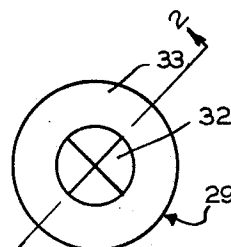
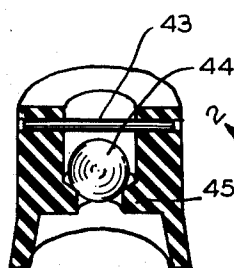
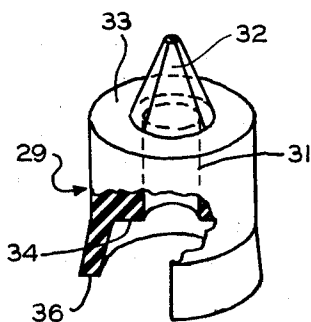
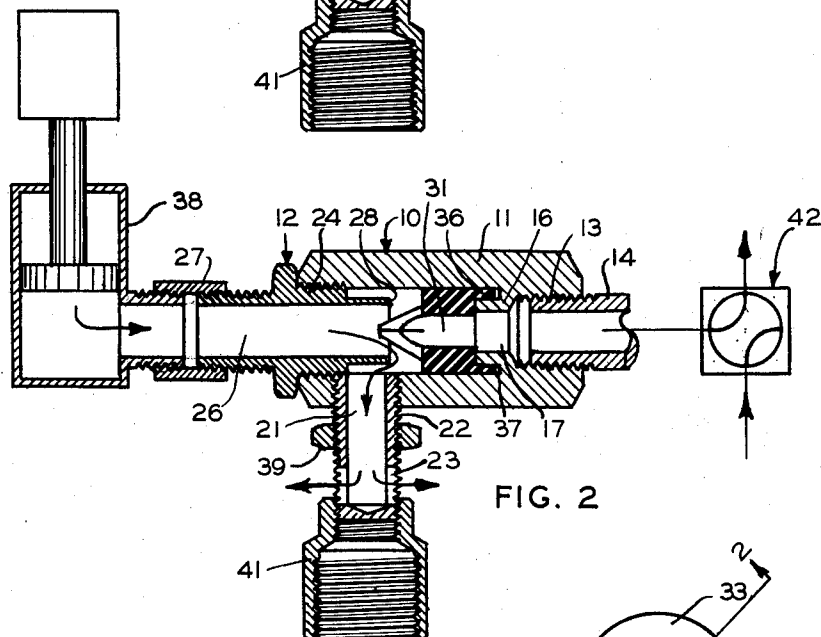
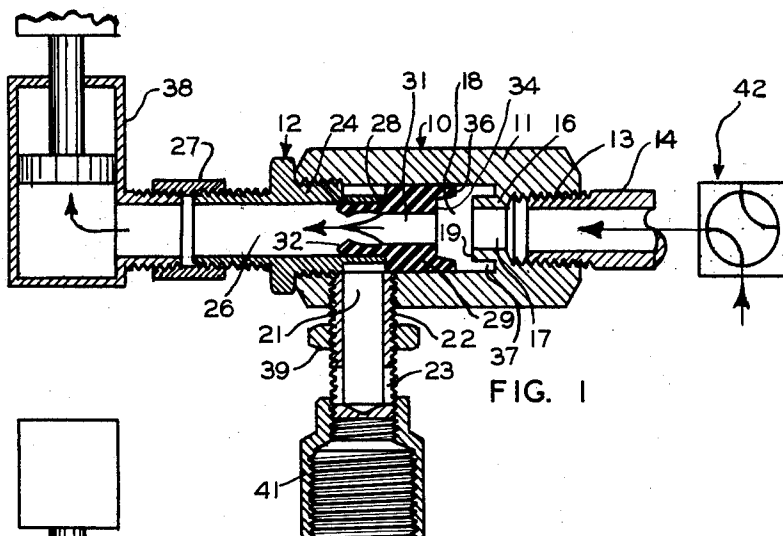


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AIR VALVE

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1

3,086,542
AIR VALVE

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My invention refers in general to air valves and has more particular reference to a rapid exhaust valve which when desired permits throttling of the exhaust air flow.

In the operation of an air cylinder by conventional valve means, the pressure cycling valve controlling the flow of air to and from the cylinder is frequently located some distance from the cylinder. As this valve is opened, air under pressure, usually about 100 p.s.i., travels rapidly through the valve and conduit, operating the cylinder at a high rate of speed. When this same valve is turned to complete the cycle by exhausting the cylinder, however, the same pressure is not available to drive the air in the reverse direction of flow with the result that the time required for completion of this reverse flow of air is ordinarily greater than that required for filling the system. To compensate for this characteristic, it is customary to provide a conduit and valve of generous dimension in order to reduce flow losses and obtain the desired maximum exhaust speed. Similar conditions are encountered in the exhaust of air from other components and systems such as pilot control air circuits.

One of the principal objects of my invention is the provision of an air valve capable of operating a cylinder or the like at a higher cyclic rate than is possible with conventional valves of similar size.

Another important object of my invention is the provision of an air valve adapted for exhausting a compressed air system at a speed substantially equal to its rate of fill.

A further important object of my invention is the provision of an air valve for filling and exhausting an air system in which the exhaust rate can be adjusted from a value substantially equal to the rate of inlet flow downwardly to a very small value.

Other objects of my invention include the provision of an air valve of the type described which is of small external dimension with respect to its capacity, which may be placed in close proximity to a circuit element such as a cylinder or other utilization instrumentality and yet be controlled from a remotely positioned air valve and which may be economically fabricated and easily maintained.

In brief, my valve is a small tubular body intended for attachment at or near the cylinder port or other point at which the exhaust is desired. A shuttle valve reciprocates within the body between inlet and outlet or utilization valve seats, exposing in the latter position an exhaust outlet of relatively large cross sectional area compared to the inlet. In the preferred embodiment the shuttle valve is formed of resilient material, such as rubber, and defines a bore which is closed at one end by resilient fingers forming a conical petal valve which opens under pressure and permits air to pass to the cylinder. When the conduit applying pressure air to my valve is vented, as by a pressure cycling valve, the fingers or petals close, thereby preventing the reverse flow of air and allowing the pressure in the cylinder to drive the shuttle against the inlet seat, thus exposing the large exhaust port. The large cross section of the path is thus opened to the air in the cylinder and its short length permits exceptionally rapid exhaust of the cylinder air. Ordinarily, the time required for exhausting the cylinder is the longest of the functions in a cycle and therefore dictates conduit size and the size of the pressure cycling valve selected. Through the use of my valve, smaller pressure air cycling valves and conduits may be utilized without reducing the cyclic rate by extending the exhaust time.

2

For a more complete description of my valve, reference is made to the following detailed specification and to the appended drawings in which:

FIGURE 1 is a partially sectioned, partially schematic representation of my valve connected to a conventional air cylinder showing the components in the position assumed while admitting air under pressure to the cylinder;

FIGURE 2 is similar to FIGURE 1 but illustrates the component parts in the position assumed when exhausting air from the cylinder;

FIGURE 3 is a perspective view of the preferred shuttle valve employed in my valve;

FIGURE 4 is a plan view of the shuttle valve shown in FIGURE 3; and

FIGURE 5 is a vertical section through an alternate form of shuttle valve.

Referring to FIGURES 1 and 2, my valve includes a body, generally designated 10, made up of an inlet body member 11 and a discharge body member 12. The inlet body member 11 is bored and threaded at its inlet end forming an inlet port 13 adapted to receive conventional conduit 14. An internal flange 16, formed integral with the body 11, defines an axial bore 17 communicating with a counterbore 18, the latter extending through the inlet body member 11 to the flange 16. The flange 16 includes an annular lip projecting into the counterbore and defining an inlet valve seat 19. An exhaust conduit 21 extends laterally into the counterbore 18 near the end of the counterbore remote from the inlet port 13 and is threaded as shown at 22 and provided with openings 23 formed therein.

The discharge body member 12 includes a portion 24 secured within counterbore 18. An axial bore forming a utilization port 26 extends through the body 12, the outer extremity being threaded to receive a nipple 27. The body 12 extends into the counterbore 18 beyond the opening of the exhaust conduit 21 and is of smaller diameter than the counterbore 18, the end forming a utilization valve seat 28.

A shuttle valve, generally cylindrical and designated 29, formed of resilient material, such as rubber, fits in sliding sealed relation within the counterbore 18. An axial opening or bore 31 extends through the shuttle valve 29 and is normally closed at its discharge end by a plurality of fingers or petals 32. These petals 32 are preferably four in number and normally assume the form of a right cone, the base diameter of which is somewhat smaller than the diameter of the opening utilization port 26 in the body 12. The face 33 of the shuttle valve around the petals 32 is flat and substantially normal to the axis of the bore 31 and adapted for sealing engagement with the similarly shaped utilization valve seat 28 when the shuttle valve is driven to the left as in FIGURE 1.

The opposite end of the shuttle valve includes a flat annular portion 34 around the axial opening 31 for making sealing engagement with the inlet valve seat 19. Sealing lips 36 are formed on the extremity of the shuttle valve immediately around the portion 34 to aid in preventing leakage of air between the shuttle valve 29 and the counterbore 18. Recesses 37 around the inlet valve seat 19 receive the lips 36 when the valve is driven against the seat 19 by the pressure of air in a cylinder 38, or other utilization instrumentality, to which the nipple 27 is connected.

In operation, my valve is located immediately adjacent the utilization instrumentality, e.g., the cylinder 38. A nut 39 and a cap 41 are threaded over the nipple 22 and adjusted to either expose the openings 23 for rapid exhaust of air or to cover and restrict air flow through the openings 23 in the event slower rate of operation is desired. A three-way pressure cycling valve 42, which may

be at a remote location, is connected to the conduit 14 and initially turned to admit air under pressure, usually at about 100 p.s.i., to the inlet port 13 of my valve. Air flows through the passage 17 against the shuttle valve 29 which is driven toward the utilization valve seat 28 by the air, making sealing engagement therewith. The resilient petals 32 project into the utilization port 26 in the member 12 and are forced open by the pressure of air, thus permitting the flow of air at high velocity into the cylinder 38. In this position, air under pressure cannot reach the exhaust conduit 21 and thus the piston in the cylinder is driven throughout its stroke. To reverse the flow of air, the valve 42 is turned to block the flow of pressure air and to exhaust the conduit 14 to atmosphere. The petal members 32, being resilient, will close as soon as the pressure in the cylinder 38 approximately equals the pressure of air in the counterbore 18. As the pressure in the conduit 14 falls slightly below the pressure in the cylinder 38, the shuttle valve 29 will be driven to the right as in FIGURE 2 into sealed relationship with the inlet valve seat 19. This permits the flow of air from the cylinder 38 through the bore 26, across the utilization valve seat 28 and through the exhaust conduit 21 at a high rate of speed which may be throttled as desired by restricting the opening 23.

It will be understood that the cross sectional area of the exhaust conduit 21 is substantially greater than the cross sectional area of the bores 17 and 31 and thus provides a much lower resistance to the flow of air than would passage through these bores if exhaust air were required to travel through them. Since air under normal shop pressure has only about $\frac{1}{4}$ of specific volume of air at atmospheric pressure, the ratio of cross sectional areas of the bores 17 and 31 to the area of the opening in the exhaust conduit 21 may be on the order of one to seven or somewhat less. Stated in other words, the valve 42 and the bore 17 may be approximately $\frac{3}{32}$ of an inch in diameter compared with a $\frac{1}{8}$ inch pipe nipple 21 without seriously reducing the speed of exhaust in comparison to the rate of fill. Maximum economy will be effected when the area of the exhaust conduit 21 is at least three times the area of the shuttle valve bore 31, which is ordinarily the minimum cross section encountered by air entering the cylinder 38.

It should not be understood that the particular form of shuttle valve described, although constituting a preferred form, is essential. The number of petals 32 may be increased beyond four or reduced to three if desired. It is also possible to substitute a shuttle of the type illustrated in FIGURE 5 for the type illustrated in FIGURE 3. This shuttle is essentially similar in structure except that in place of the petal members 32, I have substituted a check valve consisting of a ball 44 engaging seat 45 and retained as by crossbar 43.

I claim:

1. An exhaust valve comprising a body having an axial bore providing axially spaced inlet and utilization ports, an inlet valve seat surrounding the inlet port and a utilization valve seat surrounding the utilization port, a shuttle valve comprising a hollow cylinder slidably mounted in

said bore and having a pair of sealing surfaces spaced axially closer together than the spacing between said seats and adapted to make sealing engagement with said seats respectively upon sliding movement of the cylinder, said utilization valve seat being flat and substantially normal to the axis of the bore and the valve sealing surface engageable therewith being a portion of the end wall of the cylinder and being therefore also flat and substantially normal to the axis of the bore, whereby said last named sealing surface will be unseated from said utilization valve seat substantially immediately upon incipient movement of said shuttle valve toward said inlet port, check valve means carried by said shuttle valve openable upon movement of the shuttle valve toward the utilization valve seat and closable upon movement of the shuttle valve toward the inlet valve seat, an exhaust conduit communicating with the bore of the body between the two seats thereof so as to be open to the utilization port when the utilization valve sealing surface of the shuttle valve is unseated from the utilization valve seat and be closed from the utilization port when the utilization valve sealing surface of the shuttle valve is seated on the utilization valve seat, and adjustable means for controlling the outlet from said exhaust conduit.

2. An exhaust valve as claimed in claim 1 in which the check valve means carried by the shuttle valve is a petal valve having resilient fingers extending toward the utilization port from the utilization valve seat-engaging sealing surface of the shuttle valve.

3. An exhaust valve as claimed in claim 1 in which the check valve means carried by the shuttle valve is a petal valve having resilient fingers extending toward the utilization port from the radially inner margin of the utilization valve seat-engaging sealing surface of the shuttle valve.

4. An exhaust valve as claimed in claim 1 in which the shuttle valve contains a check valve seat surrounding the bore thereof and facing the utilization valve seat and the check valve means comprises a ball held captive in said bore and cooperating with said check valve seat.

5. An exhaust valve as claimed in claim 1 in which the exhaust conduit is an externally threaded tube having a closed outer end and openings in its side wall near said end and the adjustable means for controlling the outlet from said conduit comprises a tubular cap threaded on the tube for uncovering more or less of the area of said openings and having an outer portion of enlarged diameter adapted to receive all of the exhaust when the openings are substantially fully covered by the cap.

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