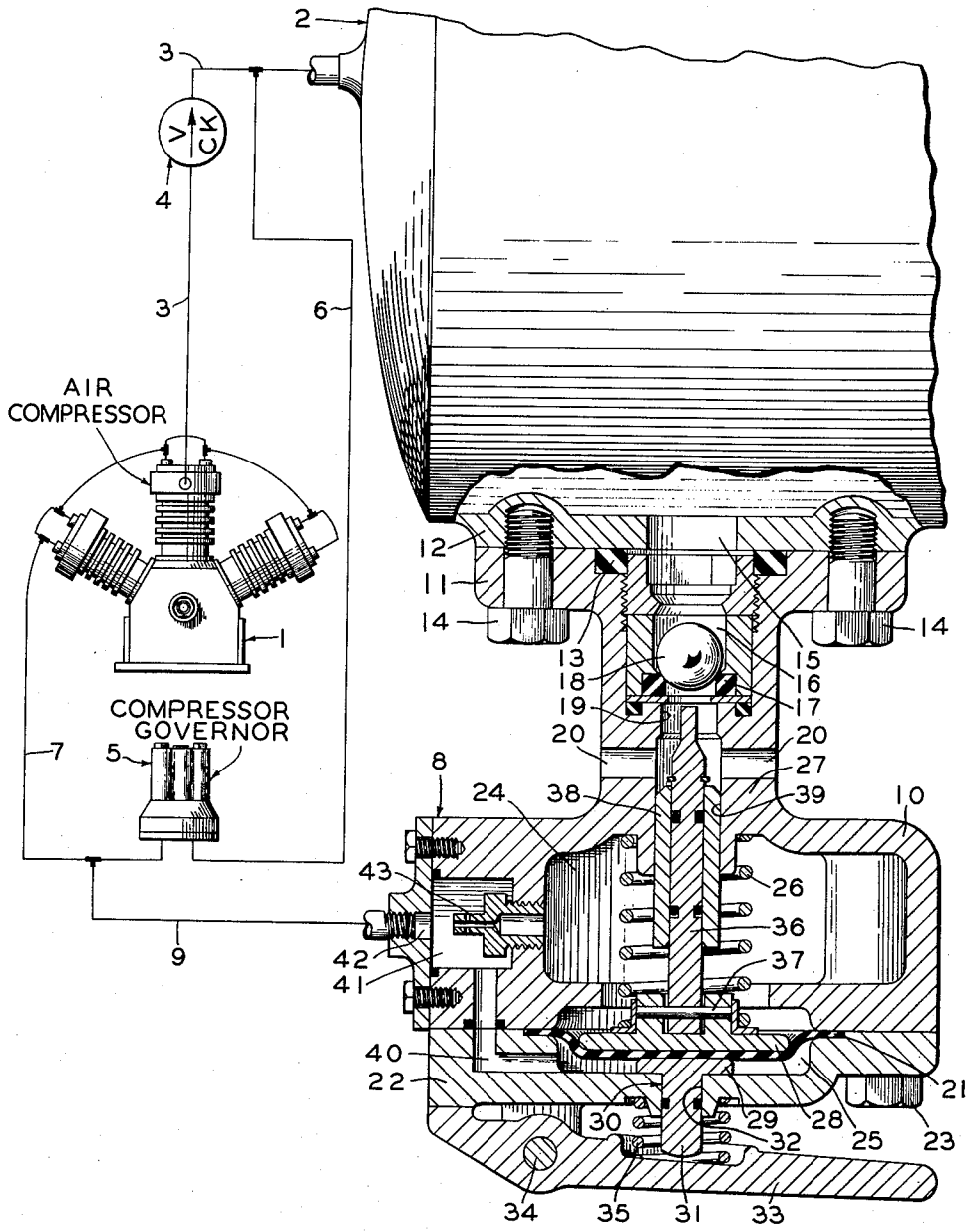
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COMBINED AUTOMATIC AND MANUAL DRAIN VALVE

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COMBINED AUTOMATIC AND MANUAL DRAIN VALVE

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This invention relates to drain valves and, more particularly, to an automatically operable drain valve constructed and arranged for optional manual operation thereof.

In a fluid pressure system, and particularly in a pneumatic system which includes a storage reservoir for pressurized pneumatic fluid, undesirable moisture condensation, as is well known, accumulates in said reservoir, and unless some means is provided for ridding the reservoir of such moisture accumulation, the moisture is distributed throughout the system and impairs the operation of fluid pressure operated devices connected in the system. One method of ridding the storage reservoir of moisture condensation is by use of an automatically fluid pressure operable drain valve which from time to time momentarily opens the storage reservoir to atmosphere to allow the moisture condensation to be ejected from the reservoir by the fluid pressure therein. Operation of the drain valve, for example, may be effected by connecting it to the delivery side of an air compressor governor so that each time the governor functions to effect delivery of fluid under pressure to the compressor unloader to unload the air compressor, fluid under pressure is supplied to the drain valve device for operating it to open the storage reservoir to atmosphere.

Experience has indicated, however, that automatically operable drain valve means alone does not always prove adequate and satisfactory for removing moisture condensation from the storage reservoir. It has previously been proposed therefore to provide manually operable valve means separate from and additional to the automatically operable drain valve device, operable at will and when necessary for draining moisture condensation from the storage reservoir when accumulation of such moisture condensation becomes excessive due to operational failure of the automatic drain valve device, or insufficient frequency of operation thereof as controlled by the governor device or other device controlling such operation. Such additional manually operable valve means requires additional piping to the storage reservoir, thereby entailing considerable additional cost in material, installation and maintenance.

Accordingly, the object of the present invention is to eliminate the need for costly piping arrangements for manually operable valve means additional to the automatically operable means for draining moisture condensation from pressurized fluid storage reservoirs, by so modifying presently existing automatically operable drain valve devices as to enable operation thereof optionally by manually operable means, thus providing a compact unit installable as a unit. Briefly, the present invention comprises a fluid pressure operable drain valve device operably controlled by any suitable control means such as an air compressor governor, for example, by having the drain valve device connected to the delivery side of the governor so that each time the governor, in well-known manner, operates to unload the compressor, a valve in the drain valve device is unseated to momentarily open the storage reservoir to atmosphere to permit moisture condensation to be expelled from the reservoir. According to the invention, the automatically operable drain valve device itself is provided with a spring-biased handle

which engages and operates a plunger associated therewith for causing engagement of a stem with the valve in the drain valve device and thereby unseating of said valve to open the reservoir to atmosphere upon manipulation of the spring-biased handle, thereby eliminating the necessity of additional piping and an additional drain cock.

The single figure drawing represents a schematic arrangement of a typical fluid pressure system, including a pressurized fluid storage reservoir having associated therewith an automatically operable drain valve device embodying the invention, said reservoir and drain valve device being shown, for purposes of clarity, in a proportionately larger scale than the balance of the system.

Description and operation

The fluid pressure system, as shown in the drawing for the purpose of illustrating, by way of example, one use of the invention, comprises an air compressor **1**, a storage reservoir **2** (only a portion of which is shown) to which compressed fluid is supplied by the compressor **1** through a conduit **3**, a check valve device **4** interposed in the conduit **3** for preventing backflow of fluid under pressure from the reservoir to the compressor, and a compressor governor device **5** for controlling an unloader device (not shown) incorporated in the air compressor, said compressor governor device being connected on its inlet side to the pressure of fluid in reservoir **2** through a conduit **6** which connects to conduit **3** between check valve device **4** and said reservoir, while the delivery side of said governor device is connected to the compressor unloader through a conduit **7** and to a drain valve device **8**, to be presently described, through a branch conduit **9**.

The drain valve device **8** embodying the invention comprises a casing **10** having formed at one end thereof a flange **11** adapted for bolting said drain valve device against a boss **12** formed on the reservoir **2**, with a sealing gasket **13** therebetween, by a plurality of bolts **14**. The reservoir **2** is provided with an opening **15** which opens directly into one end of an accumulation chamber **16** in the drain valve device **8** adjacent the flange **11** whereby moisture condensation in said reservoir may accumulate in said chamber to be expelled to atmosphere in a manner hereinafter explained. The other end of chamber **16** is surrounded by a valve seat **17** on which a ball type valve **18** is normally seated by pressure of fluid in reservoir **2** and chamber **16** acting thereon to close communication between said chamber and a bore **19** formed in casing **10** and connected to atmosphere by vent ports **20**.

At the end of casing **10** opposite flange **11** piston means or a movable abutment is provided in the form of a diaphragm **21** which is clamped at its periphery between said casing and a cap member **22** by a series of bolts **23** (only one being shown). The diaphragm **21** cooperates with casing **10** to form adjacent the upper side of the diaphragm, as viewed in the drawing, a pressure equalizing chamber **24**, and cooperates with the cap member **22** to form adjacent the opposite side of the diaphragm a pressure chamber **25**. A spring **26** disposed in chamber **24** in coaxial alignment with diaphragm **21** and compressed between an intermediate casing wall **27** in casing **10** and a diaphragm follower **28** engaging said diaphragm, urges said diaphragm toward a normal position, which will be presently defined. The side of diaphragm **21** adjacent chamber **25** rests against a flanged portion **29** disposed in chamber **25** and formed on a plunger member **30** having a stem **31** extending therefrom, in coaxial alignment with the diaphragm and follower **28**, through a coaxial bore **32** formed in the cap member **22** to terminate exteriorly thereof. The normal position of diaphragm **21** is defined by engagement of the flanged portion **29** of plunger **30** with the cap member **22**, the stem **31** of said plunger being slidingly and sealingly operable

in bore 32. A manually operable handle 33 pivoted adjacent one end about a pin 34 fixed adjacent the periphery of the cap member 22, extends underneath the stem 31 of the plunger 30, as viewed in the drawing, and is operable by manual force against the opposing force of a bias spring 35 to engage and operate the plunger 30 in an upwardly direction, as viewed in the drawing, for a purpose to be hereinafter described. Release of manual force on the handle 33 permits the spring 35 to return the handle to a normal position out of engagement with the plunger 30. A short arm on the handle at one side of the pin 34 engages the outer face of the cap member to define the normal position of the handle.

A piston stem 36 has one end fastened by a pin 37 to the follower 28 and extends coaxially therefrom through chamber 24 and is slidably and sealingly operable, correspondingly with movement of diaphragm 21, within a sleeve member 38 which is fixedly retained as by a press fit in a bore 39 formed in the wall 27. The length of stem 36 is such that, when diaphragm 21 is in its normal position, the end of said stem opposite follower 28 is out of engagement with valve 18 to permit said valve to occupy a seated position on seat 17, and when said diaphragm is operated to a release position (in a manner to be hereinafter described) defined by abutting engagement of said follower with the lower end of sleeve 38, said stem engages and moves valve 18 to an unseated position off seat 17 to establish communication between chamber 16 and atmosphere via bore 19 and ports 20.

Chamber 25 is connected by way of a passageway 40 to an inlet chamber 41 formed in casing 10, said chamber 41 being provided with an inlet 42 connected to and constantly open to conduit 9 leading from the delivery side of the governor device 5, while chamber 24 is also connected to said chamber 41 through a restricted passageway or choke 43.

For purpose of understanding the operation of the invention, it will suffice to briefly state that the compressor 1 with the unloader device (not shown) and the governor device 5 function in the well-known manner to maintain pressurized fluid in the reservoir 2 within an operating range between predetermined minimum and maximum pressure values or settings. When the pressure of fluid in the reservoir 2 has attained the maximum setting, the governor device 5, which has been set to operate responsively to the maximum and minimum settings, operates in response to said maximum pressure to open communication between conduits 6 and 7 and thereby permit fluid, at reservoir pressure, to flow to the unloader device which operates responsively to such fluid pressure to unload the compressor. While so unloaded, the compressor operates freely without compressing further fluid into the reservoir until the pressure in the reservoir through usage or other means, has been reduced to the minimum setting, whereupon the governor device operates responsively to such reduction to close said communication between conduits 6 and 7 and thereby cut off further delivery of fluid pressure to the unloader device, which, in turn, operates responsively to such cut off of fluid pressure to restore the compressor to loaded operation. The time interval during which the compressor operates unloaded may be of any duration depending upon the rapidity or rate at which the pressurized fluid in reservoir 2 is depleted.

As above noted, conduit 9 branches from conduit 7 and is connected to chamber 41 of the drain valve device 8. When the governor device 5 operates to open communication between conduits 6 and 7 to permit delivery of pressurized fluid to the unloader device, therefore, fluid at the same pressure is supplied through conduit 9 to chamber 41 of the drain valve device 8. Pressurized fluid may flow freely through passageway 40 to pressure chamber 25 on the under side of diaphragm 21, while choke 43 permits only restricted flow of pressurized fluid from chamber 41 to equalizing chamber 24, thus establishing a temporary pressure differential acting on the side of diaphragm 21 adjacent chamber 25 and effective for moving said diaphragm, against opposition of spring 26, to its release position wherein valve 18 is unseated. With valve 18 in its unseated position, any moisture condensation which may have accumulated in chamber 16 and in the reservoir 2 is expelled through bore 19 and ports 20 by fluid pressure in said reservoir.

The pressure of fluid in equalizing chamber 24 is permitted to build up gradually through choke 43 until the pressures in chambers 24 and 25 are equalized, and spring 26 is then effective for restoring diaphragm 21 to its normal position in which valve 18 is moved by fluid pressure in reservoir 2 to its seated position to cut off further venting of the reservoir to atmosphere. Thus, the duration of the interval of time during which delivery of fluid at reservoir pressure is permitted, by operation of the governor device 5, to the unloader device, and therefore to conduit 9 and chamber 41 of the drain valve device 8, has no effect on the reseating of valve 18 for terminating venting of reservoir 2, because said drain valve device operates, as immediately above described, to equalize the opposing fluid pressures in chambers 24 and 25 and thereby effect reseating of said valve 18 irrespective of the length of time that conduits 6, 7 and 9 and chambers 41, 24 and 25 are charged with fluid from the reservoir. Of course, if the governor device 5, responsively to reduction of reservoir 2 pressure to the minimum setting, operates to cut off communication between conduits 6 and 7, and therefore supply of pressurized fluid to chamber 25, before sufficient time has lapsed to permit equalization of pressures in chambers 24 and 25, fluid under pressure in chamber 25 is immediately exhausted through conduits 9 and 7 and an atmospheric vent (not shown) in the governor device to thereby establish effectiveness of fluid pressure in chamber 24 and of spring 26 to move diaphragm 21 to its normal position and thereby also effect reseating of valve 18 and consequent termination of reservoir venting.

It should be noted, however, that as long as the governor device 5, therefore, maintains communication between conduits 6 and 7 open to permit supply of pressurized fluid to the unloader device of compressor 1, and as long as fluid pressure in chambers 24 and 25 is thereby maintained in an equalized status, the drain valve device 8 remains in an inoperable condition for unseating valve 18 until the unloading cycle of operation of the governor device 5 is completed. When the governor device 5 operates to cut off supply of pressurized fluid to the unloader device of the compressor 1, fluid under pressure from said unloader device, and therefore from chambers 41, 24 and 25 of the drain valve device 8 and conduit 9, is exhausted to atmosphere back through conduits 7 and 9 and the atmospheric vent port (not shown) in said governor device. With chambers 24 and 25 of the drain valve device 8 depleted of fluid pressure, diaphragm 21 continues in its normal position, and the drain valve device is again in operable condition for unseating valve 18 to permit drainage of moisture condensation in the reservoir 2 and consequent reseating of said valve, in the manner above described, upon initial operation of the governor device 5 to effect supply of pressurized fluid to the unloader device of the compressor. Thus, with the initiation of each unloading cycle of operation of the governor device 5, operation of the drain valve device 8 also is automatically effected to momentarily open the reservoir 2 to atmosphere to allow any accumulation of moisture condensation therein to be expelled therefrom.

From the above description of the automatic operation of the drain valve device 8, it is readily apparent that any prolonged period of time between operating cycles of the governor device 5, or any operational failure of said drain valve device may result in excessive accumulation

of moisture condensation in the reservoir **2**, which condensation may be carried to any devices or mechanisms supplied with pressurized fluid from said reservoir to result in inefficient operation of or possible damage to said devices and mechanisms.

In accordance with the invention, therefore, in the event of too infrequent automatic operation of the drain valve device **8** or operational failure thereof, the operating handle **33** may be manually operated against the spring **35** to engage the plunger **30** and move said plunger against diaphragm **21** which is thereby moved from its normal position to its release position in which valve **18** is held unseated, as long as pressure is maintained on said handle, until any moisture condensation in reservoir **2** has been completely ejected, at which time the operating handle is released and springs **26** and **35** return said diaphragm and said handle, respectively, to their normal positions allowing valve **18** to return to its seated position on valve seat **17**. Thus any infrequency or failure of automatic operation of the drain valve device **8** may be overcome by manually operating said drain valve device through the operating handle **33**, and the necessity of any additional piping and a separate manually operable drain cock no longer exists.

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

A drain valve device for draining moisture condensation from a pressurized fluid container, said drain valve device comprising, in combination, a casing having therein an accumulation chamber having an opening thereto through which moisture condensation from the container may flow into the chamber, an inlet chamber having an inlet through which fluid under pressure may be supplied to and released from said inlet chamber, a pressure chamber constantly open to said inlet chamber, and an equalizing chamber, choke means carried in said casing and interposed between said inlet chamber and said equalizing chamber for providing restricted communication therebetween, a valve disposed in said accumulation chamber and cooperative with, when seated thereon, a valve seat carried in said casing in surrounding relation to an opening leading to atmosphere, for closing said accumulation

chamber to atmosphere, said valve being operable to an unseated position from said valve seat for opening said accumulation chamber to atmosphere via said opening to atmosphere, a piston in said casing having one side subjectable to pressure of fluid in said equalizing chamber and the opposite side subjectable to pressure of fluid in said pressure chamber, a stem associated with said piston and engageable with said valve upon movement of said piston to a release position in response to supply of pressurized fluid to said inlet chamber and said pressure chamber, for moving said valve to its unseated position, biasing means effective upon equalization of fluid pressure between said equalizing and pressure chambers through said choke means or upon release of fluid pressure from said pressure chamber, for restoring said piston to a normal position in which said stem is disengaged from said valve for causing return thereof to its seated position, a plunger member engageable with said opposite side of said piston and having associated therewith a stem extending exteriorly of said casing, said plunger member normally occupying one position in which movement of said piston between its normal and release positions, as effected by supply and release of said pressurized fluid in the said several chambers, is unaffected thereby, a manually operable handle pivotally mounted on the exterior of said casing, and biasing means for biasing said handle toward a first position out of engagement with said plunger member, said handle being operable to a second position into engagement with said plunger member for causing movement thereof and thereby operation of said piston to its release position.

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