

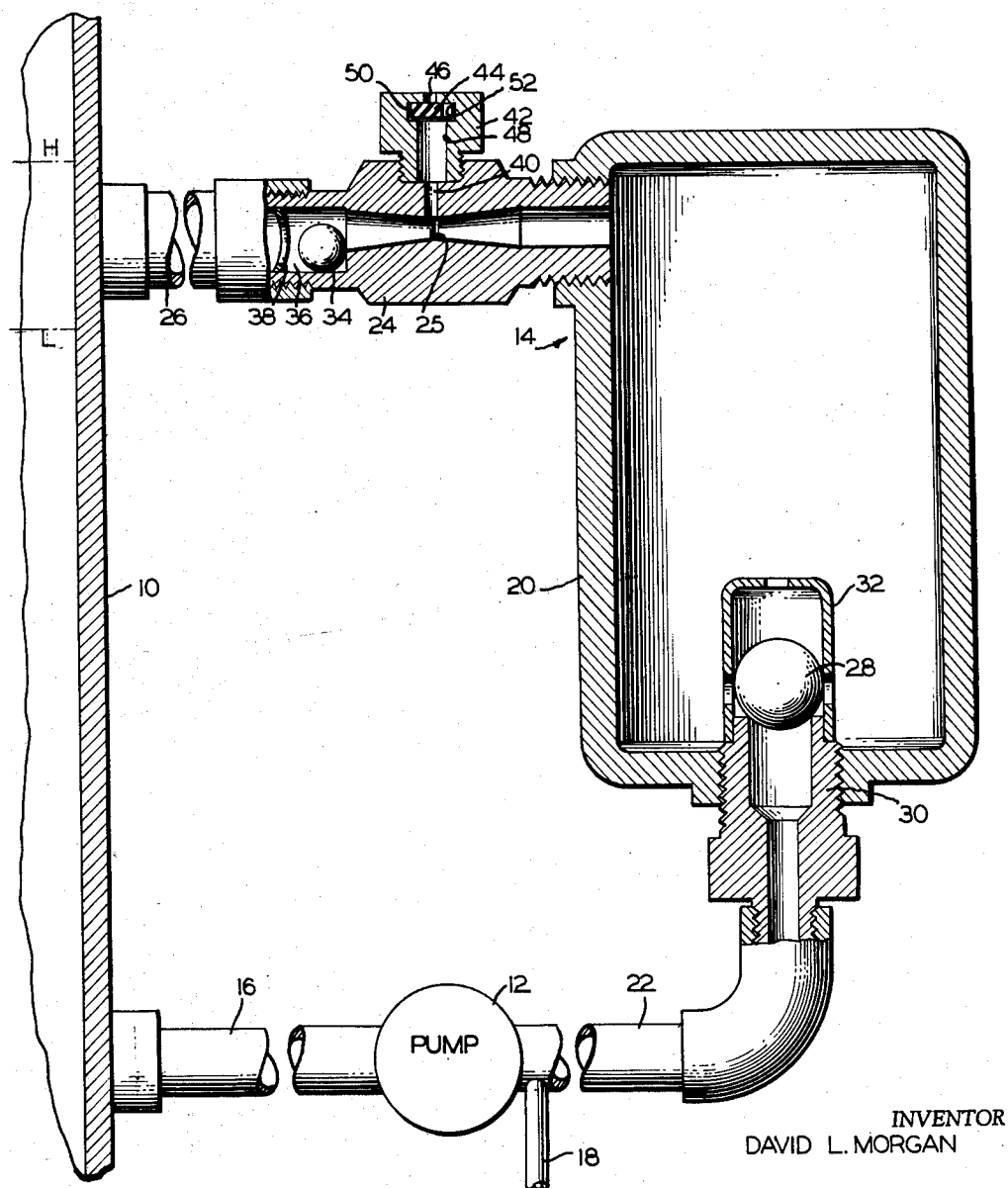
July 16, 1963

D. L. MORGAN

3,097,604

CONVERTIBLE AIR VOLUME CONTROL

Filed Dec. 13, 1961



BY

A. A. O'Brien

ATTORNEY

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CONVERTIBLE AIR VOLUME CONTROL

David Luke Morgan, Shelton, Conn., assignor to Robertshaw-Fulton Controls Company, Richmond, Va., a corporation of Delaware

Filed Dec. 13, 1961, Ser. No. 159,099

1 Claim. (Cl. 103—6)

This invention relates to a fluid pressure system and more particularly to an air volume control mechanism for supplying air to a liquid storage tank.

In a fluid pressure system, a pressure tank is generally employed to receive liquid from a pump and store the same under a predetermined pressure. To maintain the pressure on the liquid, a layer of air or other gas is confined above the liquid in the tank and this layer of air serves as an expansible cushion. In normal operation of the system, the volume of air is varied in accordance with changes in the amount of liquid in the tank and with a decrease in the amount of air, the air cushion is reduced and is replaced by the liquid. As the air cushion decreases, it is necessary that a means be provided to restore the pressure such as an air volume control used in conjunction with the pump.

One of the objections to prior art air volume control mechanisms is that considerable suction in the system is required to obtain satisfactory operation. The present invention eliminates this difficulty by being adaptable to be converted for use with either high or low suction systems.

It is a primary object of the invention to provide an improved air volume control for supplying air to a liquid supply tank.

It is a further object of the invention to provide an air volume control which may be easily converted for use with either a high or low suction system.

Another object of the invention is to provide an improved air volume control which is reliable and inexpensive to manufacture.

Briefly stated, the invention relates to an improved air volume control for supplying air to a liquid storage tank and to maintain the desired air pressure in the tank. A pump is connected to the tank and to a source of liquid to supply liquid to the tank. The air volume control comprises a housing for containing air and liquid, a float valve positioned within the housing and connected to the suction side of said pump, and a venturi connecting the tank and the housing. A check valve is also provided to connect the throat of the venturi to the surrounding atmosphere. When the pump is operated, the suction created in the housing causes liquid to be removed from the housing until the float valve seats to close the suction outlet. If the liquid level in the tank is above the venturi connection, liquid is drawn through the venturi into the housing as the liquid level within the housing decreases in response to pump suction. The liquid flowing through the venturi creates a suction causing air to be drawn in through the check valve. Stopping the pump after the float valve has seated permits liquid to return past the float valve into the housing while liquid continues to flow into the housing through the venturi thus forcing the air through the venturi into the tank to thereby increase the pressure in the tank.

In another embodiment of the invention, the air volume control may be provided with a second float valve positioned between the venturi and the tank to prevent flow of liquid from the tank into the housing while permitting air flow in either direction.

Further features, objects, and advantages will become apparent from the following description taken in connection with the accompanying drawing wherein a single figure shows a fragmentary sectional view of a fluid

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pressure system employing the air volume control of the invention.

Referring to the drawing, the fluid pressure system in general comprises a liquid storage tank 10, a pump 12, and an improved air volume control indicated generally at 14. The tank 10 is partially filled with liquid and, above the liquid, is filled with pressurized air. The output side of pump 12 is connected by conduit 16 to a wall of the tank 10 while the pump input side is connected by a conduit 18 to a source of liquid (not shown).

The air volume control 14 includes an air-and-liquid-containing housing 20, which is connected at its lower end by conduit 22 to the suction side of pump 12, and which is connected at its upper end to the tank 10 by means of horizontally arranged venturi 24 and conduit 26. Liquid flow out of housing 20 through conduit 22 may be controlled by a suitable valve such as ball float valve 28, which seats in the upper end of connection 30 when the liquid level within the housing is no longer sufficient to carry the float valve. A suitable perforated retaining member 32 may be secured to the upper end of connection 30 to guide the float valve 28 to seat on the connection when the liquid level is sufficiently decreased. The retaining member 32 also limits the upward movement of the float 28 while its perforations permit liquid communication between the connection 30 and the inside of the housing 20.

Liquid flow from the tank 10 to the housing 20 is prevented by a suitable valve such as ball float valve 34 positioned in an enlarged portion 36 in the end of venturi 24 leading to the tank 10. When there is sufficient liquid in the enlarged portion 36 and tank pressure is greater than housing pressure, float 34 seats against the associated end of venturi 24 to prevent liquid flow into the housing. A retaining ring 38 may be provided to prevent float 34 from moving out of the enlarged portion 36 toward tank 10. It will be appreciated that the float valve 34 permits air flow in either direction.

In accordance with the invention, the throat 25 of venturi 24 is connected to the surrounding atmosphere by an intersecting passage 40 leading to a bored connection 42 positioned in the exterior wall of venturi 24 and carrying a suitable check valve 44. The connection 42 is centrally bored to form an atmosphere opening 46 and a larger aligned inlet bore 48 separated by a larger chamber 50 in which the movable valve 44 is loosely positioned. As is illustrated in the drawing, an aperture 52 in valve 44 is offset from its central axis so as to be engageable with the upper wall defining the chamber 50. The check valve 44 is made of many suitable resilient material so as to be deformable under pressure and thus moved away from the upper wall of chamber 50 and establish communication between the opening 46 and the bore 48 through the offset aperture 52. With such an arrangement, the check valve 44 permits air flow from the atmosphere in the venturi when the proper pressure differential exists.

Turning now to the operation of the air volume control, assume first that the pump 12 is off and that the liquid in the tank 10 is at the high level marked H in the drawing. At such level, the housing 20 is also filled with liquid, which is the normal condition for the housing 20 when the pump 12 is not operating. If the air pressure above the liquid in the tank 10 is below a predetermined limit, the pump 12 may be started, in response to a pressure switch or other suitable means, not shown, to increase the air pressure. The suction created by the pump 12 will cause the liquid in housing 20 to be drawn out of the housing past the float valve 28, which will be floating in the upper portion of retaining member 32. The pressure differential between the tank 10 and the housing 20 and the presence of liquid in enlarged portion

36 of the venturi 24 will cause the float valve 34 to seat against the venturi, thereby preventing liquid flow from the tank 10 to the housing 20. As the liquid is withdrawn from the housing 20, air will be drawn in through check valve 44. When substantially all of the liquid has been removed from the housing, float valve 28 guided by retaining member 32 will seat against the upper end of connection 30 preventing air from being removed from the housing. After the pump 12 stops, in response to a suitable tank pressure switch, the pressure on opposite sides of pump 12 will soon equalize causing liquid to again enter housing 20 past the float valve 28. This action will pressurize the air in the housing 20 causing it to be forced past the float valve 34 into the tank 10 to thereby increase the pressure above the liquid.

If when the pump is started, the liquid in the tank 10 is at a level below the conduit 26 such as indicated at L in the drawing, air from the tank will be drawn past the float valve 34 into the housing. After the liquid level in the tank has been raised sufficiently to close float valve 34 and the pump is stopped, the control 14 will operate as described in the preceding paragraph to pressurize the tank liquid.

In accordance with the invention, the air volume control shown in the drawing may be easily converted to form a modified control requiring less suction than the control heretofore described. This may be accomplished by merely removing the float valve 34 and its retaining ring 38. With the valve 34 removed, the housing 20 will of course be in direct communication with the tank 10. If the liquid in the tank is above the connection of conduit 26 such as at H and the pump 12 is started, the pressure differential will cause liquid to flow through the venturi 24 as liquid is drawn from the housing 20.

Liquid flow through the venturi 24 will create a vacuum in the throat of the venturi causing air to be drawn in past check valve 44 into housing 20. This process will continue until all the liquid is effectively removed from the housing and float valve 28 seats to close the outlet. Liquid will continue to flow through venturi 24 from the tank 10 to the housing 20 until the housing pressure equals tank pressure. As the pressure is being equalized, the buoyancy of the air will cause it to be displaced through the venturi into the tank. It will be appreciated that the water passing through the venturi 24 provides the suction for bringing in the air rather than the pump 12. Consequently less suction is required to operate the control 14 when valve 34 is removed.

If, before the pump 12 is started, the liquid level is at L, air from the tank will flow through the venturi and enter housing 20; but since the air will only flow fast enough to replace the liquid being drawn from the housing, the pressure drop across the venturi will not be sufficient to cause an appreciable vacuum in the throat. Consequently no air will enter through the check valve until the liquid level in the tank is raised, and at which time

the control will function as described in the preceding paragraph.

Thus, it will be appreciated that an air volume control has been illustrated and described that may easily be converted to a modified form of control. As it will be obvious to those skilled in the art that various changes and modifications may be made in order to adapt it to different conditions without departing from the scope hereof, it is intended that all matter contained in the above description or shown on the accompanying drawing be interpreted as illustrative and not in a limiting sense.

What is claimed is:

In a fluid pressure system, the combination including a fluid storage tank, a pump for supplying liquid to said tank, and air volume control means for maintaining a desired air pressure in said storage tank comprising a housing containing fluids of liquid and air and having port means adjacent its top and bottom, means connecting the bottom port means of said housing to the suction side of said pump whereby operation of said pump causes a flow of liquid through the bottom port means, valve means including a ball float valve operative in response to a predetermined liquid level in said housing for controlling the flow of liquid through said bottom port means, horizontal conduit means connecting the top port means of said housing to said storage tank, venturi means having a venturi throat in said conduit means, an enlarged chamber in said conduit means between one end of said venturi means and said tank, a ball float valve in said enlarged chamber cooperating with the said one end of said venturi means to prevent flow of liquid from said tank to said venturi means, bored fitting means vertically carried by said conduit means and including a passage perpendicularly intersecting said venturi throat for establishing communication between the atmosphere and said venturi throat, an atmosphere opening on one end of said bored fitting means and an inlet bore on the opposite end thereof having a larger diameter than said atmosphere opening, a check valve chamber intermediate said atmosphere opening and said inlet bore having a larger diameter than said inlet bore, a check valve disc of resilient material loosely disposed in said check valve chamber for sealing said atmosphere opening, and a flow passage in said check valve disc being offset from said atmosphere opening and permitting an air flow to said venturi throat when said check valve disc is moved away from said atmosphere opening.

References Cited in the file of this patent

UNITED STATES PATENTS

2,421,237	Bergh	May 27, 1947
2,621,597	Armstrong	Dec. 16, 1952
2,748,798	Withrow	June 5, 1956
2,839,001	Tubbs	June 17, 1958