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TANK FILLING MEANS

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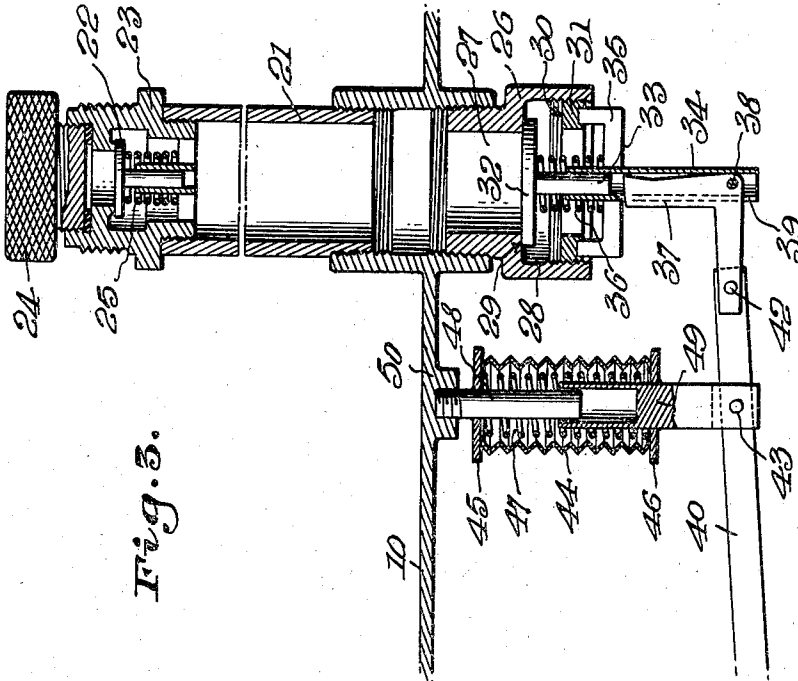
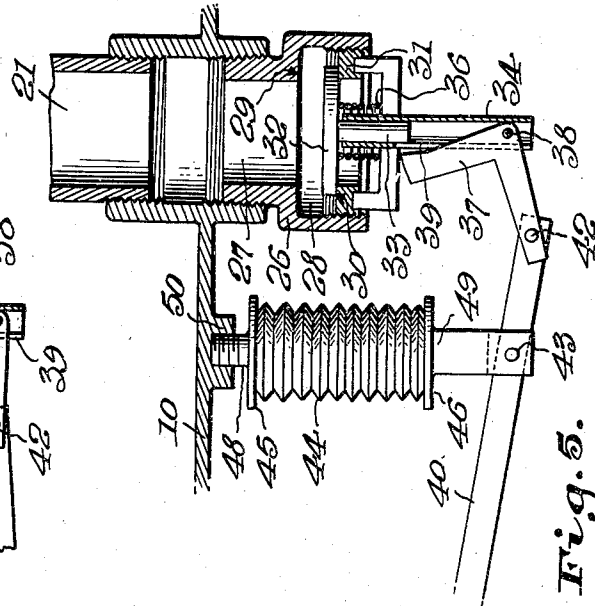
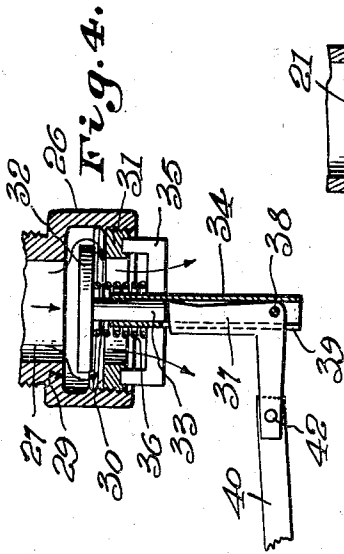


Fig. 5.

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TANK FILLING MEANS

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8 Claims. (Cl. 62—1)

The invention relates to means for filling storage tanks with liquefied gas such as butane, used quite extensively in domestic and industrial gas systems. The storage tanks are usually refilled from a tank truck through a hose which may be coupled to the filler pipe of any tank to be filled. Heretofore, it has been expected that the tank truck driver shall exercise great caution to prevent filling any storage tank to a dangerously high level. If the temperature of the liquefied gas being supplied to a storage tank be relatively high, said storage tank may be safely filled to a relatively high level, whereas if the liquefied gas be at a relatively low temperature, the storage tank cannot be safely filled to such a high level. This is true because the pressure-producing potentialities of the relatively high temperature liquefied gas (upon expansion into a given space) are not as great as those of liquefied gas at relatively low temperature with regard to the same space. Consequently, with relatively high temperature liquefied gas, less room may be left in the storage tank for expansion without danger of creating a pressure greater than the tank can safely hold, whereas if the storage tank were filled to the same level with relatively low temperature liquefied gas, there would be severe danger of producing a dangerously high pressure. The tank truck driver has heretofore been expected to use a thermometer to determine the temperature of the liquefied gas he is to discharge into any storage tank, to use said temperature as a guide in approximating the safe level to which the storage tank may be filled, to then carefully watch the liquid level gauge of the tank as it is being filled, and to stop the filling operation when the approximated level has been reached. Even when employing drivers of above-average intelligence, this filling method has proven to be unreliable and storage tanks have often exploded with disastrous results. It is to overcome such hazards that I have devised the present invention which entirely eliminates the human element in determining the safe level to which any storage tank may be filled.

With the foregoing in view, the invention resides in the novel subject matter hereinafter described and claimed, description being accomplished by reference to the accompanying drawings.

Figure 1 is a side elevation partly broken away and in section showing the invention.

Fig. 2 is a fragmentary view similar to a portion of Fig. 1 but showing the valve closing float 41 adjusted downwardly.

Fig. 3 is an enlarged vertical section through the parts shown at the left of Fig. 1, the valve 32 being in its normal closed position.

Fig. 4 is a fragmentary view similar to a portion of Fig. 3 but showing valve 32 in tank-filling position.

Fig. 5 is a view similar to Fig. 3 but showing the latch 37 tripped and the valve 32 closed to stop the filling operation.

In the drawings above briefly described, a preferred construction has been illustrated, and while that construction will be rather specifically explained, it is to be understood that within the scope of the invention as claimed, variations may be made.

A storage tank 10 is shown for butane or other liquefied gas. 11 merely denotes a gas discharge jacket or pipe around another pipe 12, the upper end of which carries a suitable fitting 13, which fitting carries a liquid level gauge 14, a pressure relief valve 15, and a pressure gauge (not shown). 16 denotes a gas discharge line connected with the jacket or pipe 11, 17 indicates a pressure-closed excess flow valve connected with said jacket or pipe, and 18 denotes suitable piping connecting a vapor return valve 19 with said jacket or pipe. At 20, I have indicated part of a float-actuated means for operating the liquid level gauge 14.

Rising from the tank 10 is a filler pipe 21, having a filling valve 22 at its upper end and also having a coupling 23 for connecting the tank-filling hose of a tank truck with the upper end of said filler pipe 21. The upper end of the coupling 23 is normally closed by a screw plug 24 and when this plug is removed, the filling hose may be readily coupled to said coupling. The hose may carry suitable provision to press downwardly upon the valve 22 and open same against the pressure of the spring 25. If the liquefied gas is to be supplied to the tank 10 by gravity, a vapor-return hose (not shown) is coupled to the vapor-return pipe 19 and extends to the tank of the tank truck to conduct vapors from the tank 10 to the truck tank while the liquefied gas is being fed from said truck tank to said tank 10. If the liquefied gas is to be pumped into the tank 10, use of the vapor-return hose and valve is not necessary.

Suitably connected with the lower end of the filler pipe 21, is a valve casing 26 which is disposed within the upper portion of the tank 10, said casing 26 having a liquid conducting passage 27 formed vertically therethrough, said passage being enlarged between its ends to provide a valve

chamber 28. This valve chamber is provided with an upper downwardly facing valve seat 29 and with a lower upwardly facing valve seat 30, the latter being preferably formed by the upper side of a ring 31 threaded into the lower end of the casing 26. A disk valve 32 is located in the chamber 28 and is provided with a downwardly projecting stem 33, which stem is slidably received in the upper end of a tubular guide 34 which is rigidly carried by and projects downwardly from the casing 26, said tubular guide 34 being secured to a spider 35 carried by the ring 31, in the present showing. A coiled spring 36 normally seats the valve 32 gently against the upper seat 29 but when liquid is being admitted through the filler pipe 21, said valve unseats. During the filling operation, however, this valve is held against coming in contact with the lower seat 30, by a pivoted latch 37 which underlies the stem 33, said latch being pivoted at 38 to the guide 34 and being preferably in the form of a bell crank with its upper end positioned to abut the stem 33 when valve 32 is forced off the seat 29. The guide 34, when of the tubular form herein disclosed, is of course provided with a suitable slot 39 through which the vertical arm of the latch 37 extends.

A vertically swingable lever 40 having a float 41, forms part of the valve means associated with the lower end of the filler pipe 21, said lever 40 being pivoted at 42 to the horizontal arm of the latch 37. The fulcrum 43 of the lever 40 is between the ends of the latter and provision is made for automatically adjusting this fulcrum upwardly when liquefied gas at relatively high temperature is being admitted to the tank 10, and for automatically adjusting said fulcrum downwardly when liquefied gas at relatively low temperature is being admitted. Whenever the tank is filled sufficiently to cause the liquid to lift the float 41, the lever 40 releases the latch 37 and the pressure of the ingoing liquid against the valve 32 immediately seats it against the lower seat 30, stopping the filling operation. As float 41 is in a lower position when liquefied gas at relatively low temperature is being admitted (due to the downward adjustment of the fulcrum 43), it will be seen that the tank will not be filled to so high a level with this liquefied gas, as it will be with liquefied gas at relatively high temperature which effects positioning of the float 41 at a higher elevation, due to the upward adjustment of the fulcrum 43. The pressure of the low temperature liquefied gas is relatively little but the pressure-increasing potentiality thereof upon reaching normal tank temperature, is much greater than that of relatively high temperature liquefied gas and it is thus necessary to leave more room in the tank for expansion when relatively low temperature liquefied gas is being fed to the tank 10, in order that a serious pressure shall not exist in said tank upon expansion of the liquid and liberation of gas therefrom.

The above mentioned vertical adjustments of the fulcrum 43 are preferably effected by means of a pressurestat subjected to the pressure within the tank 10 but it is of course possible to make use of a thermostat subjected to the temperature within said tank. In either instance, I utilize means (pressurestat or thermostat) responsive to conditions in the tank 10 for upwardly adjusting the fulcrum 43 and float 41 when relatively high temperature liquefied gas is being admitted, and for downwardly adjusting said fulcrum and float

when relatively low temperature liquefied gas is being admitted.

When handling butane, a pressurestat is preferably employed, because there is a constant pressure change with temperature change. For example, at zero degrees temperature, the pressure is zero; at 25° the pressure is ten pounds to the square inch; at 45° the pressure is twenty pounds to the square inch; at 60° the pressure is thirty pounds to the square inch, and at 75° the pressure is forty pounds to the square inch. It will thus be seen that a pressurestat may readily be used to accurately adjust the float 41 upwardly or downwardly to so position the same as to cause valve closing before the tank 10 has been filled to a level which would later become dangerous due to insufficient room for expansion.

A pressurestat has been shown and it is preferably of the construction shown more particularly in Fig. 3. A vertically disposed Sylphon bellows 44 is provided, closed at its upper end by a plate 45 and closed at its lower end by another plate 46. The upper end of the Sylphon bellows is secured suitably to the top of the tank 10 or otherwise fixedly mounted, and the lower end of said Sylphon bellows carries the fulcrum 43. Pressure increase within the tank 10 above a predetermined extent, contracts the bellows 44 thereby raising the fulcrum 43 and the float 41. Diminution of pressure in tank 10 permits expansion of the bellows 44 under the influence of a suitable spring 47 and thus the fulcrum 43 and float 41 are downwardly adjusted. In this connection, it is of course to be recalled that ingoing liquefied gas at relatively high temperature will produce more pressure in the tank 10 than liquefied gas at relatively low temperature.

In the present showing, an upper guide 48 and a lower guide 49 are slidably telescoped within the bellows 44 and are secured to the upper and lower plates 45 and 46 respectively. Each of the guides 48 and 49 may well consist of a short length of metal extending through the adjacent plate 45 or 46, and when this construction is employed, the upper end of the guide 48 may be threaded into a boss 50 carried by the upper wall of the tank 10, and the lower end of the guide 49 may be bifurcated to receive the lever 40 and carry the fulcrum 43. It is to be understood, however, that the upper end of the bellows 44 could be anchored in any suitable way and that the lower end of said bellows could carry the fulcrum 43 in any preferred manner.

The valve 32 normally stands as shown in Fig. 3, being held lightly against the seat 29 by the spring 36, and the latch 37 then occupies a position under the stem 33 as shown in said view. When liquefied gas is being admitted through the filler pipe 21, it forces the valve 32 from its seat 29 and the latch 37 limits the descent of said valve. As the liquefied gas enters the tank and changes the pressure (either up or down) in said tank, the pressurestat 44, etc. automatically effects positioning of the float 41 so that it will be lifted by the liquid supplied to the tank as soon as said liquid has reached the predetermined safe level for its temperature. When this level is reached, float 41 is operated, thereby causing lever 40 to release the latch 37, whereupon the pressure of the liquid upon the valve 32 immediately seats it against the lower seat 30 and stops the filling operation. As soon as the filling hose is uncoupled, the pressure above the valve 32 is relieved and the spring 36 immediately seats said valve against the upper seat 29. Obviously,

the entire float-actuated valve means will be self-setting for the next filling operation.

I claim:

1. In a liquefied gas storage means, a storage tank having a liquefied gas inlet passage and a gas discharge passage, valve means for closing said liquefied gas inlet passage, said valve means having a float in said tank to cause valve closing when said float is lifted by the liquid admitted to the tank, and means responsive to conditions in said tank for upwardly adjusting said float with respect to the liquid level when relatively high-temperature liquefied gas is admitted to said tank and for downwardly adjusting said float with respect to the liquid level when relatively low-temperature liquefied gas is admitted.

2. In a liquefied gas storage means, a storage tank having a liquefied gas inlet passage and a gas discharge passage, valve means for closing said liquefied gas inlet passage, said valve means having a float-carrying lever in said tank operable to cause valve closing when its float is lifted by the liquid admitted to the tank, a fulcrum for said lever mounted for vertical adjustment, and means responsive to conditions in said tank for raising said fulcrum when relatively high-temperature liquefied gas is admitted to the tank and for lowering said fulcrum when relatively low-temperature liquefied gas is admitted.

3. In a liquefied gas storage means, a storage tank having a liquefied gas inlet passage and a gas discharge passage, valve means for closing said liquefied gas inlet passage, said valve means having a float in said tank to cause valve closing when said float is lifted by the liquid admitted to the tank, and pressure-actuated means responsive to pressure conditions in said tank for upwardly adjusting said float with respect to the liquid level when relatively high-temperature liquefied gas is admitted to said tank and for downwardly adjusting said float with respect to the liquid level when relatively low-temperature liquefied gas is admitted.

4. In a liquefied gas storage means, a storage tank having a liquefied gas inlet passage and a gas discharge passage, valve means for closing said liquefied gas inlet passage, said valve means having a float-carrying lever in said tank operable to cause valve closing when its float is lifted by the liquid admitted to the tank, a fulcrum for said lever mounted for vertical adjustment, and pressure-actuated means responsive to pressure conditions in said tank for raising said fulcrum when relatively high-temperature liquefied gas is admitted to the tank and for lowering said fulcrum when relatively low-temperature liquefied gas is admitted.

5. In a liquefied gas storage means, a storage tank having a liquefied gas inlet passage and a

gas discharge passage, valve means for closing said liquefied gas inlet passage, said valve means having a float-carrying lever effective to cause valve closing when the float is lifted by the liquid in said tank, and a pressurestat in said tank carrying the fulcrum of said lever and operative to raise said lever and its float with respect to the liquid level as the gas pressure increases in said tank, and vice versa.

6. In a liquefied gas storage means, a storage tank having a liquefied gas inlet passage and a gas discharge passage, valve means for closing said liquefied gas inlet passage, said valve means having a float-carrying lever effective to cause valve closing when the float is lifted by the liquid in said tank, a syphon bellows in said tank above said lever and closed at both of its ends, means securing the upper end of said bellows to the tank, slidably engaged guides within said bellows and secured to the upper and lower ends thereof respectively, a lug projecting downwardly from the lower end of said bellows and carrying the fulcrum of said lever to lift the latter and its float when gas pressure in the tank contracts said bellows, and a spring in said bellows for extending the same to lower said lever and its float as the gas pressure decreases.

7. A tank having an upwardly projecting filler pipe, a normally closed filling valve and filling hose connecting means for the upper end of said filler pipe, valve means for a portion of said filler pipe below said filling valve, said valve means having a float in said tank to cause closing of said valve means when said float is raised by liquid admitted through said filler pipe, and automatic means for vertically adjusting said float with respect to the liquid level.

8. In a tank-filling valve, a valve casing having a vertical passage for conducting liquid downwardly therethrough, said passage being enlarged between its ends to provide a valve-receiving chamber, said chamber having an upper valve seat facing downwardly and a lower valve seat facing upwardly, a valve in said chamber having upper and lower valve portions to engage the two seats respectively, said valve having a downwardly projecting stem, a vertical guide for said stem fixedly carried by said casing and projecting downwardly below said stem, a spring exerting upward pressure on said valve to normally engage it with said upper downwardly facing seat, a latch pivoted to said guide to underlie said stem and normally hold said valve against engagement with said lower upwardly facing seat, and a float operatively connected with said latch for releasing the same when the tank has been filled to a predetermined level.

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