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DISTRIBUTING VALVE FOR PERCUSSIVE TOOLS

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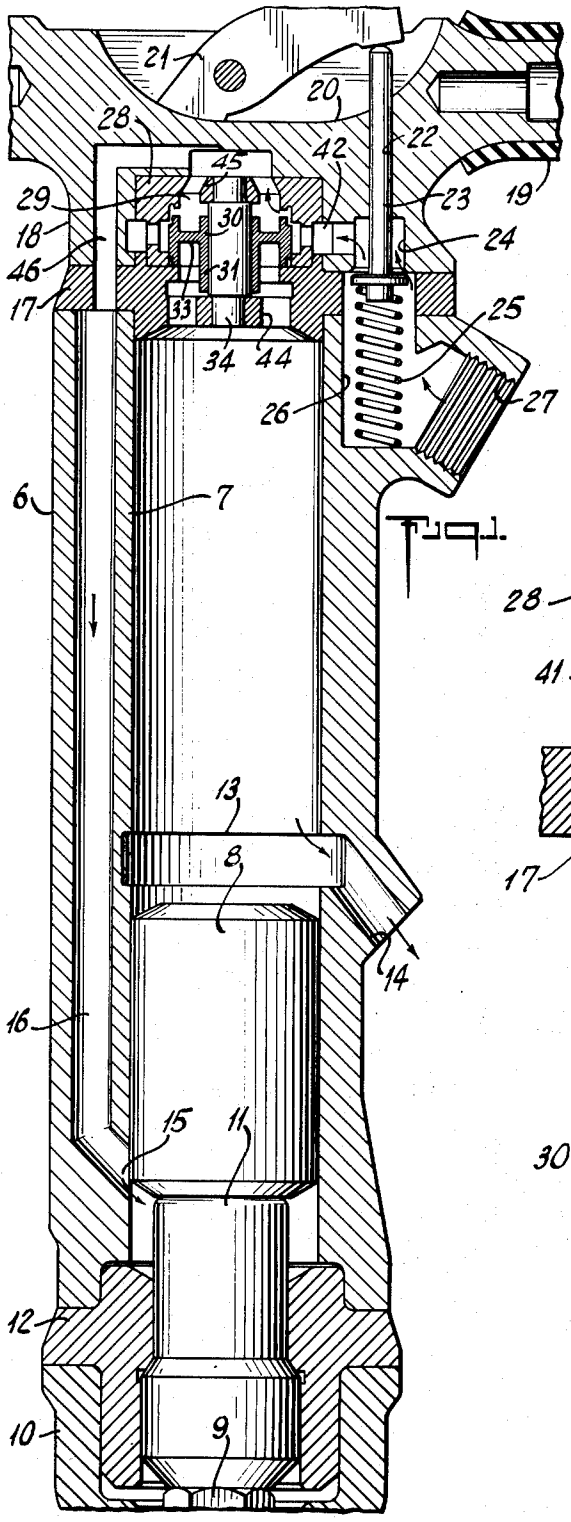


Fig. 1.

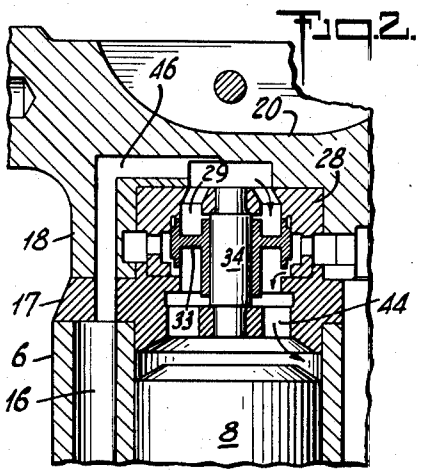


Fig. 2.

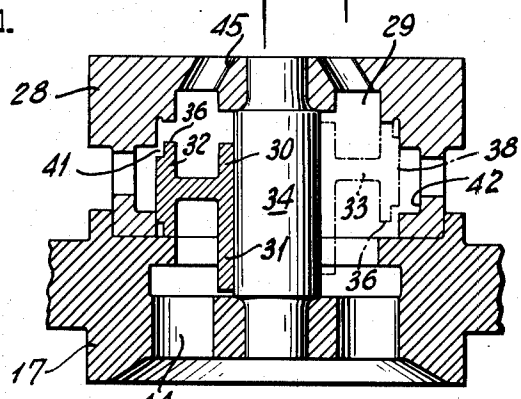


Fig. 3.

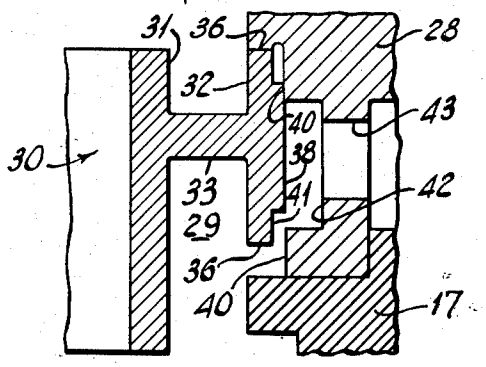


Fig. 4.

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DISTRIBUTING VALVE FOR PERCUSSIVE TOOLS

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6 Claims. (Cl. 121—29)

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This invention relates to pneumatically operated percussive tools such as demolition tools, hammers and rock drills and more particularly to a distributing valve therefor which operates with a combined end seating and lapping action.

Distributing valves of the end seating type are known to have more effective shut-off characteristics than those of the lap or slip fit type because of the tendency of the latter to leak especially when wear has taken place. End seating valves however, have a disadvantage occasioned by the fact that while the valve is traveling from one seat to the other, motive fluid can momentarily flow over both ends of the valve to opposite ends of the cylinder at the same time. In addition to being wasteful of air this simultaneous inflow to both sides of the piston tends to lessen the velocity of the latter with a consequent detrimental effect on the work output.

The object of the present invention is to overcome the aforementioned disadvantages by retaining the end seating effectiveness and at the same time preventing the inflow of live air over both ends of the valve at the same time.

Other objects and features of the invention will appear more clearly from the following description taken in connection with the accompanying drawing in which:

Fig. 1 is a longitudinal section of a demolition tool embodying the invention, with the distributing valve and hammer piston in their forward position at the start of the return stroke of the piston;

Fig. 2 is a fragmentary section similar to Fig. 1 with the valve and piston in their rearward position at the start of the power stroke;

Fig. 3 is an enlarged longitudinal section of the distributing valve and associated valve chest, the left side of the valve being shown in forward position and full lines, and the right side of the valve being shown in rearward position in broken lines; and

Fig. 4 is a further enlarged longitudinal section of the right side of the distributing valve with associated portions of the valve chest.

Referring to Fig. 1, the illustrated demolition tool or hammer comprises a cylinder 6 providing piston chamber 7 and hammer piston 8 arranged to deliver impacts to a working implement such as a drill steel 9 supported in the front head 10, either by direct engagement (not shown) or through an anvil block 11 mounted in a guide member 12 between cylinder 7 and fronthead 10. The cylinder is provided with the usual exhaust groove 13 which is overrun by the piston in each

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direction and which communicates to atmosphere through exhaust port 14. For supplying live air to the front end of the piston chamber, the cylinder 6 has a port 15 and a passage 16 extending therefrom to the rear extremity of the cylinder.

The rear end of the cylinder is closed by a back cylindrical washer 17 which is flanged to fit into the cylinder and into a backhead 18. The backhead 18, the cylindrical washer 17, cylinder 6, guide member 12 and fronthead 10 are all rigidly secured together by any suitable means such as the usual bolts (not shown). The backhead is provided with a pair of grip handles 19, a rearwardly open recess 20 for receiving manipulative throttle lever 21, longitudinal bore 22 for receiving the stem of the throttle valve 23, and a counterbore 24 which receives live air under control of the throttle valve. The lower end of the counterbore forms a valve seat engageable with the head of the throttle valve which, in the inoperative position, is seated by the action of spring 25 mounted in live air passageway 26 formed partly in the back cylinder washer and partly in the cylinder 6. The passageway is supplied through threaded opening 27 which is adapted to receive an air hose connection (not shown).

At its front face, the backhead is centrally bored to receive a valve block 28, which cooperates with the washer 17 to form a valve chest providing a valve chamber 29. A distributing valve 30 is arranged in the valve chamber for controlling the reciprocation of the hammer piston 8. The distributing valve is of the spool type or annular in shape and comprises a sleeve portion 31, an outer portion 32 and a radially disposed portion 33 therebetween. The sleeve portion is mounted with a sliding fit on a cylindrical pin 34 whose front and rear ends are firmly supported in the washer 17 and valve block 28 respectively. The outer portion 32 has front and rear ends 36 engageable with corresponding seats on washer 17 and valve block 28 respectively. It has a peripheral surface 38 fitting a cylindrical surface 40 in the valve block 28. At each end of the peripheral surface 38 is a peripheral recess 41 in the valve. The cylindrical surface 40 is broken up into a front and a rear portion by an annular recess 42 which is in constant communication with the live air counterbore 24 by means of a port 43. In accordance with this invention, the axial width of the peripheral surface 38 of the valve, although less than the distance between the end seating surfaces 36, is greater than, or at least substantially equal to,

the axial width of the annular recess 42 so that when the valve is shifting from one seat to the other, live air can not flow from the recess 42 over both ends of the valve 30 at the same time.

The valve chest 17, 28 provides space in the valve chamber 29 forwardly and rearwardly of the radial portion 33 of the distributing valve. The forward space of the valve chamber is connected through ports 44 to the rear end of the piston chamber 7. The rearward space is connected, through ports 45 in the valve block 28 to a passageway 46 in the backhead 18, which communicates with the passage 16 leading to the front end of the piston chamber.

In operation, let it be assumed the distributing valve 30 and the hammer piston 8 are in the Fig. 2 position at the start of a power stroke. Live air enters the pneumatic tool through the inlet passages 27, 26, 24, 43 (Fig. 1) to the annular recess 42 in the valve chest which constantly supplies live air to the valve chamber 29 as long as the throttle valve 23 is held open. With the distributing valve 30 in the rearward position, as shown in Figs. 2 and 4 and on the right side of Fig. 3, the live air passes from the annular recess 42 into valve chamber 29, around the front end of the outer portion 32 of the valve, thence through ports 44 to the rear end of piston chamber 7 to drive piston 7 forwardly on its working stroke. The forward recess 41 in the periphery of the distributing valve 30 forms a part of the live air passageway, and the metering of the motive fluid for the power stroke is calibrated by the depth of the forward recess 41. By increasing the difference in diameters between the peripheral surfaces 38 and the forward surface 41, the designer of the valve may increase the supply of air on the power stroke and accordingly the speed of the piston and force of the blow. During the first part of the forward stroke of the hammer piston 8, the distributing valve 30 is held in its rearward position with the rear end 36 firmly held against its associated seat in valve block 28, thereby preventing any flow of live air through ports 45 toward the end of the piston hammer. The engagement between the rear part of the peripheral surface 38 of the valve 30 and the rear cylindrical surface 40 on the valve block 28 also inhibits flow of live air toward the ports 45, but even if these cylindrical surfaces should become worn, the rear end seating surface on the valve will continue to be effective. The valve is held in its rearward position at this time due to the fact that the rear part of the valve chamber 29 is vented to atmosphere through ports 45, passageway 46, passage 16, port 15, the front end of the piston chamber 7 and exhaust port 14; whereas the surfaces at the front of the valve 30, and especially along the radial portion 33 are exposed to live air. As the hammer piston 8 advances, the pressure on the front faces of valve 30 decreases rapidly because of the increasing velocity of the motive fluid in the rear end of piston chamber 7. The air in front of the advancing piston 8 is vented through exhaust groove 13 and exhaust port 14 until such time as the exhaust groove is covered by the piston. Thereafter the residual air in the front end of the piston chamber 7 is trapped and becomes compressed by the advancing piston to increase the pressure in passage 16 and on the rear surface of the distributing valve 30. During the interval when the pressure is falling at the rear end of the piston chamber and rising at the forward end, the preponderance of pressure shifts to such extent as to trip the valve suddenly from the Fig. 2 to the Fig. 1 position. Immediately thereafter, the piston uncovers the exhaust groove 13 thereby suddenly causing a still further drop in the pressure at the rear end of the piston chamber 7. The piston completes its forward stroke by delivering a powerful impact to an anvil block 11.

Fig. 1 shows the piston at the start of its return stroke and with the valve held in its forward position by the action of live air against the rear surfaces of the valve while the forward surfaces are vented through ports 44, the rear end of piston chamber 7 and exhaust port 14. The seated forward end 36 on the valve, and to a lesser degree the forward part of the lapping surface 38, prevent escape of live air around the front end of the valve to the rear end of the piston chamber.

The piston 8 is returned by the action of live air delivered through valve block recess 42 into valve chamber 29, around the rear end of the valve 30 through ports 45, passageway 46, passage 16 and port 15. The live air thus delivered flows through the rear peripheral recess 41, the depth of which can be varied to regulate the supply of live air on the return stroke as in the case of the forward recess 41 which serves as a passageway during the forward stroke. During the initial part of the return stroke of the piston, the air at the rear end of the piston chamber 7 is vented through exhaust port 14. After the piston has covered exhaust groove 13 it compresses the air entrapped in the rear end of the piston chamber thereby building up pressure against the forward faces of the distributing valve 30. The building up of pressure against the rear faces of the valve combine with the reduction in pressure on the front face thereof to trip the valve back to the Fig. 2 position shortly prior to the time that the piston uncovers the exhaust groove 13. With the valve tripped to its rearward position and the piston at the completion of its return stroke the parts are in their Fig. 2 position to start a new cycle of operation.

From the foregoing description it is apparent that the present valve retains the advantages of an end seating valve because the end seats 36 are effective during the stationary positions of the valve without reliance upon the lapping surfaces 38 and 40, whereas the lapping surfaces are effective during the tripping movement of the valve when neither of the end surfaces 36 is seated. The contact between the rear extremity 36 and the rear seat in the valve chest is broken as soon as the valve starts to move forward, but the supplementary seal at the rear portion peripheral surface 38 prevents escape of live air to the space in back of the valve until such time as the front portion of the peripheral surface 38 attains lapping engagement with the front cylindrical surface in valve block 28, whereby the front lapping surfaces prevent the escape of live air to the space in front of the valve until such time as the front end 36 is seated. In short, the present invention prevents admission of live air to both ends of piston chamber at the same time by the combined action of end seating and lapping surfaces.

What is claimed is:

1. In a pneumatic tool, a distributing valve comprising a sleeve portion and an outer portion separated therefrom, both portions being generally of cylindrical shape and being connected by a web portion the inner portion being adapted to reciprocate on a cylindrical pin, the outer por-

tion having a cylindrical surface adapted to engage a valve chest with a lapping action and having extremities adapted to provide end seating surfaces engageable with said valve chest.

2. In a pneumatic tool, a distributing valve according to claim 1 in which the cylindrical surface is bounded between two annular recesses, one at each end of the outer portion of the valve.

3. A pneumatic percussive tool comprising a cylinder providing a piston chamber, a hammer piston reciprocable therein, a valve chamber at the end of the cylinder having ports connecting the ends of the valve chamber to the opposite ends of the piston chamber, the periphery of the valve chamber being defined by a pair of lapping surfaces arranged one toward each end, said lapping surfaces being separated by a recess adapted to be constantly supplied with live air during tool operation, and a distributing valve of the spool type reciprocably mounted in the valve chamber and responsive to pressure variations within the valve chamber to cause alternate flow of air from the live air recess to the valve chamber ports to effect automatic reciprocation of the hammer piston, said valve having lapping surfaces fitting the lapping surfaces of the valve chamber and end seating surfaces at its front and rear extremities and having a peripheral recess arranged between each lapping surface and end seating surface, said valve chamber having seating surfaces which are engaged by the valve end seating surfaces to cut off flow of live air past the corresponding end of the distributing valve.

4. A pneumatic percussive tool according to claim 3 wherein the peripheral recesses regulate the flow of live air past the ends of the distributing valve.

5. A pneumatic percussive tool according to claim 4 wherein a cylindrical pin is arranged within the valve chamber for support and guidance of the distributing valve.

6. A pneumatic percussive tool according to claim 5 in which the lapping surfaces have sufficient width in an axial direction to continue the sealing effect on one side of the valve until a sealing engagement is established by the lapping surface on the other end of the valve, whereby flow of live air over both ends of the valve at the same time is prevented.

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