

May 4, 1954

D. WILKERSON
AIR LINE DRAIN VALVE

2,677,386

Filed May 15, 1951

3 Sheets-Sheet 1

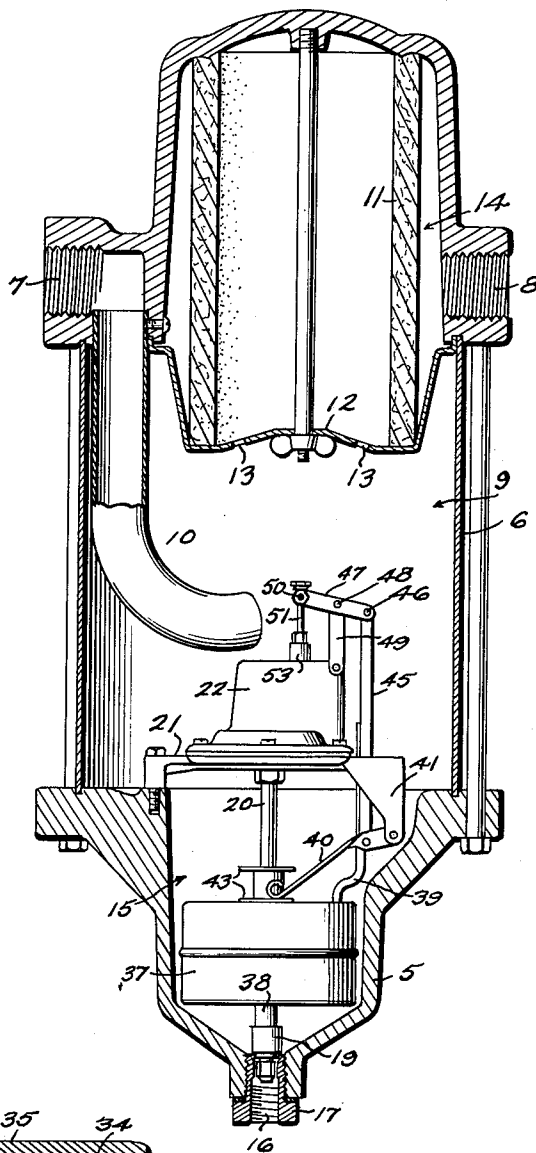


Fig. 1.

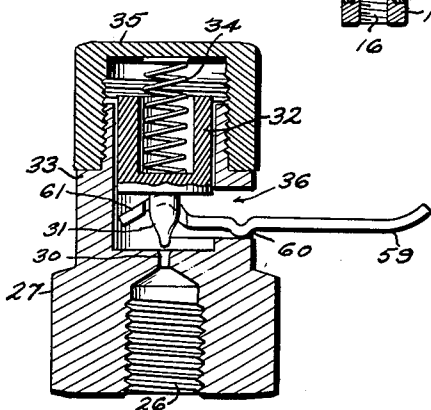


Fig. 3.

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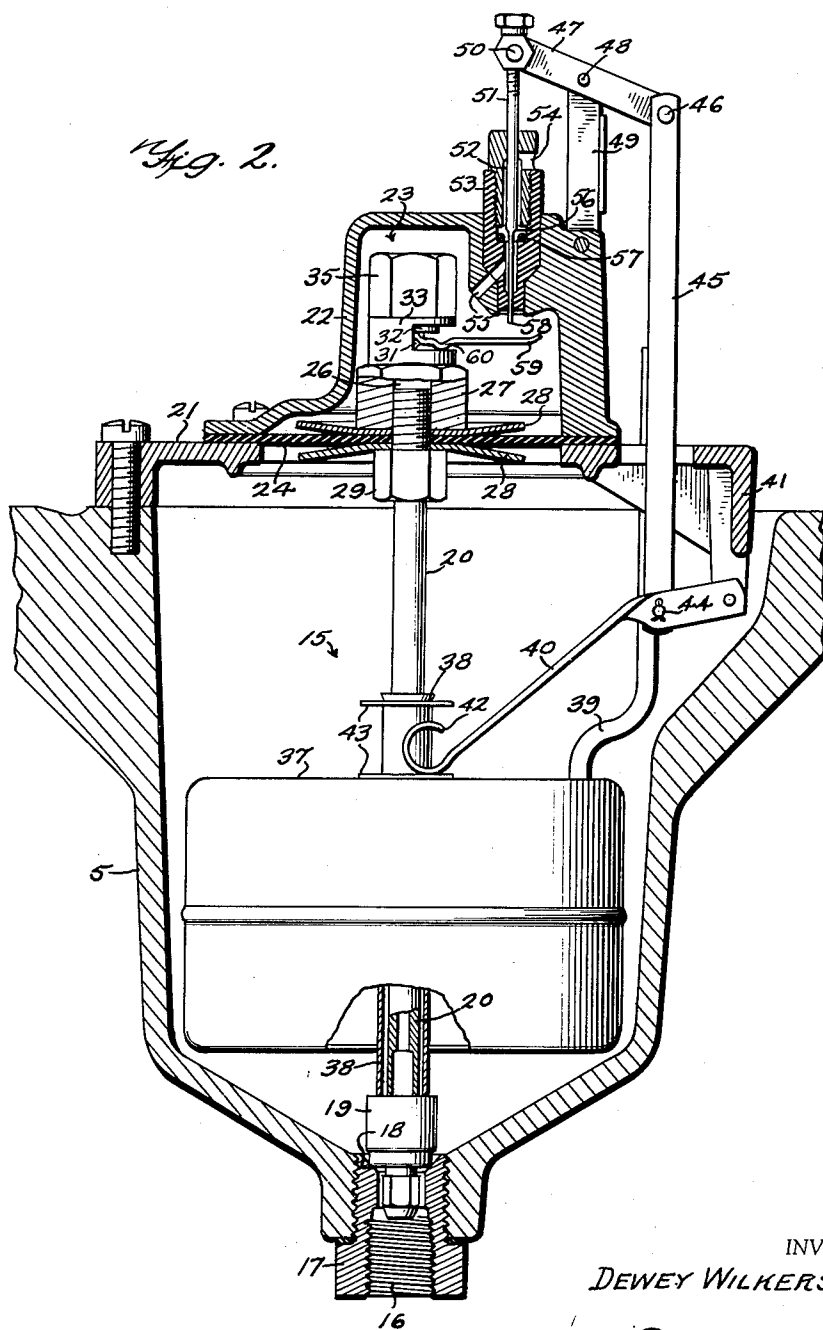
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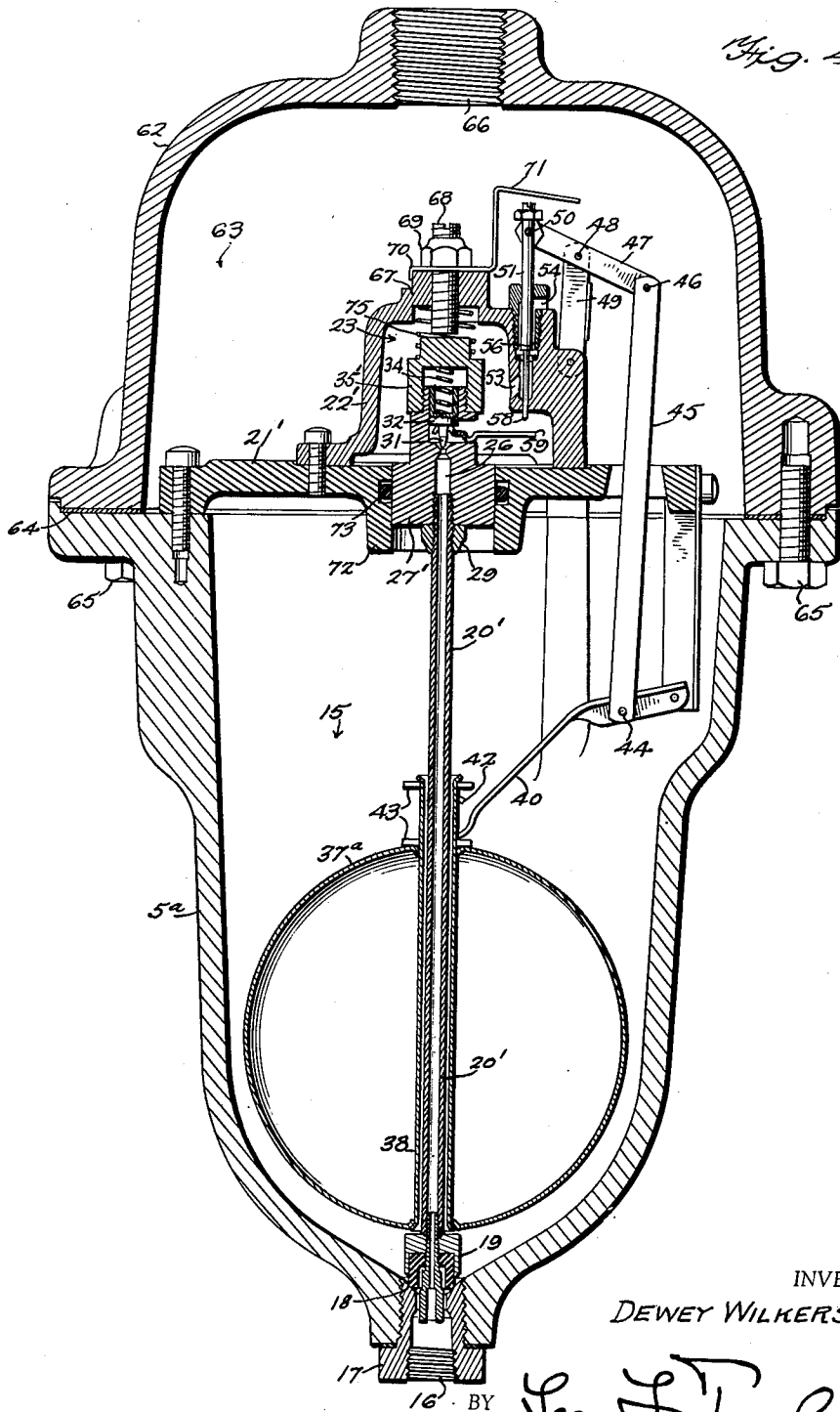
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AIR LINE DRAIN VALVE

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1 Claim. (Cl. 137—195)

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This invention relates to the cleaning of air in compressed air line installations for the purpose of removing moisture, sludge, oil and foreign matter. It provides, particularly, a drain valve that operates automatically to accomplish its function.

An object of the invention is to provide a snap action pressure differential operated drain valve adapted for coupling in any type of compressed air or fluid pressure installation, and which operates automatically in response to the level of liquid accumulation in a drain sump or trap.

Another object is to provide a valve of the character indicated having a liquid level responsive actuator operative solely as a trigger means controlling the establishment of a pressure differential which supplies the actual motive power by which the valve is opened for expulsion of water, sludge, and foreign matter from the installation.

Other and incidental objects will be apparent to persons skilled in the art.

In the accompanying drawings:

Figure 1 is substantially a vertical sectional view through an air cleaner and drain valve assembly constituting an illustrative embodiment of the invention;

Figure 2 is an enlarged fragmentary sectional view of the sump drain assembly of Figure 1, partly in elevation; and Figure 3 is substantially a vertical sectional view illustrating a detail of the mechanism.

Figure 4 is a view similar to Figure 2 but illustrating a modification adapted for heavy duty purposes.

In the form shown in Figs. 1-3 the valve is employed to control the expulsion of water and sediment accumulations in a sump 5 at the bottom of a housing 6 provided at its top with an air inlet 7 and an air outlet 8 both of which are adapted for coupling in a compressed air line, not shown. The interior of the housing constitutes an air expansion chamber 9 substantially of cylindrical form into which incoming air is centrally directed from the inlet 7 through a conduit 10 curved to set up a vortex action in the chamber. A filter sleeve 11 of cotton or other suitable material is mounted in the top of the housing between a support 12 and the top wall. Air passes from the chamber 9 through openings 13 in the support to the interior of the filter sleeve through which it passes to an annular outlet chamber 14 around the filter in open communication with the air outlet 8.

The sump 5 is formed with a well 15 of con-

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siderable depth open at its top to the air expansion chamber and at its bottom through a discharge passage 16 to the atmosphere. The passage 16 is an axial bore through a fitting 17 having a threaded connection into the dished bottom of the sump well. The inner end of the fitting comprises a valve seat 18 which cooperates with a valve head 19 on the lower end portion of a vertical hollow stem 20 to close the discharge passage.

A plate 21 is secured on the top face of the sump to extend horizontally over its well and provide support for an upstanding casing 22 having a closed interior chamber 23 separated from the well by a flexible diaphragm 24 that is marginally clamped between the base of the casing and the plate. The upper end portion of the valve stem 20 is secured to and extends through the diaphragm into the chamber 23 as an externally threaded portion 25 having threaded engagement in the bore 26 of a control valve fitting 27. Clamp washers 28 at opposite sides of the diaphragm cooperate with the fitting 27 and a nut 29 on the valve stem to secure the valve stem assembly to the diaphragm for movement therewith in response to its flexion. The fitting 27 is disposed entirely within the chamber 23, and its bore 26 opens at its upper end through an air passage 30 into the chamber above the diaphragm. This passage is controlled by a depending valve plug 31 on a cylinder 32 mounted for reciprocation in the bore of an upwardly extending neck 33 constituting a part of the fitting. An expansion spring 34 between the cylinder and a cap 35 threaded on the upper end of the fitting neck biases the valve 31 downwardly against a seat at the end of the passage to close the same. In the normal position of the parts the valve 31 is closed. When the valve is open the chamber 23 is in communication with the fitting bore 26 through a lateral passage 36 in the neck 33. The hollow valve stem 20 is open at both ends for free air passage through its bore when the control valve 31 is open. This stem extends at its lower end past the valve 19, which is fixed thereon, and well into the sump discharge passage 16 below the valve seat 18 when the valve is closed against the seat.

Well 15 of the sump is in open communication with the chamber 9 at all times, but communication between chamber 9 and the chamber 23 is under the control of means responsive to liquid level in the sump. As here shown, the liquid level responsive means comprises a buoyant member

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37, such as a float, fixed on an axial sleeve 38 that is loose on the valve stem 20 and freely slidable thereon in the well of the sump. A lower limit of travel of the float is determined by the seating of the lower end of the sleeve against the valve head 19. The float is provided with a vent pipe 39 of sufficient height to extend well above the support plate 21, through which it plays freely, when the float is in its lowest position. Motion of the float is transmitted to a lever 40 that is pivoted at one end on a depending arm 41 of the support plate and which at its other end has a loop terminal 42 loosely engaged between a pair of annular flange elements 43 fixed on the float sleeve. The lever 40 intermediate its ends has a pivotal connection 44 to the lower end of a vertical throw link 45 which at its upper end has a pivotal connection 46 to one end of a rocker lever 47. This rocker lever is fulcrumed at 48 intermediate its ends on an up-standing post 49 pivoted at its lower end on the top of the casing 22. The other end of the rocker lever has a pivotal connection 50 to the upper end of a vertically reciprocable plunger 51 that plays in and through an axial bore 52 in a fitting 53 mounted in the top wall of the casing 22. Above the top wall of the casing the fitting bore 52, which has a clearance relative to the plunger 51, opens to the air chamber 9 through a port 54 in the fitting, and beneath the top wall of the casing the bore opens through a passage 55 to the chamber 23 above the diaphragm 24. Substantially midway between the port 54 and passage 55 the plunger is diametrically reduced to provide a valve 56 which cooperates with a seat ring 57 of rubber or other suitable material mounted in the bore 52 to open and close the air passage formed thereby.

The reduced lower end portion of the plunger extends into the chamber as a tip 58 adapted to engage and depress the adjacent outer end of an actuator lever 59 having a fulcrum 60 on the bottom of the passage 36 in the fitting 27. The inner end of the lever has a bowed terminal 61 in contact with the bottom of the cylinder 32 and apertured to accommodate the control valve plug 31.

Normal position of the parts is as shown in Figs. 1 and 2, with the valve 19 seated and closing the sump discharge passage 16. Weight of the valve stem assembly including the fitting 27 above the diaphragm biases the valve firmly closed against its seat. At the same time the open ended bore of the hollow valve stem is closed at its upper end by the valve 31 seated under the bias of its spring 34. The lowered float depresses the lever 40 and correspondingly elevates the plunger 51 to lift its valve 56 from its seat 57 and hold open the passage 55, so that air pressure on opposite sides of the diaphragm 24 is equal. While the plunger 51 is elevated its tip 58 is held spaced above the outer end of the actuator lever 59. The plunger is so dimensioned that when it is lowered its valve 56 closes the air passage 55 before the completion of downward movement which continues until the tip 58 contacts and depresses the adjacent end of the lever 59 to open the control valve 31. During this interval between closing of the valve 56 and opening of the valve 31 air is trapped in the chamber 23 at full line pressure.

Water separated from the line air in the chamber 9 drains to the bottom of the sump well and the float rises in response to the rise of the liquid level therein, correspondingly lifting the lever 40

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to actuate the linkage which lowers the plunger 51. Successive increments of water in the sump well carry the float higher and thus, through the plunger 51, close the valve 56 to cut off communication between the line chamber 9 and the control valve chamber 23. Beyond this point a slight further rise in the liquid level brings the plunger tip 58 down to rock the lever 59 on its fulcrum and open the valve 31. Immediately upon opening of the valve 31 the air trapped in the chamber 23 at line pressure escapes through the valve stem bore and through the sump discharge passage 16 to the atmosphere, whereupon a pressure differential is created at opposite sides of the diaphragm. In response to this differential, the diaphragm flexes up into the lower pressure area in the chamber 23 and raises the stem 20 to lift the valve 19 from its seat to open the sump discharge passage to the atmosphere. The accumulation of water, sludge, and other foreign matter in the sump is then expelled through the open discharge by air at line pressure, whereupon the float drops quickly to raise the plunger 51 back to its initial position through the linkage described. At the start of upward movement of the plunger its tip 58 frees the lever 59 whereupon the spring 34 becomes effective to close the valve 31 and cut off air passage through the valve stem bore. Immediately following closure of the valve 31 the plunger valve 56 opens to allow air at line pressure again to pass to the chamber 23, whereupon the air pressure on opposite sides of the diaphragm equalizes and the sump valve 19 drops back to closed position against its seat as the diaphragm flexes downwardly to its original position.

It is apparent from the foregoing description that the invention in its broad aspects incorporates a pressure differential operated valve controlling the discharge of water accumulation in a sump open to a compressed air line, with means responsive to liquid level in the sump to create and abolish the pressure differential by which the sump valve is actuated. No part of the liquid level responsive means has any mechanical operating connection with the sump valve assembly, so that operation of the liquid level responsive means is unhampered in that respect.

The embodiment of the invention as shown in Fig. 4 is essentially the same as that of the preceding form both in structure and operation, and the same reference characters are employed to indicate the same parts in the several views. In the Fig. 4 form, however, the sump 5a constitutes the lower section of a two-part casing whereof the upper section consists of a dome cover 62, the interior of which provides a chamber 63 in open communication with the sump well 15. The sump and cover are provided with meeting end flanges clamped together against a sealing gasket 64 by suitable securing means 65, whereby the connected sump and cover together comprise a unit for connection with a drainage source, not shown, such as a compressed air line sump, air tank, after-cooler, or other fluid pressure installation, through an inlet passage 66 in the top of the cover.

Further, in this embodiment of the invention, the support plate 21' itself constitutes a wall closing and sealing the bottom of the chamber 23 in the casing 22' above the support plate. This casing 22' has a boss 67 on its top wall provided with a bore axially aligned with the inlet 66 and having threaded engagement with a bolt stem 68 which constitutes a stop member extend-

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ing into the chamber 23 for vertical adjustment therein. A lock nut 69 maintains a set adjustment of the stem and serves to anchor the lateral foot flange 70 of a shield plate 71 which extends above and over the upper end of the plunger 51 and rocker lever 47 to protect these elements against movement or injury by impact of solid particles passed through the inlet 66.

Also, in this embodiment of the invention, the control valve fitting 27' secured on the upper end of the hollow valve stem 20' is formed as a piston for vertical reciprocation in a cylinder bushing 72 which opens axially through the plate 21'. An annular packing ring 73 surrounds the piston in a groove in the cylinder to prevent passage of fluid past the piston. The cap nut 35' on the piston fitting 27' has an upward axial stud 74 for abutment against the lower end of the stop stem 63 to limit upward travel of the piston, and the piston is biased downwardly by an expansion spring 75 surrounding the stud and stem between the cap nut and the top wall of the casing 22. The vented float of the Fig. 2 form is in this instance substituted by a ball float 37a as being better suited to its intended uses.

In service, the inlet 66 is connected in open communication with a drainage source so that the chamber 63 and sump well 15 are subjected to the existing fluid pressure of the installation with which the connection is made. The unit is designed particularly for heavy duty under severe sludge conditions and is adapted, by use of proper heat and cold resistant materials in the discharge valve 19 and packing 73, for steam applications, or for sub zero installations, as well as for normal temperature drains. Under some intended operating conditions, small rocks, pebbles, and sand as well as sludge and water have to be drained from the installation. So long as the exposed effective area of the piston is kept substantially larger than the cross sectional area of the discharge passage 16, as shown, the passage can be any size desired; and by adjustment of the stop member 63 a corresponding adjustment of the opening extent of the discharge control valve 19 can be effected.

In the normal position of the parts, as shown in Fig. 4, the valves 19 and 31 are closed and the plunger valve 56 is open, so that the unit is closed to the atmosphere and the chambers 23 and 63 are in open communication with pressure equal above and below the piston 27'. As the float 37a rises in response to accumulation of liquid in the sump, the linkage operates to depress plunger 51 to close the valve 56 and then open the valve 31. In the several views of the drawings the valve 31 appears slightly open, for clearness of illustration; its normal position is fully closed. Immediately upon opening of valve 31 the chamber 23 vents to the atmosphere through the hollow valve stem 20, whereupon the greater pressure on the bottom of the piston

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forces it up in the cylinder bushing 72 to the extent permitted by the stop 68 to open the sump discharge valve 19, whereupon the accumulated matter in the sump is expelled to the atmosphere under the existing pressure of the installation. The float then falls and the linkage operates to lift the plunger 51 to close the valve 31 and then open the valve 56 for equalization of pressure in the chambers 63 and 23 and at both ends of the piston. Spring 75 then forces the piston and stem 20 downwardly to close the sump discharge valve 19, whereupon the unit is conditioned for another cycle of operation in the manner described.

It is to be understood that although the instant disclosure is illustrative of certain embodiments by which the invention is reduced to practice, any desired changes and modifications consistent with the scope of the invention as claimed may be made in the details of the structure as shown.

I claim:

A compressed air line drain valve comprising a casing having an air inlet chamber provided with a sump having a water outlet, a second chamber, a movable member separating said chambers and movable in response to a pressure differential therebetween, a stem assembly secured to said movable member for movement therewith, a valve fixed on the stem controlling the water outlet and biased to closed position, said stem having an air passage therethrough open at one end to said second chamber and at its other end to the atmosphere, said second chamber having an air passage in a fixed wall thereof establishing communication with the air inlet chamber, a normally open valve controlling said chamber air passage, means movable in response to liquid level in the sump to actuate the chamber air passage valve to open and closed positions, a valve in said second chamber controlling the stem air passage and biased to a normally closed position, and means operable by said chamber air passage valve in closing to open said stem air passage valve for escape of air from said second chamber to create a pressure differential at opposite sides of the movable member and thereby move said valve stem to open the sump water outlet valve.

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