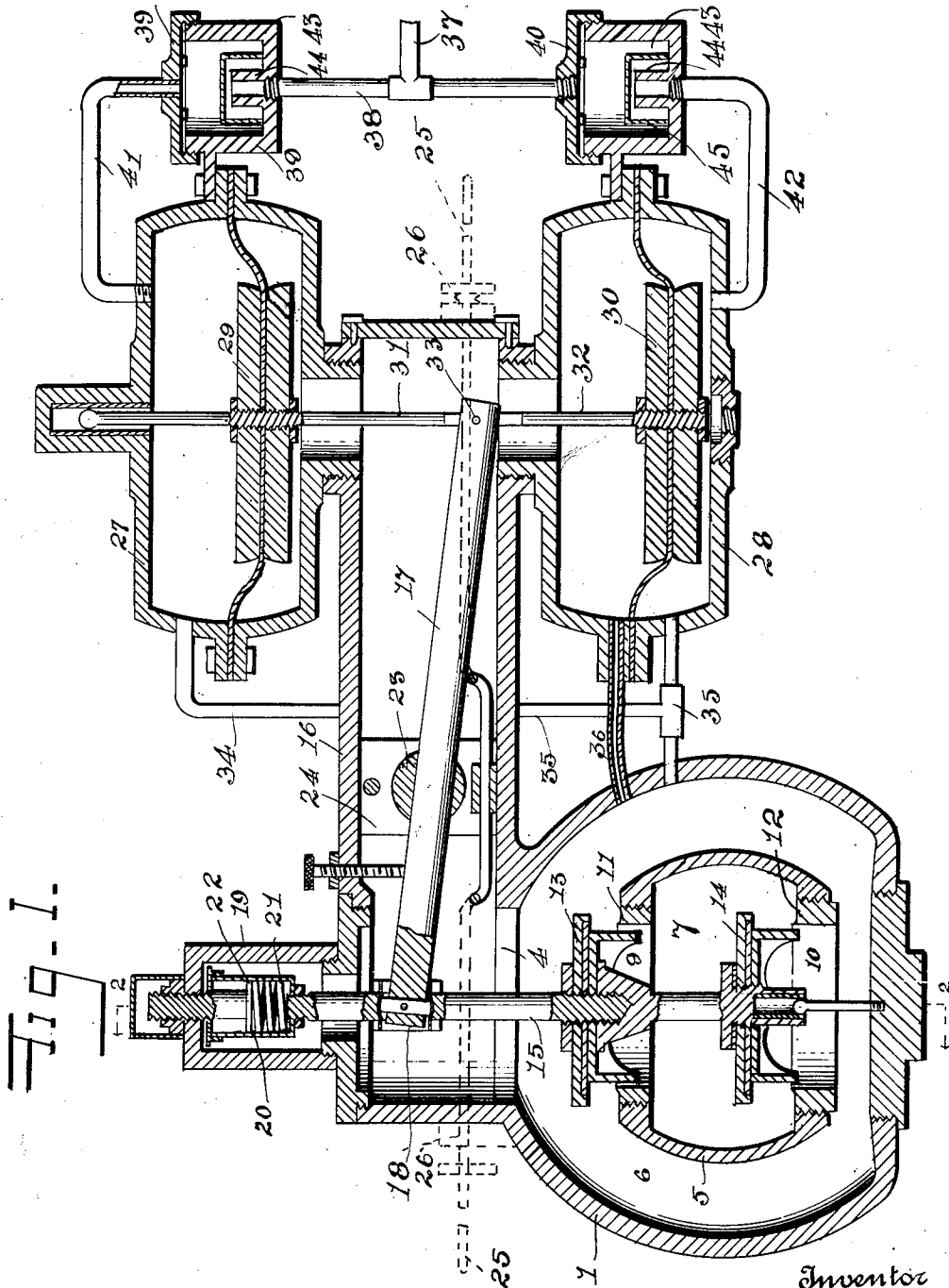


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FOR RECEIVING AND STORAGE TANKS
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2 Sheets-Sheet 1



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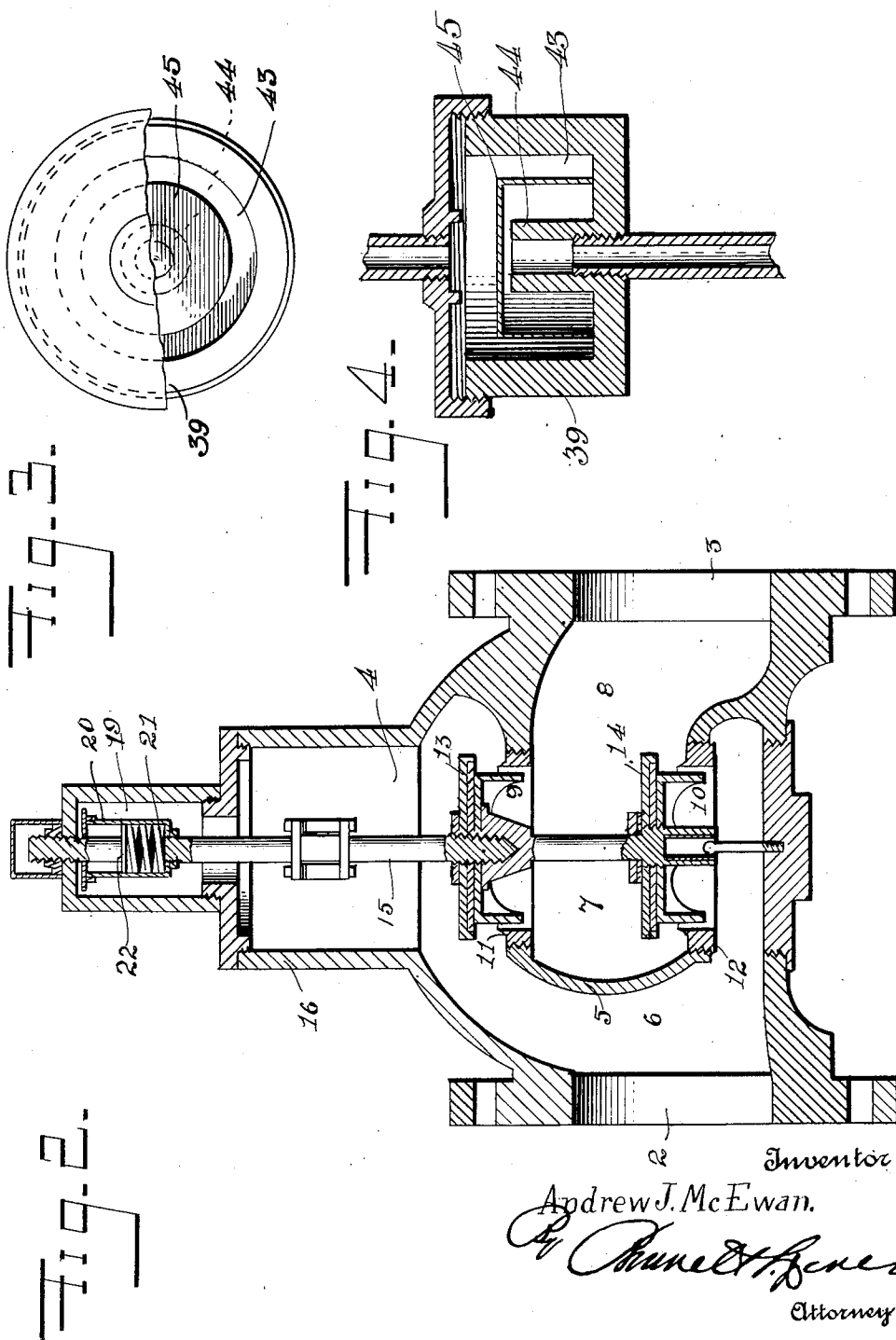
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Patented July 31, 1928.

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UNITED STATES PATENT OFFICE.

ANDREW J. McEWAN, OF TULSA, OKLAHOMA.

COMBINED VACUUM AND PRESSURE RELIEF VALVE FOR RECEIVING AND STORAGE TANKS.

Application filed September 30, 1926. Serial No. 138,783.

This invention relates to a combined vacuum and pressure relief valve for receiving and storage tanks designed for the reception of oil, gasoline or other expansible and contractible fluids or liquids.

The main object of the invention is to provide a valve of this character which is simple of construction and reliable and efficient in action and which is adapted for a pressure relief action or vent action as upon an increase of pressure of air or vapor in the top of a tank when the tank is being filled or its contents expand under more or less high temperatures, and which is also adapted for a vacuum relief action to allow air or gas to enter into the top of a tank to compensate for a reduction of pressure when any portion of its liquid contents is drawn off.

A further object of the invention is to provide a valve of this character which is sensitive in operation, adjustable to regulate its action, and adapted to effect the drainage off of any deposited liquids liable to interfere with the operation of its working parts.

The invention consists of the features of construction, combination and arrangement of parts, hereinafter fully described and claimed, reference being had to the accompanying drawings, in which:—

Figure 1 is a vertical longitudinal section through a valve of the character described embodying my invention.

Figure 2 is a sectional view through the valve casing on line 2—2 of Figure 1.

Figure 3 is a top plan view, partly in section, of one of the mercurial check valves.

Figure 4 is a vertical section through one of the check valves.

In the constructional example shown, 1 is a valve casing having side ports 2 and 3, a top port or passage 4, and a partition 5 separating the casing into an outer chamber 6 and an inner chamber 7. The partition 5 is closed on its side adjacent port 2 but communicates directly with port 3 through a passage 8, and at the top and bottom of the partition are ports 9 and 10 normally communicating with the top and bottom of chamber 6 and provided with valve seats 11 and 12, respectively. A double control valve consisting of balanced valve members 13 and 14 carried by a stem 15 control the ports 9 and 10 and are adapted to engage the valve seats 11 and 12. When the valve is

open communication is established between chambers 6 and 7 and ports 2 and 3 through ports 9 and 10 and passage 8, and when the valve is closed communication between the ports and chambers is closed.

A lever casing 16 communicates at one end through the port 4 at all times with the chamber 6, in which chamber is enclosed a control lever 17. The valve stem 15 extends through the port 4 into said chamber and is pivotally connected with the inner end of the lever, as at 18, and said stem also extends upwardly into a bonnet 19 and carries a spring cage or cylinder 20. A valve closing spring 21 abuts at one end against one end of this cage and at its opposite end against a spring abutment and tensioning device 22 adjustably mounted on the bonnet, whereby the working pressure of the spring may be varied and regulated. This spring may be employed or not as desired or required. When the pressures to be controlled are very low the spring may be omitted and the weight of the valve so proportioned with respect to other factors as to adapt the valve to automatically close by gravity in the absence of a predetermined opening pressure.

The lever 17 passes intermediate its ends through a slot in bearing roller 23 journaled in a shiftable fulcrum block 24. This fulcrum block is slidably adjustable in the casing 16 to vary the fulcrum point of the lever and the power ratios of its inner and outer ends or arms. For this purpose rods 25 are connected to the block and extend outward through stuffing-boxes 26 at opposite ends of the casing 16, the projecting ends of the rods forming handles whereby the block may be shifted externally from either end of the said casing as may be found most convenient in service. Communicating with the outer end of the casing are opposed diaphragm chambers 27 and 28 containing flexible weighted diaphragms 29 and 30 provided with stems 31 and 32 coupled to the outer end of the lever, as by a pivot pin or bolt 33. These chambers and diaphragms are of identical size, hence any pressure existing within chambers 6 and 16 will be equally effective upon each diaphragm and such effect nullified so far as operation is concerned.

In practice the high pressure side port 3 of the valve is suitably connected, as by means of a pipe, with the top of the storage tank above the level of the liquid therein,

while the low pressure side port 2 is either left open to the atmosphere or connected with a pipe leading to a salvage receptacle, when it is desired to collect and prevent the loss of vented gases or vapors. When the valve is closed, therefore, port 3 is sealed against the escape of pressure from the top of the tank through port 3, the pipe between said port and the tank constituting the high pressure line, while chamber 6, casing 16 and the inner sides of the diaphragms communicating with said casing are subjected only to atmospheric pressure or such relatively low pressure as may exist in a pipe line leading from port 2. Pipes 34 and 35 of restricted diameter compared to pipes 41 and 42 connect the upper portion of chamber 27 above the diaphragm 29 and the lower portion of the chamber 28 below the diaphragm 30 with valve chamber 6, these pipes permitting of the influx and efflux of air, gas or vapors in the movements of the diaphragms for relief actions, and pipe 35 provides for a restoration of normal pressure below diaphragm 30 following a vacuum relief action thereof. If desired, a drain pipe 36 may connect diaphragm chamber 28 above diaphragm 30 with valve chamber 6 to permit any liquid finding its way into said diaphragm chamber to drain off through chamber 6 and port 2.

A combined pressure relief and suction pipe 37 communicates in practice, like the pipe leading from port 3, with the top of the storage tank above the level of the liquid therein. This pipe also connects through a pipe 38 with a pair of mercurial check valves 39 and 40, respectively connected by pipes 41 and 42 with the chamber 27 above diaphragm 29 and with chamber 28 below diaphragm 30. Each valve 39—40 comprises a closed receptacle containing a body of mercury 43, a stand pipe 44 communicating with pipe 38 or pipe 42 as the case may be and having its upper end terminating above the level of the mercury, and a movable bell 45 serving as a valve having the lower portion of its depending flange normally submerged in the mercury and providing a seal closing connection between pipe 38 and pipe 41 or pipe 42 as the case may be. The bell 45 of the valve 39 is adapted to open under pressure of fluid flowing from pipe 38 to diaphragm chamber 27 and to close under reverse pressure from chamber 27, i. e., when the pressure in chamber 27 is greater than that in pipe 38, while the bell 45 of the valve 40 is held closed under the normal pressure in pipe 38 but is adapted to open (while at the same time bell 45 of valve 39 closes) when a partial vacuum is formed in pipe 38. The bell-valve of chamber 39 may be made somewhat heavier than the bell-valve of chamber 40 so as to adapt it to open under such a predetermined low pres-

sure (above atmospheric pressure) in pipe 38 as to normally maintain a low pressure in the top of the storage tank, which is desirable in the storage of gasoline and other more or less highly volatile liquids.

This combination valve constructed as above described is adapted to permit of the vent of gas or vapor from the top of the storage tank during a tank filling or replenishing operation, as well as during expansion of the body of liquid in the tank at high atmospheric temperatures, and for conducting the gas or vapor away from the storage tank and discharging the same into the atmosphere or into a salvage receptacle at a point suitably remote from the tank as to obviate liability of the gas or vapor catching fire and causing a resulting conflagration of the contents of the tank. The combination valve is also adapted for a vacuum relief action to supply air to the top of the tank to fill the voided space when more or less liquid is withdrawn from the tank.

The operation is as follows:

The valve 13—14 is normally closed at atmospheric pressure and adapted to open on a slight increase of pressure in the top of the tank applied to the upper surface of the diaphragm 29 or under a predetermined reduction of pressure in the top of the tank and the formation of a partial vacuum below diaphragm 30 in the chamber 28, resulting in downward movement of diaphragm 30 under the force of atmospheric pressure acting on the upper face of said diaphragm 29. Assuming that the valve is closed and that conditions in the storage tank are normal, it will be understood that when additional liquid is filled into the tank, or its contents expand upon a rise of atmospheric temperature, the pressure of the air or gases and vapors in the top of the tank will be increased, requiring a pressure relief action through the valve. This pressure is the same in the pipes 37 and 38 as in chamber 7, but the valve 13—14 is unaffected by the pressure in the chamber 7 because the pressure on the valve members is balanced. As a result of the increased pressure in pipes 37 and 38, however, which pressure acts upon the bell-valve of chamber 40 to hold said bell-valve closed, the bell-valve of chamber 39 is opened, and a vent of pressure from the tank occurs through pipes 37 and 38, the valve 39 and the pipe 41 into the top of diaphragm chamber 27, causing depression of the weighted diaphragm 29 under pressure, and a gravity depression of diaphragm 30, as a result of which lever 17 will be operated to open the valve 13—14 to allow the excess pressure from the top of the tank to vent through the port 2 until a normal pressure condition in the top of the tank occurs, when the valve 13—14 will again be closed by

gravity or the action of its closing spring 21. The valve will thus act at all times when the pressure in the top of the tank becomes excessive, from any cause, so as to give an automatic relief action. When the pressure in the top of the tank falls below normal, as when liquid is being drawn from the tank, and a vacuum relief action is required, a reduction of pressure in pipes 37 and 38 occurs, under which the bell-valve in chamber 39 is held closed, while the bell-valve in chamber 40 will be lifted by the suction off its seat and communication established through pipe 42 between the top of the tank and the diaphragm chamber 28 below diaphragm 30. As a result, a partial vacuum will be created in chamber 28 below diaphragm 30, causing said diaphragm to descend by reason of its weight, and the action of atmospheric pressure upon the upper face of diaphragm 29, causes said diaphragm to become unbalanced and descend, so that the lever 17 will operate to open the valve 13-14, allowing air to flow through the valve ports 2 and 3 and chambers 6 and 7 into the top of the tank to relieve the vacuum therein. When this condition is relieved, there will be a restoration of pressure balances on opposite sides of the valve, so that the valve will be automatically closed by gravity or the action of its closing spring. The valve device will thus operate automatically at all times for pressure relief or vacuum relief actions as conditions may require due to the filling of the tank with liquid or withdrawal of liquid therefrom, and at all times the tank will be kept sealed against loss from evaporation of its contents, while in the case of the venting of gases or vapor such gases or vapors may be collected and their loss prevented. In the event that such gases or vapors are discharged into the atmosphere, this may be done at a point sufficiently remote from the tank to prevent the gases or vapors from becoming ignited, or, in the event of their ignition, from fire being communicated to the liquid contents of the tank. It will also be seen that the construction of the valve is such that a very sensitive action may be secured and that all the working parts of the valve are enclosed and protected from the entrance of dust and dirt and possible casual derangement or injury.

Having thus fully described my invention, I claim:—

1. In a combined pressure and relief valve for controlling the flow of fluids from and to the fluid space of a liquid containing tank, a valve casing having a low pressure side and a high pressure side, the latter adapted for connection with said fluid containing space, a valve in said casing controlling communication between said sides of the casing, a lever casing communicating only with the low pressure side of the valve casing when

the valve is closed and communicating with both sides of the valve casing when the valve is open, a pair of diaphragm chambers, each containing a diaphragm and communicating at one side of the diaphragm therein with the lever casing, each diaphragm being coupled to the lever to impart a valve opening movement thereto upon a working motion of the diaphragm, pressure and suction lines communicating, one with one diaphragm chamber and the other with the other diaphragm chamber on the sides of the diaphragms opposite the points of communication of the chambers with the casing, said lines being adapted for connection with the fluid containing space of the tank, and check valves in said lines.

2. In a combined pressure and relief valve for controlling the flow of fluids from and to the fluid space of a liquid containing tank, a valve casing having a low pressure side and a high pressure side, the latter adapted for connection with said fluid containing space, a valve in said casing controlling communication between said sides of the casing, a lever casing communicating only with the low pressure side of the valve casing when the valve is closed and communicating with both sides of the valve casing when the valve is open, a pair of diaphragm chambers, each containing a diaphragm and communicating at one side of the diaphragm therein with the lever casing, each diaphragm being coupled to the lever to impart a valve opening movement thereto upon a working motion of the diaphragm, pressure and suction lines communicating, one with one diaphragm chamber and the other with the other diaphragm chamber on the sides of the diaphragms opposite the points of communication of the chambers with the casing, said lines being adapted for connection with the fluid containing space of the tank, and mercurial check valves in said lines.

3. In a combined pressure and relief valve for controlling the flow of fluids from and to the fluid space of a liquid containing tank, a valve casing having a low pressure side and a high pressure side, the latter adapted for connection with said fluid containing space, a valve in said casing controlling communication between said sides of the casing, a lever casing communicating only with the low pressure side of the valve casing when the valve is closed and communicating with both sides of the valve casing when the valve is open, a pair of diaphragm chambers, each containing a diaphragm and communicating at one side of the diaphragm therein with the lever casing, each diaphragm being coupled to the lever to impart a valve opening movement thereto upon a working motion of the diaphragm, pressure and suction lines communicating, one with one dia-

phragm chamber and the other with the other diaphragm chamber on the sides of the diaphragms opposite the points of communication of the chambers with the casing, a combined pressure and suction pipe for connecting both lines with the fluid space of the tank, and check valves in said lines.

4. In a combined pressure and relief valve for controlling the flow of fluids from and to the fluid space of a liquid containing tank, a valve casing having a low pressure side and a high pressure side, the latter adapted for connection with said fluid containing space, a valve in said casing controlling communication between said sides of the casing, a lever casing communicating only with the low pressure side of the valve casing when the valve is closed and communicating with both sides of the valve casing when the valve is open, a pair of diaphragm chambers, each containing a diaphragm and communicating at one side of the diaphragm therein with the lever casing, each diaphragm being coupled to the lever to impart a valve opening movement thereto upon a working motion of the diaphragm, pressure and suction lines for connection with the fluid space of the tank and communicating, one with one diaphragm chamber and the other with the other diaphragm chamber on the sides of the diaphragms opposite the points of communication of the chambers with the casing, a combined pressure and suction pipe for connecting both lines with the fluid space of the tank, and check valves in said lines, the check valve in the pressure line opening under such pressure as to maintain a given minimum low pressure in the fluid space.

5. In a pressure and vacuum relief valve, a valve member, counter-balanced diaphragms for respectively opening the valve member for pressure and vacuum relief actions, and means for influencing the diaphragms respectively upon increase of pressure or reduction of pressure on one or the other of said diaphragms.

6. In a pressure and vacuum relief valve, a valve, devices for respectively actuating the valve for pressure relief or vacuum relief actions, a pressure line for influencing one of said devices, a vacuum line for influencing the other device, and check valves in said lines.

7. In a pressure and vacuum relief valve, a valve, pressure and vacuum influenced diaphragms for actuating said valve for pressure and vacuum relief actions respectively, a pressure line communicating with the pressure influenced diaphragm, a vacuum line connecting with the vacuum influenced diaphragm, a combined pressure and vacuum pipe connected with said lines, and check valves in the lines between said pipe and diaphragms.

8. In a combined pressure and vacuum

relief valve, a valve, a control lever coupled to the valve, pressure and vacuum influenced devices coupled to the lever for opening the valve for pressure and vacuum relief actions respectively, a pressure line connected with one of said devices for influencing the same, and a vacuum line communicating with the other device for influencing the same.

9. In a combined pressure and vacuum relief valve, a valve, a control lever coupled to the valve, diaphragms coupled to the lever for respectively communicating pressure and vacuum relief actions thereto, a pressure line connected with one of the diaphragms for influencing the same, and a vacuum line connected with the other diaphragm for influencing the same.

10. In a combined pressure and vacuum relief valve, a valve, a lever coupled to the valve, diaphragms coupled to the lever, a fluid pressure line for influencing one of the diaphragms, a vacuum line for influencing the other diaphragm, a combined pressure and vacuum pipe connected with said lines, and check valves in said lines between the diaphragms and the pipe.

11. In a combined vacuum and pressure relief valve, a casing having high and low pressure sides and provided with ports at such sides, a balanced valve constantly exposed to both pressures and movable to open and close communication between said ports, a lever connected to the valve for positively opening or closing the same, a pair of opposed diaphragms connected to the lever for imparting valve opening and closing motions thereto, each diaphragm being exposed on one side to pressure from the low pressure side of the casing when the valve is closed and to pressure from both the high and low pressure sides of the casing when the valve is open, and means for influencing the diaphragms upon increase of pressure or reduction of pressure on one or the other of said diaphragms.

12. A pressure regulator comprising a casing having inlet and outlet ports, a valve controlling communication between said ports, an intermediately fulcrumed lever directly coupled on one side of its fulcrum to said valve for opening and closing the same, and a pair of diaphragms directly coupled to the lever on the other side of its fulcrum, both diaphragms being constantly subjected to pressure from one of the ports and acting in opposition under variations of such pressure for respectively imparting valve closing and valve opening movements to the lever.

13. In a combined pressure and relief valve for controlling the flow of fluids from and to the fluid space of a liquid containing tank, a valve casing having a low pressure side and a high pressure side, the latter adapted for connection with said fluid con-

5 taining space, a valve in said casing controlling communication between said sides of the casing, a lever casing communicating only with the low pressure side of the valve casing when the valve is closed and communicating with both sides of the valve casing when the valve is open, a pair of diaphragm chambers, each containing a diaphragm and communicating at one side of the diaphragm therein with the lever casing, each diaphragm being coupled to the lever to impart a valve opening movement thereto upon a working motion of the diaphragm, pressure and suction lines communicating, one with one diaphragm chamber and the other with the other diaphragm chamber on the sides of the diaphragms opposite the points of communication of the chambers with the casing, and check valves in said lines.

10 14. In a combined pressure and relief valve for controlling the flow of fluids from and to the fluid space of a liquid containing tank, a valve casing having a low pressure side and a high pressure side, the latter adapted for connection with said fluid con-

taining space, a valve in said casing controlling communication between said sides of the casing, a lever casing communicating only with the low pressure side of the valve casing when the valve is closed and communicating with both sides of the valve casing when the valve is open, a pair of diaphragm chambers, each containing a diaphragm and communicating at one side of the diaphragm therein with the lever casing, each diaphragm being coupled to the lever to impart a valve opening movement thereto upon a working motion of the diaphragm, pressure and suction lines for connection with the fluid space of the tank and communicating, one with one diaphragm chamber and the other with the other diaphragm chamber on the sides of the diaphragms opposite the points of communication of the chambers with the casing, and check valves in said lines, the check valve in the pressure line opening under such pressure as to maintain a given minimum low pressure in the fluid space.

In testimony whereof I affix my signature.
ANDREW J. McEWAN.