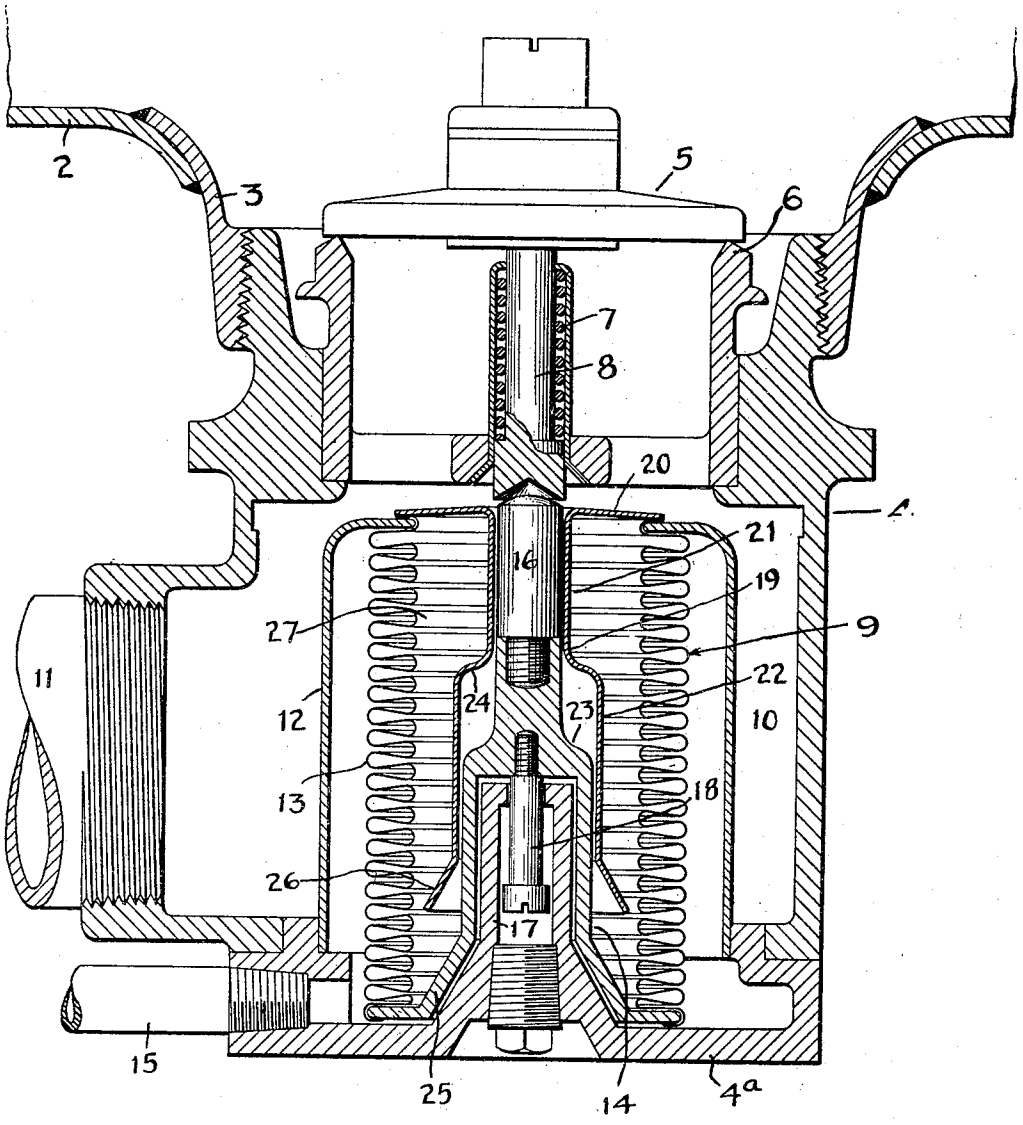
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VALVE ACTUATOR

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## VALVE ACTUATOR

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The invention relates to fluid-actuated actuators for tank valves. The actuators with which the invention is concerned are metal bellows devices. A type which has been found to be effective for such purposes is one in which the actuating fluid is admitted to a space outside the bellows, between the same and a fixed casing, the upper end of the bellows being connected to the casing and the lower end of the bellows being closed by a wall or member from which a post or thrust rod extends upward to unseat the valve.

In such an actuator, the space surrounded by the bellows forms a pocket which is open at the top and therefore accessible to extraneous liquid. The extraneous liquid may be water used in the testing of the tank, or it may be gasolene or other liquid which is transported by the tank or tank compartment and which is delivered therefrom when the valve is open. Gasolene may contain a certain proportion of water, and when the valve is open the pocket will become filled, if it does not already contain water left from the time when the tank was tested before it was put in operation. Even if the gasolene or other contents carried by the tank is the only liquid to enter and be trapped in the pocket, the water that may be present in the gasolene tends to settle to the bottom of the pocket.

Whatever its source, water in the pocket will freeze in sufficiently cold weather, and the ice in the convolutions of the bellows may either shorten its range of operation sufficiently to prevent proper opening of the valve, or even prevent operation altogether.

The object of the present invention is to obviate this difficulty. This is accomplished by provisions in the pocket which serve to expel water upward from the bottom of the pocket by reason of the operation of the bellows. Briefly, I provide a tube which extends downward in the pocket and an expelling member operatively connected with the lower end of the bellows to work in this tube. The expelling member also serves as, or serves to carry, the thrust element which unseats the valve. The lower end of the tube is preferably flared to form a contracting entrance, and the lower part of the expelling member preferably slopes outward and downward in a corresponding manner. When the bellows is contracted upward by the pressure of the actuating fluid, to open the valve, and when it elongates or descends with the closing of the valve, the expelling member moves up and down in the tube and the result is to cause water to pass or be forced up the narrow space between the expelling member and the tube and out of the top. When the expelling member descends, gasolene may be drawn down into the tube and pocket. It is not necessary that absolutely all the water be expelled, since if the amount of water in the pocket is kept small enough either there will be no freezing, or freezing if it occurs will affect only the lowermost convolution or convolutions of the bellows, and this will not reduce the travel sufficiently to interfere with full opening of the valve. It is not entirely clear why the water is forced upward through the gasolene, but I find that that is the case.

A wall or plate extends outward from the upper end of the tube to the top of the casing, or to the top of the bellows, where it is soldered or otherwise tightly joined. This closes the top of an air chamber which is formed outside the tube, between the same and the bellows, and the presence of the air cushion in this chamber, which is in communication with the lower part of the pocket, appears to contribute to the desired expulsion of water. This cushion which is slightly compressed on the upward movement, expands on the downward movement and seems to cause some of the water to be displaced at this time.

The accompanying drawing is a central vertical section of a valve actuator embodying the invention, the actuator being shown associated with the valved outlet of a tank.

The numeral 2 designates part of a shell of a truck tank or truck tank compartment. The shell is flanged down around a bottom opening to receive a welded-in collar 3, into which the upper end of an outlet fitting 4 is screwed. A normally-closed valve 5 rests on an annular seat 6 carried by the upper part of the fitting, this valve being automatically closed by a spring 7 acting with gravity,

the spring exerting its pressure against a shoulder on a depending valve stem 8.

The valve actuator 9 is preferably located in the chamber 10 of the outlet fitting, below the valve. A pipe 11 connected to an outlet in one side of the fitting represents a discharge line.

The actuator is shown mounted on a removable bottom plate $4^a$ of the fitting 4. It includes a cylindrical shell 12 tightly fitted at its lower end to the plate $4^a$, these parts forming a casing. A cylindrical metal bellows 13 has its upper end tightly secured to an inturned top flange of the shell, and its lower end tightly secured to the flange of an imperforate vertically movable piece 14. A connection 15 for actuating fluid enters an opening in the plate $4^a$ which communicates with the space around and below the bellows. Actuating fluid is forced into this space to open the valve, and is permitted to pass out when the valve is to be closed.

The piece 14 extends upward centrally of the bellows, so that its upper end, which may be made of a separate piece 16, is arranged to thrust against the valve stem 8. The piece 14 may be made hollow for part of its height so as to be guided on a central post 17 rising from the plate $4^a$, and this post may be made hollow to cooperate with a motion limiting pin 18 which extends downward from the piece 14.

A construction and arrangement of valve actuator substantially as described thus far is not new with me. In such an actuator the bellows makes a pocket open at the top, which catches water when the tank is tested with water after manufacture, and which thereafter is exposed to gasolene, oil or other liquid carried by the tank. The difficulty which results when water freezes in this pocket has been explained.

In accordance with my invention a tube 19 is provided which extends downward from the top of the pocket inside the bellows to within a comparatively short distance of the bottom. The lower end of this tube is spaced above the expanded lower part 25 of the piece 14 at a distance sufficient to permit the full intended range of movement of the bellows in opening the valve.

The upper end of this tube is tightly joined with the top of the shell 12, or with the top of the bellows, so that the only top entrance and exit for liquid to and from the pocket is through the upper end of the tube. For this purpose a plate or flange 20 is preferably formed or united with the upper end of the tube and extended outward to the shell 12, where it is soldered.

The tube preferably has a contracted upper part 21 and a broadened barrel 22. The interior of the part 21 is slightly wider than the narrow upper part of the piece 14 and its extension 16, and the interior of the barrel is slightly larger than the broad part of said piece. Through these narrow channels water is expelled from near the bottom of the pocket.

The broad and narrow portions of the piece 14 are preferably joined by a curved or inclined shoulder 23, and the corresponding portions of the tube are similarly connected by an offset 24. The fact that the plunger and tube comprise upper and lower stages of different diameters is not essential, but it has been found to work well.

At its lower end the piece 14 slopes downward and outward into proximity to the lower end of the bellows, this portion being marked 25. This is of advantage because it causes the lower portion of the pocket, where water principally lies, to be contracted to a smaller and smaller area as the bottom is approached. This portion of the vertically movable piece, or expelling member as it may be termed, coacts with a correspondingly flared entrance 26 constituting the lower end of the tube. It is believed that this converging entrance and the correspondingly formed base of the piece 14 increase the effectiveness of the expelling action.

Attention is called to the air chamber 27 which is formed within the pocket, between the tube 19 and the bellows 13 and beneath the top closure 20. This air chamber is quite closed except at the bottom, and the presence of the trapped body of air for some reason not clearly understood contributes to the water expelling action.

That this is true has been ascertained in the following manner. Instead of the sheet metal tube 21 and its top plate 20, a part was made from solid metal approximately filling the interior of the pocket to the depth of the tube and having a passageway through it similar to the interior of the tube shown. With this heavy walled tube, tightly joined at the top with the shell 12 and leaving very little air space, the pocket was relieved of more or less water by operation of the actuator, but when the form of tube shown in the drawing was substituted the water expelling action was noticeably increased. For test purposes a dam was built around the top of the tube to retain liquid. With water in the lower part of the pocket and the interior of the tube and the pool inside the dam filled with gasolene, it was evident that the water was driven upward through the gasolene.

With this invention, it becomes easy, after a tank has been tested with water before putting it in commission, to free the valve-actuating bellows devices of the several tank compartments from most of the water which enters them, by actuating the bellows several times by means of the actuating fluid. Afterwards, when the tank is in use, water, if any, remaining in the bellows, or which may settle in them from the gasolene, is ejected at each

opening of the valves. The discharge lines 11 customarily terminate in faucets, and by keeping these closed and operating the bellows devices and thereby the valves a suitable number of times, from time to time in cold weather, it can be assured that the liquid in the interiors of the bellows will be only gasolene, or that if there is any water left in the very bottom it will be so little that its freezing will not interfere with the opening of the valves.

While the preferred form of the invention has been described in detail, it will be understood that matters of form, proportion and arrangement may be altered without departing from the essential novelty.

I claim:

1. The combination with a tank-valve actuator comprising a fluid-actuated metal bellows which forms the wall of a pocket which is accessible to extraneous liquid, of an expeller located in said pocket and operatively connected with said bellows so as to be operated therewith.

2. A tank-valve actuator comprising a fluid-actuated metal bellows which forms the wall of a pocket which is accessible to extraneous liquid, said actuator characterized by the provision of an expeller comprising a tube extending downwardly in said pocket and an expelling member operatively connected with said bellows to work in said tube.

3. In a tank-valve actuator comprising a fluid-actuated metal bellows which forms the wall of a pocket which is accessible to extraneous liquid, means closing the outer part of the top of said pocket, a tube extending downward within said pocket, there being an air chamber outside said tube between the same and said bellows, and an expelling member operatively connected with said bellows to work in said tube.

4. In a tank-valve actuator comprising a fluid-actuated metal bellows which forms the wall of a pocket which is accessible to extraneous liquid, an expeller comprising means forming a tube extending downward in said pocket and providing an air chamber outside said tube and closed above, and an expelling member operatively connected with said bellows to work in said tube.

5. In a tank-valve actuator comprising a fluid-actuated metal bellows which forms the wall of a pocket which is accessible to extraneous liquid, an expeller comprising a tube extending downward in said pocket, and an expelling member operatively connected with the lower end of said bellows to eject liquid upward through said tube, said expelling member increasing in diameter toward the bottom so that the space between the same and said bellows diminishes to a small area.

6. In a tank-valve actuator comprising a fluid-actuated metal bellows which forms the wall of a pocket which is accessible to extraneous liquid, an expeller comprising a tube extending downward in said pocket, said tube having a flared skirt at its lower end, and an expelling member operatively connected with the lower end of said bellows to eject liquid upward through said tube, said expelling member increasing in diameter toward the bottom.

7. In a tank-valve actuator comprising a fluid-actuated metal bellows which forms the wall of a pocket which is accessible to extraneous liquid, means forming a tube extending downward into said pocket, and a closure for the top of said pocket outside the interior of said tube, and an expelling member operatively connected with said bellows to coact with said tube.

8. In a tank-valve actuator comprising a fluid-actuated metal bellows which forms the wall of a pocket which is accessible to extraneous liquid, an expeller comprising a tube extending downward in said pocket, the top of said pocket outside the interior of said tube being closed, said tube having a contracted upper part and a broadened barrel part, and an expelling member operatively connected with said bellows and comprising portions of different diameters to work in said barrel part and said contracted part of said tube, respectively.

9. In a tank-valve actuator comprising a fluid-actuated metal bellows which forms the wall of a pocket which is accessible to extraneous liquid, an expeller comprising a tube extending downward in said pocket, the top of said pocket outside the interior of said tube being closed, said tube having a contracted upper part and a broadened barrel part, the latter having a flaring entrance at the lower end, and an expelling member operatively connected with said bellows and comprising portions of different diameters in the two parts of said tube, respectively, the lower portion of said expelling member being formed to cooperate with said flaring entrance.

10. In a tank-valve actuator comprising a fluid-actuated metal bellows which forms the wall of a pocket which is accessible to extraneous liquid, an expeller comprising a tube extending downward in said pocket and having a flaring lower end, the top of said pocket outside the interior of said tube being closed, and an expelling member operatively connected with said bellows and having an outwardly sloping lower portion to coact with the flared lower end of said tube.

11. In a tank-valve actuator comprising a casing having a connection for actuating fluid, and a metal bellows connected at its upper end with said casing and surrounding a pocket which is accessible to extraneous liquid, a tube extending downward in said pocket and a wall extending outward from said tube to close the top of an air chamber

between said tube and said bellows, and an expelling member operatively connected with the lower end of said bellows to work in said tube.

12. A tank-valve actuator, comprising a casing having a connection for actuating fluid, a metal bellows the upper end of which is connected with said casing and the interior of which forms a pocket accessible to extraneous liquid, means providing a tube extending downward in said pocket and a closure for the top of said pocket outside the interior of said tube, and a member operatively connected at its lower end with said bellows and extending upward in said tube so as to afford a thrust element to operate a valve, said tube and member being so constituted as to expel undesired liquid from the lower part of said pocket.

13. A tank-valve actuator, comprising a casing having a connection for actuating fluid, a metal bellows the upper end of which is connected with said casing and the interior of which forms a pocket accessible to extraneous liquid, a tube extending downward in said pocket, a closure extending from said tube to said casing to close the top of an air chamber between said tube and said bellows, and a member operatively connected at its lower end with said bellows and extending upward in said tube so as to afford a thrust element to operate a valve, the construction being such that by the operation of the actuator undesired liquid is expelled upward through said tube.

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