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PRESSURE FLUID OPERATED TOOL

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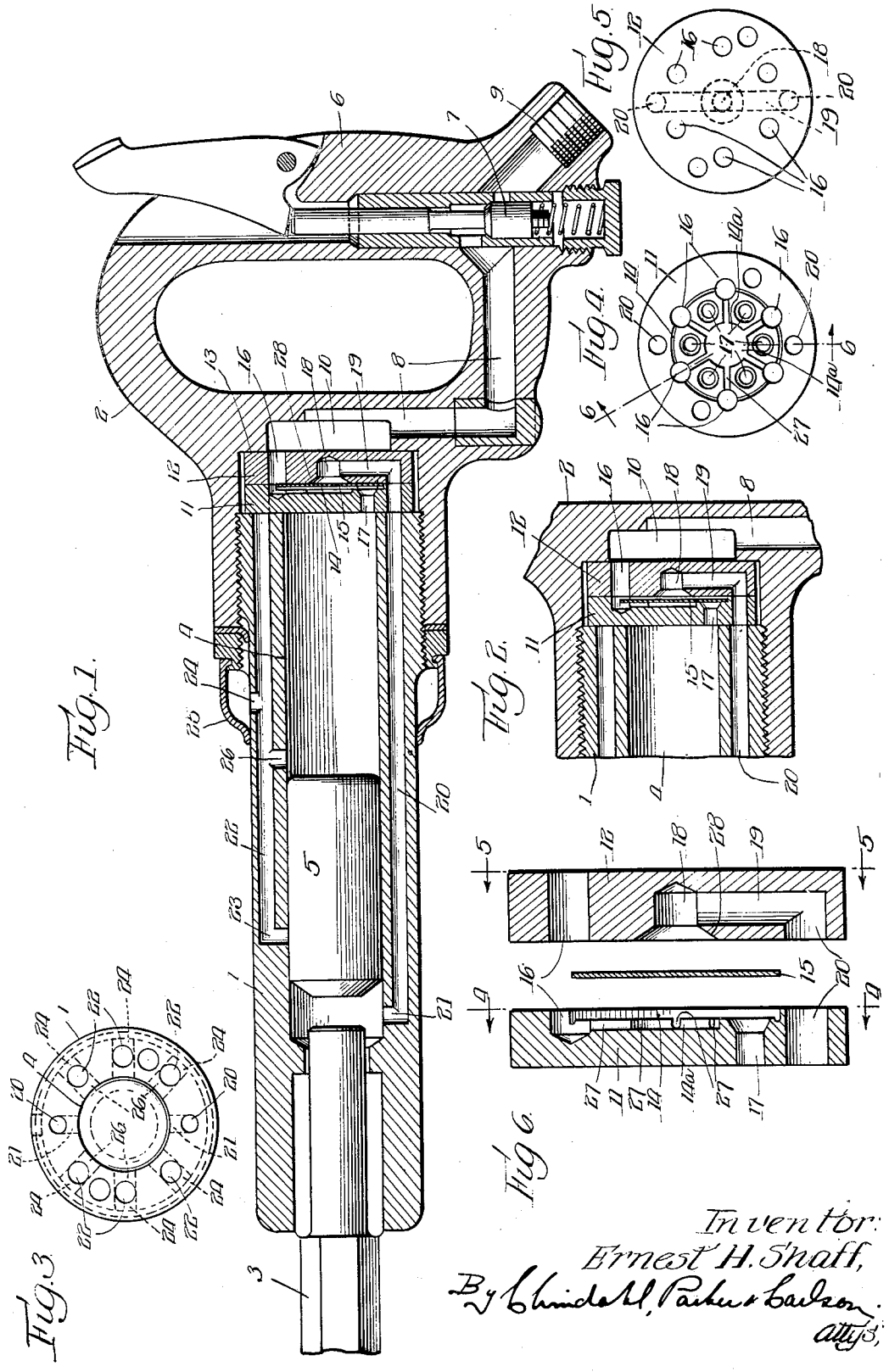


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

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PRESSURE FLUID OPERATED TOOL

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5 Claims. (Cl. 121—19)

This invention relates to pressure fluid operated tools and more particularly to a new and improved portable tool of the hammer type.

It is the general object of the invention to provide a new and improved tool of this character simple in construction and efficient in operation.

Another object is to provide such a tool with a valve mechanism of novel and improved construction insuring easier starting and improved operation of the tool.

A further object is to provide in a tool of the character indicated, a valve mechanism in which a thin disk-like valve member having an extremely short range of movement is adapted to control effectually the flow of pressure fluid to and from the piston chamber, to the end that the tool shall be capable of operating at high speed, and of developing relatively greater power for a given consumption of pressure fluid by prior tools.

Further objects and advantages will become apparent from the following detailed description taken in connection with the accompanying drawing, in which:

Figure 1 is a longitudinal central section through a preferred form of the invention, certain ports being shown in a common plane for the purpose of more clearly illustrating the operation, the valve being shown in the position it occupies during the forward stroke of the piston.

Fig. 2 is a fragmentary section similar to that shown in Fig. 1 with the exception that the valve is shown in the position it occupies during the rearward movement of the piston.

Fig. 3 is a rear end view of the barrel showing the actual location of the ports in the preferred form of the invention.

Fig. 4 is a rear end view of the forward valve casing member (along the line 4—4 of Fig. 6).

Fig. 5 is a rear end view of the rear valve casing member (along the line 5—5 of Fig. 6).

Fig. 6 is an enlarged transverse section through the valve mechanism with the ports separated, along the line 6—6 of Fig. 4.

While I have shown in the drawing and shall herein describe in detail the preferred embodiment of my invention, it is to be understood that I do not thereby intend to limit the invention to the specific form disclosed, but aim to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

As illustrated in the drawing, the exemplary form of the invention is embodied in a pressure fluid actuated tool of the type generally referred to as a "chipping hammer", which comprises a barrel 1 having a head 2 screw threaded on its rear end and a tool 3 mounted in its forward end. The barrel has a cylinder or piston chamber 4 formed therein in which a piston 5 is arranged to reciprocate to impact the tool. The piston is arranged to be reciprocated by means of a pressure fluid which is admitted alternately to opposite ends of the piston chamber by means of a valve mechanism positioned at the rear of the piston chamber. A handle portion 6 of the head 2 has a manually operable valve 7 mounted therein for controlling the flow of fluid through an intake passage 8 formed in the head, the outer end 9 of which is adapted for connection to a suitable flexible conduit leading to a fluid supply. The other end of the intake passage communicates with a chamber 10 in the head adjacent the valve mechanism.

In the preferred form of the invention, the valve mechanism comprises a cylindrical casing composed of two circular members 11 and 12 positioned intermediate the rear end of the barrel 1 and an annular shoulder 13 on the head. The valve casing has a somewhat circular recess 14 therein forming a valve chamber in which a thin disk-like valve 15 is adapted to reciprocate. This valve is arranged to control the passage of pressure fluid through the inlet passages to the opposite ends of the piston chamber, the exhaust passages from the piston chamber being preferably controlled by the piston.

The inlet passage from the chamber 10 in the head to the rear end of the piston chamber 4 comprises a plurality of ports 16 in the valve casing, which ports communicate at their rear ends with the chamber 10 and at their forward ends with the valve chamber 14, and a plurality of ports 17 in the casing member 11, which ports connect with the valve chamber and with the piston chamber. Thus when the valve 15 is in its rear position as shown in Fig. 1, fluid is admitted to the rear end of the piston chamber from the chamber 10 through ports 16, the forward portion of the valve chamber 14 and ports 17.

The inlet passage to the forward end of the piston chamber includes the ports 16 and valve chamber 14, just mentioned, and also a chamber 18 in the valve casing member 12, a plurality of transverse ports 19 in said member, longitudinal passages 20 extending from the ports 19 through the valve casing members 12 and 11 and barrel 1, and a plurality of transverse ports 21 connecting the forward ends of the passages 20 to the forward end of the piston chamber 4. Thus when

the valve 15 is in its forward position as shown in Fig. 2, fluid is admitted to the forward end of the piston chamber through ports 16, the rear portion of the valve chamber 14, chamber 18, ports 19, passages 20 and ports 21.

Pressure fluid is arranged to be exhausted from the forward end of the piston chamber during the forward stroke of the piston by means of a plurality of exhaust passages 22 which are connected to the piston chamber by transverse ports 23 (Fig. 1) and which are vented to the atmosphere by means of exhaust ports 24 in the barrel, the guard 5 being perforated suitably to provide a free exhaust. Pressure fluid is exhausted from the rear end of the piston chamber during the initial portion of the return stroke of the piston by means of a plurality of ports 26 connecting the exhaust passages 22 with the piston chamber 4 rearwardly of the ports 23 as shown in Fig. 1.

In the preferred form of the invention illustrated the valve casing is extremely simple in construction. It is shown as comprising two disk-like members which may be formed from substantially similar blanks, the ports 16 being formed by a plurality of bores extending through the member 12 and partly through the member 11. The recess forming the valve chamber is circular and is shown extending substantially half way into the ports 16 (see Fig. 4) with the result that the pressure fluid passing through the ports 16 may enter the valve chamber 14 at the side and either in front of or to the rear of the valve. Preferably a plurality of radially extending grooves 27 are formed in the face of the member 11 connecting the forward ends of the ports 16 with a central deeper portion 14^a of the valve chamber. Thus, when the valve is in its forward position as shown in Fig. 2 the area of the valve which covers the grooves 27 and the depressed portion 14^a of the valve chamber is exposed to live air pressure. As hereinafter more fully described, this pressure aids in shifting the valve to its rear position.

A further and important advantage in the arrangement of the supply ports 16, inlet ports 17, ducts 27 and central depression 14^a is, that in the rearmost position of the valve member, pressure fluid is admitted freely to the rear end of the piston chamber and this notwithstanding the limited range of movement of the valve member. As shown in Fig. 4, the ports 16 and 17 are closely spaced, there being 6 in number in each set, and the ducts or grooves 27 serve to distribute the pressure fluid directly from the supply ports 16 to the central depression and over the entire forward face of the valve chamber for passage into the inlet ports 17. By reason of the bevelled rear ends of the ports 17, the passage of air from the ducts 27 and from the depression 14^a to the ports 17 is facilitated.

It has been found that by beveling the edge 28 of the chamber 18 the hammer starts and runs easier and more efficiently. This improvement in the operation is marked, and I attribute it to a suction effect on the valve member caused by the path the bevel forces the pressure fluid to take into the chamber 18. Thus the inlet passage from the valve chamber to the forward end of the piston chamber may be said to be connected to the valve chamber by means causing the pressure fluid passing into the inlet passage to create a suction on the adjacent surface of the valve.

Assuming that pressure fluid is supplied to the inlet port 8 and that the valve 7 is in its open position, valve 15 will be in the position shown in Fig. 1 during the forward movement of the piston 5. Pressure fluid is then admitted to the rear end of the piston chamber 4 from the chamber 10 through ports 16, valve chamber 14 and ports 17, pressure fluid from the forward end of the piston chamber then exhausting through ports 23, exhaust passages 22 and exhaust ports 24. As soon as the forward end of the piston has closed the ports 23, the pressure fluid trapped in the forward end of the piston chamber is compressed so that the pressure in ports 21, passages 20, ports 19 and chamber 18 increases and tends to move the valve 15 forwardly to the position shown in Fig. 2. This movement occurs when the rear end of the piston 5 uncovers the ports 26 and permits the live pressure fluid, still being admitted to the rear end of the piston chamber through the ports 17, to exhaust through the ports 26 into the exhaust passages 22 and thereby lowers the pressure in the valve chamber 14 on the forward valve surface. Thus the movement of the valve to its forward position may be timed properly with respect to the impact of the piston on the end of the tool 3 by the positions of the exhaust ports 23 and 26.

As soon as the valve has shifted, the live pressure fluid from the ports 16 is admitted to the valve chamber 14 rearwardly of the valve (Fig. 2) and passes through chamber 18, ports 19, passages 20 and ports 21 to the forward end of the piston chamber to move the piston rearwardly. Pressure fluid in the rear end of the piston chamber then exhausts through the ports 26, exhaust passages 22 and exhaust ports 24 until the piston closes the ports 26 whereupon the pressure fluid trapped in the rear of the piston chamber is compressed and increases the pressure in the ports 17. This, together with the live pressure fluid in grooves 27 and the depressed portion 14^a of the valve chamber tends to move the valve 15 to its rear position. As soon as the piston in its rearward travel uncovers the ports 23, the live air passing through the inlet passage to the forward end of the piston chamber is permitted to exhaust through the exhaust passages 22, thereby permitting the pressure to drop in the ports 21, passages 20, ports 19 and chamber 18 and also in the rear portion of the valve chamber, whereupon the valve 15 moves to its rear position as shown in Fig. 1. This rearward shifting of the valve is so timed that pressure fluid is again admitted to the rear end of the piston chamber before there is any harmful impact of the piston against the valve casing member 11.

The reciprocatory movement of the piston 5 of course continues so long as the manually operable valve 7 is open. The improved construction shown provides for efficient operation. Because of its simple form, the valve mechanism permits of economic manufacture and insures the production of accurately formed parts. Furthermore the provision of means for supplying live pressure fluid to the forward surface of the valve and the means for effecting a suction effect on the rear surface of the valve combine with the pressure exerted by the trapped pressure fluid to insure efficient shifting of the valve.

I claim as my invention:

1. A pressure fluid operated tool having in combination, a piston chamber with a piston reciprocable therein, and means for controlling the movements of the piston comprising a valve casing at the rear end of the piston chamber and a valve member in the form of a thin sheet metal

disk, said casing providing a chamber for the valve member having flat forward and rear faces spaced apart a distance only slightly greater than the thickness of said valve member, means for supplying pressure fluid to said valve chamber on either side of said valve member comprising a plurality of supply ports spaced a short distance apart about the peripheral edge of the valve chamber, a plurality of inlet ports spaced a short distance apart inwardly of the edge of said valve member and opening from the forward side of the valve chamber into the rear end of the piston chamber, the forward face of the valve chamber having a plurality of grooves leading inwardly from said supply ports between adjacent inlet ports.

2. A pressure fluid operated tool having in combination, a piston chamber with a piston reciprocable therein, and means for controlling the movements of the piston comprising a valve casing at the rear end of the piston chamber and a valve member in the form of a thin sheet metal disk, said casing providing a chamber for the valve member having flat forward and rear faces spaced apart a distance only slightly greater than the thickness of said valve member, means for supplying pressure fluid to said valve chamber on either side of said valve member comprising a plurality of supply ports spaced a short distance apart about the peripheral edge of the valve chamber, a plurality of inlet ports spaced a short distance apart inwardly of the edge of said valve member and opening from the forward side of the valve chamber into the rear end of the piston chamber, the forward face of the valve chamber having a plurality of grooves leading inwardly from said supply ports between adjacent inlet ports, and said inlet ports having outwardly bevelled rear ends terminating closely adjacent said grooves.

3. A pressure fluid operated tool having in combination, a piston chamber with a piston reciprocable therein, and means for controlling the movements of the piston comprising a valve casing at the rear end of the piston chamber and a valve member in the form of a thin sheet metal disk, said casing providing a chamber for the valve member having flat forward and rear faces spaced apart a distance only slightly greater than the thickness of said valve member, means for supplying pressure fluid to said valve chamber on either side of said valve member comprising a plurality of supply ports spaced a short distance apart about the peripheral edge of the valve chamber, a plurality of inlet ports also spaced a short distance apart inwardly of the edge of said valve member and opening from the forward side of the valve chamber into the rear end of the piston chamber, the forward face of the valve chamber having a central depression and a plurality of grooves leading inwardly from said supply ports between said inlet ports and opening into said depression.

4. A pressure fluid operated tool having in combination, a piston chamber with a piston reciprocable therein, and means for controlling the movements of the piston comprising a valve casing at the rear end of the piston chamber and a valve member in the form of a thin sheet metal disk, said casing providing a chamber for the valve member having flat forward and rear faces spaced apart a distance only slightly greater than the thickness of said valve member, means for supplying pressure fluid to said valve chamber on either side of said valve member comprising a plurality of supply ports spaced a short distance apart about the peripheral edge of the valve chamber, a plurality of inlet ports also spaced a short distance apart inwardly of the edge of said valve member and opening from the forward side of the valve chamber into the rear end of the piston chamber, the forward face of the valve chamber having a central depression and a plurality of grooves leading inwardly from said supply ports between said inlet ports and opening into said depression, said inlet ports having outwardly bevelled rear ends opening into the forward side of the valve chamber closely adjacent said grooves and said central depression.

5. A pressure fluid operated tool having in combination, a piston chamber, a piston reciprocable in said chamber, and valve means for controlling the piston comprising a valve disk formed from a thin sheet of metal, a casing disposed transversely of the rear end of the piston chamber and providing a circular chamber, with flat front and rear faces spaced apart a distance only slightly greater than the thickness of said disk, and a central rearward extension having an outwardly bevelled forward end portion opening into the rear side of the valve chamber, a passage leading from said rearward extension to the forward end of the piston chamber, a plurality of supply ports disposed transversely of the casing and spaced a short distance apart in communication with the outer edge thereof so as to supply pressure fluid to both sides of said valve, a plurality of inlet ports leading from the forward side of said valve chamber to the rear end of the piston chamber, said inlet ports being spaced a short distance apart inwardly of the peripheral edge of the valve disk and in circumferentially spaced relation to said supply ports, and having bevelled rear ends opening into the forward side of the valve chamber, the forward face of the valve chamber having a central depression therein and a plurality of grooves leading radially from said supply ports to said central depression between the inlet ports.

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