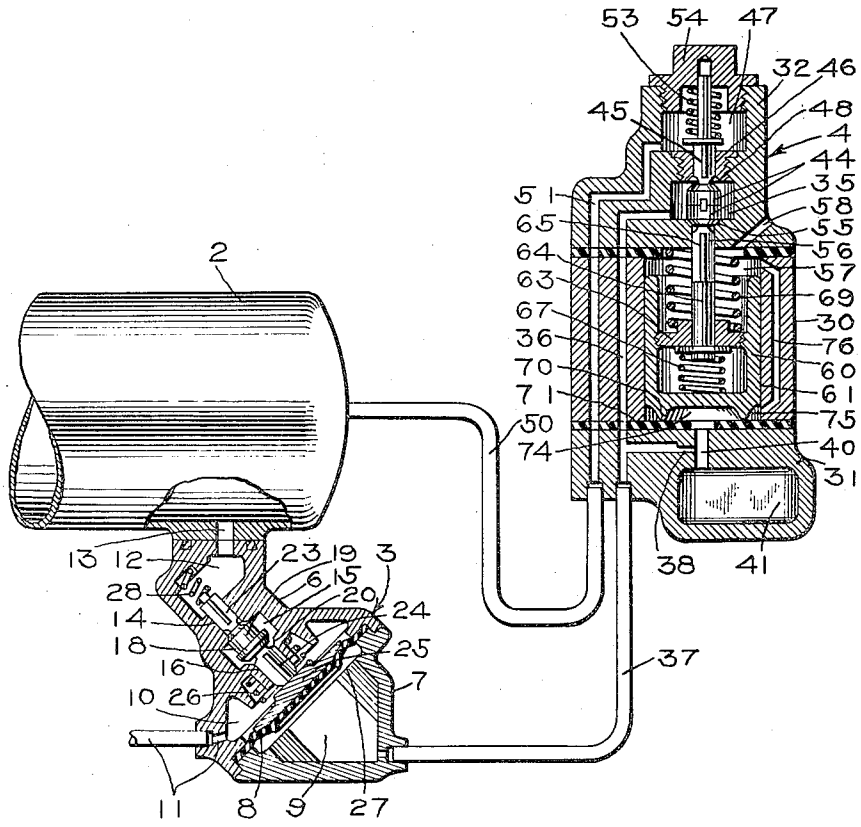
Jan. 16, 1945. R. M. OLIVER 2,367,605

DRAIN VALVE APPARATUS

Filed July 8, 1943



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Patented Jan. 16, 1945 2,367,605

UNITED STATES PATENT OFFICE

2,367,605

DRAIN VALVE APPARATUS

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Application July 8, 1943, Serial No. 493,897

5 Claims. (Cl. 303—88)

This invention relates to drain valve mechanisms for discharging condensate from storage reservoirs, and particularly to a drain valve apparatus having means for effecting discharge of condensate at predetermined intervals.

It has been proposed to equip fluid pressure storage receptacles, such as the main reservoirs and aftercoolers on a locomotive, with automatic drain valve devices, which are operative periodically to eject from the reservoirs the water which is constantly condensed from fluid under pressure passing through them. It is a principal object of my invention to provide an improved auxiliary timing valve apparatus adapted for association with an automatic drain valve device of this type.

Another object of the invention is to provide an automatic drain valve equipment comprising a fluid pressure actuated valve unit operative to eject water from a reservoir, and a fluid pressure responsive timing valve unit cooperative therewith and having a controlling valve element of the snap-acting type, in order to insure positive and prompt functioning of the drain valve device at predetermined intervals.

Other objects and advantages of the invention will appear in the following more detailed description thereof, taken in connection with the accompanying drawing, in which the single figure represents a diagrammatic view, mainly in section, of an improved drain valve equipment embodying the features of the invention.

The equipment shown in the drawing includes a main reservoir 2, a drain valve device 3, connected to the reservoir, and an auxiliary timing valve device 4, which as hereinafter more fully explained is operative by fluid under pressure from the reservoir 2 to effect alternate supply and release of fluid under pressure to and from the drain valve device at predetermined intervals.

The drain valve device 3 comprises a casing section 6 suitably secured to the bottom of the main reservoir 2, a casing section 7 bolted to the casing section 6, and a flexible diaphragm 8 which is clamped between the two casing sections in a canted position, forming on one side thereof a pressure chamber 9 and on the opposite side a chamber 10 having a drainage opening and pipe 11. Formed in the casing section 6 is a condensate collecting chamber 12, which communicates by way of a passage 13 with the interior of the main reservoir 2. A bore 14 connects the chamber 12 with a valve chamber 15, also formed in the casing section and communicating by way of a bore 16 with the chamber 10. A double valve element 18 disposed within the valve chamber 15 is engageable with a seat 19 for controlling communication between the chambers 12 and 15, or alternatively with a valve seat 20 for controlling communication between chambers 15 and 10. The double valve element 18 is supported through medium of a fluted stem 23 slidably fitting the bore 14, and a similar stem 24 slidably mounted in the other bore 16, the valve element and stems being in alignment with the axis of the canted diaphragm 8. The fluted stem 24 operatively engages a follower member 25 which is attached to the diaphragm 8, and which is subject to the force exerted by a coil spring 26 interposed between the follower element and an upper wall of the chamber 10. The spring 26 normally urges diaphragm 8 downwardly and into engagement with a stop portion 27 in the casing. A coil spring 28 is interposed between the fluted stem 23 and an upper wall of chamber 12 for moving the double valve element 18 downwardly toward the seat 20, when fluid under pressure is released from the chamber 9 during operation of the device, as hereinafter explained.

The automatic timing valve device 4 is provided with a casing structure comprising a central casing section 30, a casing section 31 bolted or otherwise secured to the lower face of the central section, and a casing section 32 similarly mounted on the upper side of the central casing section. The casing section 32 has formed therein a valve chamber 35, which is at all times in communication by way of a passage way 36 and pipe 37 with the pressure chamber 9 of the drain valve device 3. The passage 36 in addition communicates by way of a branch having a restricted portion 38 with a passage 40 and a volume chamber 41 formed in the lower casing section 31.

Mounted in the valve chamber 35 are two valve elements which are adapted to operate together and for convenience are identified as a double valve 44. A fluted stem 45 extends from the double valve 44 through a bore 46 and into a chamber 47 formed in the casing section 32, the double valve being adapted for engagement with a valve seat 48 adjacent the bore 46 for controlling communication through which fluid under pressure may be supplied from the main reservoir 2, by way of a pipe 50 and passage 51 leading to chamber 47, to the valve chamber 35. A coil spring 53 is interposed between the fluted stem 45 and a cap member 54 secured to the casing section 32, and is operative to bias the double valve 44 toward engagement with a valve seat 55.

The double valve element 44 is thus adapted to control communication from the valve chamber

35 by way of a bore 56 with a chamber 57 having an atmospheric exhaust port 58, which chamber is formed at the upper side of a valve piston 60 that is slidably mounted in a bore 61 formed in the central casing section 30. The valve piston 60 is adapted to actuate the double valve 44, and comprises a cylindrical body having a central wall 63, in which is formed an aperture through which extends a plunger 64 that is maintained in operative engagement with a fluted stem 65 extending downwardly from the double valve 44, the plunger 64 being subject to the force exerted by a coil spring 67 which rests on the lower interior surfaces of the valve piston 60. Another coil spring 69 is interposed between the upper wall of chamber 57 and the central wall 63 of the valve piston, which is thereby urged downwardly into a normal position, wherein an annular rib 70 formed on the valve piston engages a gasket 71 which is clamped between the casing sections 30 and 31. With the annular rib 70 thus seated on the gasket, a space or chamber 74 within the rib and communicating with passage 40 is cut off from the space 75 formed outwardly of the rib, and communicating by way of a passage 76 with the atmospheric chamber 57.

In operation, fluid under pressure supplied from the main reservoir 2 through pipe 50 and passage 51 to the chamber 47 in the timing valve device 4 flows through the bore 46, past the double valve 44, which is assumed to be initially positioned as shown in the drawing, and through valve chamber 35, passage 36, and pipe 37 to the pressure chamber 9 in the drain valve device 3. Fluid under pressure thus admitted to the chamber 9 acts through the medium of the diaphragm 8 and follower member 25 to hold the double valve element 18 in engagement with the upper seat 19. Fluid under pressure at the same time flows from the passage 36 through the branch thereof having the restricted portion 38 to the volume chamber 41 and also to the chamber 74 below valve piston 60. It will be understood that the pressure of fluid thus supplied to the connected chambers 41 and 74 is gradually increased at a rate determined by the flow capacity of the restricted passage 38. When the fluid pressure in the chamber 74 acting upwardly on the valve piston 60 becomes high enough to overcome the opposing force exerted by the coil spring 69, the valve piston is initially raised to establish communication between the chamber 74 and the space 75 surrounding the rib 70, whereupon fluid pressure is applied against the full pressure area of the valve piston, thereby causing sudden or snap-action movement thereof to its uppermost position. In so moving, the valve piston acts through the medium of the spring 67 and plunger 64 to force the double valve 44 away from the lower seat 55 and into engagement with the seat 48.

With the double valve 44 in its upper seated position, fluid under pressure is quickly vented from the pressure chamber 9 of the drain valve device 3 by way of the pipe 37, passage 36, valve chamber 35, bore 56, chamber 57, and atmospheric exhaust 58. Upon the reduction in the pressure of fluid in the pressure chamber 9 of the drain valve device, the springs 28 and 26 are rendered operative to shift the movable elements associated therewith downwardly until the diaphragm 8 engages the stop portion 27 of the casing, while the double valve element 18 engages the lower seat 20. During the time required for traverse of the valve element 18 of the distance between its upper seated position and lower seated position, accumulated condensate is forced from the chamber 12 through the bore 14, valve chamber 15, bore 16, and chamber 10 to the discharge communication 11. It will be understood that movement of the double valve element 18 into engagement with the lower seat 20 is accomplished quickly, however, so that the amount of fluid under pressure required to drive out the accumulated condensate is thus limited.

Meanwhile, fluid under pressure trapped in the volume chamber 41 of the timing valve device and acting upwardly against the valve piston 60 is permitted to escape at a restricted rate determined by the size of the passage 38, it being understood that such fluid is vented by way of the passage 36, valve chamber 35, bore 56, chamber 57, and exhaust passage 58. When the fluid pressure acting on the valve piston has been reduced sufficiently, the spring 69 becomes effective to move the valve piston out of its uppermost position, and as communication is thus momentarily established between the atmospheric chamber 57 and the chamber 75–74, the resultant sudden equalization of fluid pressures acting on opposite sides of the valve piston renders spring 69 effective to force the valve piston quickly into the position shown in the drawing. The coil spring 53 at the same time acts to move the double valve 44 downwardly into engagement with the lower seat 55, thus suddenly reestablishing communication between the chambers 47 and 35, through which fluid under pressure is again supplied to the pressure chamber 9 of the drain valve device 3, and also by way of the restricted passage 38 to the volume chamber 41 and inner chamber 74, as already explained.

The pressure of fluid thus supplied to the pressure chamber 9 of the drain valve device 3 forces the diaphragm 8 and the follower member 25 upwardly, thereby moving the double valve element 18 from the seat 20 and toward engagement with the upper seat 19. In traversing the distance between the two seats, the double valve element 18 permits the fluid at main reservoir pressure again to drive out accumulated condensate from chamber 12, by way of the chambers 15 and 10 and the drainage opening 11, it being understood that this discharge of compressed fluid of the main reservoir is quickly terminated upon engagement of the double valve element with the upper seat 19, so that only a small amount of air is required for the operation.

The operating elements shown in the drawing are thus again positioned as illustrated, while fluid pressure is again built up in the connected volume chamber 41 and chamber 74 in the timing valve device at the predetermined rate established by the size of the restricted passage 38. It will thus be evident that with the elements of the timing valve device, including the portion thereof containing the volume reservoir and restricted supply passage, properly proportioned with relation to the pressure normally carried in the main reservoir, the drain valve device 3 will be rendered operative periodically and often enough to keep the reservoir substantially drained at all times without undue waste of fluid under pressure.

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

1. In an automatic drainage apparatus for periodically discharging condensate from a fluid pressure storage reservoir, in combination, a valve de-

vice operative to eject condensate from said reservoir in response to either an increase or decrease in pressure of fluid in a chamber, and a timing valve device comprising valve means operative to supply and release fluid under pressure to and from said chamber, snap-acting piston means operative to effect sudden movement of said valve means in causing both supply and release of fluid under pressure, and a timing chamber having restricted communication with said first named chamber for regulating operation of said snap-acting piston.

2. In a drain valve equipment for discharging condensate accumulating in a receptacle for compressed fluid, the combination therewith of an automatic drain valve device having discharge means responsive to the variations in fluid pressure in a chamber for ejecting water deposited in said receptacle, and timing means for effecting operation of said drain valve device at predetermined intervals, comprising a casing having a timing chamber, valve means operative in one position to supply compressed fluid from said receptacle to said chamber in the drain valve device and also to said timing chamber, said valve means being operative in another position to cut off said supply communication while venting fluid from both chambers, and snap-acting piston means controlled by the pressure of fluid in said timing chamber for actuating said valve means.

3. In a drain valve equipment for discharging condensate accumulating in a receptacle for fluid under pressure, the combination therewith of an automatic drain valve device having discharge means responsive to variations in fluid pressure in a chamber for ejecting water deposited in said receptacle, and timing means for effecting operation of said drain valve device at predetermined intervals, comprising a casing having a timing chamber, and snap-acting valve means responsive to variations in pressure in said timing chamber for at one time supplying fluid under pressure to said timing chamber and to said chamber in the drain valve device, and at another time venting fluid from both said chambers.

4. In a drain valve equipment for discharging condensate accumulating in a receptacle for fluid under pressure, the combination therewith an automatic drain valve device having discharge means responsive to variations in fluid pressure in a chamber for ejecting water deposited in said receptacle, and timing means for effecting operation of said drain valve device at predetermined intervals, comprising a casing having a timed chamber, valve means having one position for permitting rapid supply of fluid under pressure to said chamber in the drain valve device and restricted supply of fluid under pressure to said timing chamber, said valve means having another position for cutting off said supply to both said chambers while venting fluid under pressure therefrom, and a snap-acting valve piston operative in accordance with the pressure of fluid in said timing chamber for controlling movement of said valve means.

5. In a drain valve equipment for discharging condensate accumulating in a receptacle for fluid under pressure, the combination therewith an automatic drain valve device having discharge means responsive to variations in fluid pressure in a chamber for ejecting water deposited in said receptacle, and timing means for effecting operation of said drain valve device at predetermined intervals, comprising a casing having a timing chamber, valve means having one position for permitting rapid supply of fluid under pressure to said chamber in the drain valve device and restricted supply of fluid under pressure to said timing chamber, said valve means having another position for cutting off said supply to both said chambers while venting fluid under pressure therefrom, snap-acting piston means controlled by pressure of fluid in said timing chamber for actuating said valve means, and yieldable means operatively connecting said piston means and said valve means.

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