Such an arrangement of temperature compensation is particularly suitable for use where the fluid whose specific gravity is being measured is under high pressure.

If the liquid is under pressure, the balance arm carrying the displacers must also be under pressure, and the motion of the arm is most suitably transmitted outside the pressure tight casing by means of a magnetic drive. Such an arrangement is illustrated in Figure 6 and consists of two magnets 25, 26 operating through a "window" of nonmagnetic material, the magnet 25 being attached to the beam and the magnet 26 to the frame 18 carry the pen.

In this arrangement also the temperature compensation may be alternatively effected by forming the end walls of the displacer 1 by corrugated flexible plates 27 which allow the liquid freely to expand and contract on variation in temperature.

What I claim is:—

1. In apparatus for measuring the specific gravity of a fluid, the combination of a hollow displacer of fixed capacity which is adapted to move in response to variations in the specific gravity of the fluid to be measured, and is adapted to contain fluid, a sealed vessel, and means connecting said displacer and vessel and permitting fluid to pass between the displacer and the sealed vessel to compensate for variations in the specific gravity, due to variations in the temperature of the fluid to be measured, said vessel, displacer and means constituting a unit, and means fulcruming the unit on an axis passing through said vessel.

2. In apparatus for measuring the specific gravity of a fluid, the combination of a hollow displacer of fixed capacity which is adapted to contain fluid, a sealed vessel, and means connecting said displacer and vessel and permitting fluid to pass between the displacer and the sealed vessel to compensate for variations in the specific gravity, due to variations in the temperature of the fluid to be measured said vessel, displacer and means constituting a unit fulcrumed on an axis passing through the volumetric center of said vessel whereby the latter is located so that the movement of the displacer about said axis is unaffected by the contents of the vessel.

3. In apparatus for measuring the specific gravity of a fluid, the combination of a rocking beam, a pair of displacers supported on the rocking beam, one of the displacers being hollow, of fixed capacity, and adapted to contain fluid, a sealed vessel, and means permitting fluid to pass between the hollow displacer and the sealed vessel to compensate for variations in the specific gravity, due to temperature variations of the fluid to be measured, said vessel, displacers, rocking beam and means constituting a unit fulcrumed on an axis passing through the volumetric center of the vessel whereby the latter is located so that the movement of the displacer about said axis is unaffected by the contents of the vessel.

4. In apparatus for measuring the specific gravity of a fluid, a rocking arm, a hollow displacer supported by the arm and which is of fixed capacity and is adapted to move in response to variations in the specific gravity of the fluid to be measured, a sealed flexible vessel, means placing the vessel in communication with the interior of the displacer and symmetrically disposed about a vertical plane passing through the pivotal axis of the arm, the displacer and flexible vessel being adapted to be filled with fluid and the flexible vessel permitting fluid to pass out of and into the displacer to compensate for variations in the specific gravity, due to variations in temperature of the fluid to be measured.

5. In apparatus for measuring the specific gravity of a liquid, a rocking arm, a hollow displacer carried by the rocking arm and of fixed capacity, the displacer being adapted to be filled with liquid and adapted to move in response to variations in the specific gravity of the liquid to be measured, and a sealed vessel means placing the vessel in communication with the interior of the displacer and partially filled with liquid so that

the point of communication with the displacer is constantly under liquid seal, the vessel being so arranged that its contents are symmetrical about a vertical plane passing through the pivotal axis of the arm so that liquid can pass between the displacer and vessel to compensate for variations in the specific gravity, due to variations in temperature of the liquid to be measured.

In testimony that I claim the foregoing as my invention I have signed my name this 14th day of January, 1931.

JOHN LAWRENCE HODGSON.