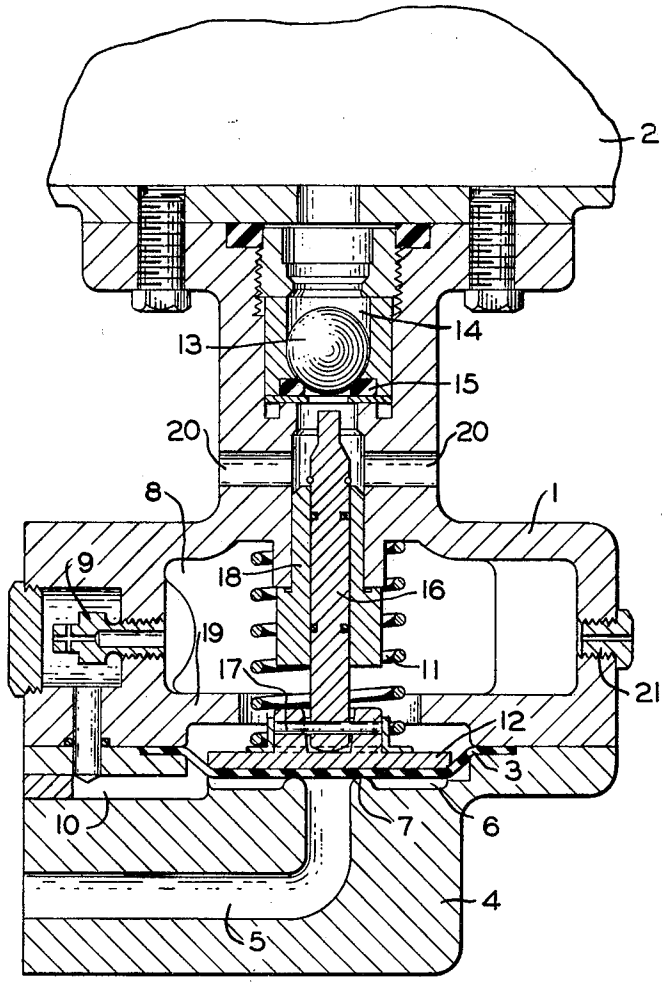
May 5, 1970 R. E. HOLLIBAUGH ET AL 3,509,901

AUTOMATIC CYCLING DRAIN VALVE

Filed Dec. 19, 1967



INVENTOR.
RICHARD E. HOLLIBAUGH
WILLIAM S. JOHNSTON
BY
A. A. Steinmiller
ATTORNEY

United States Patent Office 3,509,901 Patented May 5, 1970

3,509,901

AUTOMATIC CYCLING DRAIN VALVE

Richard E. Hollibaugh, Murrysville, and William S. Johnston, Pittsburgh, Pa., assignors to Westinghouse Air Brake Company, Wilmerding, Pa., a corporation of Pennsylvania

Filed Dec. 19, 1967, Ser. No. 691,763
Int. Cl. F16t 1/14
U.S. Cl. 137—204 5 Claims

ABSTRACT OF THE DISCLOSURE

An automatically cycling drain valve device for periodically draining accumulated moisture condensation from a compressed air system, said drain valve device being operable responsively to air pressure in the system in excess of a certain degree for periodically opening and closing to permit moisture condensate to be expelled at preselected time intervals, independently of the governor means controlling compressor operation.

BACKGROUND OF THE INVENTION

Operation of many of the drain valve devices presently employed for draining moisture condensate from a compressed air system is controlled by or synchronized with the operation of the governor device, so that operation of the drain valve device is effected each time the governor device functions to either load or unload the compressor or at intervals spanning several such cycles of governor operation. Obviously, if there should be a prolonged period of time during which there is no demand on the supply of compressed air, the pressure would not be reduced to the low pressure setting at which the governor device would operate to load the compressor, or, vice versa, if the demand over a prolonged period of time were so great that the supply pressure could not attain the high pressure setting at which the governor device would respond to unload the compressor, operation of the governor device would not be effected for changing the status of the compressor during such prolonged periods of time and, therefore, the drain valve device, in such an arrangement, would also remain closed for the same prolonged period of time. The process of moisture condensation, however, continues throughout the prolonged period of compressor operation during which no purging of the system of accumulated condensate (usually in a sump to which the drain valve device is operatively attached) occurs.

SUMMARY OF THE INVENTION

The object of the present invention, therefore, is to provide a drain valve device operable independently of the governor means and at predetermined time intervals in response to air pressure in excess of a preselected degree in a compressed air system, for automatically and periodically causing moisture condensate accumulated in the system to be purged therefrom.

The invention resides in an automatically operable drain valve device (which is normally mounted on a sump of a compressed air system) comprising a check valve biased by air pressure in the system to a normally closed position and being operable to an open position by the free end of a piston stem attached to a diaphragm type piston for permitting moisture condensate accumulated in the sump to be forcibly ejected to atmosphere. When the piston is in a valve-closing position, in which the check valve is in its closed position, a restricted portion of the pressure area on one side of the diaphragm piston is subjected to air pressure of the system. When

the force of the pressure acting on the restricted portion on the one side of the piston is sufficient for overcoming the opposing force of a spring acting on the opposite side of the piston, the entire pressure area of said one side is exposed and subjected to system pressure so that said piston and piston stem are caused to move with a snap action to a valve-opening position in which the check valve is opened to allow moisture condensate to be ejected from the sump. A first choke of preselected flow capacity permits compressed air to flow from the one side of the piston to a chamber adjacent the opposite side and thereby, after a certain time interval, sufficient equalization of pressure on both sides of the piston occurs to render the spring effective for restoring the piston to its valve-closing position. A second choke of lesser flow capacity than the first choke permits air pressure in the chamber to be gradually reduced to atmosphere, whereupon system pressure acting on the restricted portion of the pressure area on the one side of the piston again becomes effective for moving the piston to its valve-open position. Thus, operation of the drain valve device continues automatically in a cycling manner as long as air pressure in the system acting on the restricted portion of the pressure area on the one side of the piston is of a degree sufficient for overcoming the opposing force of the spring acting on the opposite side when pressure in the chamber adjacent thereto is equivalent to atmosphere.

The single-figure drawing is an elevational view, in section, of a drain valve device embodying the invention.

DESCRIPTION AND OPERATION

As shown in the drawing, a drain valve device embodying the invention comprises a casing consisting of a main casing section **1** secured to a sump **2** (only a fragmental portion of which is shown) of a compressed air system (not shown). A diaphragm type piston **3** is clamped adjacent its outer periphery between the main casing section **1** and a supplementary casing section **4** secured to said main casing section by suitable means, not shown.

A passageway **5** formed in the supplementary casing section **4** opens into a pressure chamber **6** formed jointly by the diaphragm piston **3** and said supplementary casing section, the opening of said passageway into said chamber being surrounded by an annular rib seat **7** on which the diaphragm piston sealingly seats when in a normal or valve-closing position to be hereinafter more fully defined. A control chamber **8** is formed in the main casing section **1** adjacent the side of piston **3** opposite pressure chamber **6**, said control chamber and said pressure chamber being communicated with each other via a control choke **9** of preselected flow capacity and a passageway **10** formed cooperatively in casing sections **1** and **4** and connecting said pressure chamber with said choke.

A spring **11** of preselected compression rating and disposed in control chamber **8**, under compression, acts against a diaphragm follower **12** of the diaphragm piston **3** for biasing said piston toward its normal position for cutting off communication between passageway **5** and pressure chamber **6**, passageway **10**, choke **9** and control chamber **8**.

A ball type check valve **13** for opening or closing sump **2** to atmosphere, is disposed in a valve chamber **14** formed in the upper portion of main casing section **1**, as viewed in the drawing, said valve chamber being open to said sump so that said check valve is normally held in a seated position on a valve seat **15** by air pressure in said sump, which pressure corresponds to that of the system or in a storage reservoir (not shown). A stem **16**, fastened by a pin **17** to the follower **12** on the side of piston **3** adja-

cent control chamber **8**, extends away from said piston through said chamber and through a guide sleeve **18** fixed internally of the main casing section **1**. The stem **16** is sealingly and slidably operable within the guide sleeve **18** and is of such length as to have its free end out of contact with the ball check **13**, when the piston **3** is in its normal position, but makes contact with and moves said ball check valve **13** to an unseated position off valve seat **15** when said piston is operated to a valve-opening position defined by abutment of follower **12** with a radially disposed shoulder **19** formed on main casing section **1** in control chamber **8**. When the ball check valve **13** is unseated from valve seat **15**, as will be more fully described hereinafter, sump **2** is opened to atmosphere past the unseated check valve via a plurality of atmospheric ports or passageways **20** formed in main casing section **1** on the opposite side of said check valve, whereupon moisture condensate accumulated in said sump may be forcibly ejected to atmosphere by the air pressure prevailing in said sump and valve chamber **14**.

An atmospheric choke **21** of lesser flow capacity than the control choke **9** and conveniently disposed in the outer wall of main casing section **1**, communicates the control chamber **8** to atmosphere for a purpose to be hereinafter disclosed.

In operation, passageway **5** is connected with and charged with compressed air from the main source, such as the storage reservoir (not shown), and, therefore, the pressure in said passageway always corresponds to that in said main source. Assuming that the pressure in control chamber **8** is at atmosphere and that air pressure in passageway **5** acting on the area of diaphragm **6** enclosed within the rib seat **7** is sufficient for overcoming the opposing force of spring **11**, said diaphragm is lifted from its normal position on said rib seat so that the entire area thereof adjacent pressure chamber **6** is exposed to said air pressure, thereby causing prompt positive upward movement of the piston, as viewed in the drawing, toward its valve-opening position (above defined) in which the free end of stem **16** engages and moves the ball check valve **13** off the valve seat **15**, thus initiating a cycle of operation of the drain valve device. With check valve **13** in its unseated position, moisture condensate accumulated in sump **2** is ejected, by air pressure in said sump, past the unseated check valve to atmosphere via the ports **20**.

When diaphragm piston **3** is unseated from rib seat **7**, air pressure from passageway **5** flows therepast to passageway **10** and through control choke **9** to control chamber **8**. Since the flow capacity of atmospheric choke **21** is less than that of control choke **9**, pressure entering through said control choke builds up in control chamber **8** and tends to equalize with that in pressure chamber **6** until the combined forces of such pressure in said control chamber and of spring **11** is able to overcome the force of pressure acting on the opposite side of piston **3** and thereby to restore said diaphragm piston to its normal seated position on rib seat **7**. Further flow of air pressure from passageway **5** to control chamber **8** (via passageway **10** and control choke **9**) is thus cut off, and since stem **16** has moved downwardly, as viewed in the drawing, with piston **3** and, therefore, out of contact with check valve **3**, the pressure in sump **2** above said check valve acts to reseat it and thereby close said sump to atmosphere. It is apparent, therefore, that the length of time during which the check valve **13** remains open for allowing expulsion of moisture condensate from sump **2**, is determined by the relative flow capacities of chokes **9** and **21**, the volume of control chamber **8** and the compression rating of spring **11**.

From the instant that air pressure begins to enter control chamber **8** via control choke **9**, such pressure begins to escape to atmosphere from said chamber via atmospheric choke **21**, but at a slower rate than that at which it enters so as to allow build-up of such pressure in said control chamber, as above-described, for reseating piston **3** on rib seat **7**. After piston **3** is seated on rib seat **7**, further supply of air pressure to control chamber **8**, as above noted, is cut off, but venting of air pressure therefrom continues via the atmospheric choke **21** until the pressure in said control chamber is reduced to atmosphere or to such a value at which the pressure acting on the area of piston **3** within the rib seat **7** is again effective for unseating said piston, which unseating marks the end of one cycle and the commencement of a new cycle of operation of the drain valve device, as above-described.

The drain valve device continues to operate in the cycling manner above described so long as the air pressure in the main source and, therefore, in passageway **5** is, at least, sufficient for unseating the piston **3** to initiate the operating cycle of the drain valve. The time required for each cycle, of course, is determined by several factors including the compression of spring **11**, the volume of control chamber **8** and the relative flow capacities of control choke **9** and atmospheric choke **21**.

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

1. An automatic drain valve device for purging a compressed air system of moisture condensate accumulating therein, said drain valve device comprising, in combination:

(a) a casing having therein a valve chamber, a control chamber, and a pressure chamber, said valve chamber being charged with air pressure corresponding to that in the system and being so disposed as to collect moisture condensate therein,

(b) an atmospheric passageway formed in said casing,

(c) a valve member disposed in said valve chamber and normally biased by air pressure therein to a closed position in which said valve chamber is cut off from said atmospheric passageway, said valve member being operable to an open position in which said valve chamber is communicated with said atmospheric passageway via which moisture condensate accumulated in said valve chamber is expelled to atmosphere,

(d) a piston member having a piston stem extending from one side thereof disposed adjacent said control chamber, the opposite side of said piston member being disposed adjacent said pressure chamber,

(e) passage means formed in said casing and having one end opening to said pressure chamber, said passage means being constantly charged with air pressure corresponding to that in the system,

(f) a valve seat surrounding said one end of said passage means,

(g) a biasing spring disposed in said control chamber for biasing said piston member toward a first position in which the free end of said piston stem is out of contact with said valve member and said opposite side of said piston member is seated on said valve seat for cutting off air pressure in said passage means from said pressure chamber,

(h) said biasing spring being yieldable to pressure in excess of a certain degree acting on the area portion of said opposite side within said valve seat for effecting unseating of the piston member from the valve seat, said piston member being operable, upon exposure of the entire area of said opposite side to such pressure in said passage means, to a second position in which the free end of said piston stem engages and operates said valve member to its said open position and said pressure chamber is subjected to air pressure in said passage means,

(i) a communicating passageway connecting said pressure chamber to said control chamber,

(j) a control choke of preselected flow capacity interposed in said communicating passageway and via which air pressure in said pressure chamber and said control chamber may equalize at a controlled rate for rendering said biasing spring effective, upon such

equalization of air pressure in said pressure and control chambers, for restoring said piston member to its said first position after a certain time interval, and

(k) an atmospheric choke of lesser flow capacity than said control choke and via which air pressure in said control chamber is vented to atmospher upon expiration of a time interval of greater duration than said certain time interval for rendering air pressure acting on said area portion of said other side of the piston member within the valve seat effective for unseating the piston member from said valve seat and thereby initiating a subsequent cycle of operation of the drain valve device.

2. An automatically cycling drain valve device for purging moisture condensate from an air pressure system, said drain valve device comprising:

(a) a valve member having a normally closed position and being effective when operated to an open position for releasing moisture condensate from the system,

(b) pressure controlled piston means having a stem extending concentrically therefrom for contacting and operating said valve to its said open position, said piston means having one position in which said stem is out of contact with said valve and being subjectable to a control pressure and operable responsively to establishment of a pressure differential of said control pressure across opposite sides thereof to a second position in which said stem makes contact with and operates said valve to its said open position,

(c) biasing means for biasing said piston means to its said one position,

(d) valve means carried by said piston means, said valve means having a closed position in the said one position of said piston means and being operable, upon initial movement of said piston means toward its said second position responsively to control pressure acting on one side thereof, to an open position in which both sides of the piston means are subjected to said control pressure,

(e) first means for delaying full effect of said control pressure on the opposite side of said piston means and thereby establishing said pressure differential and subsequent equalization of control pressure on both sides of the piston means, said biasing means being effective upon such equalization of control pressure for restoring said piston means to its said one position, and

(f) second means for effecting dissipation of said control pressure acting on said opposite side of said piston means for conditioning the drain valve device for a subsequent cycle of operation.

3. An automatic drain valve device, as defined in claim 2, further characterized by a casing having therein a control chamber adjacent said opposite side of said piston and a pressure chamber adjacent said one side of said piston, said control chamber being chargeable with compressed air acting on said one side of said piston means upon movement of the piston means to its said second position, said first means comprising a control choke of preselected flow capacity interposed in a passageway interconnecting said control chamber and said pressure chamber, and said second means comprising a vent choke of lesser flow capacity than said control choke for venting said control chamber to atmosphere.

4. An automatic drain valve device, as defined in claim 3, further characterized in that said one side of said piston means comprises a pressure area a portion of which is constantly subjected to said compressed air when the piston means is in its said first position, the entire area of said pressure area being exposed to such compressed air upon initial movement of the piston means toward its said second position for effecting positive snap-action thereof to said second position.

5. An automatic drain valve device, as defined in claim 4, further characterized in that said casing has a second passageway formed therein and constantly charged with compressed air at system pressure, said second passageway having at one end thereof a valve seat on which said other side of said piston means seats, when in its said first position, for cutting off communication between said second passageway and both said pressure and control chambers, said portion of the pressure area of said other side constituting the area enclosed by said valve seat when the piston means is seated thereon.

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ALAN COHAN, Primary Examiner

U.S. Cl. X.R.

137—624.14