Dec. 26, 1939. H. E. HEIGIS 2,185,103

FLUID PRESSURE OPERATED APPARATUS AND FLUID CONTROL VALVE THEREFOR

Original Filed Feb. 25, 1936

Fig. 3.

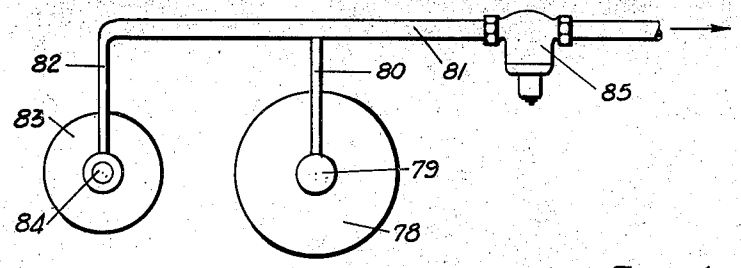


Fig. 1.

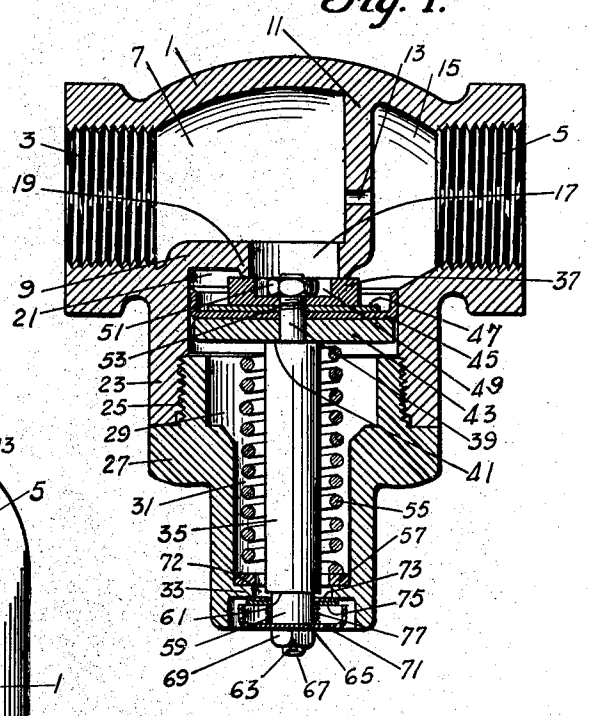
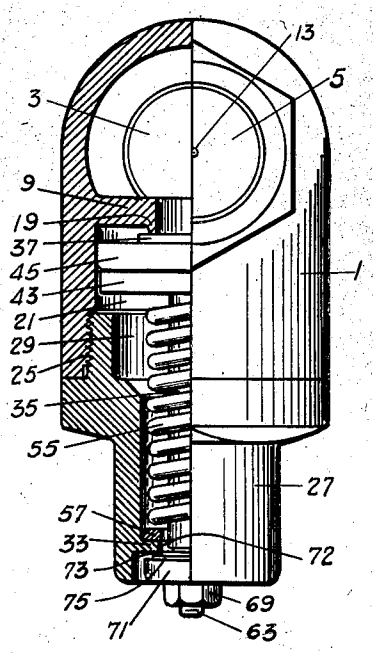


Fig. 2.



INVENTOR
HENRY E. HEIGIS
BY
J. William Carson
ATTORNEY

Patented Dec. 26, 1939

2,185,103

UNITED STATES PATENT OFFICE

2,185,103

FLUID PRESSURE OPERATED APPARATUS AND FLUID CONTROL VALVE THEREFOR

Henry Ernest Heigis, West Orange, N. J., assignor to Walter Kidde & Company, Inc., Bloomfield, N. J., a corporation of New York

Application February 25, 1936, Serial No. 65,551
Renewed February 1, 1939

6 Claims. (Cl. 169—11)

The present invention relates to a fluid pressure operated apparatus and a fluid control valve operated by the pressure of the fluid that the valve is designed to control.

The valve of this invention may be employed in numerous ways but is herein employed to prevent the escape of fluid from a system until the pressure of the fluid in the system has risen to a predetermined point. The specific valve herein disclosed is so designed that the pressure required to open the valve and permit the passage of fluid therethrough is much greater than the pressure which is necessary to maintain the valve open after it once has been opened; but it will be apparent that this design is only one of a large number of possible variations depending upon the desired difference between the pressures at which the valve is to open and to close again.

There are a great many apparatus in which fluids under high pressure are stored until the time when the fluid is to be utilized, at which time the fluid is released and is permitted to escape through pipe lines. It has been customary in such apparatus to employ a number of comparatively small containers connected to a common discharge conduit and to provide means to release the fluid from the numerous small containers substantially simultaneously.

In a great many instances means to release the fluid in one of the containers to a common discharge conduit either by manual means, or automatically, is provided. The fluid in the remaining containers is then released by the action, on appropriate mechanisms, of the pressure of the fluid released from the first container which reaches the aforementioned mechanisms by means of the conduit. Apparatus of this type has been employed in several arts but is mainly used in the art of fire extinguishing. An example of apparatus of this kind which is employed in fire extinguishing is illustrated and described in the United States Patent No. 2,000,708, granted on May 7, 1935.

In employing apparatus of this general sort disadvantages have become very apparent. Often it has been found that after the fluid has been released from the first container it escapes from the apparatus through the common discharge conduit so rapidly that it does not furnish enough pressure to operate the release mechanisms on the other containers. Accordingly it would be of great advantage to provide a means which would restrain the fluid released from the first container in the discharge conduit until the pressure of the fluid will have caused the release of the fluid in the other containers.

The valve of the present invention has been designed to meet this situation, and accordingly an object of the present invention is to provide a valve for fluids which will not permit passage of fluid therethrough until a predetermined pressure has been reached and will remain open under pressures which are less than the pressure required to open the valve.

Another object of the invention is to provide a valve which will permit the escape of any air pressure built up in the apparatus due to an increase in temperature.

A further object is to provide a valve which will check the flow of a fluid therethrough until a predetermined pressure is reached.

A still further object is to provide a fluid pressure operated apparatus including a pressure operated mechanism, means to supply a fluid medium under pressure to operate said mechanism, and means to discharge said medium, in which means are provided to restrain the discharge of said fluid until the pressure thereof has been built up sufficiently to operate said mechanism.

Further objects, not specifically enumerated above, will be apparent as the invention is described in greater detail in connection with the accompanying drawing wherein:

Figure 1 is a view in vertical, central section of a valve in accordance with the present invention.

Figure 2 is a view partially in central vertical section and partially an exterior view of the valve of Figure 1 at right angles to the view of Figure 1.

Figure 3 is a diagrammatical view of an apparatus for discharging a fluid medium under pressure, in which the valve of the present invention is employed.

In Figure 1 there is shown a valve body 1 having a threaded inlet 3 and a threaded outlet 5. The purpose of the threaded inlet 3 and outlet 5 is to permit attachment of the valve to the apparatus in which it is to be employed. The inlet 3 leads directly to an inlet chamber 7 which is bounded by the wall of the body 1, the wall 9 and the wall 11. A small bleeder hole 13 in the wall 11 connects the inlet chamber 7 with the outlet chamber 15 which is formed by the body 1 and the wall 11. The bleeder hole is furnished to permit the escape of any fluid which may collect or remain in the valve and in the system with which the valve is associated, at a pressure that is insufficient to open the valve or to maintain the valve open after it has moved to the

open position. This bleeder hole also permits the relief of any air pressure which might otherwise develope upon a rise of temperature in the apparatus. It thus prevents the presence of a fluid under pressure in the valve which is insufficient to open the valve. At the same time the bleeder hole is not large enough to allow the fluid to escape in sufficient quantity to effect the operation of the valve when the fluid pressure is increased rapidly in order to operate the valve, but merely serves as a vent for a slow escape of fluid.

A circular passage 17 passes through the wall 9. At the end of the passage 17, which is the most remote from the chamber 7, a seat 19 is formed which connects the inlet chamber 7 with the valve chamber 21, formed in the body 1 by the wall 23. The wall 23 is provided with threads 25 which coact with appropriate threads on the bonnet 27. The bonnet 27 is attached to the body 1 by the threads and it serves to close the valve chamber 21 in airtight condition. The bonnet 27 has a chamber 29 forming part of the valve chamber 21 and communicating with a passage 31 in the bonnet. A wall 33 formed in the passage reduces the size of the opening of the passage at a point near the end of the bonnet 27.

On the stem 35, which extends through the chamber 21 of the body, the chamber 29 and the passage 31 of the bonnet to the exterior of the bonnet 27, is mounted a valve seat disc 37. Normally the disc 37 rests on the seat 19. The stem 35 has a portion 39 that is smaller in diameter than the main section of the stem and forms a shoulder 41 where the portion 39 meets the main section of the stem. In the chamber 21 is a piston 43 mounted on the portion 39 of the stem 35 and resting against the shoulder 41. The diameter of the piston 43 is very nearly equal to the diameter of the chamber 21 so that very little clearance is permitted therebetween, but to prevent leakage of a fluid between the piston and the wall of the chamber 21 a leather cup washer 45 is placed on the piston having a diameter sufficient to permit it to rub against the wall of the chamber 21. Between the valve seat disc 37 and the cup washer 45 is placed a washer 47 serving to hold the cup washer in place. The valve seat disc 37 has a recess 49 wherein the nut 51 rests when it has been secured to the portion 39 by means of the cooperating threads 53 formed on the stem portion 39.

The valve seat disc 37 is ordinarily pressed against the valve seat 19 by the pressure of the spring 55 surrounding the stem 35 and resting on the piston 43 and washer 57. The washer 57 in turn bears on the wall 33 of the bonnet. The washer 57 has a central square hole instead of a round hole in order to provide the greatest possible bearing surface for the spring and still prevent binding of the washer on the stem.

The end of the stem 35 extending to the exterior of the bonnet has two sections smaller in diameter than the main portion of the stem. One portion 59 forms a shoulder 61 with the main portion of the stem and a second section 63 of less diameter than portion 59 forms a shoulder 65 with the portion 59. The section 63 has threads 67 in order that the nut 69 may be secured thereto.

A metal indicator 71 rests on the shoulder 65 and is securely held there by the nut 69. Surrounding the portion 59 is a rubber gasket 73 resting on the wall 33 of the bonnet 27. A metal washer 75 is placed on the gasket 73 and is pressed against the gasket by a spring 77 which bears on the indicator 71 and the washer 75. The gasket 73 is accordingly held securely against the wall 33 by the action of the spring 77. A space 72 is provided between the wall 33 of the bonnet and the stem 35. Any back pressure created by the movement of the piston will act on the gasket 73 and tend to push it away from the wall 33 thus breaking the seal between the gasket and the wall. If the pressure in the bonnet is greater than the tension of the spring 77 the gasket 73 will move away from the wall 33 and under such conditions the back pressure may be dissipated through the space 72 to the atmosphere. In this manner a vent is provided for the back pressure of the piston which will also allow the escape of any fluid which may leak past the cup leather and the piston when the valve has been opened by the fluid pressure. In the event that the back pressure is not sufficient to move the gasket 73 against the tension of the spring 77, then the shoulder 61 on the stem 35 will engage the gasket to move it to relieve the back pressure upon continued movement of the stem.

The indicator 71 serves a very important function in the event that the valve should remain open for any reason. If for instance, the leather cup washer should in some way prevent the return of the valve disc to its seat, or the spring should break or be unable to retain the disc on the seat, obviously, the valve would not serve the purpose for which it is intended. However, with the provision of means to indicate when the valve is open, should the valve remain open when it normally should be closed this condition may be readily ascertained, and the fault remedied before any harm has been done; and thus the valve may serve the purpose for which it was designed.

The pressures that determine when the valve will operate are dependent on the relative areas of the passage 17 and the piston 43. It is readily apparent that the pressure at which the valve will open against a fixed spring depends on the area of the passage 17. When a fluid enters the valve through the inlet 3 the pressure will press on the valve disc 37 tending to push it away from the seat 19. Hence, the bigger the exposed area of the disc, the smaller will be the pressure required to push the disc back. The passage which leads to the disc is accordingly made of such size that the pressure required to push the disc back is greater than the greatest pressure required to operate all the mechanisms that must be operated before the valve is to open. Usually the pressure is in the neighborhood of 100 pounds per square inch when the required mechanism operating pressure is about 40 pounds per square inch.

Once the valve has been opened, however, the fluid will pass through the valve and since the area of the piston 43 then exposed to the pressure of the fluid passing through the valve is much greater than the area of the disc which was exposed, a lesser pressure will retain the valve open for the passage of the fluid than was necessary to open the valve, since the force exerted by the fluid is dependent on the area over which the pressure is exerted.

It readily will be realized that the valve of the present design may be changed for various uses and may be fitted for particular uses by changing the relative areas of the disc and the piston and by the size and design of the spring used. In fact, the ratios of the two areas may be varied, as required, from a maximum greater than unity

to a theoretical minimum equal to unity, when the opening pressure is equal or very nearly equal to the closing pressure.

Referring now to Figure 3, which illustrates an apparatus for discharging a fluid medium under pressure, in which the valve of the present invention is employed, a main pressure fluid medium container is shown at 78. This container is provided with a fluid pressure operated release mechanism 79, which is connected to a main discharge conduit 81 by a branch connection 80. A control container 83, having, for example, a manually operable fluid release mechanism 84 and also containing a fluid medium under pressure, is also connected to the main discharge conduit 81 by a branch connection 82. A pressure differential fluid control valve 85, in accordance with the present invention, is interposed in the main discharge conduit beyond the connections thereto of the main and control containers of fluid medium.

In view of the detailed description of the construction and operation of the pressure differential fluid control valve itself, the operation of the apparatus of Figure 3 is readily understood. Thus, upon operation of the manual release mechanism 84 of the control container 83, the control fluid will be released into the main discharge conduit 81 behind the normally closed pressure differential fluid control valve 85, which blocks the discharge of the control medium until sufficient pressure has been built up by the outflow from the control container 83 to effect operation of the fluid pressure operated release mechanism 79 of the main container 78. As soon as the pressure has built up to the predetermined value for which the pressure differential valve 85 is set, the valve 85 opens to permit the desired discharge of the fluid medium; and by reason of the differential pressure feature of the valve 85, the valve remains open until practically all the fluid medium has been discharged, and until the pressure of the medium has fallen below some predetermined value, which is usually appreciably lower than the pressure at which the valve opens. By way of example, in a carbon dioxide discharge apparatus for handling liquid carbon dioxide the valve may be designed to open at a pressure of 100 pounds per square inch, and to close again at a pressure of 15 pounds per square inch; but the particular range of pressures is of course governed by the particular use to which the invention is put, and the operating characteristics of the apparatus.

It will of course be understood that any pressure remaining in the main discharge conduit 81 after the closing of the valve 85 will be bled off through the bleeder hole or vent 13 in the wall 11 of the valve 85 (see Figure 1); and the apparatus will be ready for operation again as soon as the empty containers have been replaced.

It will also be understood that, in the application of the invention to a use such as is shown in Figure 3, the number of containers, their types and respective modes of operation, and their particular relative arrangement in the apparatus would not constitute a deviation beyond the scope of the invention, so long as the discharge of the medium is retarded until sufficient pressure has been built up to insure operation of all the pressure operated containers, and so long as the discharge of the medium through the differential valve may proceed until there has been some predetermined drop in the pressure of the fluid medium below that required to open the valve.

Although I have shown and described a specific embodiment of my invention, I am fully aware that many modifications thereof are possible, and it is to be understood that the present invention, while it has been described with specific reference to the accompanying drawing, is not to be limited save as defined in the appended claims.

I claim:

1. In a fire extinguishing apparatus comprising a container of fire extinguishing fluid under pressure, a discharge conduit for said fluid when it is released from said container, a fluid pressure operated mechanism for releasing said fluid from said container, an operating fluid container likewise containing a fire extinguishing fluid under pressure, means to release said operating fluid from its container, and means to conduct said operating fluid to operate said fluid pressure operated mechanism comprising said discharge conduit, the combination of fluid restraining means in said discharge conduit beyond said containers to prevent discharge of fluid from the discharge conduit until the fluid therein has attained a predetermined pressure sufficient to operate said fluid pressure operated mechanism, said last named means being adapted upon operation thereof to discharge fluid from the discharge conduit until the pressure therein has fallen a predetermined amount below said first named predetermined pressure.

2. In a fire extinguishing apparatus comprising a container of fire extinguishing fluid under pressure, a discharge conduit for said fluid when it is released from said container, a fluid pressure operated mechanism for releasing said fluid from said container, an operating fluid container likewise containing a fire extinguishing fluid under pressure, means to release said operating fluid from its container, and means to conduct said operating fluid to operate said fluid pressure operated mechanism comprising said discharge conduit, the combination of fluid restraining means in said discharge conduit beyond said containers to prevent discharge of fluid from the discharge conduit until the fluid therein has attained a predetermined pressure sufficient to operate said fluid pressure operated mechanism, said last named means being adapted upon operation thereof to discharge fluid from the discharge conduit until the pressure therein has fallen a predetermined amount below said first named predetermined pressure, and means constituting a continuous relatively restricted vent past said fluid restraining means.

3. In an apparatus comprising a container of a fluid medium under pressure, a discharge conduit for said fluid when it is released from said container, a fluid pressure operated mechanism for releasing said fluid from said container, an operating fluid container likewise containing a fluid medium under pressure, means to release said operating fluid from its container, and means to conduct said operating fluid to operate said fluid pressure operated mechanism comprising said discharge conduit, the combination of fluid restraining means in said discharge conduit beyond said containers to prevent discharge of fluid from the discharge conduit until the fluid therein has attained a predetermined pressure sufficient to operate said fluid pressure operated mechanism, said last named means being adapted upon operation thereof to discharge fluid from the discharge conduit until the pressure therein has fallen a predetermined amount below said first named predetermined pressure.

4. In an apparatus comprising a container of a fluid medium under pressure, a discharge conduit for said fluid when it is released from said container, a fluid pressure operated mechanism for releasing said fluid from said container, an operating fluid container likewise containing a fluid medium under pressure, means to release said operating fluid from its container, and means to conduct said operating fluid to operate said fluid pressure operated mechanism comprising said discharge conduit, the combination of fluid restraining means in said discharge conduit beyond said containers to prevent discharge of fluid from the discharge conduit until the fluid therein has attained a predetermined pressure sufficient to operate said fluid pressure operated mechanism.

5. In an apparatus comprising a container of a fluid medium under pressure, a discharge conduit for said fluid when it is released from said container, a fluid pressure operated mechanism for releasing said fluid from said container, an operating fluid container likewise containing a fluid medium under pressure, means to release said operating fluid from its container, and means to conduct said operating fluid to operate said fluid pressure operated mechanism comprising said discharge conduit, the combination of fluid restraining means in said discharge conduit beyond said container to prevent discharge of fluid from the discharge conduit until the fluid therein has attained a predetermined pressure sufficient to operate said fluid pressure operated mechanism, said pressure being lower than the maximum attainable by the fluid medium, and said last named means being adapted upon operation thereof to discharge fluid from the discharge conduit until the pressure therein, upon decreasing from a maximum, has attained a value differing from said initial operating pressure of said fluid pressure operated mechanism by an amount varying from a maximum to a minimum as previously determined.

6. In an apparatus comprising a container of fluid medium under pressure, a discharge conduit for said fluid when it is released from said container, a fluid pressure operated mechanism for releasing said fluid from said container, an operating fluid container likewise containing a fluid medium under pressure, means to release said operating fluid from its container, and means to conduct said operating fluid to operate said fluid pressure operated mechanism comprising said discharge conduit, the combination of fluid restraining means in said discharge conduit beyond said container to prevent discharge of fluid from the discharge conduit until the fluid therein has attained a predetermined pressure sufficient to operate said fluid pressure operated mechanism, said pressure being lower than the maximum attainable by the fluid medium, and said last named means being adapted upon operation thereof to discharge fluid from the discharge conduit until the pressure therein, upon decreasing from a maximum, has attained a value differing from said initial operating pressure of said fluid pressure operated mechanism by a minimum amount.

HENRY ERNEST HEIGIS.