No. 698,271. Patented Apr. 22, 1902.

N. GILPATRICK.

IMPACT ENGINE.

(Application filed Feb. 13, 1901.)

(No Model.)

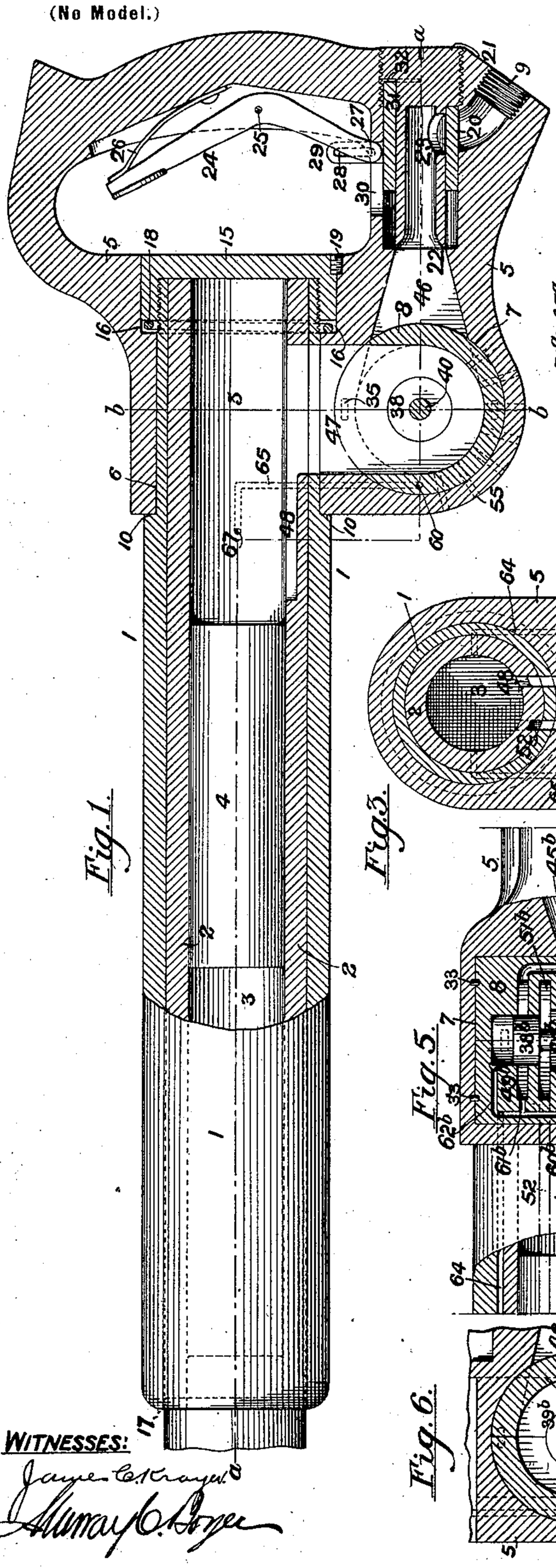

Fig. 1.

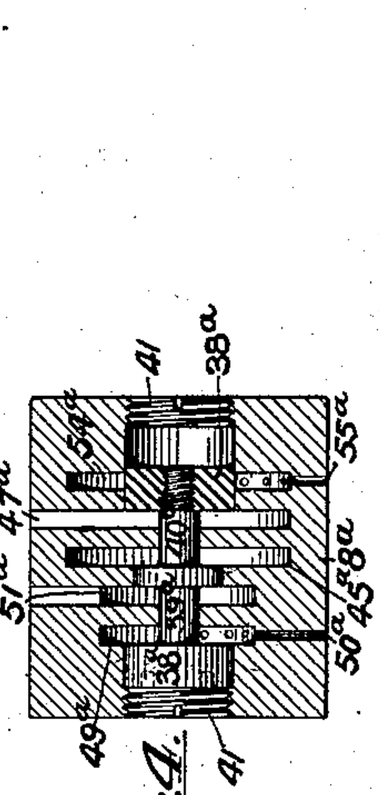

Fig. 4.

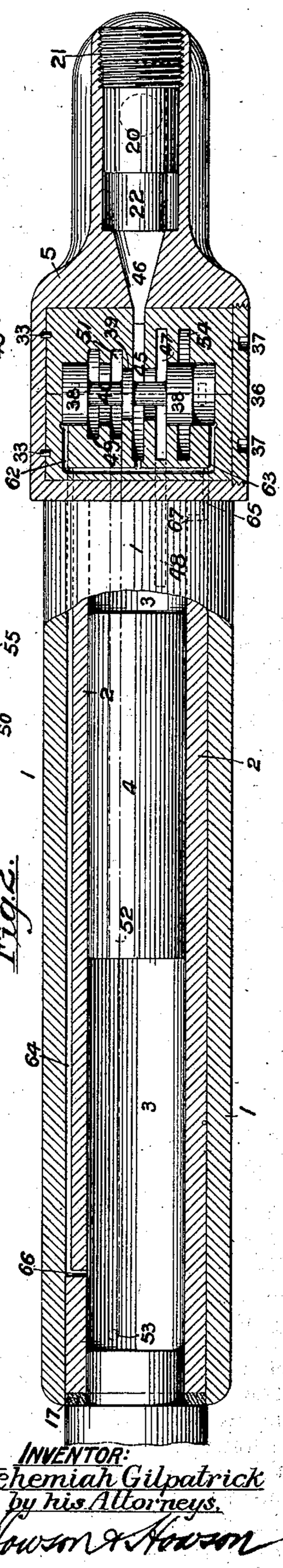

Fig. 2.

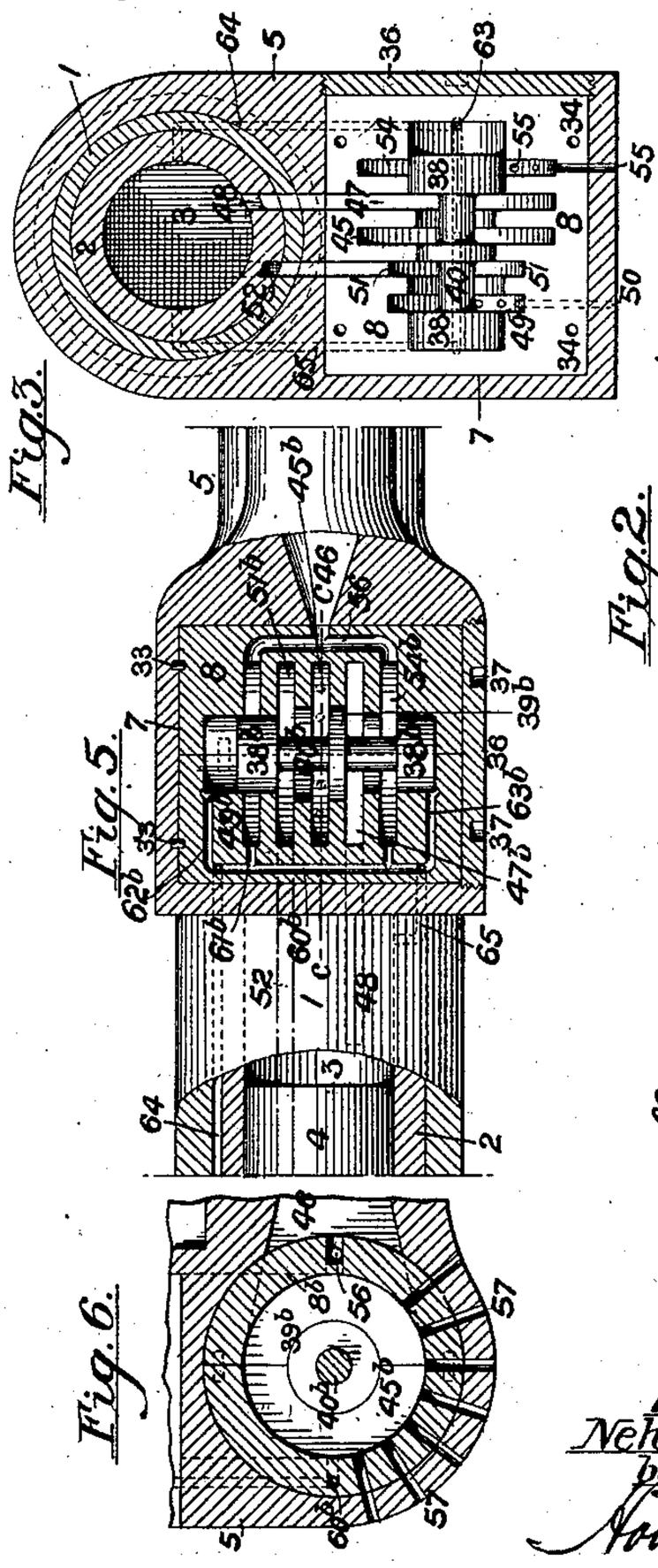

Fig. 3.

Fig. 5.

Fig. 6.

WITNESSES:

James C. Crayon.

Murray C. Boyce

INVENTOR:

Nehemiah Gilpatrick

by his Attorneys,

Howson & Howson

UNITED STATES PATENT OFFICE.

NEHEMIAH GILPATRICK, OF ST. JOHNSBURY, VERMONT.

IMPACT-ENGINE.

SPECIFICATION forming part of Letters Patent No. 698,271, dated April 22, 1902.

Application filed February 13, 1901. Serial No. 47,182. (No model.)

To all whom it may concern:

Be it known that I, NEHEMIAH GILPATRICK, a citizen of the United States, and a resident of St. Johnsbury, Caledonia county, Vermont, have invented certain Improvements in Impact-Engines, of which the following is a specification.

My invention relates to that class of percussive engines known as "pneumatic impact-tools;" and it consists of certain improvements in machines of this character and in the valve for operating the same, whereby I am enabled to increase the efficiency of the tool and effect a stroke of any desired length with a piston or plunger of any desired size.

My invention is fully illustrated in the accompanying drawings, in which—

Figure 1 is a longitudinal view of the tool, mainly in section. Fig. 2 is a longitudinal sectional plan view taken on the lines *a a*, Fig. 1. Fig. 3 is a cross-sectional view of the cylinder, valve, and valve-block, taken on the line *b b*, Fig. 1; and Figs. 4, 5, and 6 are sectional views illustrating modifications of the valve and valve-block.

Although the several improvements forming the subject of my invention are applicable to pneumatic tools in general, I have shown them in connection with a long cylinder, making what is known as a "long-stroke" tool, the chamber of such tool being approximately three times the length of the piston.

In my improved tool the valve is so arranged with respect to the cylinder that the chamber of the latter is unobstructed by said valve or the valve-block, and hence a stroke of greater length may be obtained than has hitherto been possible with this class of tools. This valve is located outside the cylinder and is arranged to move in a line parallel to a line drawn through the center of the cylinder at right angles to the same. The valve is contained within a valve-block having suitable ports and passages for the flow of the motive fluid, whereby said valve may be shifted automatically during the movement of the piston or plunger.

In the drawings herewith, 1 represents the outer shell or casing of the tool, and 2 is the inner sleeve, within which is formed the chamber 3 for the passage of the piston or plunger 4. The outer shell 1 is preferably shrunk onto the inner sleeve 2, so that when completed the cylinder is practically one piece. 5 is the handpiece or handle, having a socket 6 to receive said cylinder, an opening 7 for the reception of the valve-block 8, and having also an opening 9, in which may be secured a suitable connection of the tube leading from the pressure apparatus. The handpiece 5 rests on a shoulder 10, formed by reducing the end of the cylinder, and the latter is held to the handpiece by means of a threaded cap 15, adapted to a recess 16 in said handpiece and engaging the threaded end of the cylinder, as clearly shown in Fig. 1. The opposite end of the cylinder is open, and the stock of the tool may be fitted directly into the same, a gasket 17 of suitable material packing said stock and serving to prevent leakage at this point. To assist in retaining the cap 15 in place, I arrange a section of wire spring 18 between the end of said cap and the bottom of the recess 16, and as an extra precaution to prevent the turning of said cap 15 a finely-threaded set-screw 19 is arranged in a suitable hole tapped into the cap and handpiece.

The inlet of motive fluid to the tool is controlled by a throttle-valve 20, consisting of a hollow tube-like section or sleeve which closes the opening 9, in which the tube leading from the pressure apparatus is secured. For the purpose of conveying the motive fluid to the chamber of the valve-block from said opening 9 I provide the screw-plug 21, carrying a tube-like projection 22, which has a port 23, closed by the valve 20. This valve surrounds the tube projection 22 and is movable on the same, being operated by a lever 24, pivoted at 25 to the handpiece, the latter being slotted for this purpose and a spring 26 being provided, whereby said valve is normally held in the closed position. The lever 24 is provided with a pin 27, which passes through a slot 28, formed in a lug 29, secured to the side of the throttle-valve. It is necessary to slot the handpiece at 30 to provide for the passage of the connection of the valve 20 with the lever 24, and in order that this slot may be of sufficient length to permit the proper movement of the valve and yet be closed during extreme movement of the same I extend said valve

at one side, as at 31, and recess the screw-plug at 32 to receive said extension.

Located in the opening 7, formed in the handpiece, and arranged outside the piston-chamber on a line parallel to a line drawn through the center of the cylinder at right angles to the same is the valve-block 8, in the present instance made in two pieces which are held in place in the opening in the handpiece by the pins 33, let into the end wall of the latter. Each half of the valve-block is provided with recesses 34, adapted to receive dowel-pins 35, so that the ports, passages, and recesses in said block will register when the halves are put together. To hold the valve-block in the recess 7, I provide the screw-cap 36, which is provided with depressions 37 to receive the prongs of a suitable key for turning it into place.

The valve-block has a series of ports, passages, and recesses, shortly to be described, and has a piston-valve centrally located therein, said valve having heads 38 at each end, preferably of the same diameter, though I do not wish to limit myself to this precise construction, said heads 38 being adapted to the end bores of the valve-block. The valve is also provided with a central disk 39, preferably of less diameter than the heads 38, and this disk 39 is adapted to the central bore of the valve-block. The heads 38 and disk 39 of the valve are connected together by a stem 40 of reduced diameter, and said valve is arranged in the valve-block before the halves of the latter are put together.

Instead of making the valve-block in two halves, as shown in Figs. 1, 2, 3, and 5, I may make the main portion or barrel 8^a in one piece, as shown in Fig. 4, with a central bore extending through the same, such bore to be the same as that of the valve-block shown in Figs. 1, 2, and 3—that is to say, with the end bores of greater diameter than the middle bore. With this form of valve-block it will be necessary to make the valve in two pieces, as shown in Fig. 4, in which one of the heads 38^a is detachable, being adapted to the threaded end of the stem 40^a. The through-bore of the valve-block is closed by means of screw-plugs 41, which serve as the end walls of the valve-chamber and determine the length of stroke of the valve.

In the valve-block 8 is a recess 45, communicating with the inlet-passage in the tube projection 22, controlled by the throttle-valve 20, such communication being through the passage 46, and 47 is a passage leading from the valve-block to the piston-chamber, communication between this passage and the recess 45 being around the stem 40 of the piston-valve, as shown in the drawings.

The passage 47 is extended from the valve-block through the cylinder and terminates in the form of a shallow groove 48, cut into the inner wall of the piston-chamber below the port-opening, such shallow groove providing for the transit of the motive fluid to the piston gradually to prevent shock and assisting in the rapid removal of such force from in front of the piston on the return stroke of the same. An exhaust-recess 49 is located in the valve-block, and such recess communicates with the atmosphere through openings 50, extending through said block and the handpiece-casing. Alongside the recess 49 is a similar recess 51, connected with the main exhaust-passage 52, the latter communicating with the piston-chamber through the port 53 near the end of the same opposite the valve. Communication between the recesses 49 and 51 is afforded around the stem 40 of the piston-valve. The main exhaust-passage 52 is formed between the casing 1 and the inner sleeve 2 by grooving the outer surface of the latter. A recess 54 is also located in the valve-block for exhausting the motive fluid from in front of the piston on the return stroke of the same. This recess communicates with the atmosphere through the passages 55, cut through the valve-block and shell of the handpiece, as clearly shown in Figs. 1 and 3.

Located within the valve-block and communicating with the ends of the valve-chamber is a passage 60, said passage forming a duct to convey motive fluid to move the valve within the valve-block, such fluid holding the valve in the changed position whatever such position may be. This passage 60 communicates with the recess 45 in the valve-block by means of the port 61 and with the valve-chamber by means of the short end passages 62 and 63. This passage 60 also communicates with the passages 64 and 65, which open into the piston-chamber, through the ports 66 and 67, the former near the port 53 and the latter at a point near the valve-block.

The passages 64 and 65 are of less area than the passage 52, but, like the latter, are formed by grooving the outer surface of the inner sleeve 2. They are provided to permit the motive fluid to leak or weep into the piston-chamber, so that the valve will be held in the different positions during the movements of the piston by the initial pressure of the motive fluid acting upon the inner surface of the enlarged ends 38 of the valve.

The motive fluid entering the recess 45 in the valve-block besides serving to move the piston in the chamber 3 passes into the passage 60 and thence to the valve-chamber through the end passage 63 and acting upon the enlarged end of the valve will hold the same in the position shown in Figs. 2, 3, and 4 of the drawings. At the opposite end of the valve-block, however, the motive fluid cannot enter the passage 62, and the excess of such pressure leaks into the chamber 3 through the passage 64 and port 66 in advance of the piston and passes from said chamber through the port 53, passage 52, thence to the recesses 51 and 49 in the valve-block, and from the latter to the atmosphere through the openings 50. Although this leakage through the passage 64 is constant dur-

ing the forward movement of the piston and through the passage 65 on the return stroke of said piston, the volume of motive fluid so lost is so little as to have no appreciable effect upon the operation of the tool. As this leakage into the passage 64 is taking place adjacent to the passage 62, leading to one end of the valve, said valve will not be moved, particularly as pressure is passing from the passage 60 through the end passage 63 to the opposite end of the valve-chamber and tending to hold the valve in the position shown in Figs. 2, 3, and 4 of the drawings. This same result might be attained by having a valve with a central disk of greater diameter than the heads and changing the former exhaust-recesses to inlet-recesses and the former inlet-recess to an exhaust-recess. Such construction I have illustrated in Figs. 5 and 6. In Fig. 5 the valve is shown in a position opposite to that shown in Figs. 2, 3, and 4. In this valve the heads 38^b are provided and the central disk 39^b, of a greater diameter than said heads, said disk and heads being connected by the stem 40^b. In this structure the motive fluid enters from the passage 46 and passes into a two-way duct 56. From one end of this duct 56 the motive fluid enters the recess 54^b and passing around the stem 40^b of the valve enters the passage 47^c and from there passes into the piston-chamber behind the piston. The exhausting fluid from in front of the piston is meanwhile passing through the exhaust-passage 52, which communicates with the recess 51^b in the valve-block, and from said recess it passes around the stem 40^b of the valve to the recess 45^b and from the latter to the atmosphere through the openings 57. When the valve is shifted as the piston reaches the end of its stroke, the motive fluid will pass from the opposite end of the two-way duct 56 to the recess 49^b, thence around the stem 40^b of the valve to the recess 51^b, and from the latter to the passage 52 of the cylinder, entering the piston-chamber from the port 53 at the rear of the moving piston and serving to return said piston to its initial position. As the piston is retracted the fluid in front of the same passes from the piston-chamber through the passage 47^b, thence around the valve-stem 40^b to the recess 45^b, and from this latter recess to the atmosphere through the openings 57. In this form of structure the passage 60^b communicates with the recesses 49^b and 54^b through the ports 61^b. The effect of this passage 60^b and the end passages 62^b and 63^b, which latter communicate with the passages 64 and 65 of the cylinder, is the same as with the other structures.

The operation of the tool is as follows: Motive fluid being admitted to the passage 46 in the handpiece through the throttle-valve 20 and tubular stem 22, any air within the tool will pass out through the port 53 and passage 52 of the cylinder to the exhaust-recess 49, and thence through the openings 50 in the valve-block and handpiece to the atmosphere. The incoming motive fluid passes from the passage 46 to the recess 45 in the valve-block, thence around the stem 40 of the piston-valve to the passage 47 in said block, and from this latter passage enters the piston-chamber behind the piston and moves the latter forward. At the same time a portion of the motive fluid is leaking or weeping into the piston-chamber ahead of the piston from the passage 64 through the port 66, such leaking fluid being removed from said chamber through the port 53 and passage 52 with the other exhausting fluid. When the piston reaches the end of its stroke, the port 66 is closed and the motive fluid which fills the passage 60 in the valve-block is thereby trapped at the end passage 62 and passes to the end of the valve-chamber instead of passing into the piston-chamber. The pressure against both ends of the valve is now equal through the motive fluid filling both passages 62 and 63; but the full pressure of the motive fluid being directed against the inner surface of one of the heads of the valve the latter will be moved to a position opposite to that shown in Figs. 2, 3, and 4 of the drawings. This action will be accomplished, as the surface of the valve-head exposed to the full pressure of the motive fluid is greater than the surface of the central disk 39 of the valve. When the valve is in either position, it may be shifted by the full pressure of the motive fluid acting upon the surface of the central disk when the end pressures are equal. The valve having now been shifted to a position opposite to that shown in Figs. 2, 3, and 4 of the drawings, the motive fluid from the inlet-passage 46 will pass to the recess 45, from which it passes around the valve-stem 40 to the recess 51, and thence to the passage 52, extending through the cylinder of the tool. From this passage 52 the motive fluid enters the piston-chamber through the port 53, and getting behind the piston the latter will be returned to its original position. During this movement of the piston the fluid in front of the same has been exhausting to the atmosphere through the openings 55 cut through the valve-block and casing from the recess 54, such exhausting fluid passing to the same from the passage 47 of the valve-block around the stem 40 of the valve. Until the moving piston has cut it off the motive fluid has also been leaking into the piston-chamber through the port 67 from the passage 65, so that the piston-valve could be maintained in the proper position, such passage 65 communicating with the passage 60 in the valve-block and the latter with the end passage 62, leading to the outer surface of the head of the valve. The passages 64 and 65, communicating with the end passages 62 and 63, respectively, alternately bleed the full pressure and convey the same to the heads of the valve. This operation may be continued indefinitely.

The modifications shown in the views Figs.

4, 5, and 6 extend only to the valve and valve-block, the structure of the rest of the tool remaining the same.

Having thus described my invention, I claim and desire to secure by Letters Patent—

1. In a pneumatic hammer, a cylinder, an impact-piston therein, a sleeve detachably secured to one end of the cylinder, said sleeve having a recess formed in one side of the same at right angles to the cylinder and out of line of the same, a chambered valve-block arranged in said recess and communicating directly with the cylinder, and a fluid-actuated piston-valve arranged within said block, substantially as described.

2. In a pneumatic hammer, a cylinder, an impact-piston, a handle portion having a sleeve by which it is detachably secured to the cylinder, said sleeve having a recess formed in one side of the same at right angles to and out of line of the cylinder, a chambered valve-block arranged in said recess having a differentially-aread valve-chamber formed therein, and a fluid-actuated and differentially-aread piston-valve arranged in said valve-chamber, substantially as described.

3. In a percussive engine, the combination of a cylinder, a piston movable within said cylinder, a valve controlling the inlet and outlet of the motive fluid to and from the cylinder, said cylinder being provided with a longitudinal opening leading from the valve for the initial passage of the motive fluid, substantially as and for the purpose set forth.

4. In a pneumatic hammer, the combination of a cylinder, a piston movable within said cylinder, a valve-block located wholly outside of the cylinder, a differentially-aread piston-valve located within said valve-block, said valve adapted to move in a line at right angles to and out of line of the cylinder, said cylinder having passages of reduced area communicating with passages of the same area within the valve-block, whereby the motive fluid may be conveyed to the ends of the piston-valve to hold the same in the different positions, said valve being moved by the initial pressure of the motive fluid.

5. In a pneumatic hammer, the combination of a cylinder, a piston movable within said cylinder, a valve-block located wholly outside of the cylinder, a valve arranged within said valve-block and adapted to move at right angles to and out of line of the cylinder, said cylinder having a series of passages of reduced area, and said valve-block having similar passages communicating therewith, the passages of the cylinder opening into the opposite ends of the same, substantially as and for the purpose set forth.

6. In a pneumatic hammer, a cylinder, an impact-piston, a handle portion having a sleeve by which it is detachably secured to the cylinder, and cushioning means interposed between said cylinder and the handle portion.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

NEHEMIAH GILPATRICK.

Witnesses:
ERNEST GILPATRICK,
GUY W. HILL.