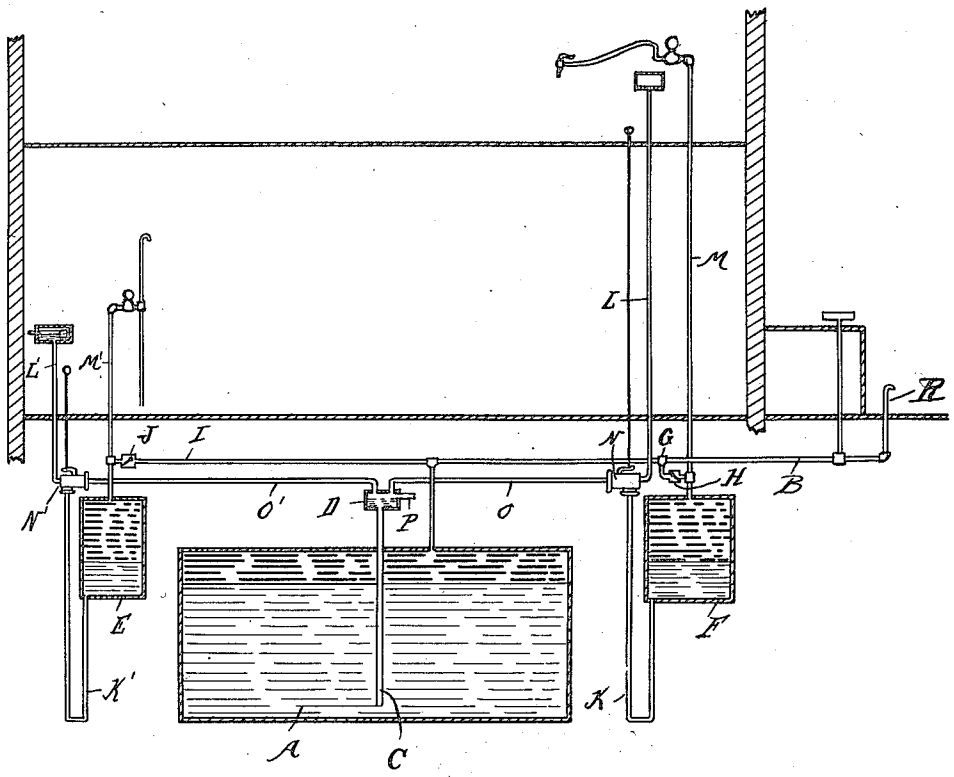
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HYDRAULIC STORAGE AND DELIVERY SYSTEM.

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1,286,972. Patented Dec. 10, 1918.



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HYDRAULIC STORAGE AND DELIVERY SYSTEM.

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To all whom it may concern:

Be it known that I, FREDERICK G. FARR, a citizen of the United States of America, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Hydraulic Storage and Delivery Systems, of which the following is a specification, reference being had therein to the accompanying drawings.

The invention relates to hydraulic systems of the type in which the fluid to be stored and delivered, such as hydrocarbon oil, is displaced by fluid of greater specific gravity, such as water. With such systems the fluid may be delivered to any height or under any pressure desired, by the provision of the necessary head or pressure on the displacement fluid. It is, however, impossible to provide sufficient head or pressure for the delivery of the fluid at one level and also to deliver to a lower level without danger of the accidental escape at the lower level through leakage of valves or other cause. Thus where handling a highly inflammable fluid, the vapor of which is explosive, the delivery at two different levels is dangerous.

It is the object of the present invention to provide for the delivery at different levels without the danger element or the possibility of placing on the oil delivered at one level the pressure head for delivery at a higher level. This I accomplish by the peculiar construction of the system as hereinafter set forth.

The drawing represents diagrammatically my improved system as designed for two different levels.

A is the storage tank, B is a conduit for filling the tank with the oil and C is a conduit for introducing the displacement fluid, which is connected to a tank D at a suitable level for producing the desired head. Instead of delivering the oil directly from the tank A the system is provided with a plurality of small tanks E F, which receive their supply from the tank A and each of which is provided with an independent displacement connection having a head suited to the level at which the oil is to be delivered.

As the auxiliary tanks E and F are of relatively small capacity it is essential to re-fill the same frequently, and it is highly desirable to accomplish this re-filling automatically. Furthermore, it is essential to prevent the pressure head of either auxiliary tank from communication with the other tank or the main storage tank, which I have accomplished as follows:

The tanks E and F are connected to the main tank by conduits connected to the top of each of said tanks for the delivery of the oil, said conduits containing check-valves which prevent flow of oil backward from the auxiliary tanks to the main tank. As shown, the filling conduit B for the main tank is connected by a conduit G containing a check-valve H with the tank F, and by a conduit I containing a check-valve J with the tank E. The auxiliary tanks are also respectively provided with water supply connections K and K′, which extend downward below the tank a sufficient distance to form a trap which will prevent displacement of oil therethrough. Water is supplied to conduits K K′ from heads L L′ suited to the elevation to which the oil is to be delivered through delivery pipes M M′, and control valves N N′ are employed for respectively connecting the conduits L L′ with the conduits K K′. The valves N N′ also control the discharge of water from the conduits K K′ when disconnected from the head conduits L L′, the discharge being led to the tank D through conduits O O′. An indicator or tell-tale pipe R is in communication with the pipe B at one end thereof.

With the construction as described, when the system is filled with oil through the conduit B it will displace the water from the main tank A through the conduit C, tank D and overflow pipe P. The pipe P is arranged at such a level with relation to the outlet of the tell-tale pipe R that the head of water in the pipe C will effect a discharge of oil through said pipe R before the oil in the tank has accumulated to such an extent that it will gain entrance to the pipe C. When the main tank is filled the auxiliary tanks will be automatically filled therefrom by the flow of oil through the conduits B, G and I, which will displace the water from the auxiliary tanks through the conduits K K′ and outer conduits O O′ into the tank D, from which the water will be discharged into the main tank A. Whenever oil is to be drawn from one of the aux-

iliary tanks, such as F, the valve N will be manipulated to connect the conduit K with the head conduit L and at the same time to disconnect the conduit K from the outlet conduit O. The pressure on the displacement fluid will therefore be raised and will cause the flow of oil through the delivery conduit M to the point of discharge. As soon as the delivery is effected the valve N will be again manipulated to close the connection between the conduits L and K and open connection between the conduits K and O. This will again permit the automatic filling of the auxiliary tank by the inlet of oil through the conduits B and G and the displacement of the water into the tank D and main tank A.

It will be noted that with this system the oil may be delivered from the auxiliary tank at the same time that the main tank is being filled. This is important as in many places the delivery cannot be interrupted long enough for the filling of the main tank, and consequently it has been the practice to provide two or more storage tanks so that one may be used while the other is being filled.

With my improved system one main storage tank is all that is required, and the auxiliary tanks may be made of relatively small capacity, only providing sufficient storage for use during the time in which the main tank is being re-filled.

My improved system is one which is particularly applicable to the conversion of an old non-displacement system into a displacement system. Thus with the hydraulic displacement systems it is usual to place beneath the tanks a trap for the water discharge, so as to prevent possibility of the oil or lighter fluid being forced out into the sewer. Where an old tank is to be used for a hydraulic system, it would be difficult to place such a trap in connection therewith, and furthermore such tanks might not be of sufficient strength to safely withstand the pressure necessary for the discharge and delivery of the fluid. With my improved system, however, the pressure on the main tank is limited without possibility of any increase. Furthermore the connections are all made through the upper end of the tank, which is accessible. Again, by placing the auxiliary tanks where they are below the level of the head for the lighter fluid and at the same time are above the level of the bottom of the main tank, and extending the members K and K′ downwardly from said auxiliary tanks so as to form traps such as are disclosed in the drawing, this will effectually prevent discharge of the lighter fluid into the receptacle D which is connected with the overflow, and thus there is no possibility of discharging the oil into the sewer.

What I claim as my invention is:

1. In a hydraulic storage and delivery system, the combination with a main tank, of means for maintaining a constant limited displacement head thereon such as to maintain a head of greater elevation for the lighter fluid, an auxiliary tank within the elevation of the head for the lighter fluid, means for intermittently placing on said auxiliary tank a displacement head greater than that upon the main tank to deliver the lighter fluid, and means for automatically connecting said auxiliary tank with said main tank upon the relief of the greater head, whereby the head of the lighter fluid from said main tank will displace the heavier fluid in said auxiliary tank into said main tank.

2. In a hydraulic storage and delivery system, the combination with a main tank, of a connection for filling said tank with a fluid of lighter specific gravity, a displacement connection for said main tank having a constant head such as to balance in said fill connection a head of greater elevation, an auxiliary tank below the elevation of the higher head, means for intermittently placing on said auxiliary tank a displacement head greater than that on said main tank, and means automatically operating upon the relief of said greater head on said auxiliary tank for discharging the displacement fluid therefrom into said main tank by the pressure of the head of said lighter fluid.

3. In a hydraulic storage and delivery system, the combination with a main tank, of a fill connection for the fluid of lighter specific gravity into said tank, a displacement connection for said tank having a constant limited head such as to balance a head of greater elevation in the fill connection, an auxiliary tank arranged below the head of greater elevation, a connection between said auxiliary tank and the upper end of the main tank, a check-valve in said connection permitting flow of fluid from the main tank to the auxiliary tank but preventing flow in reverse direction, a connection between the lower end of said auxiliary tank and the displacement connection of said main tank, and means for closing the latter connection and placing on said auxiliary tank a greater displacement head and alternately cutting off said greater head and opening said displacement connection, whereby in the latter position the head of the lighter fluid will displace the heavier fluid from said auxiliary tank into said main tank.

4. In a hydraulic storage and delivery system, the combination with a main tank, of means for maintaining on said tank a constant limited head for the heavier displace-

ment fluid, a fill connection for the lighter fluid of sufficient elevation to displace the heavier displacement fluid against its constant head, an auxiliary tank below the head of the lighter fluid, balancing the head of the heavier fluid in said main tank, a connection to the lower end of said auxiliary tank discharging slightly above the displacement head of said main tank and into said tank, a connection between the upper end of said auxiliary tank and the upper end of said main tank, a check-valve in the latter connection permitting flow of the fluid only in the direction from said main tank to said auxiliary tank, and means for intermittently closing the lower connection from said auxiliary tank and for simultaneously placing on said tank a greater displacement head, whereby upon the cutting off of said greater head and opening of the lower connection from said auxiliary tank the head of lighter fluid will force said fluid from the main tank past the check-valve into the auxiliary tank, displacing the heavier fluid therein, and the discharge of said heavier fluid into said main tank will maintain the displacement head thereof.

5. In a hydraulic storage and delivery system, the combination with a main tank, of a connection for the heavier displacement fluid, having a receptacle at the upper end thereof with an overflow connection, maintaining a constant head, a fill connection for said main tank at an elevation such as to displace the heavier fluid from the main tank into said receptacle and overflow, the head of the lighter fluid in said fill connection being at a greater elevation in said receptacle, an auxiliary tank arranged below the head of the lighter fluid, a connection from the bottom of said auxiliary tank rising slightly above said receptacle and arranged to discharge thereinto, a connection between the upper end of the main tank and the auxiliary tank having a check-valve therein permitting flow only in the direction from the main tank to the auxiliary tank, a greater displacement head for said auxiliary tank, and a valve for simultaneously closing the lower connection to said auxiliary tank and placing the same in communication with said greater head and for alternately closing off said greater head and opening said lower connection, whereby the head of the lighter fluid on said main tank will displace fluid therefrom to said auxiliary tank, and the heavier fluid in said auxiliary tank will be displaced into said receptacle to maintain a constant displacement head on said main tank.

6. In a hydraulic storage and delivery system, the combination with a main tank, of means for maintaining on said main tank a constant head of the heavier displacement fluid, a fill connection for said main tank at an elevation such as to displace the heavier fluid against its head and to maintain a balancing head of the lighter fluid at a greater elevation, a plurality of auxiliary tanks arranged below the elevation of the head of the lighter fluid, means for independently and intermittently placing on said auxiliary tanks unequal displacement head which are greater than the head on the main tank, connections between the upper ends of said auxiliary tanks and the upper end of said main tank having check-valves therein permitting flow of fluid only in a direction from the main tank toward the auxiliary tank, a connection from the lower end of each of the auxiliary tanks leading to the head for the main tank and slightly above the elevation thereof, and a controlling valve for each auxiliary tank, whereby said lower connection is closed and the greater head placed on said tank and alternately said greater head is closed and said connection is opened to permit automatic re-filling of said auxiliary tanks by the head of lighter fluid in said main tank and to displace the heavier fluid from said auxiliary tanks into said main tank.

7. In a hydraulic storage and delivery system, the combination with a main tank, of a conduit extending downward in said tank to near the bottom thereof, said conduit having a receptacle at the upper end thereof with an overflow connection, a fill connection to the upper end of said main tank in which a balancing head of the lighter fluid is maintained at an elevation higher than that of the displacement head, an auxiliary tank arranged above the bottom of said main tank and below the head of the lighter fluid, a connection to the lower end of said auxiliary tank depending therefrom to approximately the level of the bottom of the main tank and then rising to slightly above the level of said receptacle and discharging thereinto, a connection between the fill connection of said main tank and the upper end of said auxiliary tank having a check-valve therein permitting flow only in the direction from the main tank to the auxiliary tank, a greater displacement head for said auxiliary tank, and means for intermittently closing the lower connection to said auxiliary tank and placing on said tank the greater head and alternately cutting off said greater head and opening said lower connection.

8. In a hydraulic storage and delivery system, the combination with a main tank, of means for maintaining a constant limited displacement head thereon such as to maintain a head of greater elevation for the lighter fluid, an auxiliary tank within the elevation of the head for the lighter fluid,

means for intermittently placing on said auxiliary tank a displacement head greater than that upon the main tank to deliver the lighter fluid, and means for utilizing the head of the lighter fluid from the main tank to displace the heavier fluid from said auxiliary tank into said main tank subsequent to release of the auxiliary tank from the greater head.

9. In a hydraulic storage and delivery system, the combination with a main tank, of a connection for filling said tank with a fluid of lighter specific gravity, a displacement connection for said main tank having a constant head such as to balance in said fill connection a head of greater elevation, an auxiliary tank below the elevation of the higher head, means for intermittently placing on said auxiliary tank a displacement head greater than that on said main tank, and means for utilizing pressure of the head of the lighter fluid in the auxiliary tank for discharging the displacement fluid therefrom into said main tank subsequent to release of the auxiliary tank from the greater displacement head.

10. In a hydraulic storage and delivery system, the combination with a main tank, of means for maintaining, a constant limited displacement head thereon such as to maintain a head of greater elevation for the lighter fluid, an auxiliary tank within the elevation of the head for the lighter fluid, means for intermittently placing on said auxiliary tank a displacement head greater than that upon the main tank to deliver the lighter fluid, and means for automatically connecting said auxiliary tank with said main tank upon the relief of the greater head, whereby the head of the lighter fluid from said main tank will displace the heavier fluid in said auxiliary tank therefrom.

11. In a hydraulic storage and delivery system, the combination with a main tank, of a connection for filling said tank with a fluid of lighter specific gravity, a displacement connection for said main tank having a constant head such as to balance in said fill connection a head of greater elevation, an auxiliary tank below the elevation of the higher head, means for intermittently placing on said auxiliary tank a displacement head greater than that on said main tank, and means automatically operating upon the relief of said greater head on said auxiliary tank for discharging the displacement fluid therefrom by the pressure of the head of said lighter fluid.

12. In a hydraulic storage and delivery system, the combination with a main tank, of means for maintaining on said main tank a constant head of the heavier displacement fluid, a fill connection for said main tank at an elevation such as to displace the heavier fluid against its head and to maintain a balancing head of lighter fluid at a greater elevation, a plurality of auxiliary tanks arranged below the elevation of the head of the lighter fluid, means for independently and intermittently placing on said auxiliary tanks unequal displacement heads which are greater than the head on the main tank, and means for automatically connecting each of said auxiliary tanks with said main tank upon release of the displacement head corresponding to said auxiliary tank, whereby the head of the lighter fluid from said main tank will displace the heavier fluid in either auxiliary tank therefrom.

In testimony whereof I affix my signature.

FREDERICK G. FARR.