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DISTRIBUTING VALVE FOR PERCUSSIVE TOOLS

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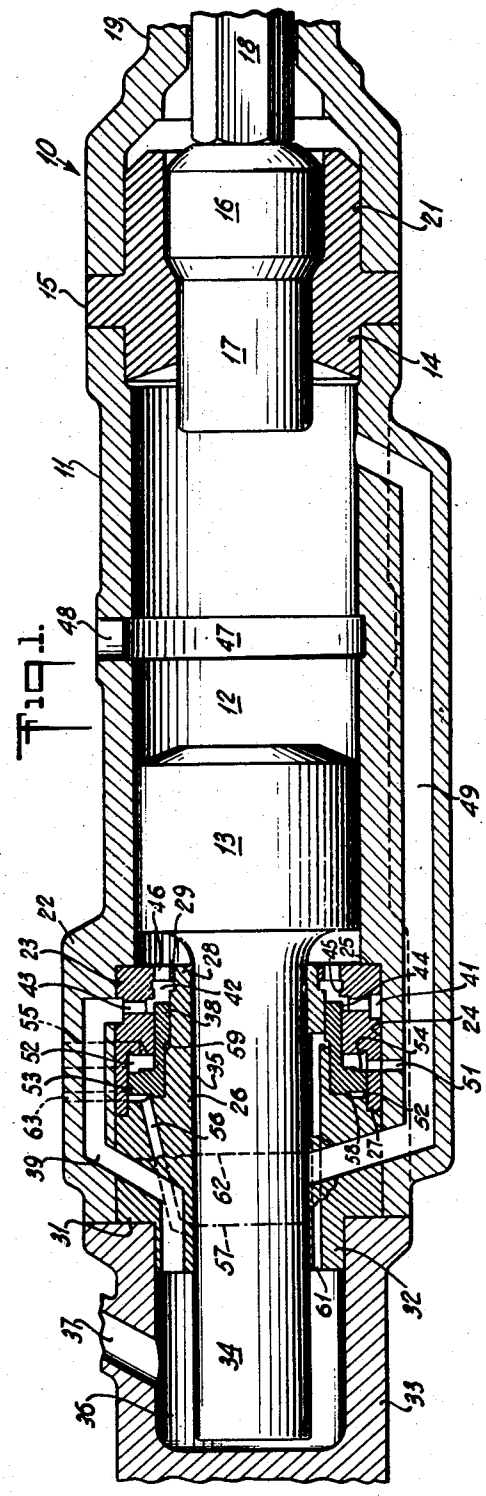


Fig. 1.

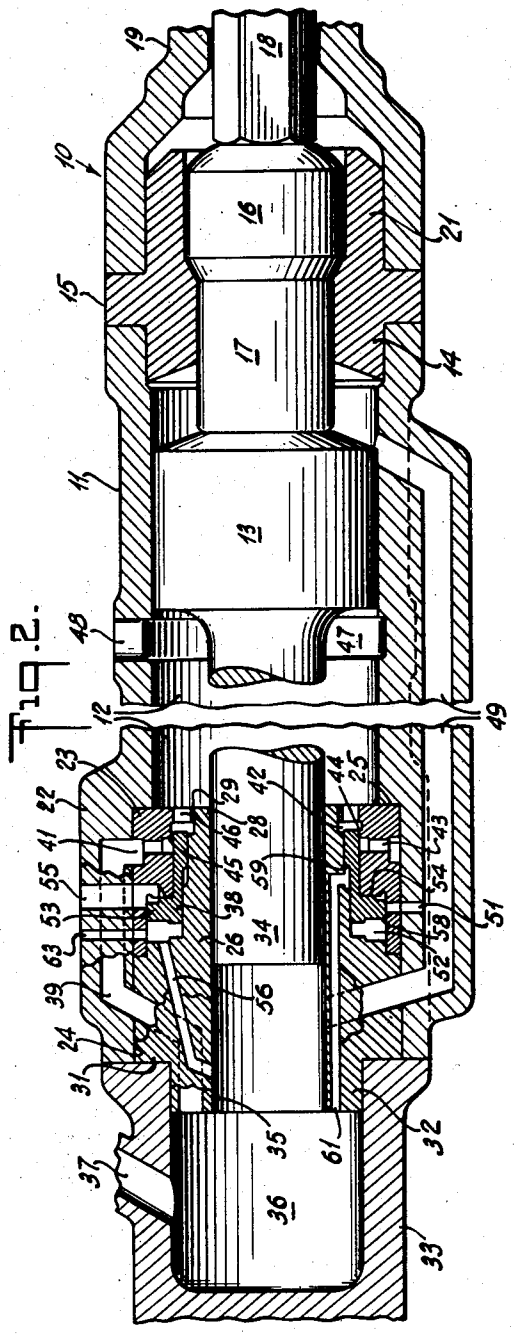


Fig. 2.

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DISTRIBUTING VALVE FOR PERCUSSIVE TOOLS

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3 Claims. (Cl. 121—18)

1

This invention relates to fluid pressure actuated percussive tools such as rock drills, pavement breakers, demolition tools and the like and particularly to valve mechanism for at least partly controlling the operation of the tool.

The main object of the invention is to include a special distributing valve in the rock drill or tool to act as an auxiliary device in addition to the stem of the hammer piston for controlling the admission and exhaust of pressure fluid for driving the piston.

A further object is to provide a fluid pressure actuated tool of the indicated type with an auxiliary exhaust from the front piston chamber in order to free the forward end of the piston from pressure fluid during its forward stroke.

It is also an object to provide a tool of the mentioned character with two passages controlled by the stem of the hammer piston for operating the distributing valve thereof.

Other objects and various advantages inherent in the construction and arrangement of the present invention and attained by its use will appear more fully in detail as this specification proceeds.

The invention is illustrated in the accompanying drawing forming part hereof and in which:

Fig. 1 is a longitudinal section of the main portion of a rock drill, pavement breaker or tool embodying the invention, showing the hammer piston at the start of a forward stroke; and

Fig. 2 is a similar section of the same showing the hammer piston at the beginning of a return stroke.

In conventional pavement breakers and similar tools of the valveless or semi-valveless type, the shank or stem of the piston forming the hammer is constantly exposed to the full pressure of the motive fluid while the differential area of said piston is intermittently exposed to the motive fluid by uncovering a portion in or upon the piston shank. While by this means the total rear area of the piston is exposed to the pressure of the motive fluid on the forward working stroke, certain disadvantages are inherent in allowing motive fluid to reach the differential area of the piston in this manner. If the neck is made sufficiently long to expose the rear area of the piston to the driving fluid during a considerable portion of its stroke a premature uncovering tends to occur on the rearward stroke with consequent slowing down of the piston and possible short-stroking thereof. Another disadvantage is that with the piston shank alone acting as a valve, any provision for an auxiliary exhaust from the front piston chamber is unobtainable.

2

With the foregoing objects in view and in order to overcome the mentioned disadvantages, the invention contemplates departing from the conventional construction in but few though important principles as will now be set forth.

Hence, referring again to the drawing, in the practice of the invention a tool casing, generally indicated at 10 has a cylinder portion 11 with the piston chamber 12 therein containing a reciprocable hammer piston 13. The forward end of the cylinder is fitted upon the rear portion of a tappet bushing 14 and seated against an intermediate flange 15 on the latter, the cylinder and bushing being secured together by any suitable means, such as bolts (not shown). This tappet bushing serves as a front end wall for the piston chamber and forms a guide member or bearing for the tappet or anvil block 16 which is slidably mounted therein for limited reciprocation and provided with a shank 17 projecting rearwardly into said piston chamber in a position to receive the impacts of hammer piston 13 during operation. The tappet is adapted to transmit the blows imparted by the hammer piston to the end of a drill steel 18 or other working implement supported in the extreme forward hollow end or guide 19 of the tool casing beyond the tappet bushing. The rear portion of guide 19 is enlarged and secured upon the forward end 21 of the tappet bushing against flange 15, said bushing thus forming a fixed link between the tool guide 19 and the cylinder casing 11 in somewhat conventional manner and form.

In the rear portion 22 of the casing a relatively light valve block 23 is secured within counterbore 24 and seated against a locating shoulder 25, while a more massive interior valve block 26 is secured in the same counterbore 24 in alignment with valve block 23, with the rear end of the latter seated in recess 27 in valve block 26. The forward reduced end 28 of valve block 26 is arranged to fit into, and terminate forwardly flush with, an internal flange 29 upon valve block 23. The massive internal valve block 26 has a rear shoulder 31 terminating substantially flush with the rear end of the outer casing portion 22, but beyond shoulder 31 a reduced portion 32 of valve block 26 extends rearwardly while upon said reduced portion the fluid supply reservoir 33 is mounted with the forward end thereof disposed against the rear valve block shoulder 31 and the rear end of the outer casing portion 22.

The hammer piston has a relatively long stem or shank 34 extending slidably into the smooth bore 35 which runs through the full length of

inner valve block 26 and serves as a guide bearing for said stem, the latter projecting with its rear end into the fluid supply or reservoir chamber 36 of reservoir 33 in the extreme rearward or retracted position of said hammer piston. This fluid supply chamber 36 in reservoir 33 is supplied constantly with pressure fluid such as compressed air by way of an inlet port 37 through a throttle valve (not shown).

The two previously described valve blocks 23 and 26 complement each other and together form a valve chest for a sleeve valve 38 slidable therein between both blocks in parallelism with the longitudinal axis of the piston and the stem thereof but wholly out of contact with the same.

If the operation of the tool thus far outlined is now followed, the operating parts may first be assumed to occupy their respective positions as shown in Fig. 1. The piston 13 and sleeve valve 38 are both disposed in extreme rearward or retracted positions in which the rear end of piston stem 34 projects into fluid reservoir chamber 36 as already noted. A fluid passage 39 opens rearwardly into said chamber and conducts pressure fluid from the latter forward to a peripheral groove 41 upon the valve block 23 communicating with an inner valve chamber 42 through a plurality of inwardly directed fluid supply ducts or ports 43. The fluid passes the inner valve extremity 44 serving as a cut-off portion, as well as a corresponding stationary casing cut-off portion or shoulder 45 and from valve chamber 42 proceeds through a plurality of fluid discharge ports 46 directly into the rear portion of piston chamber 12 against the rear pressure differential area of the hammer piston, driving the latter forward toward tappet 16.

Midway along the length of the piston chamber, an exhaust groove 47 connects with a main exhaust port 48 opening to atmosphere and allows spent fluid to escape from before the advancing hammer piston up to the point at which said piston covers said groove. Beyond that point the pressure of the fluid in the piston chamber would tend to rise in the forward portion thereof due to the forward travel of said piston, should said fluid simply be allowed to remain confined in said chamber. However, the forward portion of said piston chamber is connected with the forward end of a passage 49 extending rearwardly in the outer wall of the cylinder casing and provided with two rear terminal ports, the first forming an exhaust passage 51 connecting with an annular valve flange chamber 52 occupied by the valve flange 53 having the valve operating portion 54, the chamber opening to atmosphere through rear exhaust port 55. Thus the fluid in front of the hammer piston will be allowed to escape through passage 49, rear terminal port 51, annular chamber 52 and finally out through exhaust port 55.

The enumerated group of ports and passages thus forms auxiliary exhausting means in addition to the main exhaust port 48 and take effect when the latter ceases to act and serve to remove fluid from the path of the moving hammer piston so as to prevent the building up of fluid pressure by the advance of the latter which would reduce the power and effectiveness of the forward stroke of said hammer piston. The result is that the latter is driven at maximum speed toward the tappet by the pressure fluid acting on the rear piston area and the rear end of piston stem 34 and consequently delivers its blows upon the rear end of tappet shank 17 with maximum power. When the rear end of the piston head has uncovered the exhaust groove 47, the excess fluid pressure in the rear portion of the piston chamber will immediately be released through exhaust port 48, but the supply of pressure fluid to said piston chamber has by this time been checked by valve 38 so that the hammer piston finishes its forward stroke largely by the momentum already attained during approximately the first half of its movement, which is very swift in any case.

During the forward travel of the piston stem, the latter uncovers two ports in swift succession, the first being rear valve passage 56 opening into bore 35 when the stem has advanced to the position indicated by broken line 57 in Fig. 1, this valve passage leading to the rear portion of valve flange chamber 52 behind rear face 58 on flange 53 of valve 38, allowing fluid at full operating pressure from reservoir chamber 36 to impinge against the mentioned rear face 58 of said valve flange and thereby immediately shift the valve forward into the position shown in Fig. 2. In this shifted position of the valve, the end or cut-off portion 44 peripherally engages slidably with the stationary cut-off portion or shoulder 45 and completely isolates valve chamber 42 and ports 46 from the pressure fluid arriving through passage 39 from the reservoir, thereby blocking further supply of pressure fluid to the piston chamber behind the hammer piston. In order to stabilize the valve 38 in this attained forward position and prevent accidental premature or partial displacement therefrom until positively operated rearwardly, a relatively small rear holding area or portion 59 is provided interiorly of the valve and held by pressure fluid in constant communication with the chamber 36 through passage 61 in valve block 26 independently of the pressure fluid periodically entering passage 56, but cooperating therewith during the forward movement of the valve. When such shifting of the valve occurs, the exhaust port 55 conveniently permits escape of fluid from the valve flange chamber 52 to facilitate movement of the valve.

During and subsequent to the forward shifting of the distributing valve, the hammer piston continues its forward movement and thus the second port uncovered by the piston stem when the stem advances to the position indicated by broken line 62 is the relatively large inlet opening which forms the second or rear termination of passage 49, for admitting pressure fluid from reservoir chamber 36 through the open rear portion of bore 35 and through passage 49 into the forward portion of piston chamber 12. Introduction of pressure fluid in front of the hammer piston allows the fluid to exert its full pressure on the front end thereof, and as the latter has a greater area than that of the rear end of the stem located in or facing the chamber 36, the pressure fluid thus introduced produces the immediate return movement of said hammer piston toward the rear. Rearward travel of the hammer piston first causes the expulsion of residual fluid in the piston chamber behind the head of piston 13 through exhaust port 48 until the exhaust groove 47 is covered by the piston head, when the latter begins to compress the fluid confined in the rear portion of the piston chamber. The pressure of the confined fluid rises rapidly to a sufficiently high level for the fluid to act through ports 46 on the front end 44 of the valve 38 to overcome the resistance of the constant holding pressure of the fluid from passage 61 against internal holding area 59. The attained pressure of the

fluid shifts the valve rearwardly to the original position of Fig. 1, again opening communication between passage **39** and ports **46**, while a bleeder outlet port **63** releases to the atmosphere any fluid trapped behind the rear face **58** of the valve flange **53** and thereby facilitates the return of the valve to its original rear position. In the latter position the valve is stabilized by live air acting on the front end of the valve over an area much larger than opposed area **59**. This returned position of the valve also opens communication between passage **49**, the exhaust passage **51**, chamber **52** and exhaust port **55**, so that all the parts, ports and passages are at once ready for a new cycle of operation.

It is now evident that the present fluid operated tool contains but two moving parts, aside from the tappet which imparts the blows of the hammer piston to the tool steel, these two moving parts being hammer piston **13** and automatically operating valve **38**, and the operation is both certain and altogether automatic as outlined above, the tool being not only simple but durable, as no fragile parts or any parts requiring adjustment are used.

It is equally evident that steel or any other metal or alloy found useful in tools of this general type may be employed for making the device, and any material suitable for this purpose may therefore be included in its construction.

What is claimed is:

1. A pneumatic percussive tool comprising a cylinder providing a piston chamber, a valve block mounted in said cylinder rearwardly of the piston chamber, a fluid pressure supply chamber rearwardly of the valve block, a hammer piston having a head reciprocable in the piston chamber and having a shank guided within the valve block, the rear face of the shank being in constant communication with the supply chamber to urge the piston forwardly, passages through the valve block in communication between the supply chamber and the front and rear portions of the piston chamber for reciprocating the piston, the front cylinder passage being opened and closed by the piston shank, a distributing valve in said valve block arranged to open and close the rear cylinder passage when in rear and forward

positions respectively, said valve comprising a sleeve-like body provided with a front face in communication with the rear cylinder chamber to trip the valve rearwardly upon the exposure thereof to fluid compressed to a predetermined degree of pressure in the piston chamber, a flange whose rear face communicates with the supply chamber through a passage adapted to be covered and uncovered by the rear and forward movement of the piston respectively, and a shoulder in constant communication with the pressure supply chamber which is adapted, in conjunction with the pressure upon the flange from the supply chamber, to move the valve forwardly and which is adapted thereafter to maintain the valve in such forward position against accidental displacement until overcome by the pressure of the fluid compressed in the rear pressure chamber.

2. A pneumatic percussive tool according to claim 1 which is provided with a main exhaust near the middle of the piston chamber, and an auxiliary exhaust effective during the forward stroke of the piston after it closes the main exhaust, said auxiliary exhaust leading from the front end of the piston chamber through the valve block to atmosphere and arranged to be opened and closed by the distributing valve.

3. A pneumatic percussive tool according to claim 1 which is provided with a main exhaust near the middle of the piston chamber, and an auxiliary exhaust effective during the forward stroke of the piston after it closes the main exhaust, said auxiliary exhaust leading from the front end of the piston chamber through the valve block to atmosphere and arranged to be closed by the distributing valve only in the forward position of the latter.

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