May 2, 1933. C. F. BECKWITH 1,906,834

OVERHEAD STORAGE TANK

Filed May 1, 1931 2 Sheets-Sheet 1

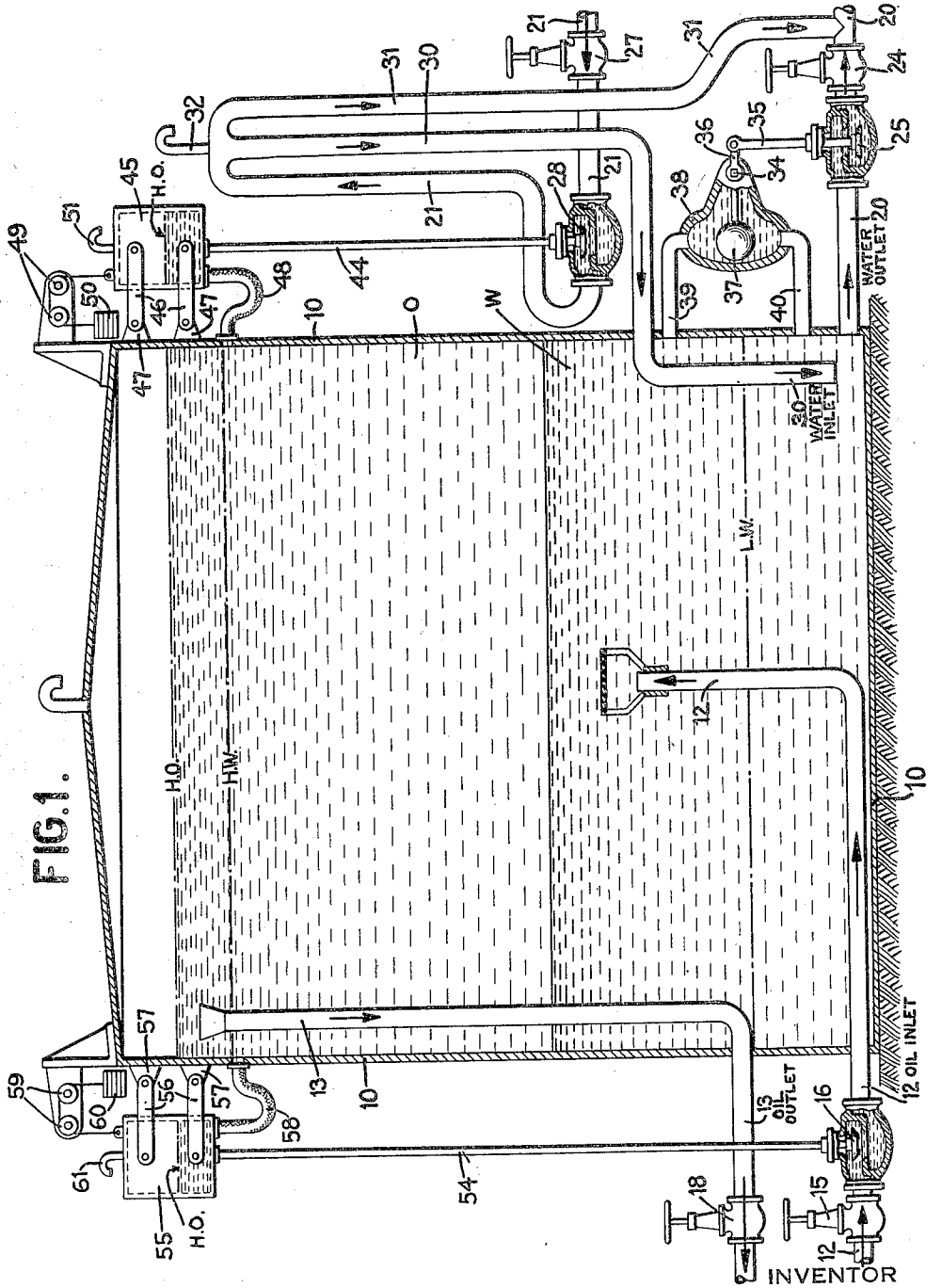

FIG. 1.

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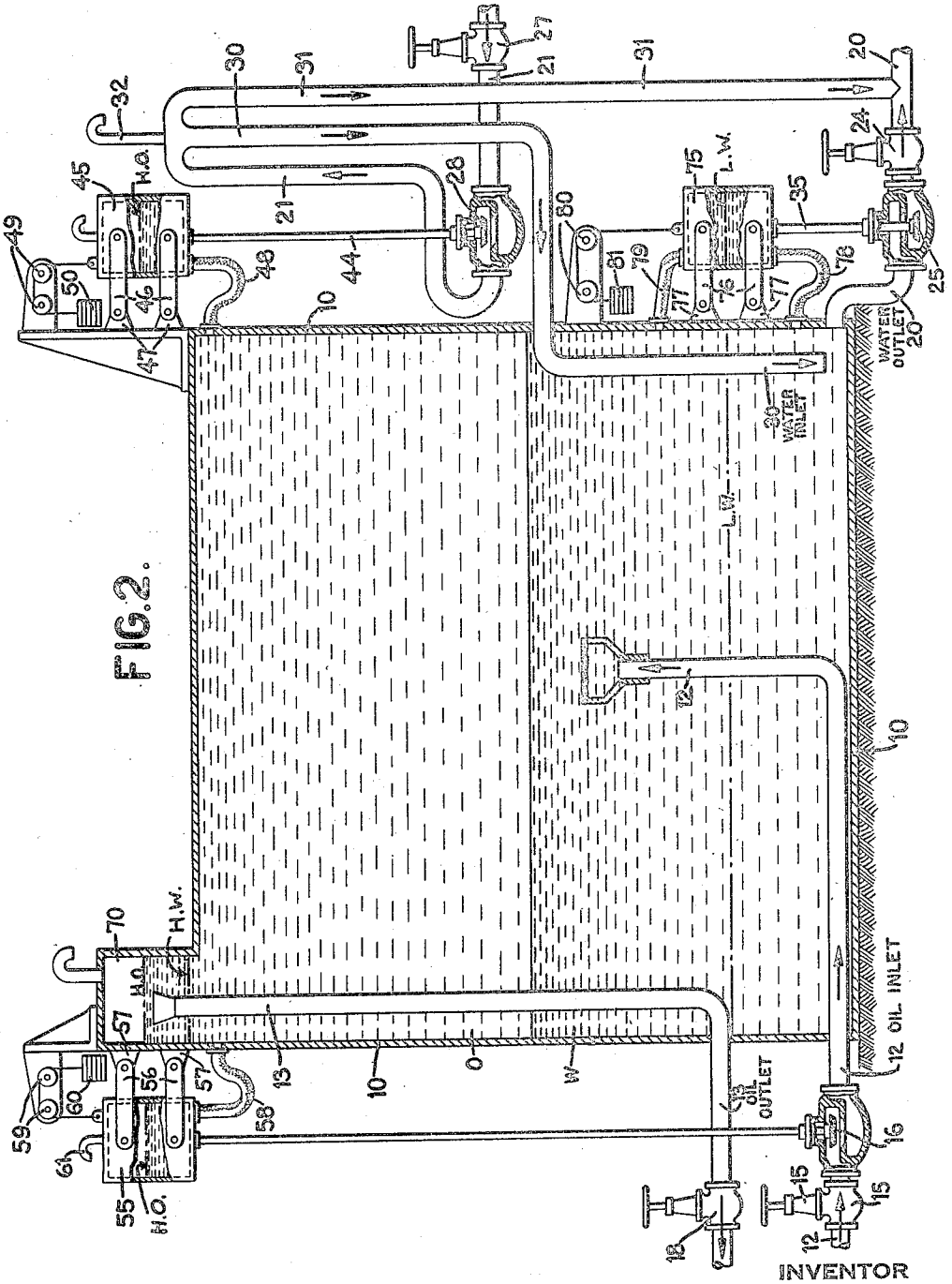

FIG. 2.

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Patented May 2, 1933

1,906,834

UNITED STATES PATENT OFFICE

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OVERHEAD STORAGE TANK

Application filed May 1, 1931. Serial No. 534,276.

This invention pertains to a liquid storage system in which stored liquid as oil is hydraulically floated or displaced in and/or from a tank or reservoir by a displacement liquid as water with which the stored liquid is immiscible and upon which the stored liquid floats. The invention more particularly pertains to automatic mechanism for controlling the inflow or outflow of both the stored liquid and displacement liquid so that the latter cannot recede so low that the stored liquid can be drawn out and wasted from the displacement liquid drain or outlet, and further the automatic control means prevents the displacement liquid rising above the stored liquid outlet and being withdrawn from the tank with the stored liquid.

It is an object of the invention to provide a liquid storage system in which automatic means are provided for preventing the displacement liquid from exceeding a predetermined high level within the tank and to prevent the displacement liquid from receding below a predetermined low level in the tank, as well as for preventing the level of the stored liquid from exceeding a predetermined height in the tank whether the level of the stored liquid in the tank is being raised by the inflow of displacement liquid or whether it is being raised as a result of the filling of the tank with the stored liquid.

Other objects of the invention will be more apparent from the following description taken in connection with the accompanying drawings showing preferred embodiments thereof, in which:

Figure 1 is a section through the storage reservoir or tank showing the stored liquid and the displacement liquid therein with the automatic mechanism for controlling the levels of these two liquids in the tank, in which the displacement liquid is flowing into the tank to raise the level of the oil or stored liquid, and with various other parts such as the float box and a container also in section.

Figure 2 shows another example of the invention and is a section through a storage tank having an outlet box at the top within which the liquid level is maintained by the control means and within which the storage liquid outlet is located. A balanced container also controls the low water level for the tank, whereas in the first view a float performs this function.

In hydraulic storage systems, such as that to be described herein, the displacement liquid is preferably water because of its high specific gravity and because it is immiscible with the stored liquids, such as gasoline and oils which float on water. Liquids other than water are, of course, contemplated by the invention for the displacement liquid and liquids other than oil may be stored provided the two liquids do not substantially mix and provided the stored liquid floats on the displacement liquid. Similarly, the invention contemplates more than two liquids in such cases where the stored liquid is miscible with water or the displacement liquid to be used and another liquid be resorted to to form a liquid partition between the two miscible liquids. In the interest of convenience and brevity, the displacement liquid will be termed water hereinafter and the stored liquid will be termed oil.

It is economical in such storage systems to provide automatic means to prevent the displacement liquid or water from receding below a predetermined low level in the tank since there is danger or possibility that the stored liquid or oil carried thereupon would be wasted down the water outlet which usually leads to a waste drain with the displacement liquid. Again it is desirable that the water shall not rise to such a level that it may be drawn or drained out through the stored liquid or oil outlet with the oil. This means that the water must be controlled so that it cannot rise above the oil outlet as will be described hereinafter.

Automatic means are also provided to prevent the stored liquid or oil from exceeding a predetermined high level inasmuch as the stored liquid would then be wasted out of a vent provided at the top of the tank. In the hydraulic storage systems, such as that to be disclosed herein, the excessively high level of oil may result through two causes, namely, the excessive feeding in of water so long as the top level of the displacement liquid or

water is not at its predetermined maximum level, or it may be caused by the excessive feeding-in of the oil itself. In order to avoid such waste, the storage system is provided with automatic means to control both the inflow and outflow of the water and the inflow of the oil and also provides means to prevent the level of the water from exceeding a predetermined high level.

The storage tank or reservoir 10, shown in the accompanying sheets of drawings, stores the oil O which may be oil of any sort including gasoline and petroleum oils which are immiscible with the water W and float thereupon. The displacement water W is preferably used as a displacement liquid because of its high specific gravity, its immiscibility with the liquids to be stored and because it is the most readily obtained and least expensive liquid. The storage tank 10 is provided with an oil inlet 12 and an oil outlet 13, the latter reaching into the tank at a point relatively near the top thereof. The oil inlet 12 includes a manually controlled valve 15 and an automatically controlled valve 16 whereas the oil outlet 13 includes only a manually controlled valve 18. It is clear that a single pipe may be utilized as both inlet or outlet if desired.

In addition to the oil inlet 12 and outlet 13, the tank 10 has also a water outlet connection 20 which is connected to the tank adjacent its bottom and a water inlet connection 21. The water outlet connection 20 is provided with a manually controlled valve 24 and an automatically controlled valve 25. The water inlet connection 21 is also provided with a manually controlled valve 27 and an automatically controlled valve 28. The water inlet connection 21 may be connected in any manner with the tank, but in the preferred construction it connects at the top of an overflow pipe 30 which pipe is connected to the tank 10 at its bottom and extends at a predetermined height with respect to the tank 10 for a purpose to be described. The water W, therefore, in flowing into the tank 10 passes through the valves 27 and 28 and the inlet connection 21 into the top of and through the overflow pipe 30 to the tank. The top of the overflow pipe 30 is connected with an overflow discharge outlet 31 leading to the water outlet connection 20 at a point outside of the valves 24 and 25 so that the water will always have an unobstructed outlet to the drain or to a water storage reservoir. A vent 32 connects the top of the overflow pipe 30 with the atmosphere.

As previously described, the water outlet connection 20 is provided with an automatically actuated valve 25 to close the water outlet 20 when the water reaches the low level LW. The valve 25 is carried upon a valve stem 35 pivotally connected to an arm 36. The arm is mounted upon a pivot 34 pivotally carried in the side walls of a float box 38 within which a float 37 is provided and carried upon the pivot 34. The float box 38 is connected with the tank 10 through the connecting pipes 39 and 40 one of which leads into the top of the float box and the other leads into the bottom in order to prevent air or gases from being pocketed therein. The float 37 is so adjusted that it floats in the heavier water W but sinks in the lighter oil O. The liquids in the tank reach the float box 38 through the connections 39 and 40 between the float box and the tank 10 and the float 37 is controlled by the water within the tank to automatically open or close the valve 25.

The water inlet connection 21 has been previously described as including an automatically controlled valve 28. The valve 28 is carried upon a valve stem 44 which stem is in turn attached to a container 45 located near the top of the tank. The container 45 is carried upon parallel links 46 which are pivoted to the container and pivoted upon the brackets 47 carried upon the tank 10 or other structure thereby enabling the container to move up and down as will be described in more detail hereinafter. A flexible connection 48 connects the tank 10 with the container 45 so that the liquids within the tank may flow into the container 45 through the flexible connection and yet permit the container to rise or fall, as will be described.

The container 45 is balanced in position upon its links 46 by a cable passing over a system of pulleys 49 and having counterbalancing weights 50 attached to the end of the cable. The counterbalancing weights 50 are so adjusted that the container 45 is raised when the liquids within the container are at a predetermined height therein and consequently, at a predetermined height in the tank 10. When the liquids in the container 45 and consequently in the tank 10 exceed this predetermined height, the additional weight of the liquid within the container 45 overbalances the counterweights 50 and the container 45 drops to close the valve 28. Upon the level of the liquid in the container 45 and tank 10 falling below the predetermined level, the weight of liquid in the container is reduced and the counterweights raise the container which opens the valve 28 controlled thereby. A vent 51 prevents the pocketing of gas or air within the container.

The automatic valve 16 in the oil inlet 12 is controlled by similar mechanism to that described for the automatic valve 28. The valve 16 is carried upon a valve stem 54 which is secured to a container 55 located at the top of the tank 10 and carried upon the parallel links 56 which are pivoted to the container and pivotally mounted upon the brackets 57 secured to the tank 10 or other

structure. A flexible tube or connection 58 connects the interior of the container 55 with the tank 10 so that the liquids in the tank may flow thereinto and yet permit the container to rise and fall. The container 55 is maintained in raised position by a cable passing over a system of pulleys 59 and counterweights 60 attached to the other end of the cable. The counterweights 60 are so adjusted that when the liquid within the container 55 reaches a predetermined level and consequently the level of the liquid within the tank 10 is at the same level, the additional weight of the liquid within the container 55 overbalances the counterweights 60 and the container drops to close the valve 16. The container 55 carries a vent 61 to provide an outlet for gases or air which may otherwise enter and pocket in the container and prevent the liquid from rising to the same level as the level of the liquid in the tank. It will be observed that the containers 45 and 55 and their associated mechanism are identical and function in the same manner and at the same time so that one container may well control both the oil inlet valve and the water inlet valve.

In the operation of the storage system, the tank 10 is initially empty so that the container 45 is in its upper position and the automatic valve 28, which the container controls in the water inlet connection 21, is open. The manually controlled valve 27 in the water inlet connection is then opened and water flows into the tank 10 through the water inlet connection 21, the manually controlled valve 27, the automatic valve 28 and down through the overflow 30, as shown by the arrows and into the tank 10. The level of the water W in the tank rises until it reaches the high level HW in the tank, at which level the water W is also at the top of the overflow 30 which determines the high level HW for the water. The water W when it reaches the level HW in the tank passes over the overflow 30 and into the discharge pipe 31 to the water outlet connection 20 and then to the waste drain or a water storage reservoir. It will be observed therefore that the level of the water W cannot exceed the level determined by the height of the overflow 30 which corresponds with the level HW in the tank. Upon the water flowing into the discharge pipe 31 and through the water outlet connection 20 to the waste drain, the manually controlled valve 27 in the water inlet connection 21 is closed.

With the tank 10 filled with water, the water has entered into the float chamber 38 through the pipes 39 and 40 and the float 37 floats therein and opens the automatic valve 25 in the water outlet connection 20. The manually controlled valve 24 however is closed so that the opening of the automatic valve 25 is without effect. At this point the tank 10 is ready to be filled with oil O whereupon the manually controlled valve 15 in the stored liquid inlet 12 is opened and the manually controlled valve 24 in the water outlet connection 20 is also opened. The container 55 is in its uppermost position since there is no liquid within the container 55 or not sufficient liquid to overbalance the container and counterweights, and the automatic valve 16 is open in the oil inlet 12 so that the oil O can flow into the tank. In this stage of the operation of the liquid storage system, the oil O flows into the tank through the oil inlet 12 and the water W flows out of the tank through the water outlet connection. The level of the water W continues to fall as the water drains out of the tank 10 until the level LW is reached.

As previously described, the float 37 sinks in oil O and only floats upon the water W so that when the oil or water level sinks below the float 37, the float sinks and closes the automatic valve 25 and no further outflow of water can take place through the water outlet connection 20. It is clear therefore that if the water W cannot recede below the level LW, it will be impossible for the oil O to be wasted out of the water outlet connection 20.

The oil continues to flow into the tank 10 through the oil inlet 12 until the level of the oil reaches the level HO in the tank and a corresponding level in the container 55. At this level, the oil in the container 55 overbalances the counterweights 60 so that the container 55 sinks and automatically closes the valve 16 and no further oil can enter the tank through the oil inlet 12. Upon closing of the automatic valve 16 the manually controlled valve 15 in the oil inlet and valve 24 in the water outlet connection are closed and the tank is filled with oil O.

For the purpose of discussion to show that the mechanism described is wholly automatic, let it be assumed that the oil O flows into the storage tank 10 through the oil inlet 12 at a faster rate than the water W flows out of the tank through the water outlet connection 20. Under such circumstances, the oil will reach the level HO in the tank 10 and the level of the liquid in the container 55 corresponds with the level in the tank since the liquid flows into the container through the flexible connection 58. The added weight of the oil O overbalances the counterweights 60 so that the container 55 sinks and closes the valve 16. Obviously, the further inflow of oil is stopped. The water W, however, continues to flow out of the water outlet connection 20 and consequently, the level of the liquid within the tank and also within the container 55 falls below the level HO thereby lightening the weight of the container and the liquid therein and the counterweights 60 function to raise the container 55 and open the automatic valve 16 so that the oil may

again flow into the tank through the stored liquid inlet 12.

It is clear that the above described closing and opening of the automatic valve 16 may continue any number of times until the level of the water W reaches the low level LW, whereupon the float 37 sinks and automatically closes the valve 25 so that the water can no longer flow out through the water outlet connection 20. After this has occurred, the oil again reaches the level HO whereupon the container 55 is filled with liquid and sinks to close the valve 16 which remains closed until the conditions are manually changed as will be discussed. At this point in the process of filling the tank with oil O the manual valve 15 in the oil inlet 12 and the manual valve 24 in the water outlet connection 20 are closed. It might be mentioned that throughout the filling of the tank with oil, the container 45 rises and falls with the container 55 to open and close the valve 28 in the water inlet connection 21. It should be further noted, however, that the manual valve 27 in the water inlet connection 21 has been closed as previously mentioned, so that the opening and closing of the automatic valve 28 has no effect upon the liquids within the tank and water does not flow therein so long as the manual valve 27 is closed.

When the tank 10 is filled with oil O as above described, the container 45 is also filled with liquid so that the counterweight 50 is overbalanced and the container 45 sinks to close the valve 28 in the water inlet connection 21 at substantially the same time that the container 55 sinks to close the valve 16. The manually controlled valve 27 in the water inlet connection 21 is then opened and the liquid storage system is ready for the withdrawal of the oil O from the tank. In order to withdraw the oil from the tank 10, the manually controlled valve 18 in the oil outlet 13 is opened and the oil flows out by gravity or suction through this pipe line. The oil O flowing out of the tank lowers the level of the liquid therein so that the liquid flows out of the container 55 which is raised by the counterweights 60 which in turn opens the valve 16. As previously described, however, after the tank has been filled with oil, the manually controlled valve 15 in the oil inlet 12 has been closed so that this opening of the automatic valve 16 has no effect.

The oil O also flows out of the container 45 as previously discussed, and the counterweights 50 raise the container 45 and open the automatic valve 28 in the water inlet connection 21. The manually controlled valve 27 has already been opened so that as the automatic valve 28 opens, the water flows into the tank through the water inlet connection 21 and the overflow pipe 30 to keep the level of the oil O above the top of the oil outlet 13. If now sufficient oil has been withdrawn from the tank the valve 18 is closed whereupon the level of the liquid within the tank rises as the water W flows into the tank until the liquid enters the container 45 which sinks and closes the automatic valve 28 thereby cutting off the inflow of water. This series of operations continue to function every time that oil is withdrawn from the tank upon opening of the valve 18 until the level of the water reaches the level HW. When the water W reaches this level, the overflow pipe 30 is filled with water and the water then flows from the water inlet connection 21 over the overflow 30 and down the discharge pipe 31 into the water outlet connection 20 as described above. When this occurs, it is apparent to the operator that all of the oil has been withdrawn from the tank whereupon the manually controlled valve 27 is closed and the tank may again be filled with oil in the manner previously described.

In Figure 2 essentially the same storage system is shown as in Figure 1 with certain differences in tank construction and water outlet valve control mechanism which will be described. The tank 10 is provided with a stored liquid outlet box 70 at its top and the level of the liquid in the tank is maintained within the box so that the volume of air space at the top of the tank is materially reduced which results in a material reduction in the loss of oil from evaporation and tank breathing. The oil outlet 13 necessarily extends upwardly into the box 70 since the oil level is maintained therein and the control containers 45 and 55 are so positioned that the level of the liquids is kept within the box.

Instead of providing a float as in Figure 1 to control the water outlet valve 25 so that the water cannot recede below the low water level LW, a balanced container 75 is utilized in place thereof and secured to the valve stem 35. The container is carried upon parallel links 76 which are pivoted to the container and also pivotally carried upon the brackets 77 carried by the tank 10. Flexible connections 78 and 79 connect the container 75 at the bottom and top thereof respectively with the tank 10. The liquid levels within the tank will exist also within the container, that is, within the limits of the container's vertical height or dimension. The container is counterbalanced by a cable attached thereto and passing over pulleys 80. Counterbalancing weights 81 are carried on the other end of the cable which weights are so selected or adjusted that when the level of water is above the low water level LW, the weight of the water or water and oil in the container 75, in addition to the weight of the container, overbalances the weights 81 and maintains the valve 25 open. It will be seen therefore that a container similar to the containers con-

trolling the other valves may be used also to control the water outlet valve.

The storage system shown in Figure 2 operates in the same manner as that shown in Figure 1. The containers 45 and 55 operate the respective valves 16 and 28 in the same manner and hence will not be described with respect to the construction shown in Figure 2. The container 75 when the tank 10 is filled with water overbalances the counterweights 81 and drops thereby opening the water outlet valve 25. Since manual valve 24 is closed excepting when the tank is being filled with oil, the opening of valve 25 at any other time is without effect. In filling the tank with oil after the tank is filled with water and then allowed to flow out of the tank as described in the operation of the construction of Figure 1, the water level drops below the flexible connection 79 at the top of the container 75 and the lighter oil will enter the container until the low water level is reached. At this level the weight of the container including the liquids has been reduced by the flowing in of lighter oil in place of the heavier water which results in the weights 81 overbalancing the container and its liquid contents which automatically raises the container and closes the water outlet valve 25. The manual valve 24 in the water outlet pipe 20 is then closed so that when water is fed into the tank 10 in order to discharge oil therefrom, the opening of valve 25 because of container 75 filling with the heavier water and dropping, will have no effect upon the storage system at any other time than when filling the tank with oil.

The storage system functions to automatically prevent the water from exceeding a predetermined high level HW and from receding below a predetermined low level LW as well as to automatically control the inflow of both oil and water so that the level of the stored liquid or oil cannot exceed the predetermined high level HO. The control means for the water or displacement liquid also automatically opens the valve 28 to feed water into the tank whenever the oil level drops below the level HO and thereby maintains the level of the oil at all times above the oil outlet 13 excepting when the water reaches its high level HW. It will be seen therefore that the storage system described herein is completely automatic. In addition, the system operates so that the liquid is maintained substantially at a predetermined level in the tank during liquid transference and consequently tank breathing or inhaling and exhaling of stored liquid vapors as a result of liquid transference is substantially eliminated. Similarly, a manual valve has been provided in each inlet or outlet in which there is an automatically controlled valve and it is clear that the automatic mechanism for the automatic valves may be rendered inoperative in closed position when desired and the manually controlled valves may then be dispensed with.

What is claimed is:

1. A liquid storage system comprising a tank, a stored liquid inlet and a stored liquid outlet for the tank, a valve in the inlet and a valve in the outlet, a displacement liquid inlet connection and a displacement liquid outlet connection made with the tank, a valve in the inlet connection, a valve in the outlet connection, means controlling the valves in the inlet and outlet connections to prevent the draining off of displacement liquid when it reaches a predetermined low level in the tank and to admit displacement liquid when the stored liquid level falls therein including a container for operating the displacement liquid inlet valve, a container for operating the stored liquid inlet valve, means mounting the containers at the top of the tank for movement in relation to the storage tank when the level of liquid therein varies from a predetermined level, means to convey liquid from the storage tank to the movable containers, and operating connections between the movable containers and the respective valves.

2. A liquid storage system comprising a tank, a stored liquid outlet box at the top of the tank, a stored liquid outlet projecting into the box, a stored liquid inlet for the tank, a valve in the inlet and a valve in the outlet, a displacement liquid inlet connection and a displacement liquid outlet connection made with the tank, a valve in the inlet connection, a valve in the outlet connection, means controlling the valves in the inlet and outlet connections to prevent the draining off of displacement liquid when it reaches a predetermined low level in the tank and to admit displacement liquid when the stored liquid level falls therein including a container positioned on a level with the outlet box for operating the displacement liquid inlet valve, a container positioned on a level with the outlet box for operating the stored liquid inlet valve, means mounting the containers at the top of the tank for movement in relation to the storage tank when the level of liquid therein varies from a predetermined level, means to convey liquid from the storage tank to the movable containers, and operating connections between the movable containers and the respective valves.

3. A liquid storage system comprising a tank, a stored liquid inlet and a stored liquid outlet for the tank, a valve in the inlet and a valve in the outlet, a displacement liquid inlet connection and a displacement liquid outlet connection made with the tank, a valve in the inlet connection, a valve in the outlet connection, means controlling the valves in the inlet and outlet connections to prevent the draining off of displacement liquid when

it reaches a predetermined low level in the tank and to admit displacement liquid when the stored liquid level falls in the tank including a container for operating the displacement liquid inlet valve, a container for operating the stored liquid inlet valve, parallel links pivoted to the containers and to the tank adjacent the top thereof for movement of the containers relatively to the tank, counterweight means connected to the containers to balance the containers and liquid therein when at a predetermined level, means to convey liquid from the storage tank to the movable containers, and operating connections between the movable containers and the respective valves.

4. A liquid storage system comprising a tank, a stored liquid inlet and stored liquid outlet for the tank, a valve in the inlet and a valve in the outlet, a displacement liquid inlet connection and a displacement liquid outlet connection made with the tank, a valve in the inlet connection, a valve in the outlet connection, means controlling the valves in the inlet and outlet connections to prevent the draining off of displacement liquid when it reaches a predetermined low level in the tank and to admit displacement liquid when the stored liquid level falls in the tank, a container for operating the stored liquid inlet valve, a container for operating the displacement liquid inlet valve, parallel links pivoted to the containers and to the tank adjacent the top thereof for movement of the containers relatively to the tank, counterweight means connected to the containers to balance the containers and liquid therein when at a predetermined level, a flexible connection between the tank and each container to convey liquid from the storage tank to the movable containers, and operating connections between the movable containers and the respective valves.

5. A liquid storage system comprising a storage tank, a stored liquid inlet for the tank, a stored liquid outlet for the tank adjacent the top thereof, a valve in the outlet and a valve in the inlet, a displacement liquid inlet connection made with the tank, a displacement liquid outlet connection made with the tank adjacent the bottom thereof, a valve in each displacement liquid connection, an overflow having a connection within the tank adjacent the bottom thereof and extending upward to a predetermined height to prevent the level of the displacement liquid from exceeding a predetermined high level in the tank, a movable container at the top of the tank connected to the valve in the displacement liquid inlet connection and controlled by the level of the stored liquid in the tank to automatically open the valve in the displacement liquid inlet connection so that displacement liquid flows into the tank and maintains the stored liquid at a predetermined level, a movable container at the top of the tank connected to the valve in the stored liquid inlet connection to automatically close the valve upon the stored liquid in the tank reaching a predetermined level, and flexible connections between each container and the tank.

6. A liquid storage system comprising a storage tank, a stored liquid inlet for the tank, a stored liquid outlet for the tank adjacent the top thereof, a valve in the inlet and the outlet, a displacement liquid inlet connection made with the tank, a displacement liquid outlet connection made with the tank adjacent the bottom thereof, a valve in each displacement liquid connection, means controlling the valve in the displacement liquid outlet connection to prevent the displacement liquid from receding below a predetermined low level, an overflow having a connection within the tank adjacent the bottom thereof and extending upward to a predetermined height to prevent the level of displacement liquid from exceeding a predetermined high level in the tank, a movable container at the top of the tank connected to the valve in the displacement liquid inlet connection and controlled by the level of the stored liquid in the tank to automatically open the valve in the displacement liquid inlet connection so that displacement liquid flows into the tank and maintains the stored liquid at a predetermined level, a movable container at the top of the tank connected to the valve in the stored liquid inlet connection to automatically close the valve upon the stored liquid in the tank reaching a predetermined level, and flexible connections between each container and the tank.

7. A liquid storage system comprising a storage tank, a stored liquid inlet for the tank, a stored liquid outlet for the tank adjacent the top thereof, a valve in the stored liquid outlet and a valve in the inlet, an upwardly extending overflow pipe having a connection within the tank adjacent the bottom thereof and having an outlet at a predetermined height to prevent the level of displacement liquid from rising in the tank to a level above the outlet in the overflow pipe, a displacement liquid inlet connection made with the overflow pipe adjacent to the outlet, a displacement liquid outlet connection made with the tank, a valve in each displacement liquid connection, a movable container at the top of the tank connected to the valve in the displacement liquid inlet connection and controlled by the level of the stored liquid in the tank to automatically open the valve in the displacement liquid inlet connection so that displacement liquid flows into the tank and maintains the stored liquid at a predetermined level, a movable container at the top of the tank connected to the valve in the stored liquid inlet connection to automati-

cally close the valve upon the stored liquid in the tank reaching a predetermined level, and flexible connections between each container and the tank.

8. A liquid storage system comprising a storage tank, a stored liquid inlet to the tank, a stored liquid outlet for the tank adjacent the top thereof, a valve in the stored liquid inlet and a valve in the outlet, a displacement liquid inlet connection made with the tank, a displacement liquid outlet connection made with the tank adjacent the bottom thereof, a valve in each displacement liquid connection, means to prevent the level of displacement liquid from exceeding a predetermined high level in the tank, means connected to the valve in the displacement liquid inlet connection and controlled by the level of the stored liquid in the tank to automatically open the valve in the displacement liquid inlet connection so that displacement liquid flows into the tank and maintains the stored liquid at a predetermined level, and means connected to the valve in the stored liquid inlet connection to automatically close the valve upon the stored liquid in the tank reaching a predetermined level.

9. A liquid storage system comprising a storage tank, a stored liquid inlet for the tank, a stored liquid outlet for the tank adjacent the top thereof, a valve in the stored liquid inlet and a valve in the outlet, a displacement liquid inlet connection made with the tank, a displacement liquid outlet connection made with the tank adjacent the bottom thereof, a valve in each displacement liquid connection, means controlling the valve in the displacement liquid outlet connection to prevent the displacement liquid from receding below a predetermined low level, means to prevent the level of displacement liquid from exceeding a predetermined high level in the tank, means connected to the valve in the displacement liquid inlet connection and controlled by the level of the stored liquid in the tank to automatically open the valve in the displacement liquid inlet connection so that displacement liquid flows into the tank and maintains the stored liquid at a predetermined level, and means connected to the valve in the stored liquid inlet connection to automatically close the valve upon the stored liquid in the tank reaching a predetermined level.

10. A liquid storage system comprising a storage tank, a stored liquid inlet for the tank, a stored liquid outlet for the tank adjacent the top thereof, a valve in the stored liquid outlet and a valve in the inlet, a displacement liquid inlet connection made with the tank, a displacement liquid outlet connection made with the tank adjacent the bottom thereof, a valve in each displacement liquid connection, an overflow having a connection within the tank adjacent the bottom thereof and extending upward to a predetermined height to prevent the level of displacement liquid from exceeding a predetermined high level in the tank, means connected to the valve in the displacement liquid inlet connection and controlled by the level of the stored liquid in the tank to automatically open the valve in the displacement liquid inlet connection so that displacement liquid flows into the tank and maintains the stored liquid at a predetermined level, and means connected to the valve in the stored liquid inlet connection to automatically close the valve upon the stored liquid in the tank reaching a predetermined level.

11. A liquid storage system comprising a storage tank, a stored liquid inlet for the tank, a stored liquid outlet for the tank adjacent the top thereof, a valve in the inlet and a valve in the outlet, a displacement liquid inlet connection made with the tank, a displacement liquid outlet connection made with the tank adjacent the bottom thereof, a valve in each displacement liquid connection, means controlling the valve in the displacement liquid outlet connection to prevent the displacement liquid from receding below a predetermined low level, an overflow having a connection within the tank adjacent the bottom thereof and extending upward to a predetermined height to prevent the level of displacement liquid from exceeding a predetermined high level in the tank, means connected to the valve in the displacement liquid inlet connection and controlled by the level of the stored liquid in the tank to automatically open the valve in the displacement liquid connection so that displacement liquid flows into the tank and maintains the stored liquid at a predetermined level, and means connected to the valve in the stored liquid inlet connection to automatically close the valve upon the stored liquid in the tank reaching a predetermined level.

12. A liquid storage system comprising a storage tank, a stored liquid inlet for the tank, a stored liquid outlet for the tank adjacent the top thereof, a valve in the stored liquid outlet and a valve in the inlet, a displacement liquid outlet connection made with the tank adjacent the bottom thereof, an upwardly extending overflow pipe having a connection within the tank adjacent the bottom thereof and having an outlet at a predetermined height to prevent the level of displacement liquid from raising in the tank to a level above the outlet in the overflow pipe, a displacement liquid inlet connection made with the tank, a valve in each displacement liquid connection, means connected to the valve in the displacement liquid inlet connection and controlled by the level of the stored liquid in the tank to automatically open the valve in the displacement liquid in-

let connection so that displacement liquid flows into the tank and maintains the stored liquid at a predetermined level, and means connected to the valve in the stored liquid inlet connection to automatically close the valve upon the stored liquid in the tank reaching a predetermined level.

13. A liquid storage system comprising a storage tank, a stored liquid inlet for the tank, a stored liquid outlet for the tank adjacent the top thereof, a valve in the stored liquid outlet and a valve in the inlet, a displacement liquid outlet connection made with the tank adjacent the bottom thereof, an upwardly extending overflow pipe having a connection within the tank adjacent the bottom thereof and having an outlet at a predetermined height to prevent the level of displacement liquid from raising in the tank to a level above the outlet in the overflow pipe, a displacement liquid inlet connection made with the overflow pipe adjacent to the outlet, a valve in each displacement liquid connection, means connected to the valve in the displacement liquid inlet connection and controlled by the level of the stored liquid in the tank to automatically open the valve in the displacement liquid inlet connection so that displacement liquid flows into the tank and maintains the stored liquid at a predetermined level, and means connected to the valve in the stored liquid inlet connection to automatically close the valve upon the stored liquid in the tank reaching a predetermined level.

14. A liquid storage system comprising a storage tank, a stored liquid inlet for the tank, a stored liquid outlet for the tank adjacent the top thereof, a valve in the stored liquid outlet and a valve in the inlet, a displacement liquid outlet connection made with the tank adjacent the bottom thereof, an upwardly extending overflow pipe having a connection within the tank adjacent the bottom thereof and having an outlet at a predetermined height to prevent the level of displacement liquid from raising in the tank to a level above the outlet in the overflow pipe, a displacement liquid inlet connection made with the overflow pipe adjacent to the outlet, a valve in each displacement liquid connection, a discharge pipe connecting the outlet for the overflow pipe to the displacement liquid outlet connection beyond the valve therein, means connected to the valve in the displacement liquid inlet connection and controlled by the level of the stored liquid in the tank to automatically open the valve in the displacement liquid inlet connection so that displacement liquid flows into the tank and maintains the stored liquid at a predetermined level, and means connected to the valve in the stored liquid inlet connection to automatically close the valve upon the stored liquid in the tank reaching a predetermined level.

15. A liquid storage system comprising a tank, a stored liquid inlet and a stored liquid outlet for the tank, a valve in the inlet and a valve in the outlet, a displacement liquid inlet connection and a displacement liquid outlet connection made with the tank, a valve in the inlet connection, a valve in the outlet connection, means controlling the valves in the inlet and outlet connections to prevent the draining off of displacement liquid when it reaches a predetermined low level in the tank and to admit displacement liquid when the stored liquid level falls therein including a container for operating the displacement liquid inlet valve, a container for operating the stored liquid inlet valve, means mounting the containers at the top of the tank for movement in relation to the storage tank when the level of liquid therein varies from a predetermined level, a third container for the displacement liquid outlet valve, means mounting the third container at the bottom of the tank for movement in relation to the storage tank, means to convey liquid from the storage tank to the movable containers, and operating connections between the movable containers and the respective valves.

16. A liquid storage system comprising a tank, a stored liquid inlet and a stored liquid outlet for the tank, a valve in the inlet and a valve in the outlet, a displacement liquid inlet connection and a displacement liquid outlet connection made with the tank, a valve in the inlet connection, a valve in the outlet connection, means controlling the valves in the inlet and outlet connections to prevent the draining off of displacement liquid when it reaches a predetermined low level in the tank and to admit displacement liquid when the stored liquid level falls in the tank including a container for operating the displacement liquid inlet valve, a container for operating the stored liquid inlet valve, parallel links pivoted to the containers and to the tank adjacent the top thereof for movement of the containers relatively to the tank, a third container, parallel links pivoted to the containers and to the tank adjacent the bottom thereof for movement of the container relatively to the tank, counterweight means connected to the containers to balance the containers and liquid therein when at a predetermined level, means to convey liquid from the storage tank to the movable containers, and operating connections between the movable containers and the respective valves.

In testimony whereof I affix my signature.

CHARLES F. BECKWITH.