

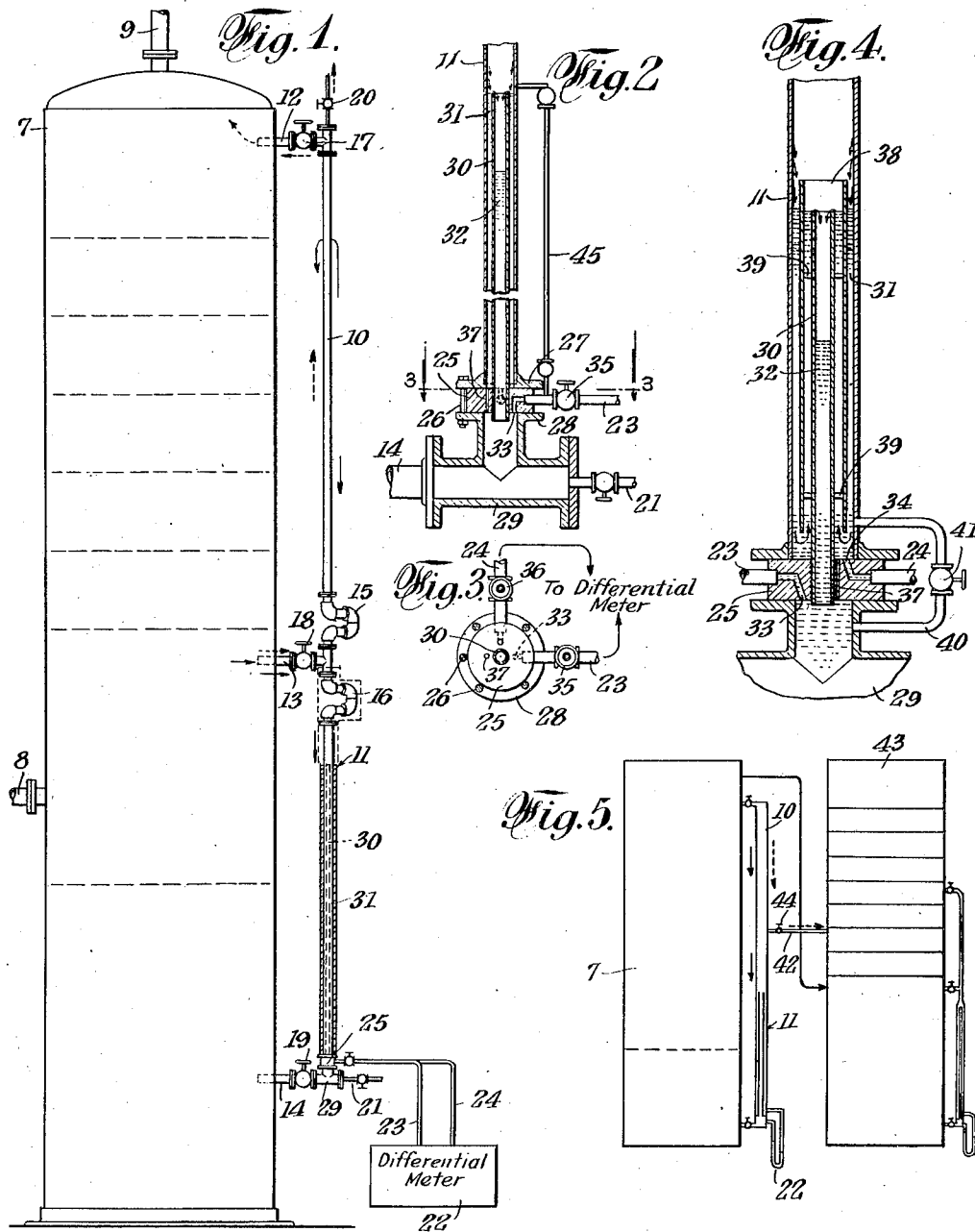
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LEVEL COLUMN FOR EVAPORATORS AND FRACTIONATING TOWERS

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LEVEL COLUMN FOR EVAPORATORS AND  
FRACTIONATING TOWERSJames W. Gray, Mountain Lakes, N. J., assignor  
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This invention relates to the gaging of liquid levels in fractionating towers, evaporators and the like, as in the co-pending J. W. Gray Patent 2,031,533 of February 8, 1936.

Special objects of this invention are to provide simple, practical and efficient means for gaging the level of liquid in the bottom of fractionating towers and the like, which will show the true level substantially without requiring corrections for differences in weights and temperatures of oil within the tower and in the gaging column; apparatus of such form that the range of measurement of the gage may be readily varied without changing external connections; and to automatically maintain a clean body of oil in the gage column and prevent coking or tarring of the gage connections to the bottom of the tower.

The foregoing and other desirable objects are attained by the novel features of construction, combinations, relations of parts and means of operation hereinafter disclosed and broadly covered in the annexed claims.

The drawing accompanying and forming part of the following specification shows by way of illustration several different embodiments of the invention and it is further to be understood that the structure may be otherwise modified and changed all within the true spirit and broad scope of the invention.

Fig. 1 is a broken and part sectional view illustrating an embodiment of the invention as combined with a typical fractionating tower.

Fig. 2 is a broken part sectional view on a larger scale illustrating the detail structure of the sump or well formation at the foot of the gaging column and the same-level connections to the differential meter.

Fig. 3 is a broken horizontal sectional detail as on substantially the plane of line 3-3 of Fig. 2.

Fig. 4 is a further enlarged broken sectional view similar to Fig. 2, illustrating additional details for effecting a continuous circulation of clean gaging liquid at the foot of the column.

Fig. 5 is a diagrammatic view illustrating further modifications.

In the illustrations, there is indicated at 7, a fractionating tower, evaporator or the like, provided with a vapor inlet 8, in the intermediate or lower portion and a vapor outlet 9, at the top, typifying apparatus to which the invention is particularly applicable, holding liquids and containing both condensable and non-condensable or fixed gases.

The level gaging column comprises in the first illustration an upper, uninsulated condensing portion 10, and a lower, preferably insulated condensate collecting and standing liquid holding portion 11.

The upper portion is shown as having a top

connection 12, with the vapor space in the top of the tower and a lower connection 13, with the lower or intermediate portion of the vapor space. The lower portion of the column is indicated as having a bottom connection 14, draining back into the liquid space in the bottom of the tower. Expansion joints, free of liquid pockets, are indicated at 15, 16, for equalizing the connection of the adjoining ends of the upper and lower portions with the intermediate tower connection 13.

Top, intermediate and bottom valves 17, 18, 19, provide control for the corresponding tower connections. A manually operable vent 20, is indicated at the top of the column for releasing fixed gases and a hand controlled drain is shown at the foot of the column at 21.

A differential meter 22, of standard or any suitable design is shown connected by piping 23, 24, with a separating disc or member 25, which is interposed between abutting or adjoining ends of sections at the foot of the column.

In Figs. 2, 3 and 4, the member 25, is indicated clamped by coupling bolts 26, or equivalent, between flanges 27, 28, of the lower column section and the T-fitting 29, forming the foot of the column.

Mounted on the interposed member 25, and providing a passage therethrough is shown a stand-pipe 30, rising to a height dependent on the range of liquid level measurement.

Figs. 2 and 4 show how this standpipe constitutes a trap for maintaining a well of condensate liquid 31, about the same, opposed to the body of contained liquid 32, forming part of the tower liquid, constituting the other leg of the hydrostatic balance. These views also indicate by the arrows how excess of condensate collecting and flowing down the inner wall of the enclosing tubing will overflow the standpipe from the outer well 31, into the inner well 32, and how the latter will flush back into the bottom of the tower to prevent coking or tarring up the connection 14.

The tower side of the differential meter connects by piping 23, with a port 33, opening downwardly into the space below the intermediate member 25, and the other side of the meter connects by the piping 24, with the port 34, opening upwardly into the standing head of liquid in the well 31. Valves 35, 36, enable either one or both these gage lines to be shut off as may be required.

To prevent stagnation in the foot of the standing well of liquid, a relatively small port, such as indicated at 37, may be provided through the intermediate member, providing a certain flow of liquid from the bottom of the trapped well or sump direct to the tower. Such flow while sufficient to prevent stagnation should not be great-

er than the flow of condensate down the column.

Another, alternate or supplementary method of assuring local circulation in the foot of the standing body of trapped liquid is shown in Fig. 4, where there is illustrated a cylindrical wall 38, open at both ends and interposed between the standpipe and the surrounding column pipe with space at the bottom and at the sides to pass the condensate as indicated by the arrows first downwardly and thence upwardly into over-flowing relation over the lip of the standpipe. This circulation enforcing tube may be supported by suitable brackets or arms 39, on the outside of the standpipe.

As another alternative or as supplemental to the preceding, an external bypass 40, Fig. 4, may be provided about the intermediate separating member 25, and if desired, be equipped with a valve 41, which may be partially or entirely opened or closed, as conditions require or seem desirable.

Fig. 5 illustrates how the upper condensing portion of the gage column may be vented of fixed gases by a third connection 42, extending to a zone of lesser pressure, which in this particular instance, is a lower pressure still or tower 43. This fixed gas venting connection may be equipped with a suitable valve such as indicated at 44.

This particular form of the invention is used with advantage with a tower in which there are no baffles or trays etc., between the middle and top gage column connections. In such a case there is no pressure drop between these two points and hence little tendency for flow of vapors. Without some source of pressure drop in the tower, the middle or top connection may be made to some other source, such as middle connection 42, to the second tower 43, as in Fig. 5, or even open to air as by means of the vent 20 for the top connection 17 in Fig. 1.

A preferred rate of condensate has been found to be from about 5 to 10 gallons per hour, but it will be appreciated that the rate may vary considerably, dependent upon actual conditions.

The complete operation may be more fully appreciated by considering briefly the operation of the usual two-connection gage column. These are usually equipped with shut-off valves at the top and bottom tower connections and with a drain at the foot of the column. With such a structure, it is necessary from time-to-time to close the top connection and open the drain to bleed out the heavy tar which accumulates in the bottom of the column and prevents the level in the column from following the level in the tower. After thus flushing the column, it is impossible to immediately tell the true level as the condensate then forms so fast in the top of the column as to set up a circulation preventing a true reading. The vapors entering the top of the column condense with such rapidity as to entrap uncondensed portions and force them down through the bottom connection back into the tower. To overcome this condition, expert attention and understanding of conditions are required. Usually, the bottom connection is closed and the top connection opened to permit a gradual accumulation of gas in the top of the column and then the bottom valve opened slowly as solid liquid is collected in the column. Then only, after it is possible to get the bottom connection fully open will the true tower level be shown by the column. This condition may then continue until necessary again to purge the column of tar. The present invention overcomes these defects entirely by creating a circulation and maintaining a quantity of fixed

gases in the top of the column, preventing too rapid condensation and operating as a cushion to steady the action of the column.

In all forms of the invention there are the three connections, at least two of which are with the tower. The bottom connection returns condensate into the tower. The second connection with the tower, whether it be at the top as in Fig. 5 or at an intermediate position as in Fig. 1, provides for a vapor flow from the tower into the column and has substantially the same tower pressure as exists at the bottom connection, after due allowance for hydraulic head. The third connection allows fixed gases to escape from the upper condenser portion of the column and while preferably it is usual to vent back into the same tower, providing a slight differential exists between the required tower vapor connection and the fixed gas vent connection (Fig. 1), it is practical to vent the condenser of fixed gas back to a lower pressure vessel as in Fig. 5, or even to vent by an automatic or hand regulated valve such as 20, in Fig. 1. In case the vent be not back to the same tower, it may be located either at the highest point or at the lowest point of the condenser, as at 42, in Fig. 5. In the first form illustrated, the fixed gas passes counter-current to the condensate as in Fig. 1, where such gases are indicated by broken line arrows and the condensate by the full line arrows. In Fig. 5, the fixed gas and condensate flow concurrently as indicated respectively by the dotted line and full line arrows. The two constituents, that is the condensable and the non-condensable vapors are thus made to cooperate to maintain true accurate level indication. The condensable portions condense in the upper part of the column and as they accumulate, flush the bottom of the column back into the tower and the non-condensing portions are vented so that they will not collect in the top of the column and prevent entrance of the mixed vapors.

In all forms, the level device is protected from coking or solidifying action of the heavy oils at the bottom connection of the column by the flow of clean condensate down the column back into the tower. This permits use of various desired forms of indicators, such for example, as differential meters, both indicating and recording, gage glasses, float chambers, try-cocks, etc.

The bottom valve 19, is useful for determining both the operation and the zero setting of the differential meter. When this valve is closed, the differential meter will shift toward zero differential and if there be a gage glass on the column, such as indicated at 45, in Fig. 2, the liquid will be seen to be rising. By observing the speed at which this rise occurs, it can be determined whether sufficient condensate is coming down and then if necessary, to change this rate, the valves 17, 18, in the upper and middle connections, either or both may be regulated as required, but the preferred method is to regulate by valve 17.

The internal type of sump as will be clear from Figs. 2 and 4, keeps the liquid in both legs at substantially the same temperature. Consequently, the level meter will actually show zero differential when the liquids in the two columns are at the same level. Also, because of the fact that the connections to the meter leave the column at the same level, no corrections for difference in the weights of the oil in the two columns are required.

Changes in the range of measurement are

readily made. Upon disconnecting the T 29, the mounting plate 25 and the standpipe or inner column attached to it may be removed as a unit and this may be replaced by a unit having a longer or shorter standpipe. This pipe may be any height between the middle and bottom column connections. The new zero differential level will be at the top of the replacement pipe. No changes are required on the lines connected with the differential meter. If desired, the inner pipe may have a screw-threaded mounting in the supporting plate as indicated at 46, Fig. 4, so that it may be easily changed to a shorter or longer pipe to vary the zero differential level.

By extending the connections of the column into the tower an appreciable distance, as indicated in dotted lines in Fig. 1, local effects contiguous to the wall of the tower are avoided.

The oil within the tower is of heavier gravity and higher temperature than the oil, which is the condensate in the gaging column. As the temperature of oil decreases, the density increases and consequently the lighter gravity oil in the gaging column has a density which may be practically the same as the oil within the tower. Because of this automatic compensating effect, it has not been found necessary to make any corrections for difference in temperature or gravity of these two oils and the gaging column has been found to give closer readings than the use of tri-cocks and ordinary gage glasses.

While shown in conjunction with and particularly applicable to evaporators and fractionating towers, it will be appreciated that the invention is of special utility wherever the problem of both fixed gases and condensable vapors are present. The claims are therefore intended as covering the invention in a broad inclusive sense.

What is claimed is:

1. In a liquid level gaging column for fractionating towers and the like, a member for interposition between couplings of a gage column, a standpipe opening through and carried by said member, said member having a restricted flow, stagnation preventing passage therethrough permitting liquid flow between the couplings but less than that provided by said standpipe.

2. In combination with a fractionating tower, evaporator or the like, a gage column having a bottom connection draining back into the liquid holding portion at the foot of the tower, an intermediate connection opening to the vapor space above the liquid level in the tower and a top connection opening into the vapor space at the top of the tower and whereby condensate resulting from circulation of vapor from the tower through said intermediate and top connections will create condensate in the top of the column and which, accumulating in the foot of the column will flush the foot of the column back into the liquid in the tower, a partition member in the lower portion of the column, a standpipe extending up from said partition member and providing passage between opposite sides of said partition member to thereby hold a definite level of liquid about the same in the foot of the gage column, liquid gaging means connected with the column at opposite sides of said partition and a stagnation preventing flow passage between opposite sides of said partition member and restricted to a flow less than the flow of condensate down the column.

3. A liquid level gage for a fractionating tower or the like, comprising in combination with a fractionating tower or the like, a vertical column at the side of the tower, the lower end of said column communicating with and draining back into the tower below the liquid level therein, means establishing communication between the upper portion of said column and the vapor space within the tower above the liquid level therein to enable flow of condensable vapor and non-condensable fixed gases between the vapor space in the tower and the upper portion of the column, means associated with the upper portion of said column for effecting withdrawal of fixed non-condensable gases from said upper portion of the column to thereby maintain circulation of condensable vapors and fixed gases from the tower into the upper portion of the column, the condensation of condensable vapors in the upper portion of the column and the draining of same into the lower portion of the column and back at the foot of the column into the liquid space in the tower and the relief of fixed gases from the top of the column as such condensation takes place to effect continued circulation of the condensable vapors and fixed gases from the tower into the upper portion of the column, a partition across the lower portion of the column, a standpipe rising from said partition and providing passage between opposite sides of the partition to hold a definite level of condensate in the foot of the gage column, liquid gaging means connected with the interior of the column at opposite sides of said partition and a stagnation preventing passage between opposite sides of said partition member and restricted to a flow less than the flow of condensate down the column.

4. A liquid level gage for a fractionating tower or the like, comprising in combination with a fractionating tower or the like, a vertical column at the side of the tower, the lower end of said column communicating with and draining back into the tower below the liquid level therein, means establishing communication respectively between the upper end and intermediate portions of said column and upper and intermediate portions of the tower in the vapor space above the liquid level in the tower for enabling flow of condensable vapors and non-condensable fixed gases from said vapor space in the upper portion of the tower, means associated with the upper end of said column for effecting withdrawal of fixed non-condensable gases from the top of the column to thereby induce flow of fixed gases and condensable vapors from the vapor space in the tower into the upper portion of the column and whereby said vapors will condense in the upper portion of the column, drop into the bottom of the column and drain back into the liquid space in the tower to flush out the bottom connection of the column, a partition across the lower portion of the column, a standpipe rising from said partition and providing passage between opposite sides of the partition to hold a definite level of condensate in the foot of the gage column, liquid gaging means connected with the interior of the column at opposite sides of said partition and a stagnation preventing passage between opposite sides of said partition member and restricted to a flow less than the flow of condensate down the column.

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