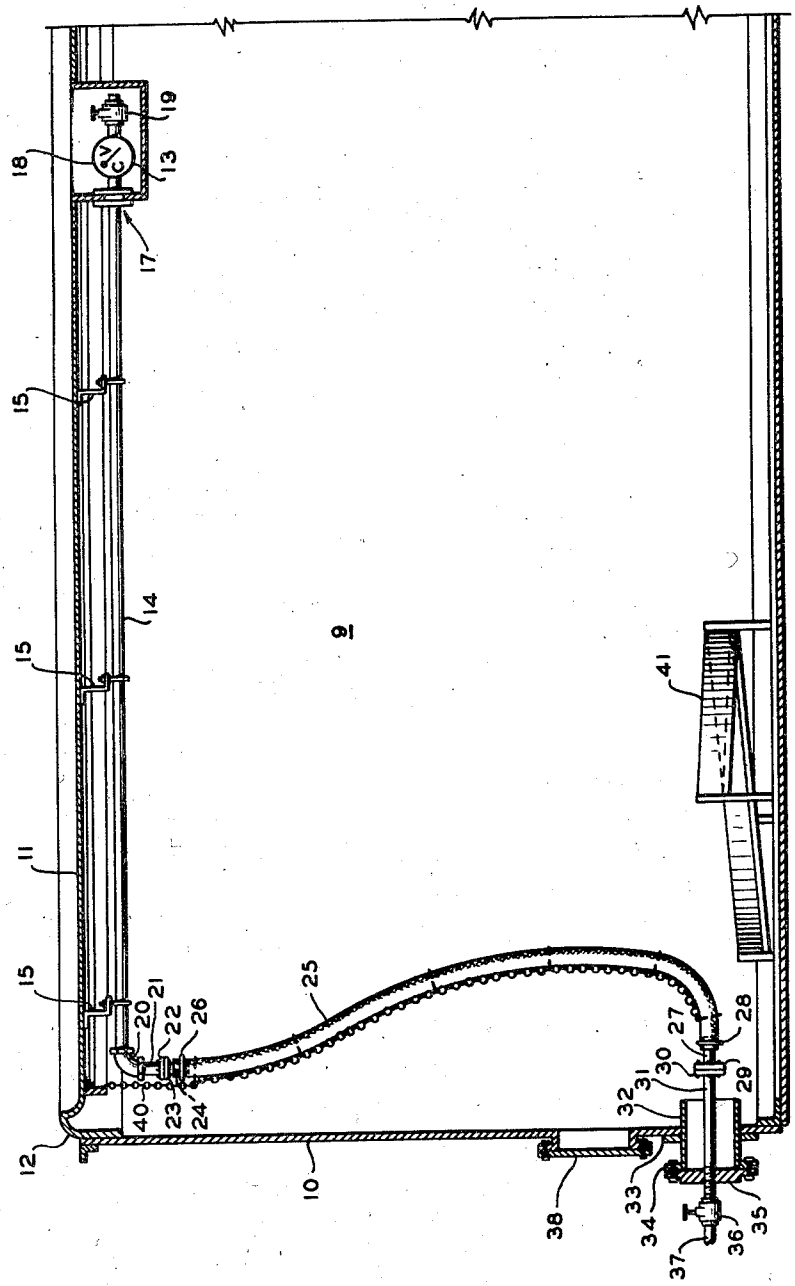
April 23, 1957 J. G. OBERST 2,789,722

FLOATING ROOF STORAGE TANK

Filed Aug. 3, 1953 2 Sheets-Sheet 1

FIG. 1.



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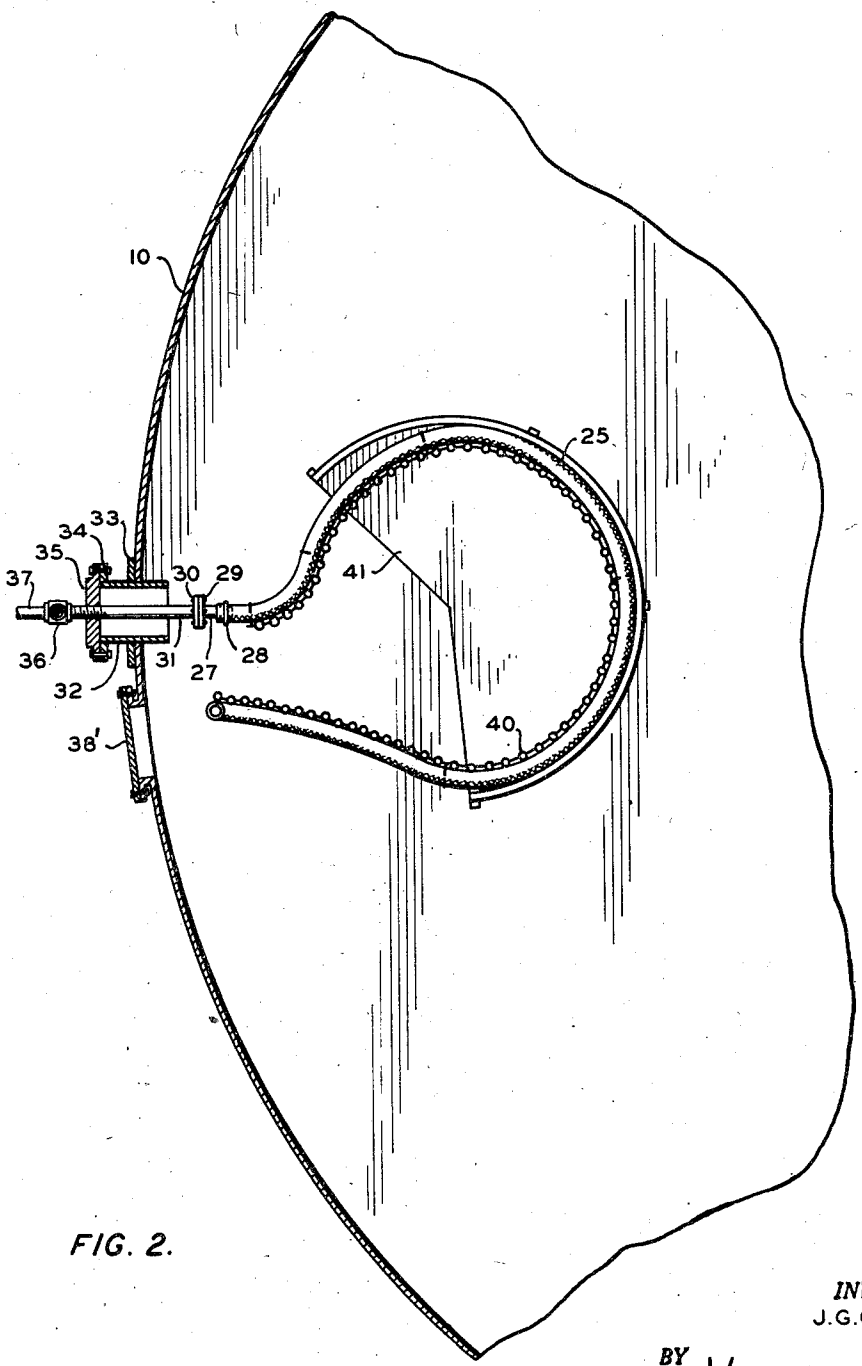


FIG. 2.

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FLOATING ROOF STORAGE TANK

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6 Claims. (Cl. 220—26)

This invention relates to floating roof storage tanks. In another aspect it relates to drainage systems to prevent water from accumulating on floating roof storage tanks.

Various types of floating roof liquid storage tanks are known in the art. For the most part these tanks comprise a generally cylindrical upright wall having a floating roof which is supported by the liquid in the tank. The peripheral edge of the roof is provided with a suitable sealing means that slides up and down the inner surface of the tank wall as the roof rises and falls due to variations in the level of the liquid in the tank. It is of course apparent that the roof cannot engage the wall so closely as to prevent movement of the roof in response to changes in liquid level, and as such it becomes important to prevent the leakage of rain water from the roof into the tank.

In order to prevent this leakage of water into the tank it is general practice to position a sump near the center of the roof at the lowest point thereon to collect water. This sump is in turn connected to a drain outlet near the bottom of the tank. Since the roof is movable, the means connecting the sump with the drain outlet must be sufficiently flexible to follow movement of the roof. One drainage system that has been used heretofore employs a jointed metal drainage pipe which is connected at one end to the sump and at the other end to an outlet near the bottom of the tank. However, the joints in such a flexible system have been a source of trouble and often develop leaks which necessitate frequent repairs. This presents a problem because workmen cannot enter the tank until it has been sufficiently vented to remove toxic vapors or gases. Such a procedure is, of course, costly and time consuming.

Another drainage system that has been used heretofore comprises a flexible conduit attached at one end to the sump and at the other end to an external drain outlet. While this system eliminates several of the difficulties inherent in the jointed pipe system it has not been entirely satisfactory from a maintenance standpoint. Occasional repair and replacement of the flexible conduit is required. The procedure that has generally been followed in replacing this flexible conduit has been to connect one end of a line to the upper end of the conduit near the sump and to withdraw the conduit from the tank through the drain opening in the wall. The line then is attached to a new conduit which is drawn back through the tank. This system, however, requires a crew of workmen operating from the roof near the sump as well as a crew on the ground. If the tank is partially or fully empty there is considerable difficulty involved in reaching and working from such a position on the roof. A second disadvantage is the possibility of the flexible conduit being broken at a point within the tank. If this occurs it is not possible to insert a new conduit without completely emptying the tank of toxic vapors so that workmen can enter.

In accordance with the present invention there is provided an improved drainage system for use with a floating roof storage tank. This drainage system comprises generally a rigid conduit which is attached to the lower surface of the roof and which extends from the sump to a point near the periphery of the roof. A flexible conduit is in turn attached to the rigid conduit near the periphery of the roof and extends downwardly through the tank to a drain opening positioned in the wall of the tank near the bottom thereof. A manhole is provided in the wall of the tank near the drain opening such that when the roof is in its down position both ends of the flexible cable are accessible from the outside of the tank at or near the ground level. This system eliminates the need for a crew of workmen to mount the roof of the tank to replace the flexible conduit. Since both ends of the conduit are accessible from the ground, repair and replacement work is simplified considerably. In addition to the saving of labor in making such repairs, a reduction in the length of flexible conduit results from this system. The flexible conduit, which is considerably more expensive than a metal pipe, need only be of sufficient length to reach from the bottom drain opening to the edge of the roof rather than to the center of the roof. Furthermore, this permits the use of a single length flexible cable in nearly all of the storage tanks of a given type. This is true because it is common practice to build storage tanks of substantially the same height irrespective of the volume of the tanks; the larger tanks are made of greater diameter rather than of greater height.

Accordingly, it is an object of this invention to provide an improved roof drainage assembly for use with floating roof storage tanks.

Another object is to provide an improved roof drainage assembly which incorporates a minimum length of flexible connecting hose.

A further object is to provide an improved roof drainage assembly incorporating a flexible hose in such a manner that the hose can readily be repaired or replaced at the ground level without entering the tank.

Various other objects, advantages and features of this invention should become apparent from the following detailed description taken in conjunction with the accompanying drawing in which:

Figure 1 is a vertical view, shown partially in section, of a floating roof storage tank having the roof drainage assembly of the present invention incorporated therein; and

Figure 2 is a top view, shown partially in section, of a modified form of the tank assembly of Figure 1.

Referring now to the drawing in detail and to Figure 1 in particular, there is shown a storage tank 9 having a vertical wall 10. A floating roof 11 is positioned within the tank and engages wall 10 at the periphery thereof by means of a suitable seal 12 which permits the roof to slide up and down inside tank wall 10. Roof 11 is provided at its center with a sump 13 in which is accumulated any water that may be deposited on the roof.

A pipe 14 is attached to the lower surface of roof 11 by a plurality of brackets 15, and one end of pipe 14 extends into sump 13 through a suitable packing gland 17. A check valve 18 and a gate valve 19 are inserted near the end of pipe 14 inside sump 13, check valve 18 being oriented such that liquid can flow out of sump 13 into pipe 14 but not in the reverse direction. The second end of pipe 14 terminates near the periphery of roof 11 where it is provided with a 90° elbow 20 into which is threaded or welded a nipple 21 having a flange 22 attached to the opposite end thereof. A flange 23 is bolted to flange 22 and in turn supports a nipple 24 about which is fitted a flexible hose 25. A clamp 26 or other suitable means (nipple can be vulcanized into hose ends) serves to hold hose 25 on nipple 24.

Hose 25 is constructed of a flexible material which is resistant to the liquid in tank 9. If the tank is used for

oil storage, hose 25 can be made of a material such as polymerized butadiene or neoprene, for example. Hose 25 extends downwardly from its point of attachment to pipe 14 and is attached at its second end to a nipple 27 by a clamp 28 or other suitable method. A flange 29 is attached to nipple 27 and flange 29 is bolted to a flange 30 which is attached to a pipe 31. An opening is provided in the wall of tank 10 to receive a section of pipe 32 which is of larger diameter than pipe 31. A reinforcing flange member 33 is positioned about pipe 32 in abutment with tank wall 10. The outer end of pipe 32 is provided with a flange 34 to which is bolted a second flange 35. Pipe 31 is threaded or welded in flange 35 and a gate valve 36 is attached to pipe 31 exterior of tank 9. An outlet drain conduit 37 is attached to the second opening of gate valve 36. A chain 40 is attached to roof 11 and to hose 25 at a plurality of points thereon. Chain 40 thus serves the dual functions of providing ballast for hose 25 and helping to retain the upper end of hose 25 in engagement with nipple 24. If desired, a hose with built in ballast can be employed. An inclined support member 41 can be positioned on the bottom of tank 9 if desired such that hose 25 rests thereon when the roof is in the down position. This support tends to eliminate kinks and strains in the hose. A normally closed opening or manhole 38 is provided in tank wall 10 adjacent pipe 32.

In Figure 2 there is shown a slightly modified configuration of the tank assembly wherein a manhole 38' is positioned at substantially the same level as pipe 32 and in closely spaced relation therewith. In view of the two embodiments illustrated in Figures 1 and 2, it should be apparent that manholes 38 or 38' can be positioned at any desired location near the bottom of tank wall 10. If pipe 32 is of sufficiently large diameter to enable ready access to hose 25 therethrough, manhole 38 or 38' can be dispensed with entirely.

The operation of the drainage assembly of this invention should readily become apparent. Valves 19 and 36 normally are open such that any water which accumulates in sump 13 is immediately removed through pipe 14 and hose 25. If a leak should develop in conduit 25, valve 36 can be closed to prevent loss of the contents of tank 9.

When it becomes necessary to repair or replace hose 25, tank 9 is emptied to lower roof 11 to its down position such that the connection of the upper end of hose 25 to pipe 14 is adjacent manhole 38. Thus both ends of hose 25 can be reached by workmen at the ground level from outside tank 9. Hose 25 can then be repaired or replaced without the need of workmen entering the tank or mounting the roof thereof. If hose 25 should become broken it can readily be removed and replaced since both ends of the hose are accessible from a common position.

In view of the foregoing remarks it should be apparent that there is provided in accordance with this invention an improved drainage system for use with floating roof storage tanks. This system enables the use of a considerably shorter flexible conduit than has been required in the drainage systems of the prior art; and, furthermore, enables the use of a single length flexible conduit in nearly all the storage tanks of a given type. Maintenance work on this drainage system is considerably simplified because both ends of the flexible conduit can be reached from a single location at the ground level outside the tank.

While this invention has been described in conjunction with a present preferred embodiment thereof it should be apparent that the invention is not limited thereto.

What is claimed is:

1. In a liquid storage tank provided with a floating roof that normally rests upon the liquid in said tank, means for draining the upper surface of said roof comprising, in combination, a drain in said roof, a first rigid conduit attached to and positioned under the lower surface of said roof, said first conduit communicating at one end with said drain, the second end of said conduit being near the periphery of said roof, a flexible conduit having an upper end thereof detachably connected to said second end of said first conduit, said flexible conduit having a lower end positioned near the side wall of said tank and in communication with a region exterior of said tank through a first opening in said tank near the bottom thereof, and a normally closed second opening in the side-wall of said tank near the bottom thereof, said second opening positioned so as to be substantially adjacent said detachable connection when said roof is in said lower portion of said tank, whereby said detachable connection is accessible through said second opening from the exterior of said tank when said roof is in said lower portion of said tank.

2. The combination in accordance with claim 1 further comprising a check valve in said first conduit to permit flow through said first conduit from said drain but not in the reverse direction, sealing means positioned within said first opening to establish a fluid-tight connection between said tank and said flexible conduit, a ballast chain attached at its upper end to said roof and attached to said flexible conduit at a plurality of points thereof, an inclined support positioned in the bottom of said tank, said support being located such that said flexible conduit rests thereon when said roof is in said lower portion of said tank, said drain being a sump positioned in said roof near the center thereof, the center of said roof being the lowest point thereof.

3. The combination in accordance with claim 1, wherein said second opening is positioned at substantially the same level as said first opening and in closely spaced relation therewith.

4. The combination in accordance with claim 1 wherein said lower end of said flexible conduit is detachably connected to said first opening in said tank near the bottom thereof, said lower end of said flexible conduit also being so positioned as to be accessible through said second opening from the exterior of said tank when said roof is in said lower portion of said tank.

5. In a liquid storage tank provided with a floating roof that normally rests upon the liquid in said tank, means for draining the upper surface of said roof comprising, in combination, a sump in said roof near the center thereof, a pipe attached to and positioned under the lower surface of said roof, said pipe communicating with said sump at one end the other end of said pipe being at a point near the periphery of said roof, a check valve in said pipe to permit flow through said pipe from said sump but not in the reverse direction, a flexible hose having its upper end detachably connected to said other end of said pipe, a drain outlet in the side wall of said tank near the bottom thereof, a valve in said drain outlet, the lower end of said flexible hose detachably connected to the end of said drain outlet inside said tank, and a normally closed opening in the side-wall of said tank near the bottom thereof and in closely spaced relation to said drain outlet, said opening being so positioned as to be adjacent said upper end of said hose when said roof is in the lower portion of said tank, whereby said upper and lower ends of said flexible hose are accessible through said opening from the exterior of said tank when said roof is in said lower portion of said tank.

6. In a liquid storage tank provided with a floating roof that normally rests upon liquid in said tank, means for draining the upper surface of said roof comprising, in combination, a drain in said roof, a first rigid conduit attached to and positioned under said roof, said first conduit communicating at one end with said drain, the other end of said first conduit being at a point adjacent the periphery of said roof, a second flexible conduit having an upper end thereof detachably connected to said other end of said first conduit, said second conduit being in communication at its lower end with a region exterior

of said tank through an opening in the side wall of said tank near the bottom thereof, said opening positioned so as to be adjacent said detachable connection when said roof is lowered, whereby said detachable connection is accessible through said opening from a region exterior of said tank when said roof is in the lower portion of said tank.

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