Oct. 4, 1932. O. O. APP 1,880,337

PRESSURE FLUID OPERATED IMPLEMENT

Filed July 31, 1926 3 Sheets-Sheet 1

Fig. 1.

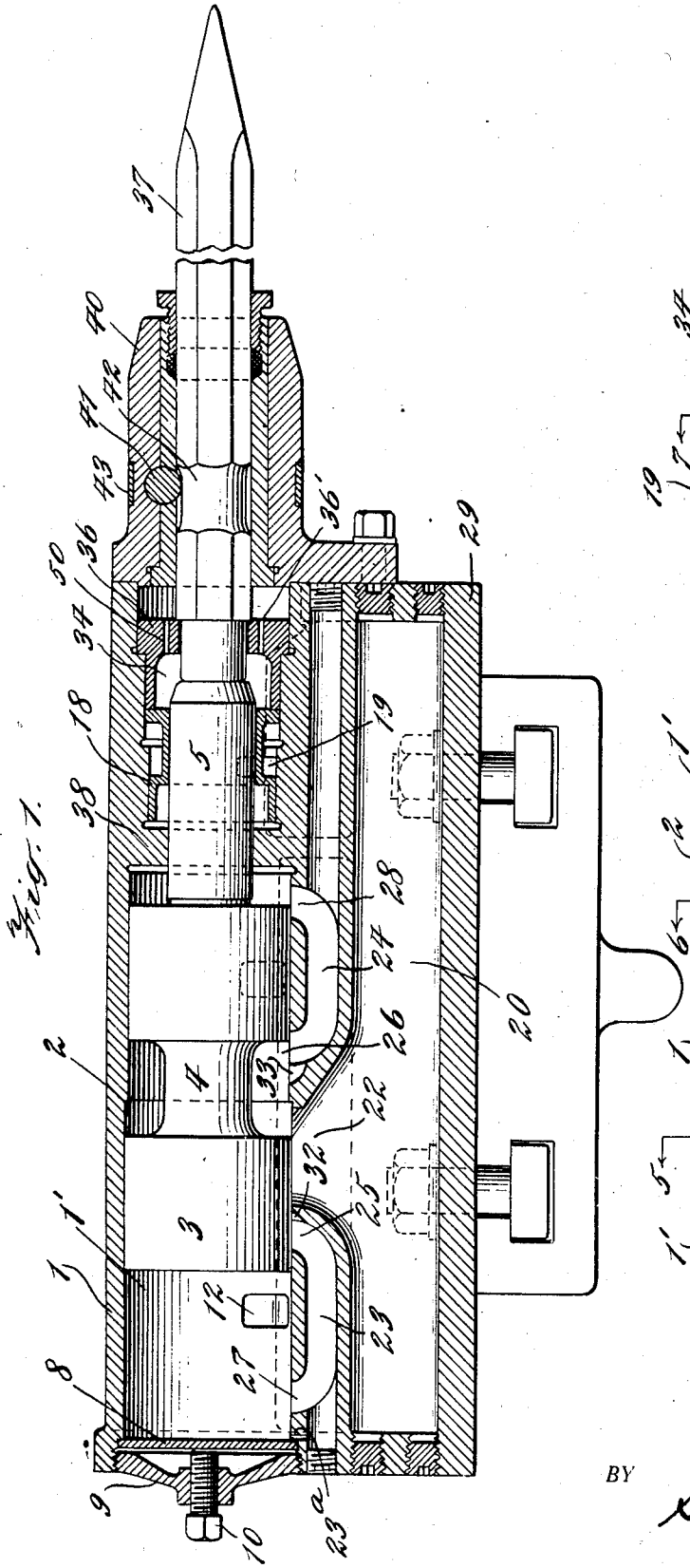
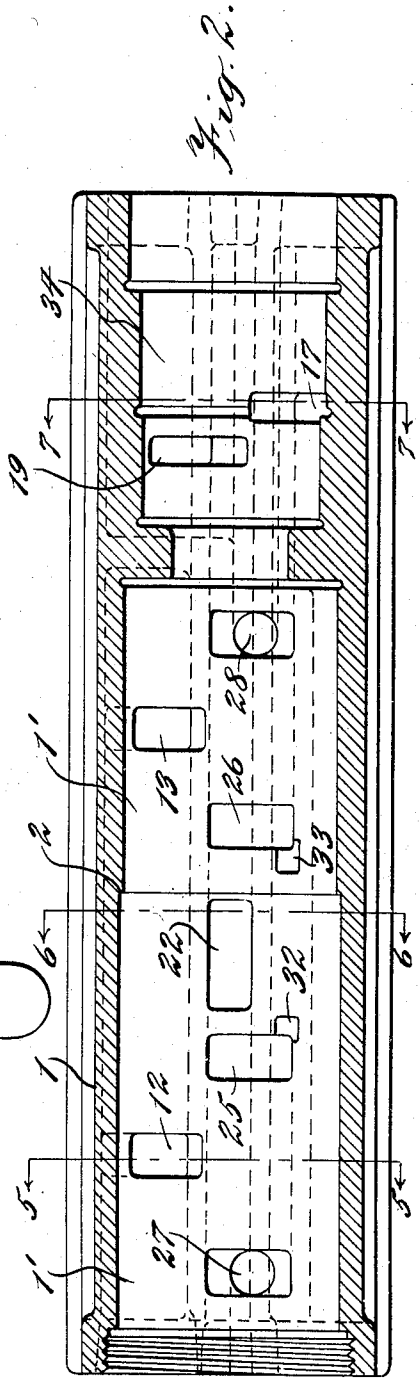


Fig. 2.



INVENTOR.
Oliver O. App
BY Stockbridge & Bond
ATTORNEYS

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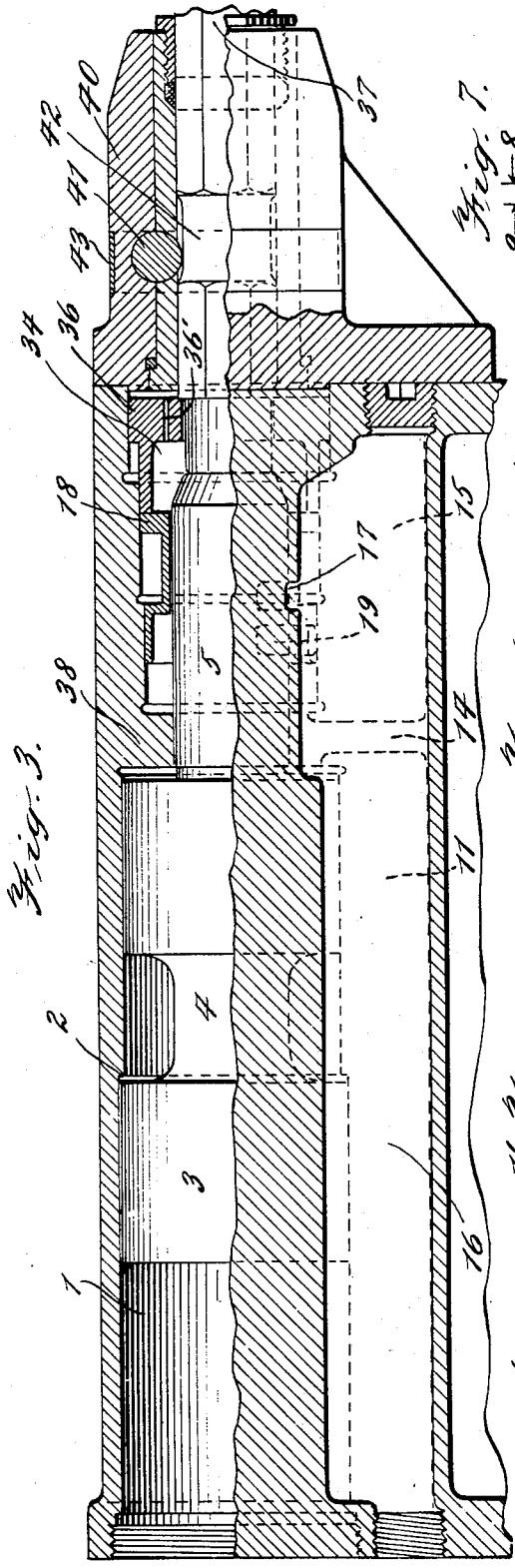

Fig. 3.

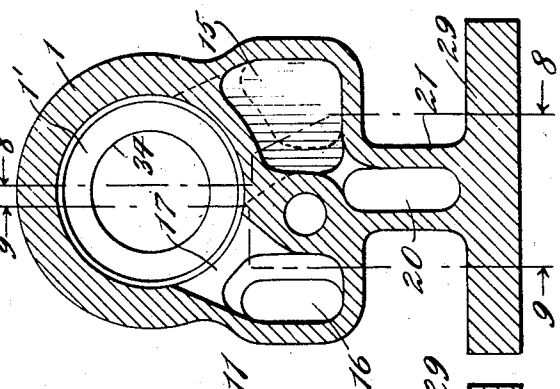

Fig. 7.

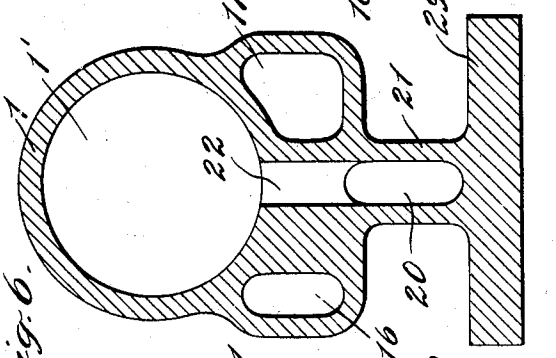

Fig. 6.

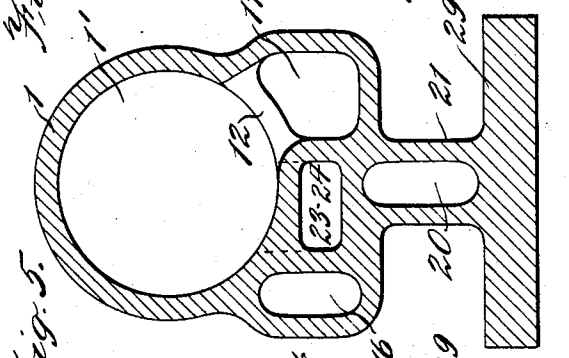

Fig. 5.

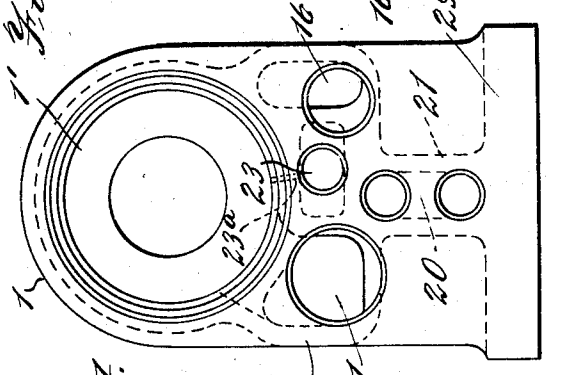

Fig. 4.

INVENTOR.
Oliver O. App
BY
Stockbridge & Boast
ATTORNEYS

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Fig. 8.

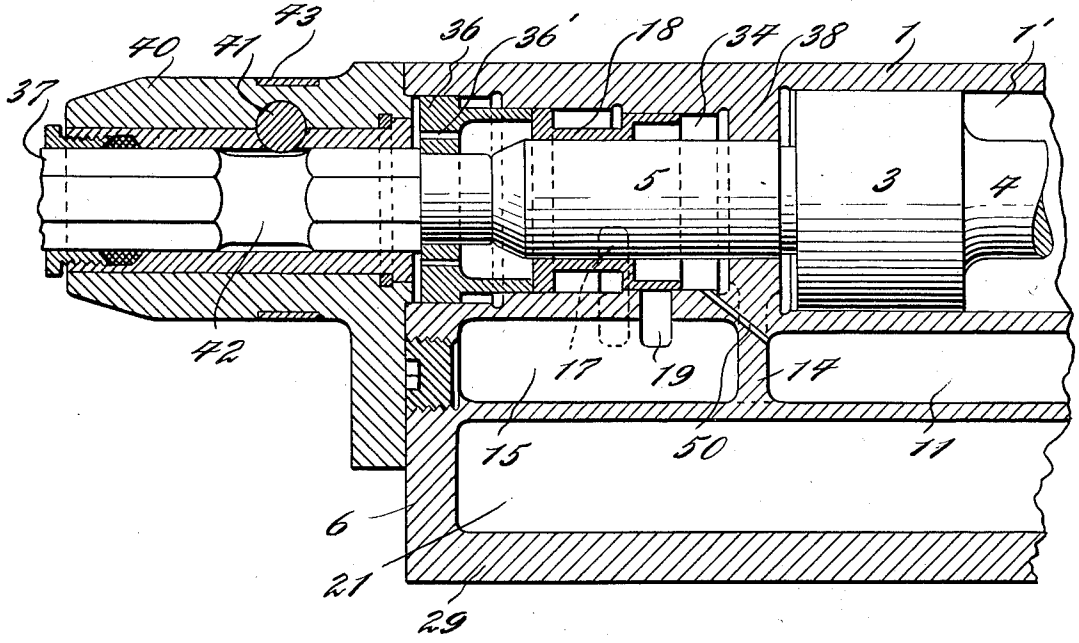
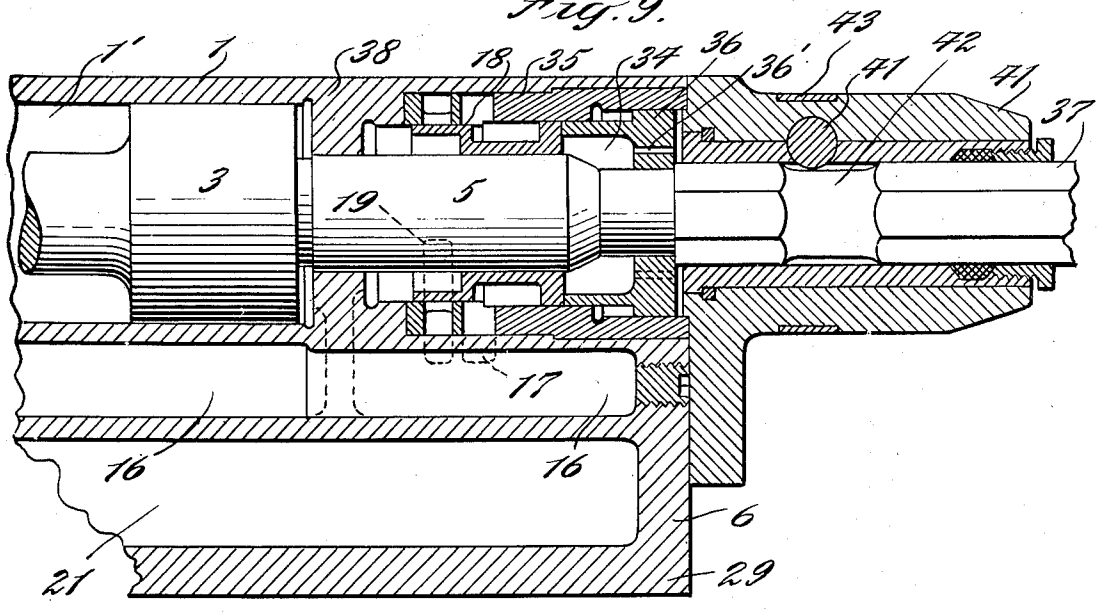


Fig. 9.



INVENTOR.

Oliver O. App

BY

Stockbridge & Borst

ATTORNEYS.

Patented Oct. 4, 1932

1,880,337

UNITED STATES PATENT OFFICE

OLIVER O. APP, OF NEW YORK, N. Y.

PRESSURE FLUID OPERATED IMPLEMENT

Application filed July 31, 1926. Serial No. 126,170.

The implement to which this invention relates is an automatic hammer, operated by compressed air or other pressure fluid, and designed for general use, either individually in portable form, or in multiple, as on rock tunneling machines having a rotary head carrying a plurality of the hammers. Generally speaking the hammer is of the character of that disclosed in my prior Patent #1,319,034, of October 21, 1916, upon which this invention constitutes an improvement. While in one form the hammer is valve controlled, certain features of my invention may be utilized in a valveless hammer.

An object of my invention is to provide a hammer which may be very sensitively controlled by pressure of the tool against the work. Another object is to eliminate the possibility of injury to the valve by reason of its positive actuation. Another object is to insure that the valve, which is biased to closed position, will positively move to shut off the air when the tool is not in contact with the work. Another object is the provision of practical and effective means to vent the chamber in front of the piston and sleeve to relieve excess pressure before the piston and sleeve and to prevent dust and other deleterious matter from getting into the hammer. Another object is to construct an entirely closed system which will operate under any degree of moisture or pressure. Other objects are convenience and economy in manufacture and assembly, simplicity and durability of construction, and reliability and facility in operation. Still other objects and advantages of my invention will appear from the following description.

In accordance with my invention the air at line pressure is led to an annular chamber around the control valve by a longitudinal passage along one side of the cylinder from whence it is delivered under control of said valve to a longitudinal passage in the opposite side of the cylinder leading to the piston by a passage whose opening into the cylinder chamber is controlled by the piston acting as a piston valve. One or more exhaust openings are properly disposed in the cylinder while the space between the piston and tool is adequately vented by passages leading therefrom to the exhaust manifold. Not only is this construction extremely simple, but it has also has the merit of locating the control valve in the space within the cylinder between the piston and tool and makes possible the positive actuation of the valve in both directions, and also eliminates the use of fingers, rods or the like for the operative connection of the tool and valve.

I shall now describe the illustrated application of my invention and shall thereafter point out my invention in the appended claims:

Fig. 1 is a longitudinal section of a hammer made in accordance with my invention;

Fig. 2 is a horizontal section of the cylinder proper showing the various parts;

Fig. 3 is a section similar to Figure 2 but showing the intake channel;

Fig. 4 is an end elevation of the hammer taken along line 4—4 of Figure 2;

Fig. 5 is a sectional detail taken along line 5—5 of Figure 2;

Fig. 6 is a section on line 6—6 of Figure 2;

Fig. 7 is a section on line 7—7 of Figure 2;

Fig. 8 is a side elevation partly in section taken on line 8—8 of Figure 7;

Fig. 9 is a section on line 9—9 of Figure 7 showing a slightly modified form of valve structure.

The hammer generally is constructed of iron or other suitable material with a cylinder housing 1 being internally cored to form a working cylinder 1′ having two sections of different internal diameters, an intermediate annular shoulder 2 being formed by the increase of the diameter of the cylinder beyond this shoulder. A corresponding piston 3 having turned portions to fit

the cylinder sections is reciprocally disposed in this cylinder and has an undersized annular portion 4 intermediate of its end portions. Forward of its front end the piston has a reduced extension 5 which constitutes the hammer portion of the piston designed to strike the rear end of the tool. Formed integrally with the cylinder housing 1 and extending therefrom is a base portion 6 which extends substantially the full length of the housing, except at the front end where the housing has a tool carrying member secured thereto by screws or any such means. This member will be described in detail later. The base portion 6 depending from housing 1 has a narrow rib portion 21 and then flares out into a flat web portion 29 by which the device may be secured to any support by means of bolts or the like. The rear end of the cylinder is closed by means of a metal disk 8 held against an internal shoulder in the cylinder by means of a cap 9 threaded into the end of the cylinder, and having a compression screw 10 screw-threaded through the center of cap 9 and contacting with disk 8 (as illustrated in Fig. 1) which acts as a lock nut securely locking the cap 9.

Formed in the base portion 6 below the cylinder are a plurality of longitudinally extending ducts or chambers for the admission and delivery of air and for exhausting the various chambers, these ducts being closed at their extremities by flush plugs wherever they are not connected to supply or discharge lines. On one side below the cylinder there is an exhaust duct 11, open at its rear end to the atmosphere or to an exhaust line, extending substantially the full length of section 6 but having near its forward end a baffle or partition wall 14 which forms an independent chamber 15 for purposes to be described hereafter. The cylinder has two ports 12, 13 near its ends by means of which duct 11 communicates with the cylinder to exhaust the two chambers in the ends of said cylinder, these ports being spaced sufficiently in from the ends of the cylinder to provide cushioning chambers therein.

Cored in the base 6 transversely across the cylinder from duct 11 is a duct or passage 16 which constitutes the intake chamber and is connected at its rear end to the high pressure air line from some suitable source. This chamber 16 extends forwardly to that portion of the cylinder surrounding the forward end 5 of piston 3 and communicates with that portion through a port 17 at its forward end, the opening of which is controlled by a cylindrical slide valve 18, to be described later, which valve controls the passage of air through duct 16, port 17 and port 19 leading into chamber 15 as indicated in Figs. 3 and 8. Chamber 15 connects with a passageway 20 (Fig. 7) which is continuous through the entire length of the center rib portion 21 of base 6. This passageway 20 communicates with the cylinder at approximately its longitudinal center through a port 22 (Fig. 6) from which port air may pass through either port 25 or 26 into by-passes 23 and 24 according to the position of piston 3. The piston, due to its decreased portion 4, acts as a piston valve and closes either port 25 or 26 so that air may only be admitted to compression chambers in the cylinder to the rear of the piston through port 27 or to the front of the piston through port 28. The by-passes 23, 24 as well as the chamber 20 are extended through the entire length of the base in order to enable the passages to be cleaned if occasion arises and may be plugged at the extreme ends with flush plugs.

In any horizontal cylinder and piston there is usually a tendency for the piston to come to a state of equilibrium at the so-called "dead-center" position and to overcome this objectionable feature, which prevents easy starting of the piston, the present cylinder is constructed with one portion of a larger diameter than the other as clearly shown in Figs. 1, 2 and 3. This results in a larger area upon one side of the piston causing the piston to be moved toward one end of the cylinder. As an additional aid in this respect the two ports 25 and 26 are formed with leaks 32 and 33 made, for example, by a milling tool.

A small pin hole 23*a* is drilled connecting the extreme end of the cylinder with the by-pass 23 to create a leak to avoid sticking of the piston in its extreme rear position.

The front chamber 34 of cylinder 1 surrounding the forward portion 5 of the piston, the hammer end of the piston, including the ports 17 and 19, and housing the valve 18 may be termed a valve chamber and is also slightly enlarged at one section, namely, the forward end to bias the valve to maintain it normally in its forward position. Within the valve chamber and surrounding the forward end of the piston is a hollow cylindrical slide valve 18. The valve is designed with an upstanding annular channel of sufficient size to embrace the two ports 17, 19 to establish communication between them and with a flat section of sufficient size to prohibit the passage of air between these two ports by covering one port and has sufficient clearance around the forward end of the piston to allow leakage of air forward and out at the tool. This leakage will prevent any foreign matter from entering and getting into the mechanism. The chamber 34 may be of the proper diameters to receive the valve as shown in Figs. 1, 3 and 8 or the bore may be enlarged to receive first a renewable sleeve 35 (Fig. 9) which will have ports coinciding with ports 17, 19 which sleeve will receive the valve 18.

Forward of the valve in chamber 34 is a thrust collar 36 of hardened steel, or some other material, which contacts with the valve at one end and with the tool 37 at the other end so that when the tool encounters an obstacle and is shoved rearwardly the valve 18 is moved longitudinally by collar 36 and thereby communication is established between ports 17 and 19. Thrust collar 36 has a series of holes 36′ drilled through the forward vertical portion thereof to prevent any back pressure being accumulated forward of the collar.

Valve 18 being biased to its forward position by reason of the difference in diameter of the two sections of chamber 34, creating a greater pressure at one end of the valve, is constantly urged forward into contact with the thrust collar and forces this element into engagement with the tool thereby forcing the tool forward. The inner rear end wall 38 of the chamber 34 serves to separate the cylinder proper from the chamber 34 and also to limit the rearward motion of the valve and associated mechanism.

Secured to the extreme forward end of cylinder 1 by means of bolts or the like is a tool chuck or support 40 internally bored so as to present the shank of the operating tool, such as a rock drill, in alignment with the hammer. The chuck is also bored to receive a transverse pin 41 which protrudes slightly beyond the inner bore of the chuck to engage an annular recess 42 in the end of the tool to limit the longitudinal movement of the tool and to prevent the tool from becoming detached from the chuck. The pin is removably retained within the small bore by a retaining spring clip 43 surrounding the chuck and seating in an annular groove cut in the outer periphery of the chuck.

If it is desired to make the system a closed one so that the hammer may be operated under any atmospheric conditions or even when submerged in water a stuffing box 37 may be constructed around the tool holding packing 37′. In the implement illustrated the box and packing is shown as being placed on the outer end of the chuck to prevent any foreign matter from entering into the valve mechanism through the clearance around the tool and in addition to this a small hole 50 is made establishing communication with the chamber 34 and the exhaust chamber in order to relieve any back pressure that may build up within the chamber 34.

The operation of the hammer is as follows:

Air at high pressure is admitted to duct 16 through a connection at its rear end and is passed forward to port 17. Assuming the tool to be in its most rearward position as shown in Fig. 1 it will be seen that thrust collar 36 and valve 18 are also in their most rearward position thereby permitting the air to be passed through ports 17 and 19 and into chamber 15 from whence it is passed into chamber 20 and into the cylinder through ports 22. With the piston in the position shown in Fig. 1 the air still at line pressure is by-passed through port 26, by-pass 24 and port 28 into the cylinder compression chamber in front of piston 3. The air then drives the piston rearwardly uncovering exhaust port 13 from which the air is exhausted from the forward end of the cylinder into the exhaust chamber 11. As the piston is moved rearwardly it closes port 26 and establishes communication between port 22 and by-pass 23 through port 25 and thereby admits the air at line pressure through port 27 to the cylinder at the rearward end of piston 3 thus imparting a reciprocatory motion to the piston causing it to strike the end of the tool at each forward stroke and impart a working blow to it. The port 12 connects the rear portion of the cylinder to the exhaust chamber 11 to exhaust the cylinder on the return stroke of the piston.

The above operations were described upon the assumption that the tool was in its most rearward position. However under normal inoperative conditions valve 18 and associated parts are forced into their most forward position due to the difference in diameters of the two sections of the valve chamber 34 which creates a larger surface upon one side of the valve thereby forcing it forward and with the valve in its forward position port 17 is closed by the valve thereby preventing air at line pressure from entering port 19, and consequently the piston remains idle and inoperative.

If the tool is in engagement with hard material, it will generally not at first be driven out materially by the stroke of the hammer and the valve 18 will therefore remain open because of the engagement of the collar 36 with the outer end of the valve and the above described operation will be rapidly repeated until the rock or other material against which the hammer impinges is broken off. When this occurs the hammer is driven out to the position shown in Figure 3 and the valve will follow it by reason of the differential pressure upon it and thereby shut off the air by closing port 17 and stop the hammer.

It will be noted that the force of the blow delivered to the tool depends upon the nature of the material which is being worked. If the material is comparatively soft the hammer drives the tool out relatively farther than is the case when working on hard material and since the valve is partially closed by such actuation of the parts, the next and succeeding blows will be lighter in character until the valve is driven out sufficiently far to completely shut off the air; while if the material is hard so that it is substantially unyielding the blows continue rapid and of full violence until the material breaks off and

permits the tool to move out and thus close the valve. In other words the hammer works only so long as the tool is against the work and is forced inwardly enough to open the valve and the blows are in proportion to the work required to be done. When there is no work in front of the tool or when, in the case of a portable implement, the device is removed from the work the parts automatically assume the inactive position shown in Figure 3, the outward movement of the valve to closed position carrying the tool with it if necessary. The operation of the device is again started merely by applying the tool to the work. The importance of this will be appreciated in connection with a tunneling machine where a plurality of tools are employed upon a revolving head, by reason of which characteristic each tool does only the work which it is called upon to do in the movement of the head and ceases to function as soon as it is free from engagement with material to operate upon.

It is obvious that various modifications may be made in the construction shown in the drawings and description given by way of example without departing from the principle and scope of my invention as defined in the appended claims.

I claim:

1. A fluid pressure operated implement comprising a cylinder, a piston operably mounted in the cylinder, a valve housing in front of the cylinder having a valve chamber coaxial with the cylinder and air ports communicating therewith, said valve chamber having sections of different diameters, air ducts having passages leading from a source of fluid under pressure to a port in the valve chamber and from a port in the valve chamber to the cylinder, a valve slidably mounted in the valve chamber having sections corresponding in diameter to the sections of the valve chamber and a reduced central portion uniting the sections, the reduced portion of the valve being adapted to overlie the port in the valve chamber communicating with the passage leading from the source of fluid under pressure to the valve chamber and the port in the valve chamber communicating with the passage leading from the valve chamber to the cylinder, and a tool extending into the valve chamber and adapted when a force is exerted thereon to move the valve against the unbalanced force acting on the sections thereof.

2. A fluid pressure operated implement comprising a cylinder, a piston operably mounted in the cylinder, a valve housing in front of the cylinder having a valve chamber coaxial with the cylinder and air ports communicating therewith, said valve chamber having sections of different diameters, air ducts having passages leading from a source of fluid under pressure to a port in the valve chamber and from a port in the valve chamber to the cylinder, a valve slidably mounted in the valve chamber having sections corresponding in diameter to the sections of the valve chamber and a reduced central portion uniting the sections, the reduced central portion of said valve being equal to the distance between the outer edges of the port in the valve chamber communicating with the passage leading from the source of fluid under pressure and the port in the valve chamber communicating with the passage leading from the valve chamber to the cylinder, and a tool extending into the valve chamber and adapted when a force is exerted thereon to move the valve against the unbalanced force acting on the sections thereof.

3. A fluid pressure operated implement comprising a cylinder, a valve housing in front of the cylinder having a valve chamber coaxial with the cylinder and air ports communicating therewith, said chamber having sections of different diameters, a piston operably mounted in the cylinder and having a reduced end portion extending into the valve chamber in front of the cylinder, air ducts having passages leading from a source of fluid pressure to a port in the valve chamber and from another port in the valve chamber to the cylinder, a valve slidably mounted on the reduced end of the piston in the valve chamber having sections corresponding in diameter to the sections of the valve chamber and a reduced central portion uniting the sections, the reduced central portion being adapted to overlie the port in the valve chamber communicating with the passage leading from the source of fluid under pressure and the port in the valve chamber communicating with the passage leading to the cylinder, and means to hold a tool free to reciprocate in front of the reduced end of the piston, the tool having a shoulder adapted to abut against the end of said valve and move the valve with the tool against the unbalanced force acting on the sections thereof.

4. A fluid pressure operated implement comprising a cylinder, a piston reciprocally disposed therein and forming chambers in the front and the rear of the piston, the piston having a reduced central portion forming with the cylinder walls an intermediate chamber, air ducts leading from said intermediate chamber to the chambers formed in the front and the rear of the piston, a valve housing in front of the cylinder having a valve chamber coaxial with the cylinder and air ports communicating therewith, said valve chamber having sections of different diameter, air ducts having passages leading from a source of fluid under pressure to a port in the valve chamber and from a port in the valve chamber to the intermediate chamber formed in the cylinder, a valve slidably mounted in the valve chamber having sec-

tions corresponding in diameter to the sections of the valve chamber and a reduced central portion uniting the sections, the reduced portion of the valve being adapted to overlie the port in the valve chamber communicating with the passage leading from the source of fluid under pressure to the valve chamber and the port in the valve chamber communicating with the passage leading from the valve chamber to the cylinder, and a tool extending into the valve chamber and adapted when a force is exerted thereon to move the valve against the unbalanced force acting on the sections thereof.

In witness whereof, I hereunto subscribe my signature.

OLIVER O. APP.