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SAFETY VALVE DEVICE
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Fig. 1

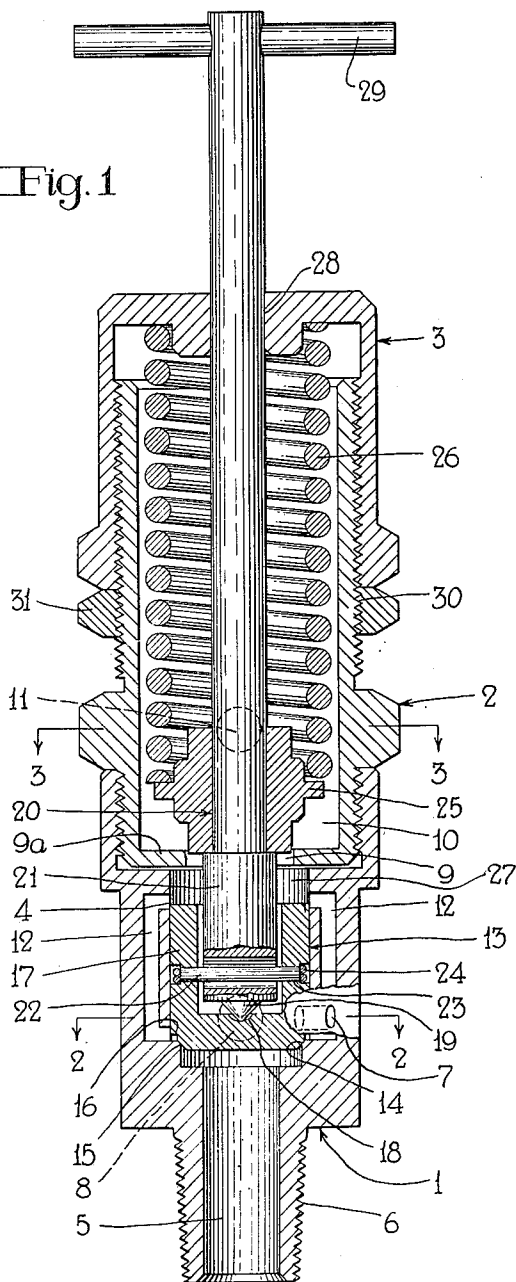


Fig. 3

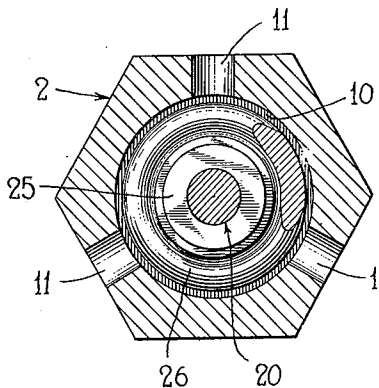
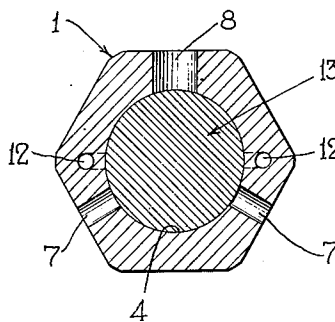


Fig. 2



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SAFETY VALVE DEVICE

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3 Claims. (Cl. 137—53)

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This invention relates to fluid pressure relief valves and more particularly to safety valve devices of the poppet type used in fluid pressure apparatus.

The principal object of this invention is to provide an improved safety valve device, in which the valve thereof will move quickly to a wide open position immediately after the valve begins to open in response to a predetermined degree of fluid pressure, and which will move quickly and positively to its seat when the pressure has diminished a certain degree.

Another object is to provide a safety valve device of the poppet type which is capable of adjustment for operation over a wide range of fluid pressures without permitting the valve to unintentionally pulsate or vibrate at a rapid rate in a vertical direction relative to the body.

A further object is to provide a safety valve device which upon attaining a certain degree of fluid pressure in the device with which the safety valve device is associated will operate to reduce the fluid pressure therein at a steady rapid rate to a lower pressure setting.

Other objects and advantages will appear in the following more detailed description given in connection with the accompanying drawing, wherein:

Fig. 1 is a vertical sectional view of a safety valve device embodying the improvements of this invention;

Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1; and,

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1.

In the embodiment shown, the safety valve device comprises a valve body 1, a spring housing 2, and a cap 3.

Provided in the body 1 is a bore 4 which may communicate by way of a passage 5 at the bottom of said bore with a reservoir or other fluid pressure element or port to be vented, in which reservoir or port the body is arranged to be mounted by means of an integral pipe-threaded nipple 6. Located in the periphery of the bore 4 near the bottom are a pair of small discharge ports 7 and a large discharge port 8 which ports connect said bore to the atmosphere. At the top the bore 4 is open by way of an opening 9 in an end-wall 9a of the housing 2 to a spring chamber 10 in the housing 2, the spring chamber being always open to atmosphere by way of a plurality of apertures 11. Located in diametrically opposite sides of the bore are two pressure ports 12 which may conduct fluid under pressure from the

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bottom of the bore to a point located a short distance below the top thereof.

For controlling communication between the passage 5 and the bore 4 a piston valve member 13 is slidably mounted in the bore 4, the lower end of the member being undercut and provided with a frusto-conical valve 14 for engagement with a corresponding valve seat 15 encircling the upper end of the passage 5. The undercut produces a shoulder 16 which, as will hereinafter more fully appear, aids in accelerating the opening movement of the valve. As will be observed in Fig. 1, a piston portion 17 of the member 13 is arranged to normally close the discharge ports 7 and 8 and to partially lap off both ends of the pressure ports 12. The upper face of the valve portion of the member 13 is provided with a conical recess 18 for engagement with a head 19 of a thrust stem 20.

The thrust stem 20 has an enlarged cylindrical portion 21 at its lower end to which the valve member 13 is loosely attached by means of a pin 22 in a transverse opening 23 of the stem, the pin being retained in place by a helical spring 24 which is disposed in a suitable peripheral slot provided in the member. Through the medium of a plug 25, upon which a spring 26 seats, a downward pressure is exerted by the spring 26 on the portion 21 of the thrust stem 20, thereby urging the valve member 13 toward its normal seated position in which it is shown in the drawing. It should be noted that when the valve 14 is in its normal closed position, there is only a small clearance space between the plug 25 and the adjacent wall of the opening 9, the plug 25 thus helping to define a chamber 27 at the top of the bore 4. The upper end of the stem 20 is slidably guided in a bore 28 of the cap 3 and terminates outside the safety valve device in a T-shaped handle 29 which is provided for manually unseating the valve.

The pressure of the spring 26 may be regulated by adjusting the position of the cap 3 on the housing 2 by means of the screw-threads 30. A check nut 31 is provided for locking the cap 3 in its adjusted position.

In operation, when the pressure of fluid in the reservoir or port to be vented and thus in passage 5 and acting over the exposed area of the face of valve 14 is sufficient to overcome the opposing pressure of the spring 26 which has been adjusted to the desired venting pressure, the valve 14 will be moved thereby away from the seat 15. When the valve 14 is raised slightly, fluid under pressure will then flow past the valve seat 15 into the

bore 4 beneath the valve member 13 and become effective over the full area of the face of the piston portion 17. The resulting additional force exerted on the shoulder 16 accelerates the movement of the valve member 13 toward its wide open position. In the course of this movement of the member, fluid under pressure will be discharged to atmosphere by way of the large discharge port 8. Further movement of the valve member in this direction will uncover the discharge ports 7 in addition to opening the port 8 wider and at the same time will close the upper end of the ports 12.

It should here be mentioned that as soon as the valve 14 moves out of engagement with the seat 15, the movement of the valve member 13 to its extreme open position will be so rapid that it will lap the ports 12 where such ports communicate with the chamber 27, before the fluid which may flow therethrough can appreciably increase the pressure of fluid in this chamber. Further, the movement of the piston member will be so rapid that in an instant following the unseating of the valve 14 the plug 25 will be moved to a position to provide a relatively wide open communication between the chamber 27 and the atmospheric chamber 10 so that any tendency for the pressure of fluid to build up in chamber 27 is eliminated. From this it will be apparent that the chamber 27 will, during the opening movement of the valve member 13, be maintained at substantially atmospheric pressure. By thus preventing any material increase in the pressure of fluid in the chamber 27 the snap action of the valve 14 toward its open position will be substantially unopposed by any fluid pressure which may flow to chamber 27 through the ports 12.

It is to be noted that the large discharge port in the wall of the bore 4 in the housing is located adjacent the bottom of the bore and in line with the upper edge of the valve seat 15, so that any water or dirt which may collect on the flat surface encircling the valve seat will be discharged therethrough to the exterior of the housing. Although fluid under pressure is discharged from the inlet passage 5 as soon as the valve 14 unseats, it is not intended that this port alone serve to provide full discharge capacity, but rather, for the purpose of insuring the rapid movement or snap action of the piston valve to its full open position, it is desired that the full discharge capacity be provided only after the full area of the face of the piston valve has been subjected to the pressure of fluid in the inlet passage. In the present embodiment of the invention this result is attained by the use of the two supplementary discharge ports 7 which are each of such diameter and so arranged that they are lapped by the piston valve when the piston valve is seated and are each uncovered after the piston valve has moved a chosen distance following the unseating of the piston valve. It should here be mentioned that if the ports 7 were arranged so that they would serve to discharge fluid from the inlet passage 5 upon the initial unseating movement of the piston valve the amount of fluid discharged would be so great as to offset the benefit derived from the use of the shoulder 16 of the piston valve, that is to say, the discharge would be such that it would materially slow down the quick movement of the piston valve to its full open position.

As the pressure in the passage 5 is reduced to approximately the closing pressure by reason of this venting of fluid, the spring 26 will act

through the medium of the plug 25 to move the valve member 13 toward the seated position in which it is shown. This movement permits the piston portion 17 to again uncover the lapped ends of the pressure ports 12. Fluid under pressure will flow by way of these ports 12 from the space in the bore 4, below the piston valve member, to the chamber 27 above the piston valve member.

It will be apparent that the end of the plug 25 which is in engagement with portion 21 of the plunger stem, as it approaches or nears the wall 9a of the housing will restrict the flow area of the opening 9 in the flange so that when the piston member 13 uncovers the ports 12 the flow of fluid from these ports to chamber 27 will increase the pressure in this chamber, and when the end face of the plug moves into alignment with the upper face of the end wall 9a, the maximum restriction of the opening 9 is attained. At this time the flow of fluid from chamber 27 to the chamber 10 and thereby to the atmosphere will be at such a slow rate that the pressure of fluid in chamber 27 will quickly substantially equalize with the pressure of fluid acting on the face of the valve 14. With the fluid pressures acting on opposite sides of the piston member 13 being substantially equal, the movement of the valve into engagement with its seat will be accelerated. It will here be understood that the pressure of fluid in chamber 27 acts on the end face of the plug 25 in opposition to the force of spring 26 but since the area over which the fluid pressure acts is much less than the area of the face of the valve 14 this opposition will not materially affect the snap action of the valve member 13 to its closed or seated position.

The fluid pressure remaining in the chamber 27 after the valve has been seated will be dispelled slowly to chamber 10 by way of the clearance space around the plug 25 in the opening 9 and thence to atmosphere by way of the apertures 11.

Having now described my invention, I claim as new and desire to secure by Letters Patent, is:

1. A safety valve device comprising a housing having a bore connected at one end to a fluid pressure inlet passage and connected at the other end in the atmosphere, an outlet port in a wall of said bore intermediate its ends, a conduit formed in said housing and connecting opposite ends of said bore, a piston valve operatively mounted in said bore and having a normal position for closing said port and said inlet passage, said piston valve being operative to another position in response to a certain pressure of fluid in said inlet passage to connect said inlet passage to one end of said conduit and to said outlet port and to close the other end of the conduit, means biasing said valve toward its normal position and operative in response to a reduction in the pressure of fluid in said inlet passage to move said valve piston toward its normal position, and means associated with said piston valve and movable therewith for restricting the flow area of the connection between said other end of the bore and atmosphere when said piston valve moves toward its normal position.

2. A safety valve device comprising a housing having formed therein a fluid pressure inlet passage and a fluid pressure outlet passage, a piston valve operative by fluid under pressure in said inlet passage and acting on one side of the piston valve for establishing a communication through which fluid is vented from the inlet

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passage to said outlet passage, a seat for said valve in said housing, a spring cooperating with said valve to move said valve toward said seat upon a decrease in the pressure of fluid in said inlet passage to a certain degree, a pressure chamber at the other side of said piston valve, a communication connecting said pressure chamber to the atmosphere, a passage in said housing for establishing a communication in response to the movement of said piston valve towards said seat, for admitting fluid under pressure to said pressure chamber, and means operative in response to the movement of said piston valve towards said seat for restricting the flow of fluid from said pressure chamber by way of said second mentioned communication so as to effect an increase in the pressure of fluid in the chamber.

3. A safety valve device comprising a housing having provided therein a fluid pressure inlet passage and a fluid pressure discharge port, a piston valve slidably mounted in said housing for controlling communication between said inlet passage and said discharge port, said valve having one position for closing the communication and having another position for establishing the communication, a chamber at one side of said piston valve, an atmospheric communication leading from said chamber, a pressure passage through which fluid under pressure may be supplied from said inlet passage to said chamber, said piston valve in said other position closing the communication between said chamber and pressure passage, a member operatively associated with said piston valve for movement therewith, a spring interposed between and operatively

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engaging said housing and member for biasing said piston valve toward its said one position, said spring acting in response to a reduction in the pressure of fluid in said inlet passage to a certain degree to move said member and piston valve toward the said one position of the piston valve, said piston valve in its movement toward its said one position uncovering said pressure passage to admit fluid under pressure from said inlet passage to said chamber and said member as it moves with said piston valve restricting the flow area of the atmospheric communication leading from said chamber to insure a rapid increase in the pressure of fluid in the chamber to lessen the effect of the force acting on the piston valve in opposition to the force of said spring and thereby accelerate the valve piston in its movement to its said one position, and said piston valve in its said one position closing communication between said inlet passage and said pressure passage.

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