

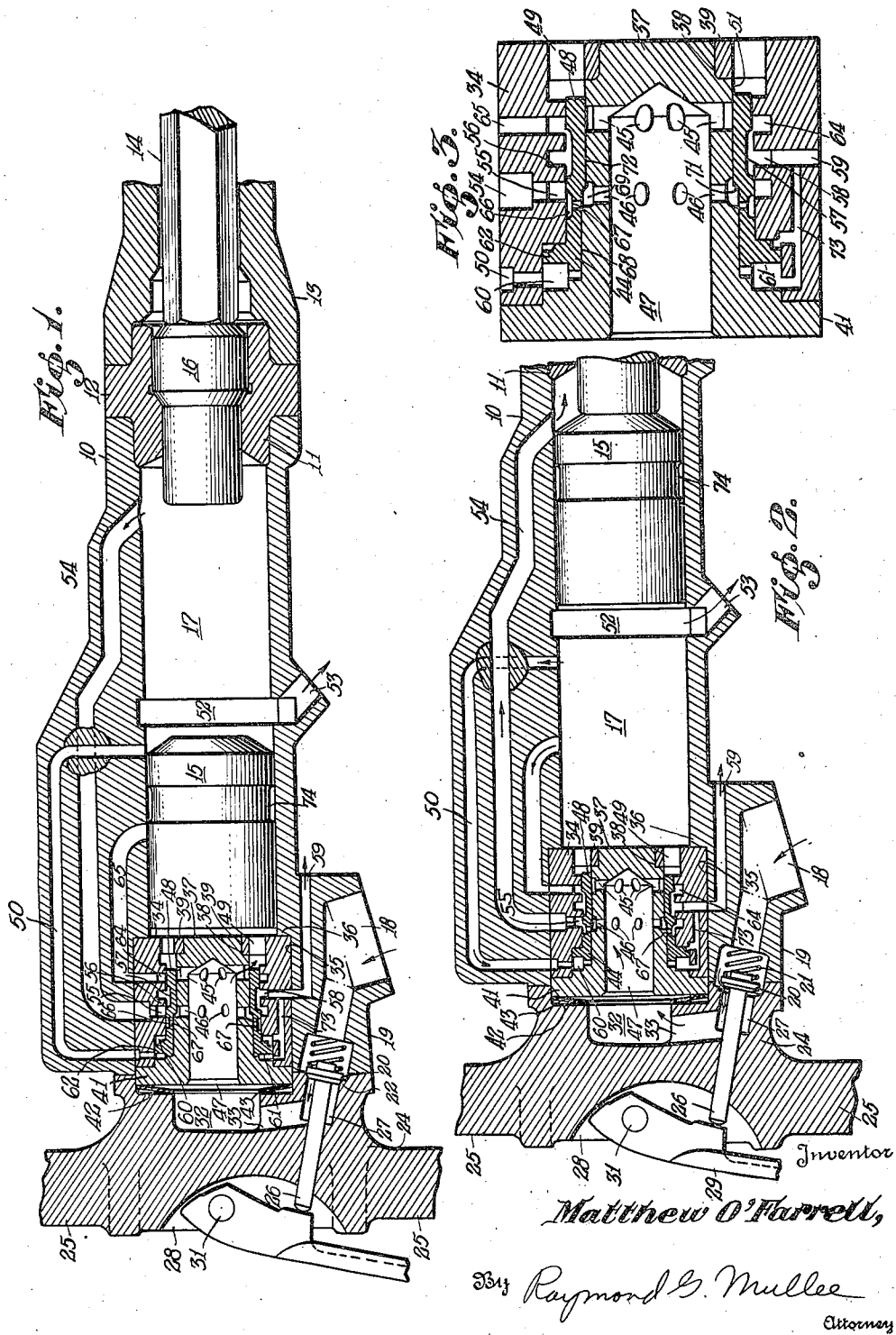
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DISTRIBUTING VALVE FOR PERCUSSIVE TOOLS

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DISTRIBUTING VALVE FOR PERCUSSIVE TOOLS

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This invention relates to fluid operated percussive tools such as pavement breakers, rock drills and other tools of the same general category, and more particularly to the distributing valves thereof and the arrangement of the ports and passages associated with and controlled by said distributing valves.

The main object of the invention is to provide a pneumatic percussive tool with a distributing valve cooperating with special passages for facilitating flow of pressure fluid into the ends of the cylinder and particularly to induce, through scavenging of the front piston chamber in said cylinder, an increased acceleration of the hammer piston on its forward stroke, and thereby cause the latter to deliver a heavier striking blow to the working implement than would result from a conventional structure for this purpose.

Another object is to use but two principal moving parts, namely, the hammer piston and the distributing valve, and obtain the efficient operation of the tool solely by virtue of the form of the valve and arrangement of the fluid passages controlled thereby without resorting to auxiliary valves or other devices.

Other objects and the advantages of the invention will be set forth more in detail in the following description when considered in connection with the accompanying drawing in which:

Fig. 1 is a longitudinal section of a sufficient portion of a fluid operated percussive tool to embody the present invention and disclose the details thereof, both the hammer piston and distributing valve being shown in initial rear starting position;

Fig. 2 is also a partial section of the same tool showing the hammer piston at the end of the forward power stroke and the distributing valve in operated forward position for initiating the return stroke of the hammer piston; and

Fig. 3 is a section of the valve chest and distributing valve therein on an enlarged scale twice that shown in Figs. 1 and 2.

In percussive tools the efficiency of the operation obviously depends largely on the power and speed of the forward working strokes of the hammer piston. Especially is it important for the tool during operation to be capable of promptly expelling the spent pressure fluid from before the hammer piston in the front piston chamber during the forward travel of said piston, because the presence of any residual fluid remaining to impede or cushion the movement of the piston will definitely reduce the speed and power of the working stroke with the result that the blows de-

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livered by said hammer piston are not as powerful as to constitute efficient use of the pressure fluid expended in operating the tool.

It is therefore now proposed to provide a percussive tool with special facilities for quickly and thoroughly scavenging the forward piston chamber in front of the advancing hammer piston during operation so that the pressure fluid driving the latter will cause it to accelerate in speed in the forward direction and deliver its blows to the working implement at maximum speed.

Thus in the practice of the invention, a cylinder casing 10 is secured upon one end of a tappet bushing 11 against flange 12 on the latter and said bushing in turn secured to a tubular guide 13 for a working implement 14, by means of side bolts (not shown), the working implement being a drill steel, cutter or other implement. The cylinder casing 10 contains a slidable hammer piston 15 longitudinally reciprocable therein to strike the tappet 16 which is loosely mounted in bushing 11 and adapted to transmit the impacts thus received to implement 14.

In order to drive the hammer piston, pressure fluid is conducted to the piston chamber 17 and exhausted therefrom through a special arrangement of passages as will now be explained.

Pressure fluid is introduced into inlet port 18 in the rear portion 19 of the cylinder casing from a source of pressure fluid through an air hose (not shown) and is controlled by throttle valve 20 normally held closed by spring 21 against valve seat 22 within back head 24 integral with grip handles 25, only a portion of the latter being shown. The rear portion 19 of the cylinder casing is secured to back head 24 by the usual side bolts (not shown). The throttle valve has a stem 26 extending through valve chamber 27 and through back head 24 to the other side of the latter so as to form a plunger projecting at its free end into recess 28 upon the outer side of said back head. The latter by said recess also provides a housing for pivotally mounting the manual throttle control lever 29 on a pin or bolt 31 in suitable position to engage against the exposed end of the valve stem and depress the latter when the lever is manually depressed toward said back head, the valve stem thereby opening the valve to allow pressure fluid to enter the valve chamber and pass into reservoir 32 through passage 33.

A tubular valve block or valve case 34 is mounted within a counterbore 35 in cylinder casing 10 and abuts against a shoulder 36 on the latter. A second hollow valve block 37 is fitted into valve

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block 34 and formed with an annular peripheral recess 38 at the forward end for receiving an inwardly extending flange 39 on block 24. The inner block 37 has a rear flange 41 which lies partly in cylinder casing counterbore 35 and partly in a recess 42 in back head 24. A resilient washer 43 is disposed between said flange and back head within the recess. Both valve blocks together form a valve chest in which a hollow distributing valve or sleeve 44 is longitudinally shiftable, while the pressure fluid distributed and controlled by the valve reaches the latter through two groups or rows of ports 45, 46, spaced apart in chamber 47 within valve block 37, said chamber virtually forming a continuation of the pressure fluid reservoir 32 previously mentioned.

When the distributing valve 44 occupies the initial rear or starting position shown in Fig. 1 and the hammer piston likewise is also in its rear position, and the operator presses lever 29 toward backhead 24, thereby depressing valve stem 26 and opening throttle valve 20, pressure fluid enters valve chamber 27 and through passage 33 enters chambers 32 and 47. From the latter chamber the fluid travels through ports 45 past the forward end 48 of the valve and through rear cylinder ports 49 into the rear portion of piston chamber 17 to impinge against the rear of hammer piston 15 and drive the same to its extreme forward position shown in Fig. 2. The distributing valve is meanwhile held in its rear position by pressure fluid acting on front end 48 until this effect is neutralized, as will be explained. The valve is thereafter shifted in the same direction as that traveled by the hammer piston when the latter uncovers port 50 (to be described), with the result that in the forward position front end 48 of said valve closely surrounds and covers the edge or shoulder 51 of the inner valve block 37 (Fig. 3) and cuts off communication between ports 45 and 49 as will also be referred to later on.

During the mentioned forward travel of the hammer piston the residual fluid in the forward portion of the piston chamber 17 in front of the piston is mostly exhausted through exhaust groove 52 and main exhaust port 53. When these are covered by the piston, the remainder of the fluid will be driven out through the forward end of passage 54 which communicates at the rear end thereof with groove 55 surrounding valve 44 in valve block 34 and then passes beneath partition 56 and over the neck 57 on the valve into exhaust groove 58 on the other side of said partition, whence the fluid escapes to atmosphere through auxiliary exhaust passage 59. The pressure fluid continues to act against end 48 of the valve until the piston uncovers exhaust groove 52. Also during the latter stage of the forward movement of the piston, before exposing the main exhaust groove 53, said piston uncovers the forward end or opening of passage 50 which communicates at its rear end with valve flange chamber 60, allowing pressure fluid from the rear portion of the piston chamber 17 to enter said passage and chamber to exert pressure on the rear surface 61 of valve flange 62 and by virtue of its greater area than that of front end 48, overcomes the holding effect of the latter, the pressure being actually exerted on the entire rear end of valve 44 as soon as the valve has begun to move forward, with the result that valve 44 is driven forward rapidly from the position of Fig. 1 to that illustrated in Fig. 2.

As soon as the distributing valve shifts for-

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ward, the main exhaust groove 52, opening to the atmosphere through exhaust port 53 independently releases the pressure fluid from the rear piston chamber, but as the valve then occupies the shifted forward position, the front end 48 thereof covers edge or shoulder 51 of valve block 37 already referred to and cuts off the supply of pressure fluid from chamber 47 to rear cylinder ports 49. As a result the rear portion of the piston chamber 17 largely exhausts through the main exhaust groove and port.

However, in the forward position of the valve it no longer connects the forward portion of the piston chamber with groove 58 and auxiliary exhaust passage 59 through passage 54 and its associated groove 55 by way of valve neck 57, but said neck instead interconnects said groove 58 and auxiliary exhaust passage 59 with further groove 64. As groove 64 communicates through passage 65 with an intermediate part of the rear portion of the piston chamber between rear cylinder ports 49 and main exhaust groove 52, exhausting of spent fluid from said rear portion is speeded up by part of the fluid escaping through auxiliary exhaust passage 59.

The distributing valve has a groove 66 located rearwardly of neck 57 with a plurality of holes or apertures 67 piercing the wall of said valve in said groove to the interior 68 of the valve so as to form passages which communicate with groove 69 (Fig. 3) on an intermediate portion of inner valve block 37. Groove 69 in turn communicates through ports 46 in the latter block with the interior pressure fluid reservoir 47 within the same valve block.

In addition to the above, valve 44 has an intermediate shoulder 71 between its greater internal diameter 68 and the smaller internal diameter 72, said shoulder cooperating with valve flange 62 during the forward shifting of the valve and forming a limited holding area effective to hold the valve in the attained forward position by means of the pressure fluid constantly present in groove 69, until the proper moment for the next working stroke of the hammer piston arrives.

While the valve occupies the forward position shown in Figs. 2 and 3, groove 66 on the valve communicates directly with groove 55 connected to passage 54, while apertures or ports 67 connect groove 55 with the interior reservoir or chamber 47, so that the pressure fluid will be free to travel through passage 54 to the front portion of piston chamber 17 to drive the hammer piston back to the initial position shown in Fig. 1. As the piston is about to return to initial position, with the valve in forward position, most of the spent fluid in the rear of the piston chamber exhausts through groove 52 and port 53. During the return stroke, the piston first covers the main exhaust groove 52 and thereafter also covers the cylinder opening of passage 50, but the remaining pressure fluid in the path of said piston in the rear portion of the piston chamber will continue to exhaust through passage 65, groove 64, valve neck 57, groove 58 and auxiliary exhaust passage 59 until the hammer piston finally covers the forward cylinder opening of said passage 65. As the last mentioned opening is thus closed and the hammer piston approaches rear cylinder ports 49, the residual fluid in the path of the piston becomes compressed and serves the double purpose of cushioning and checking the rear return movement of said piston, and when the pressure has become sufficiently intense, of also pressing

on the front end 48 of valve 44 through ports 49 to overcome the holding force exerted by the live pressure fluid on internal holding area 71 and thereby shift said valve to its initial rear position appearing in Fig. 1 and thus complete the cycle of operation. The apparatus is then immediately ready for a few cycle which proceeds at once to repeat the cycle just described if the pressure fluid is still supplied to the hammer piston by manually holding throttle valve 20 open by means of lever 29.

In order to facilitate shifting of the distributing valve in both directions and to further promote escape of spent pressure fluid from passage 50, the valve flange chamber 60 is vented fore and aft to a bleeder passage 73 which connects with auxiliary exhaust passage 59, thus preventing fluid from being trapped forwardly or rearwardly of valve flange 62 in said chamber. The valve is therefore not impeded in movement by entrapped fluid but is capable of shifting abruptly and responsively under the influence of pressure fluid acting through passage 50 on rear face 61 of flange 62 for forward shifting, and through rear cylinder ports 49 on the front end 48 of the valve for rearward shifting or return of said valve, resulting in correspondingly responsive and positive operation of the hammer piston. As a further means for facilitating the rearward movement of the valve during the return stroke of the piston, the latter is provided with an annular groove 74 which connects the passage 50 with exhaust groove 52 just prior to the rearward shifting of the valve, thereby venting any residual pressure fluid in the rear part of valve flange chamber 60. It is evident from the foregoing that the speed and the power of the blows delivered by said piston are greatly augmented by the speed of scavenging of pressure fluid from the path of movement of the valve as well as of the piston.

What is claimed is:

1. In a pneumatic percussive tool, a cylinder, a hammer piston reciprocable therein, the cylinder having a main exhaust port overrun by the piston in either direction, a valve block at the rear end of the cylinder having an internal chamber to provide a reservoir adapted to be constantly supplied with live pressure fluid, a sleeve type distributing valve encircling the valve block and arranged to reciprocate, a valve case surrounding the valve, the valve case having a groove in constant communication with the front end of the cylinder, the valve block having two axially

spaced holes or rows of holes, the front end of the valve being arranged to cover and uncover the forward hole to control the supply of live air from the reservoir to the rear end of the cylinder, the valve also having apertures arranged to establish and disestablish communication between the rear hole and the groove to control the supply of live air to the front end of the cylinder.

2. In a pneumatic percussive tool, a cylinder, a hammer piston reciprocable therein, the cylinder having a main exhaust port overrun by the piston in either direction, a valve block at the rear end of the cylinder having an internal chamber to provide a reservoir adapted to be constantly supplied with live pressure fluid, a sleeve type distributing valve encircling the valve block and arranged to reciprocate to control the distribution of pressure fluid from the reservoir to the respective ends of the cylinder, a valve case surrounding the valve, the valve case having three axially spaced annular grooves, the intermediate groove being connected to exhaust, the rear groove to the front end of the piston chamber, and the front groove to the rear portion of the cylinder, the valve having a neck portion arranged in one position of the valve to connect the intermediate and rear grooves to provide an auxiliary exhaust for the front end of the cylinder and in another position to connect the intermediate and front grooves together to provide an auxiliary exhaust for the rear end of the cylinder.

3. A percussive tool according to claim 2 in which the valve block and valve have perforations adapted to establish communication between the reservoir and the rear annular groove when said groove is cut off from the intermediate groove to admit live air to the front end of the cylinder.

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