United States Patent

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[54] **FILLING ARRANGEMENT FOR SUBTERRANEAN STORAGE TANKS**
4 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **137/592,** 220/85
[51] **Int. Cl.** **F17c 13/00,** B65d 25/02
[50] **Field of Search** 137/590, 592, 582; 220/85.5, 86

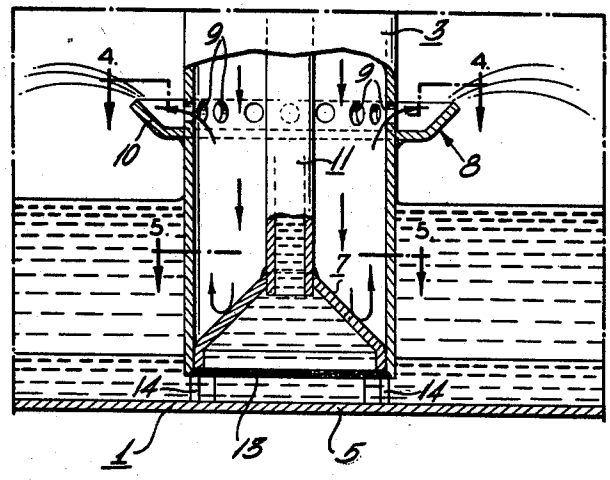
[56] **References Cited**

UNITED STATES PATENTS

1,042,107	10/1912	Grant	220/85
2,123,809	7/1938	Seitz	137/592
2,294,176	8/1942	Gredell	220/86
2,310,450	2/1943	Longdin	220/86

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ABSTRACT: A fill pipe for a subterranean storage tank has a hydraulic jump therein, near the bottom of the pipe and near the bottom of the tank, to absorb a portion of the kinetic energy of the falling liquid. The fill pipe has a smaller pipe therein, to enable removal of water from the tank floor.



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FIG. 1.

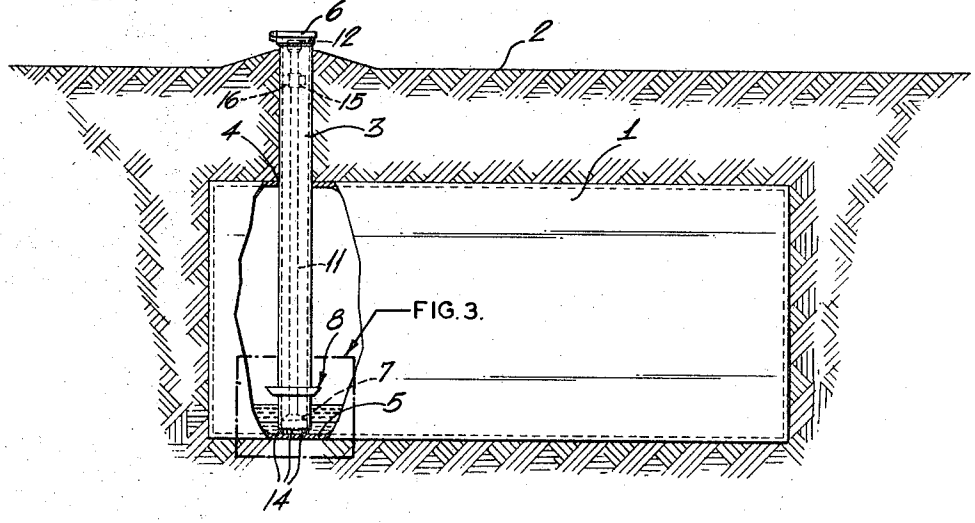


FIG. 3.

FIG. 2.

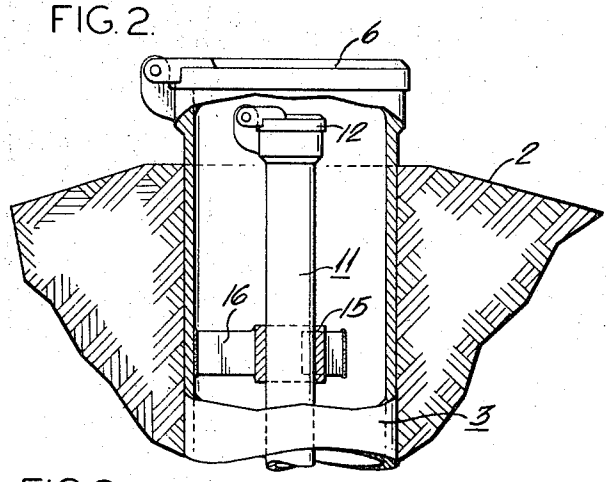


FIG. 4.

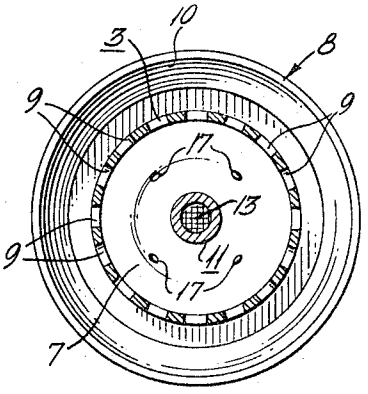


FIG. 3.

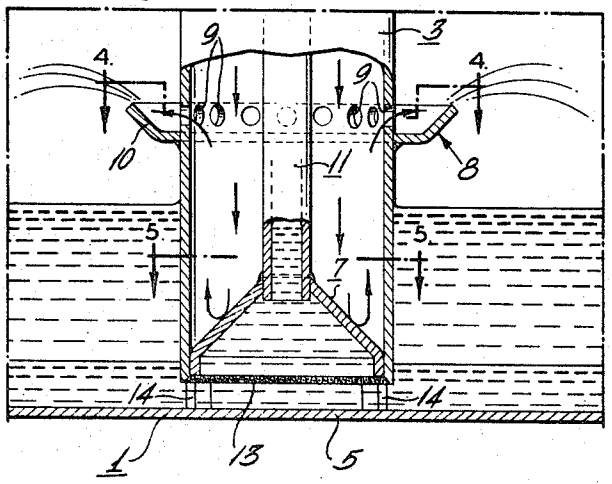
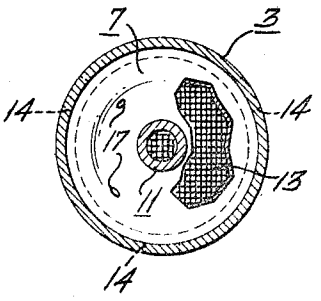


FIG. 5.



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FILLING ARRANGEMENT FOR SUBTERRANEAN STORAGE TANKS

This invention relates to a filling arrangement for subterranean storage tanks, such as the tanks commonly used at service stations for the storage of liquid fuel (gasoline).

One of the problems facing the petroleum industry in its gasoline-marketing operations is contamination of gasoline by dirt and water. These foreign materials can cause both the service station operator and the motorist a great deal of trouble and inconvenience. Dirt can clog the small jets in modern carburetors and can also clog fuel line filters. Water can cause rust, corrosion, fuel line freezeups, and, if it comes in slugs, can cause an engine to stop. This can lead to dollar cost liabilities, borne by the oil company, for repairs, and also to loss of customer goodwill. Also, water may freeze in the service station gasoline pumps, which is a great inconvenience to the service station operator.

The problem of dirt has been attacked by installing filters, capable of removing very fine particles, ahead of the gasoline pump nozzle.

Reducing the water contamination is a much more difficult problem. Cleanliness is a big help, but the problem cannot be solved by this alone. Water gets into the fuel in service station storage tanks in many ways, some of which are: (1) the floating roofs on large storage tanks at the refinery may leak rain water, the water in these tanks then being conveyed by tank trucks to service stations and delivered into the service station storage tanks; (2) "breathing" of service station storage tanks; (3) rain leaking into the fill tubes of service station storage tanks.

Chemical or physical drying of the gasoline stream just prior to its entry into the customer's automobile gasoline tank is technically possible. Drying apparatus using molecular sieves, activated alumina, etc., will do a very thorough job, but such apparatus is currently very costly, and also inconvenient. This apparatus is too expensive to use without regeneration, and regeneration presents an almost insurmountable logistics problem.

The problem of contamination (both by water and dirt) is particularly acute just after a load of gasoline is delivered to the service station storage tank. The mixing action of the falling fuel on the layer of water and dirt usually present at the bottom of the subterranean storage tank causes these contaminants to become dispersed in the fuel.

The present invention, in its broadest aspects, contemplates reducing the amount of energy available for mixing at the time the fuel is delivered to the subterranean storage tank, that is, at the time the service station storage tank is filled. This, along with a campaign of cleanliness, greatly reduces the amount of contamination in the fuel delivered to the customer.

Accordingly, an object of this present invention is to provide an improved filling arrangement for subterranean liquid fuel storage tanks.

Another object is to provide a filling arrangement for subterranean liquid fuel storage tanks characterized in that it functions to reduce the mixing of water, dirt, and fuel during the tank-filling operation.

A further object is to provide a device of the aforesaid character which can be applied to tanks already in service, as well as to new tanks.

An additional object is to provide a device of the foregoing character which is inexpensive to construct and install.

A still further object is to provide a filling arrangement for subterranean liquid fuel storage tanks which has incorporated therein a facility which allows water to be removed from the tank floor.

The objects of this invention are accomplished, briefly, in the following manner: A fill pipe extends from the surface down to the top of a subterranean liquid fuel storage tank, and thence through the interior of this tank to the bottom thereof. The fill pipe is coupled to the interior of the tank near the bottom thereof but somewhat above the same, this coupling comprising a hydraulic jump arrangement which causes the falling liquid to change its direction of flow as it leaves the fill pipe and passes to the tank interior. A smaller pipe is mounted concentrically within the fill pipe and is open to the tank interior only at a location closely adjacent the bottom of the tank; this smaller pipe extends upwardly to the surface.

A detailed description of the invention follows, taken in conjunction with the accompanying drawing, wherein:

FIG. 1 is a somewhat diagrammatic vertical sectional view, with a portion thereof broken away, of a subterranean storage tank equipped with a filling arrangement according to the invention;

FIG. 2 is a fragmentary vertical section, on an enlarged scale, of the upper portion of the filling arrangement;

FIG. 3 is a fragmentary section, on an enlarged scale, of the portion of the filling arrangement included in the dot-dash rectangle labeled "FIG. 3" in FIG. 1;

FIG. 4 is a sectional view taken along line 4–4 in FIG. 3; and

FIG. 5 is a sectional view taken along line 5–5 in FIG. 3.

Referring now to the drawing, numeral 1 denotes a subterranean storage tank, of the type customarily used at service stations for the storage of liquid fuel (gasoline). This tank is provided with the usual vent and discharge or dispensing lines (not shown), and is located below the surface or "grade" 2. A continuous fill pipe 3 extends substantially vertically from the surface 2 (actually, from a point slightly above the surface) to the top of tank 1. Pipe 3 is sealed at 4 through the top of tank 1, and continues downwardly, substantially vertically, through the interior of the tank 1 to the bottom 5 thereof, that is, to the tank floor.

The upper end of pipe 3, at or slightly above the surface 2, is closed by a removable fill cap of conventional construction (illustrated as a pivoted closure 6).

The lower end of pipe 3 is closed by means of a substantially imperforate hollow frustoconical member 7, resembling somewhat an inverted funnel, to the outer conical surface of which the lower end of pipe 3 is sealed, as by welding. Member 7 will be referred to further hereinafter.

Near the bottom 5 of the tank, but somewhat above the same, the fill pipe 3 is coupled to the interior of tank 1, to enable liquid to flow from the fill pipe into the tank interior. This coupling employs a hydraulic jump arrangement denoted generally by numeral 8. The arrangement 8 comprises a plurality of spaced horizontally extending apertures 9 which are drilled in approximately radial directions through the wall of pipe 3, and also a diverting or deflecting means 10; the means 10 consists of a shield member fixed to the outside of pipe 3, just below the apertures 9, having an upwardly extending wall at its outer periphery such as to deflect or divert the liquid issuing through the apertures 9 upwardly, or away from the tank bottom 5.

The hydraulic jump arrangement 8, comprising the apertures 9 and diverter means 10 acting in combination, serves to change the direction of flow of the liquid which is flowing (essentially falling) down the fill pipe 3. That is to say, the direction of flow is essentially reversed (from downwardly, in pipe 3, to upwardly, as the liquid leaves diverter means 10). This reversal of the flow acts to absorb a portion of the energy of the falling liquid, which is to say that much of the kinetic energy of the drop is converted into mechanical energy loss, by way of turbulence and viscous friction. As a result of this loss of energy, the energy available for mixing of the new fuel being delivered into tank 1, with the layer of water and dirt usually present at the bottom 5 of the tank (i.e., the mixing at the time the tank 1 is being filled, by way of the fill pipe 3), is appreciably reduced; therefore, such mixing, and the resulting contamination, are considerably reduced.

It is desired to be pointed out that, since the extreme lower end of pipe 3 is substantially sealed off or closed, the only high-flow-rate coupling between fill pipe 3 and the interior of the tank 1 is by way of the hydraulic jump arrangement 8. Because of the energy conversion action of the arrangement 8, there will be some reduction in the maximum rate of flow of the liquid through pipe 3, and consequently some lengthening

in the time required to fill the tank 1. However, it is quite probable that the reduction in water-gasoline mixing (obtained by the use of this invention) will economically balance the lengthened fill time.

As previously stated, the outer conical wall or conical surface of the inverted-funnel member 7 is utilized to substantially seal off (from the tank interior) the lower end of pipe 3. Member 7 comprises part of a means for enabling water to be removed from the tank floor 5. The upper, small-diameter opening of member 7 is sealingly coupled to the lower end of a substantially vertical tube 11 which is mounted concentrically in pipe 3. This concentric mounting is effected at the lower end of tube 11 by means of member 7 (which secured to both tube 11 and pipe 3), and near the upper end of tube 11 by means of a mounting sleeve 15 closely surrounding and secured to tube 11, sleeve 15 being secured to the inner wall of pipe 3 by way of a spider or spoke arrangement 16. The diameter of tube 11 is small compared to that of the fill pipe 3. Tube 11 extends from member 7 up to the surface 2 (actually, to a point slightly above the surface), and is closed at its upper end by a removable cap (illustrated as a pivoted closure 12) which is separate from closure 6 and is located somewhat below the latter.

The lower, large-diameter end of the funnellike member 7 is covered by a circular piece 13 of foraminous material (screen) secured around its edge to the inner wall of member 7. The foraminous material 13 excludes solid particles which are larger than a predetermined size from the interior of member 7. The screen 13 is maintained spaced slightly above the tank bottom 5 by means of a plurality of spaced support feet 14 whose upper ends contact the assembly of member 7 and fill pipe 3, and whose lower ends contact the tank bottom 5.

It may be seen that the lower end of member 7 (and thus also the lower end of tube 11, which is connected for fluid transmission to the upper end of member 7) opens closely adjacent the tank bottom 5. By connecting the intake or suction of a suitable pump to the upper end of tube 11, the "water bottoms" may be pumped out of tank 1, whenever desired. The water would pass through screen 13 into the interior of member 7, and thence upwardly through tube 11 to the surface.

One problem which will suggest itself, at least to those skilled in the art to which this invention relates, is the possibility that that portion of fill pipe 3 between member 7 and the jump arrangement 8 will eventually become filled with water, from repeated deliveries into the tank 1. Thereafter, some of this water (albeit a very small amount) would be mixed with the liquid during each delivery into the liquid bulk in tank 1.

The above problem may be obviated by providing several small-diameter weep holes 17 (see FIGS. 4 and 5) in the member 7. These holes would allow the trapped, delivered water to weep down into the "water bottoms" layer at the bottom of tank 1. The holes 17 should be sufficiently small in diameter to avoid any substantial flow therethrough (and thus also any substantial mixing, by way of the holes) during delivery (which last-mentioned flow would, of course, bypass the hydraulic jump arrangement 8, and might also cause water to be mixed with the incoming delivery, if the water level in the tank is sufficiently high). The small flow which will occur through holes 17 during delivery would be enough to keep these holes open, preventing them from becoming clogged by dirt.

It is pointed out that, if the level of the "water bottoms" in the tank is kept below the weep holes 17 (for example, by pumping out the "water bottoms" through tube 11, as previously described), even the small mixing problem alluded to in the preceding paragraph would be avoided.

It may be here noted that the combination filling and bottoms-removal arrangement of this invention is inexpensive to construct and install.

Another arrangement for reducing the amount of energy available for mixing at the bottom of the tank 1 (instead of utilizing the hydraulic jump arrangement 8) would be to load the fill pipe 3 full of an inert packing such as large stones, ping-pong balls, etc. In this case, also, viscous friction would use up most of the kinetic energy of the falling liquid. Here, again, there would be some pressure drop, and consequently a decrease in flow rate, but, on the other hand, there would be a reduction in water-gasoline mixing.

Another modification might be to utilize some of the energy of the falling liquid to power a pump which would remove water from the tank bottom (such as a pump which would be connected to the upper end of tube 11). This modification would of course be a more expensive filling arrangement than that disclosed in detail hereinabove, but in the modified arrangement the tank would be cleaned automatically each time a load of gasoline was delivered into the tank.

We claim:

1. In combination with a subterranean storage tank for liquid fuel: a continuous fill pipe extending substantially vertically from the surface to the top of said tank and thence substantially vertically through the interior of said tank to the bottom thereof, said pipe being coupled to said tank interior near the bottom thereof, the liquid flowing downwardly through said pipe during a tank-filling operation developing a substantial amount of kinetic energy; means cooperating with said pipe for absorbing an appreciable portion of the kinetic energy of said liquid prior to the termination of flow of the liquid from said pipe through said coupling into said tank interior; and a substantially vertical tube, whose diameter is less than that of said pipe, mounted within said pipe, the lower end of said tube opening closely adjacent the bottom of said tank and said tube extending upwardly to the surface.

2. Combination of claim 1, including also a hollow, frustoconical member having its upper, small-diameter end connected for fluid transmission to the lower end of said tube; the lower end of said full pipe being sealed to the outer surface of said member at the lower, large-diameter end of the latter.

3. Combination defined in claim 1, wherein said tube is mounted concentrically in said pipe.

4. Combination defined in claim 1, wherein the lower end of said tube is fastened to the lower end of said fill pipe.