Sept. 28, 1948. S. M. McCARTHY 2,450,291

AIR CHARGER FOR STORAGE TANKS

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Fig. 2.

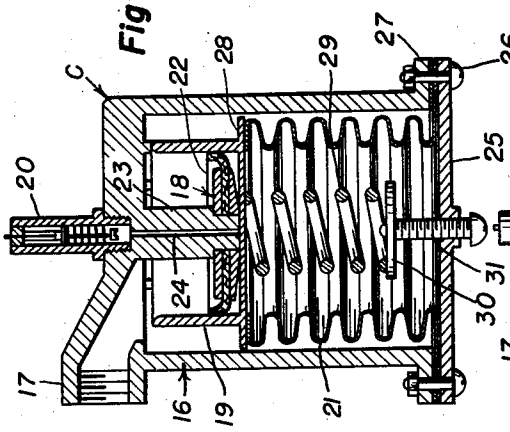
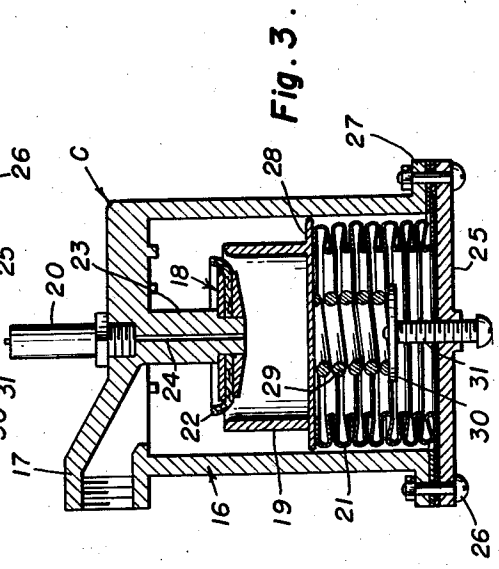


Fig. 3.



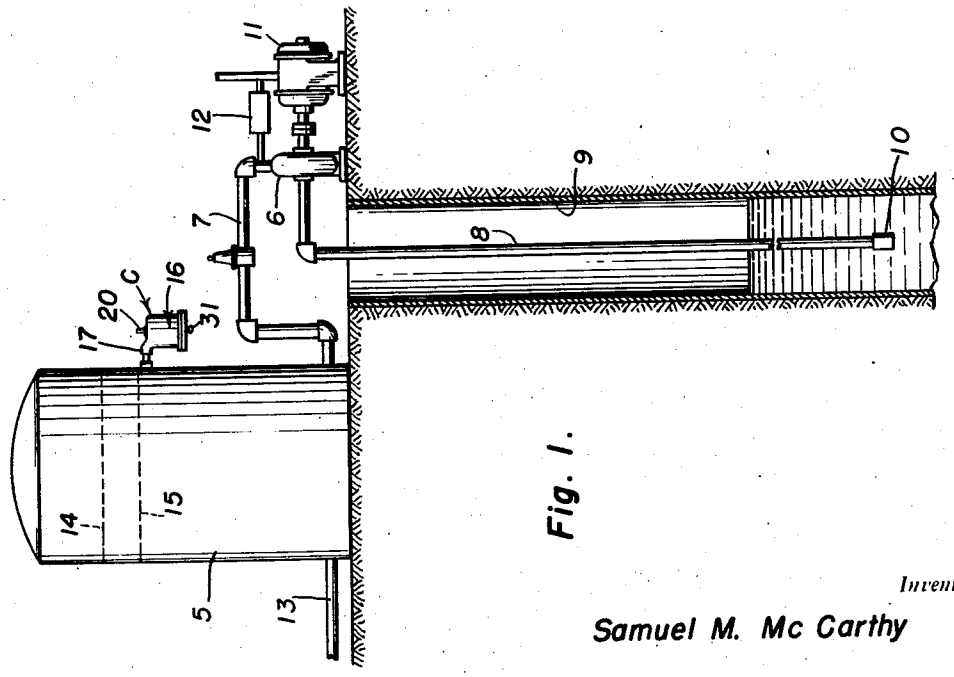


Fig. 1.

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Fig. 4.

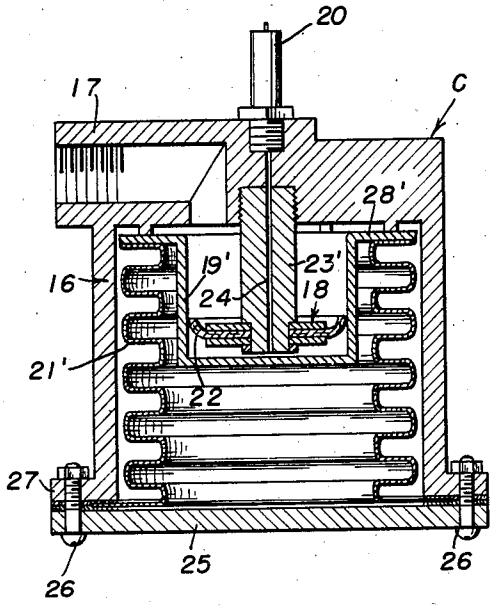


Fig. 5.

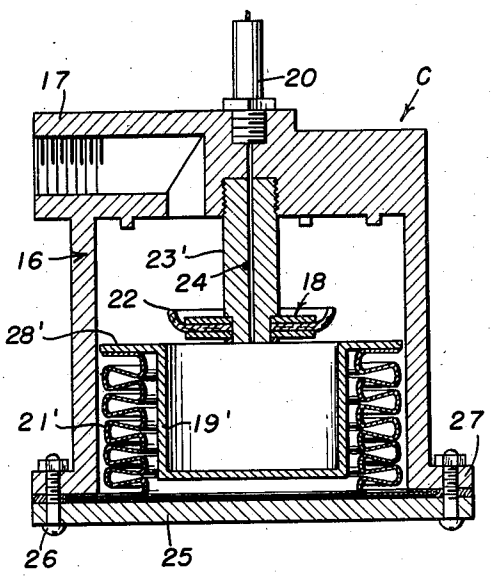


Fig. 7.

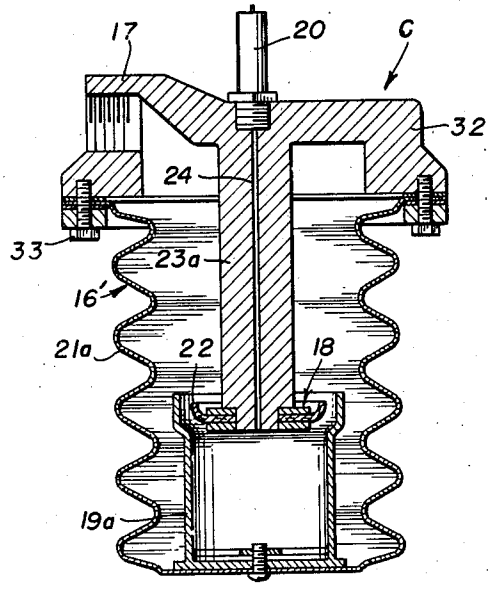
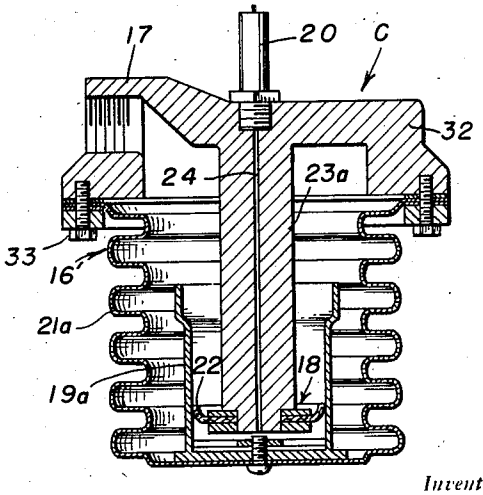


Fig. 6.



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Patented Sept. 28, 1948 2,450,291

UNITED STATES PATENT OFFICE

2,450,291

AIR CHARGER FOR STORAGE TANKS

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Application May 5, 1947, Serial No. 746,145

7 Claims. (Cl. 103—6)

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This invention relates to water pressure systems such as are associated with water pumps for supplying dwellings and the like, and more particularly to an air charger for use in connection with well pumps.

Such water pressure systems include a water tank which receives water from the pump and stores the water under pressure. An air cushion is maintained over the top of the water in the tank so as to force the water from the tank through the pipes of the system. As the pressure in the tank is lowered to a predetermined point by drawing water from the tank, the pump is automatically started and water is supplied to the tank until it reaches a predetermined level and the air pressure is built up to a predetermined point. It is common practice in such systems to provide for automatically starting the pump when the pressure in the tank drops to a predetermined point and for automatically stopping the pump when the pressure rises to a predetermined point. It will thus be evident that it is necessary to maintain the quantity of air in the tank within predetermined limits and to replenish air to the tank as it is absorbed or lost, in order to maintain the required cushion of air in the tank.

With most types of air chargers, air is supplied to the tank through the pump, or a connection is required between the air charger and the pump.

The primary object of the present invention, therefore, is to provide an air charger which will automatically supply air to the tank each time the pump is operated, and wherein the air is not drawn through the pump and no connection is required between the air charger and the pump.

A further object is to provide a device of the above kind, wherein the introduction of air is responsive to the pressure in the storage tank.

The exact nature of the present invention, as well as more specific objects and features thereof, will become apparent from the following description when considered in connection with the accompanying drawings, in which:

Figure 1 is an elevational view showing a characteristic water pressure system equipped with an air charger constructed in accordance with the present invention.

Figure 2 is an enlarged central vertical sectional view of the air charger shown in Figure 1, the movable parts of the air charger being in the positions they assume when the pressure in the storage tank is reduced below a predetermined point.

Figure 3 is a view similar to Figure 2 with the

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movable parts of the air charger in the positions they assume when the pressure in the storage tank is increased above a predetermined point.

Figure 4 is a view similar to Figure 2 showing a modification.

Figure 5 is a view similar to Figure 3 of the modification shown in Figure 4.

Figure 6 is a view similar to Figure 2 of a further modification.

Figure 7 is a view similar to Figure 3 of the modification shown in Figure 6.

Referring in detail to the drawings, 5 indicates the pressure tank into which the water is pumped and stored under pressure. This tank is connected to the discharge side of a pump 6 by a pipe 7, and the suction pipe 8 of the pump 6 extends into the well 9 and has the usual foot valve 10. Pump 6 is operated by an electric motor 11 which is energized by a pressure controlled switch 12. The arrangement, as usual, is such that when the pressure within the tank 5 falls below a predetermined point, the switch 12 is automatically closed and remains closed until the pressure is built up to an upper predetermined pressure limit, the switch 12 serving to connect the motor 11 to a suitable source of current. Water is drawn from the tank 5 through discharge pipe 13. The upper and lower liquid levels in the tank 5 are indicated respectively at 14 and 15. In other words, when the pressure of the tank 5 falls low enough to start the motor 11 operating, the liquid in the tank will be at the line 15 when the normal air supply is present in the tank, and when the pressure in the tank rises high enough to stop the motor 11, the liquid in the tank will be at the line 14.

The air charger for automatically introducing air into the tank 5 is generally indicated at C, and it includes a chamber 16 having a constant top communication at 17 with the tank 5 substantially at the desired low liquid level 15 in the tank. A fixed piston 18 is provided in the chamber 16, and a reciprocable cylinder 19 is also provided in said chamber and adapted to be moved in one direction by liquid under pressure from the tank 5 along and off of the piston 18 as shown in Figure 3 when the pressure in the tank 5 is increased above a predetermined point. Means, including a check valve 20, provides for a passage of a charge of outside air into the cylinder 19 in response to suction produced within and by said cylinder when the latter is moved in said one direction along the piston 18. The arrangement is such that when the cylinder 19 is moved off of piston 18, the liquid from tank 5 may enter cylinder 19 and force the

charge of air from the latter into the chamber 16 for passage into and to the top of tank 5. Spring means is provided for moving the cylinder 19 in the opposite direction onto and along the piston 18 when the pressure in tank 5 is reduced below a predetermined point, such spring means at least including a resilient metallic bellows 21 to which cylinder 19 is attached. The piston 18 includes means which provides for forcing the liquid from the cylinder 19 into the chamber 16 when said cylinder 19 is moved in said opposite direction onto and along the piston. This means may consist in the provision of a piston 18 which has a flexible cup member 22 that may yield inwardly out of contact with cylinder 19 under the force of liquid under pressure which is within cylinder 19 when the latter moves onto and along the piston 18. In other words, as the cylinder 19 moves onto and along piston 18, the water in the cylinder will force its way past the piston and out of cylinder 19. On the other hand, when the cylinder 19 moves in the other direction, along and off of piston 18, the suction thereby produced in cylinder 19 will keep the cup member 22 in snug contact with the cylinder so that air will be drawn into the latter through the check valve 20. As shown, piston 18 is fixed on the lower end of a rod or stem 23 rigid with and depending from the top of chamber 16 centrally of the latter. The rod or stem 13 has an axial passage 24 therethrough which communicates at its upper end with the check valve 20 mounted in the top of chamber 16.

In the embodiment of Figures 2 and 4, the casing 16 has a detachable bottom 25, and the lower end of bellows 21 has an outturned flange bolted at 26 between the margin of the bottom 25 and an outturned flange 27 provided on the lower end of the body portion of chamber 16. Also, in these embodiments, the bellows 21 are disposed within a hollow metallic casing forming the chamber 16, and the cylinder 19 is secured to the top of the bellows.

In the embodiment of Figure 2, cylinder 19 is disposed wholly upon the top of the bellows and it has an external annular flange 28 at the bottom against which fluid under pressure from tank 5 acts to force the cylinder 19 downwardly against the action of the spring means embodying at least the bellows 21. In this form of Figure 2, the spring means also includes a helical compression spring 29 disposed within the bellows 21, said spring bearing at its upper end against the bottom of cylinder 19 and at its lower end upon a vertically adjustable abutment 30 carried by the upper end of an adjusting screw 31 threaded through the bottom 25 of chamber 16. This arrangement provides for accurate adjustment of the spring means so that the same may be kept at the proper strength for efficient operation of the air charger even though the expansive strength of bellows 21 may vary or decrease after continued use.

In the embodiment of Figure 4, the cylinder 19' is disposed within the upper portion of bellows 21' and has the external annular flange 28' at the top thereof, said flange being secured to the upper end of bellows 21'. In this embodiment, the rod 23' is shown as a separate attachable member, and the spring 29 and its tension adjusting means, in the form of Figure 2, are dispensed with. By nesting the cylinder 19' within the bellows, the overall height of the chamber 16 may be decreased.

In the embodiment of Figure 6, the chamber 16' is formed in part by a rigid section 32 and in the remaining part by the bellows 21*a*. As shown, the upper end of bellows 21*a* is bolted at 33 to the underside of section 32, and the cylinder 19*a* is disposed within and secured to the bottom of bellows 21*a* so that the piston rod 23*a* is necessarily made longer than in the other two forms of the invention. By thus utilizing the bellows as a part of the chamber, the construction is simplified and made less expensive although the bellows is not effectively housed and protected as may be necessary or desirable in some installations.

Other than specifically described above, the forms of Figures 4 and 6 are similar in essential respects to the construction of Figure 2, and remaining parts of all of the forms are indicated by similar reference characters.

In explaining the operation of the present air charger, it may be assumed that the pressure in tank 5 is at the desired upper limit and that the cylinder 19, 19' or 19*a* is in its lowered position off of the associated piston 18. When the pressure in tank 5 is reduced by drawing water therefrom through the pipe 13, the spring means of the air charger, composed of the bellows or of the bellows and spring, forces the cylinder upwardly onto and along piston 18, any liquid in the cylinder being forced past the cup member 22 of the piston out of said cylinder and into chamber 16 so that the liquid is not trapped in the cylinder and will not prevent its upward movement. The cylinder will then be at its upper limit of movement as shown in Figures 2, 4 and 6. When the pressure in tank 5 has reached a predetermined low level, pump 6 will be thrown into operation so as to force liquid from the well into tank 5 and thereby build up the pressure within the latter. The liquid under pressure from tank 5 enters chamber 16 and ultimately reaches a sufficient pressure to force the cylinder 19 downwardly against the action of the spring means consisting of the bellows or bellows and spring. When this takes place, suction is produced within the cylinder beneath the piston 18, thereby forcibly drawing outside air into the cylinder past check valve 20 and through passage 24. The cylinder then moves downwardly off of piston 18, and the liquid under pressure rushes into the cylinder so as to force the charge of air out of the latter into the top of chamber 16, from whence it may pass through the liquid into tank 5 and rise to the top of the latter. Check valve 20 will of couse prevent passage of air or liquid out of the cylinder or chamber 16 through passage 24 and will only permit entrance of air through passage 24 when the cylinder moves downwardly along piston 18. Should the pressure in tank 5 again be reduced by withdrawing water therefrom, the spring means consisting of the bellows or the bellows and spring will overcome the pressure of the liquid in tank 5 and return the cylinder to its upper position so that the device may again operate to supply another charge of air to the tank 5 in the manner previously described. This cycle of operation is repeated each time the pump is started to build up the pressure in the tank 5 and the pressure in the tank 5 is subsequently reduced by withdrawal of water therefrom. It will thus be seen that the device provides for introduction of air in the storage tank in response to the pressure within the latter. In other words, the device will automatically supply air to the tank each time the pump is operated, and such device requires no connection between the same and the pump and draws the air directly from the atmosphere instead of through the pump.

It will be apparent that the present air charger

is relatively simple in construction and will operate efficiently over a long continued period of time without getting out of order or requiring adjustment or repair. Moreover, the device may be readily installed by simply connecting the outlet of the chamber **16** with the storage tank **5** at a point substantially at or slightly below the desired lower liquid level in the storage tank as shown in Figure 1. Further modifications and changes in details of construction are contemplated, such as fall within the scope of the invention as claimed.

What I claim is:

1. An air charger for a water system having a storage tank and a pump for supplying water from a well to the tank, comprising a chamber having a constant top communication with the tank substantially at the desired low liquid level in the tank, a fixed piston in said chamber, a reciprocable cylinder in said chamber adapted to be moved in one direction by liquid under pressure from said tank along and off of said piston when the pressure in said tank is increased above a predetermined point, means including a check valve providing for passage of a charge of outside air into said cylinder in response to suction produced by the cylinder when so moved along the piston, the cylinder moving off of said piston so that the liquid may enter the cylinder and force the charge of air from the latter into the chamber for passage into and to the top of the tank, and spring means for moving the cylinder in the opposite direction onto and along the piston when the pressure in said tank is reduced below a predetermined point, said piston including means providing for forcing the liquid from the cylinder into said chamber past the piston when the cylinder is moved in said opposite direction onto and along the piston.

2. The construction defined in claim 1, wherein the cylinder is of smaller diameter than said chamber and is provided with an external annular flange adapted to be actuated upon by the liquid under pressure from the tank for moving the cylinder in said one direction.

3. The construction defined in claim 1, wherein the cylinder is of smaller diameter than said chamber and is provided with an external annular flange adapted to be acted upon by the liquid under pressure from the tank for moving the cylinder in said one direction, said spring means comprising a resilient bellows having the cylinder attached thereto.

4. The construction defined in claim 1, wherein the cylinder is of smaller diameter than said chamber and is provided with an external annular flange adapted to be acted upon by the liquid under pressure from the tank for moving the cylinder in said one direction, said spring means comprising a resilient bellows having the cylinder attached thereto and nested therein.

5. The construction defined in claim 1, wherein said spring means includes a helical compression spring acting upon the cylinder to move the latter in said opposite direction, and means to adjust the compression of said spring.

6. The construction defined in claim 1, wherein said spring means embodies a resilient bellows forming part of said chamber and having said cylinder attached thereto.

7. The construction defined in claim 1, wherein said check valve is mounted in the top of said chamber, and a piston rod fixed to and depending from the top of said chamber and having the piston mounted upon the lower end thereof, said piston rod having a passage therethrough for conducting the air from the check valve into the cylinder past the piston.

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