(No Model.) 3 Sheets—Sheet 1.

F. E. HARTHAN.

PNEUMATIC TOOL.

No. 590,661. Patented Sept. 28, 1897.

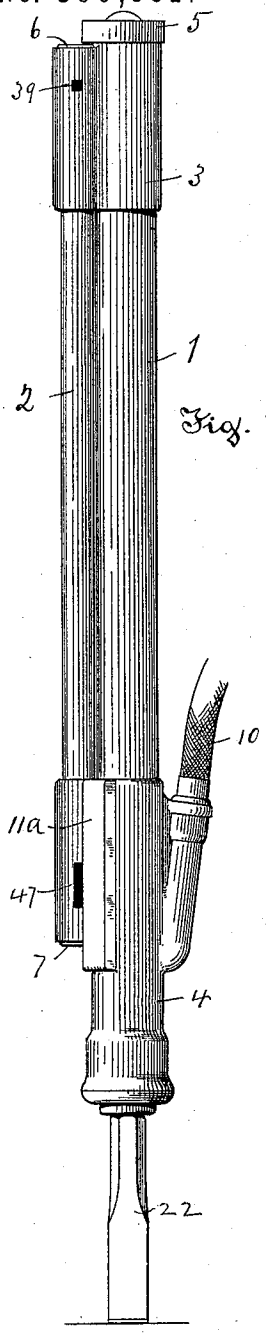

Fig. 1.

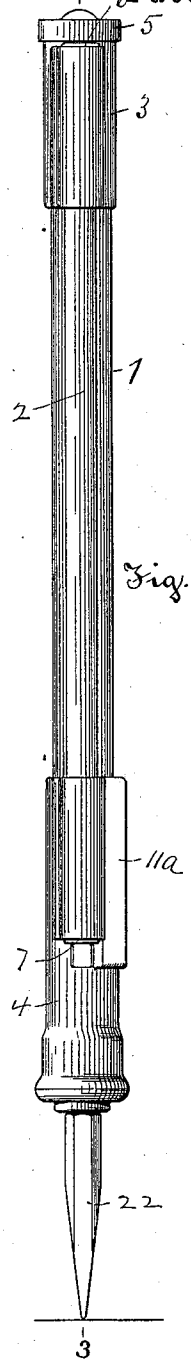

Fig. 2.

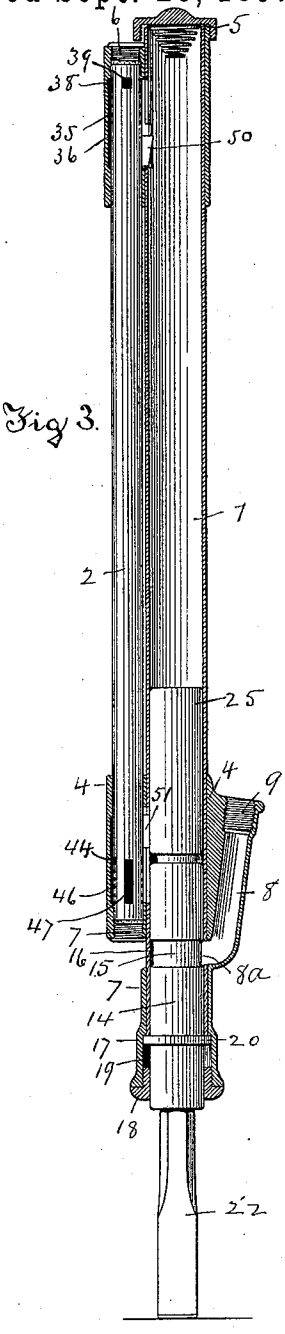

Fig. 3.

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(No Model.) 3 Sheets—Sheet 2.

F. E. HARTHAN.

PNEUMATIC TOOL.

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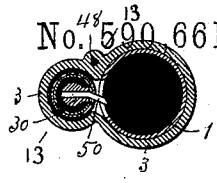


Fig. 5.

Fig. 14

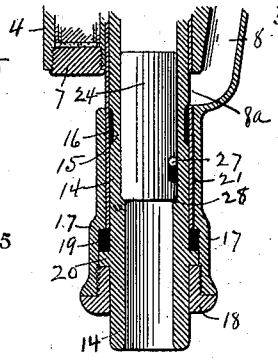


Fig. 15.

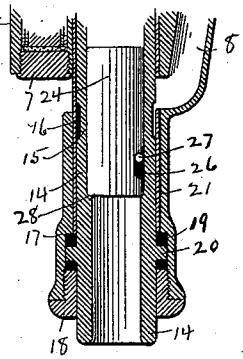
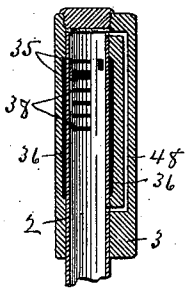


Fig. 13.



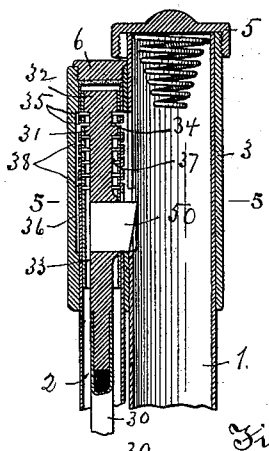
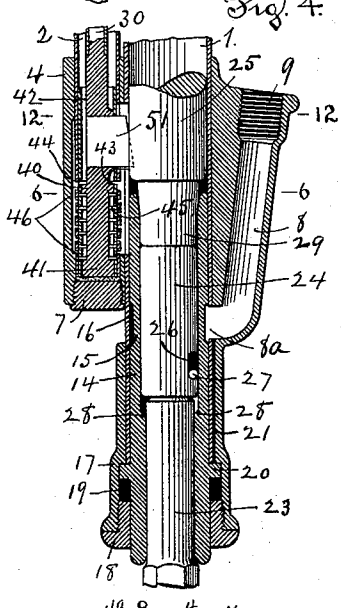


Fig. 4.



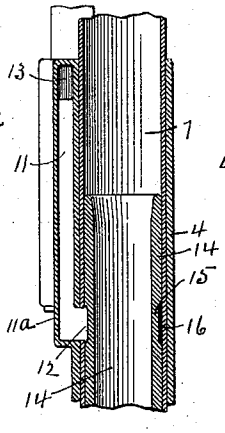


Fig. 7.

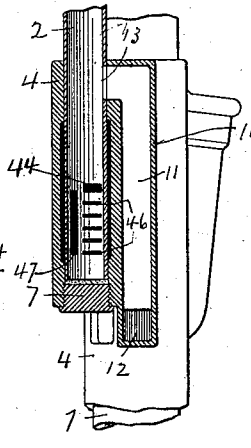


Fig. 8.

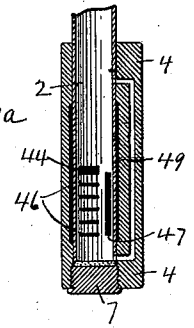


Fig. 9.

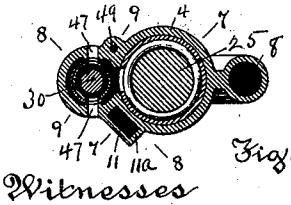


Fig. 6.

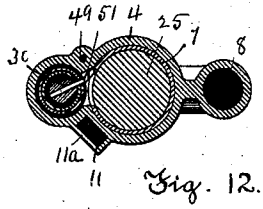


Fig. 12.

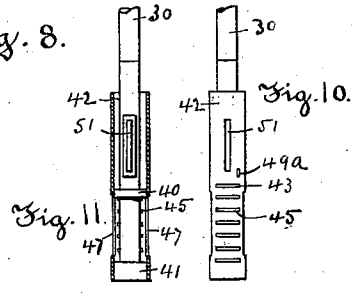


Fig. 11.

Fig. 10.

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(No Model.) 3 Sheets—Sheet 3.

F. E. HARTHAN.

PNEUMATIC TOOL.

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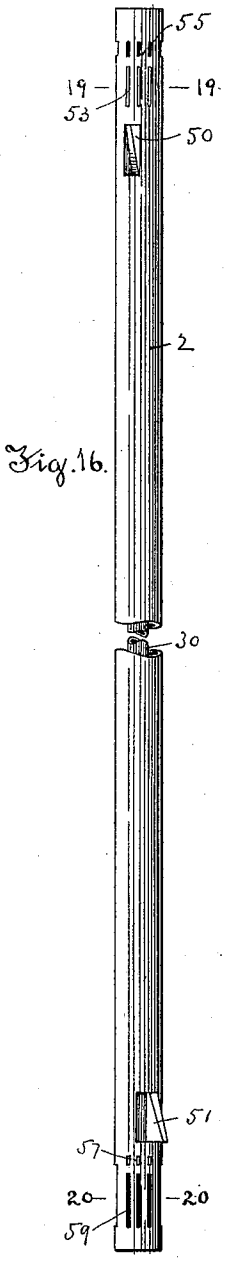

Fig. 16.

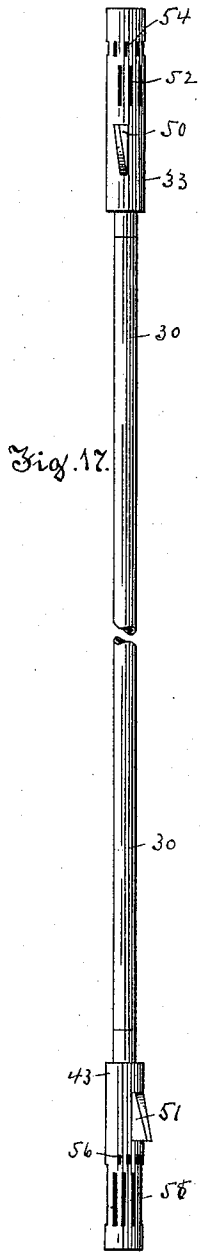

Fig. 17.

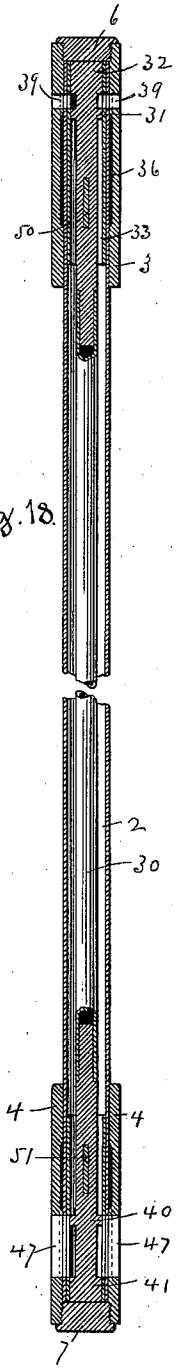

Fig. 18.

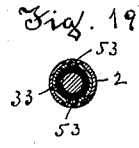

Fig. 19.

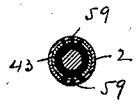

Fig. 20.

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Lena Kester.

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By his Attorney
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UNITED STATES PATENT OFFICE.

FRANK E. HARTHAN, OF WORCESTER, MASSACHUSETTS.

PNEUMATIC TOOL.

SPECIFICATION forming part of Letters Patent No. 590,661, dated September 28, 1897.

Application filed June 26, 1896. Serial No. 597,056. (No model.)

To all whom it may concern:

Be it known that I, FRANK E. HARTHAN, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented a new and useful Improvement in Pneumatic Tools, of which the following is a specification.

My present invention relates to that class of percussion-tools which are actuated by the pressure of atmospheric air or other fluid, such as are employed in rock-drilling, stone-dressing, riveting, calking, hammering, or similar operations; and it consists in the novel construction and arrangement of parts, as hereinafter set forth, and pointed out in the appended claims.

The objects of my invention are to simplify the construction in this class of tools and reduce their cost, to increase their durability and efficiency of operation, and particularly to enable the force of the blow to be regulated by the pressure of the tool upon the work, to increase the movement of the reciprocating hammer by which the blow is delivered upon the tool, and to provide means for cushioning the reciprocating hammer at the delivery of its blow.

In the accompanying drawings, which form a part of this specification, I have represented a pneumatic tool embodying my improvements.

Figure 1 is a side elevation of one of my improved pneumatic tools. Fig. 2 is a side elevation of the same, but representing the tool as turned one-quarter way from the position shown in Fig. 1. Fig. 3 is a central vertical longitudinal sectional view on line 3 3, Fig. 2, with the tool-socket, reciprocating hammer, and valve-cylinder shown in full. Fig. 4 is a central sectional view on the same plane as that shown in Fig. 3, but on a larger scale, with the valve-cylinder and tool-socket also shown in sectional view and with the central portions of the valve-cylinder removed. Fig. 5 is a transverse sectional view on line 5 5, Fig. 4. Fig. 6 is a transverse sectional view on line 6 6, Fig. 4. Fig. 7 is a longitudinal central sectional view of a portion of the hammer-cylinder, said section being shown on line 7 7, Fig. 6. Fig. 8 is a sectional view of the same portion of the hammer-cylinder as shown in Fig. 7, but with the section taken on line 8 8, Fig. 6. Fig. 9 is a sectional view of a part of one of the heads or casings which incloses one end of the valve-cylinder, said section being taken on line 9 9, Fig. 6. Fig. 10 represents the valve carried upon the lower end of the reciprocating and rocking valve-stem. Fig. 11 represents the lower end of the valve-stem, with the cylindrical shell attached thereto shown in central sectional view. Fig. 12 is a transverse sectional view on line 12 12, Fig. 4. Fig. 13 is a sectional view of the head or casing inclosing the upper valve, shown on line 13 13, Fig. 5. Fig. 14 is a central sectional view of the lower portion of the tool, shown on the same plane as the section in Fig. 4, but with the socket in its lowest position. Fig. 15 is a similar central sectional view of the same part as shown in Fig. 14, but with the socket partially raised. Fig. 16 is a view of the valve-cylinder with the valves contained therein, said cylinder being represented as removed from the jackets and showing a modified arrangement of the inlet and outlet ports adapted to be opened and closed by the rotation of the valve-stem. Fig. 17 represents the valve-stem and valves in their modified form removed from the valve-cylinder. Fig. 18 is an elevation in central sectional view of the valves, valve-cylinder, and inclosing jackets, showing a modified form of valve, as represented in Figs. 16 and 17. Fig. 19 is a transverse sectional view on line 19 19, Fig. 16; and Fig. 20 is a transverse sectional view on line 20 20, Fig. 16.

Similar numerals refer to similar parts in the different figures.

Referring to the drawings, 1 denotes the hammer-cylinder, and 2 the valve-cylinder. The hammer and valve cylinders are inclosed at their ends in cast-metal sleeves or jackets 3 and 4, which unite the opposite ends of the cylinders 1 and 2. The jacket 3 incloses the upper end of the hammer-cylinder, which is closed by a cap 5, and also the upper end of the valve-cylinder, which is closed by a plug 6. The jacket 4 incloses the lower end of the hammer-cylinder and also the lower end of the valve-cylinder, which is closed by a plug 7.

The lower jacket 4 is provided with an air-passage 8, having an internal screw-thread 9

at its upper end to receive the coupling of a hose 10, leading to an air-supply. The opposite end of the passage 8 communicates at 8^a with the hammer-cylinder 1. The jacket 4 is also provided with an air-passage 11, Figs. 7 and 8, inclosed in a shell 11^a, which is integral with the jacket 4. The air-passage 11 communicates at its lower end with the hammer-cylinder by means of an opening 12 in the same horizontal plane as the opening 8^a and communicating at its upper end with the valve-cylinder at 13.

Inclosed within the lower end of the hammer-cylinder is a socket 14, capable of a limited sliding motion and provided with a contracted section or neck 15, forming an annular chamber 16, which when the socket is raised in its highest position, as shown in Figs. 3 and 4, is in the same horizontal plane as the opening 8^a from the air-passage 8 and the opening 12, leading into the air-passage 11, thereby forming a continuous passage from the air-supply into the valve-cylinder 2.

Immediately below the end of the hammer-cylinder 1 the jacket 4 is slightly enlarged, as at 17, and is closed at its lower end by a screw-threaded thimble 18, forming an annular chamber 19 to receive the outwardly-projecting flange 20 on the socket 14, by which the sliding motion of the socket is limited to the length of the annular chamber 19. The flange 20 fits closely within the annular chamber 19 and forms a piston which receives an air-pressure on its upper side by means of a small air-passage 21, communicating with the air-passage 8, thereby causing the socket 14 to be normally held in its lowest position with its flange 20 resting against the thimble 18, as represented in Fig. 14, and with the neck 15 carried below the opening 8^a, thereby closing the air-passage and shutting off the supply of air to the valve-cylinder. The lower end of the socket 14 is adapted to receive the shank 23 of a tool 22.

The shank 23 is held loosely in the lower end of the socket 14, with its upper end bearing against the lower end of a cylindrical block 24, intermediate between the end of the shank and the reciprocating hammer 25, contained in the hammer-cylinder 1. The intermediate block 24 is slotted at one side, as at 26, to receive a pin 27, held in the socket and serving to limit the upward-sliding motion of the block 24 and connecting it with the socket, so that when the hammer-cylinder 1 is held by the operator with the tool 22 resting upon the work the pressure of the tool upon the work will force the intermediate block 24 upward against the pin 27 raising the socket 14, so as to carry its neck 15 upwardly into the plane of the openings 8^a and 12 and thereby opening the passage from the air-supply to the valve-cylinder. If the pressure is removed from the tool 22, the socket 14 will be forced down by the pressure of the air above the flange 20, carrying the neck 15 below the opening 8^a and thereby cutting off the air-supply. The downward motion of the intermediate block 24 is limited by a shoulder 28, so as to prevent the pin 27 from accidentally receiving the force of the hammer.

A blow is imparted to the tool 22 through the intermediate block 24 by means of the reciprocating hammer 25, which consists of a short cylindrical block capable of sliding freely within the hammer-cylinder 1. The lower end of the hammer 25 is reduced in size, forming a straight cylindrical section 29 at its lower end and adapted to enter the bore of the socket 14 at the downward stroke of the hammer. The straight section 29 of the hammer moves freely in the socket 14, but fits closely enough to prevent the too rapid escape of air as the hammer moves downward, causing a body of air to be imprisoned between the lower end of the hammer and the upper end of the intermediate block 24, forming an air-cushion which prevents the upsetting of the intermediate block 24, and also renders the blow upon the tool 22 more elastic, preventing the liability of breaking away the cutting edge of the tool.

A reciprocating motion is imparted to the hammer 25 by the application of air-pressure alternately above and below the hammer and controlled by means of a valve mechanism automatically operated by the movement of the hammer and comprising valves contained in the upper and lower ends of the valve-cylinder 2 and united by a common stem, so that they will be moved simultaneously.

Referring to Fig. 4 of the drawings, 30 denotes the valve-stem, provided at its upper end with heads 31 and 32, to which is attached a sleeve 33, having a series of transverse slots 34 below the head 31, which are capable of being brought opposite corresponding transverse slots 35, formed in the valve-cylinder, by the sliding movement of the valve-stem, thereby allowing air under pressure contained in the valve-cylinder to pass into a chamber 36, formed in the jacket 3 and communicating with the upper end of the hammer-cylinder above the hammer 25. The sleeve 33 between the heads 31 and 32 is provided with transverse slots 37, capable by the sliding motion of the valve-stem of being brought into alinement with similar slots 38 in the valve-cylinder, whereby the air contained in the hammer-cylinder during the upward movement of the hammer 25 is allowed to enter between the heads 31 and 32 and pass out through openings 39, Figs. 1, 3, and 13. The slots 35 and 38 form, respectively, inlet and outlet ports for the upper end of the hammer-cylinder, the inlet-ports being opened and the outlet-ports closed by the downward motion of the valve-stem, the reverse motion of the valve-stem opening the outlet and closing the inlet ports. The valve-stem at its lower end is similarly provided with heads 40 and 41, to which is attached a sleeve 42, having a transverse slot 43 above

the head 40, which is brought opposite a slot 44 in the valve-cylinder to form an inlet-port to admit air to the hammer-cylinder below the hammer.

The sleeve 42 between the heads 40 and 41 is provided with a series of transverse slots 45, which when brought into alinement with the slots 46 in the valve-cylinder form outlet-ports, through which air from the hammer-cylinder is allowed to enter between the heads 40 and 41 during the downward movement of the hammer and be exhausted through openings 47, Figs. 1, 3, 8, and 9. The slight reciprocating movement of the valve-stem and sleeves 33 and 42, carried thereon, for the purpose of alternately opening and closing the inlet and outlet ports at the opposite ends of the valve-cylinder is automatically accomplished by the reciprocating motion of the hammer 25, as follows: The valve-cylinder is slightly longer than the entire length of the reciprocating valves, and a small air-passage 48 is formed in the jacket 3, as represented in Fig. 13, connecting the upper end of the valve-cylinder above the head 32 with the valve-cylinder near the lower end of the sleeve 33. A similar small air-passage 49 connects the lower end of the valve-cylinder with the cylinder near the upper end of the sleeve 42. The sleeve 42, as represented in Fig. 10, is provided with a small hole 49^a, which is carried into alinement with the air-passage 49 by the slight rocking motion of the valve-stem. The sleeve 33 is provided with a similar hole, (not shown,) which is carried into alinement with the air-passage 48 by rocking the valve-stem in the opposite direction, so that as the valve-stem is rocked slightly in one direction the air-passage 48 at the upper end of the valve-cylinder is opened and the air-passage 49 at the lower end is closed, the reverse rocking movement of the valve-stem opening the air-passage 49 at the lower end of the cylinder and closing the air-passage 48 at the upper end of the cylinder, thereby admitting air from the central portion of the valve-cylinder alternately above and below the heads 32 and 41 and imparting a reciprocating motion to the valve-stem. The rocking motion of the valve-stem 30 is effected by means of the blades 50 and 51, which are attached to the valve-stem and project into the hammer-cylinder in the path of the reciprocating hammer 25. The blade 50 has its inner edge beveled and bent so the upward movement of the hammer will rock the valve-stem in one direction, and the blade 51 has its inner edge beveled and bent in the opposite direction, so the downward movement of the hammer will reverse the rocking motion of the valve-stem. As the hammer 25 moves down against the blade 51 the valve-stem is rocked to open the air-passage 48 and close the air-passage 49, thereby admitting air above the head 32 to force the valve-stem down, and the downward movement of the valve-stem opens the lower inlet-ports to admit air from the valve-cylinder 2 to the hammer-cylinder 1 beneath the hammer, and at the same time opens the outlet-ports at the upper end of the valve-cylinder, causing the hammer 25 to be raised. As the hammer 25 moves upwardly past the blade 50 the rocking motion of the valve-stem is reversed, closing the air-passage 48 and opening the air-passage 49, admitting air below the lower head 41 to raise the valve-stem, which opens the inlet-ports at the upper valve, admitting air above the hammer, and also opens the outlet-ports at the lower valve, causing the air-pressure to drive the hammer downward and impart a blow to the tool 22 through the intermediate block 24.

The valve mechanism, as represented in Figs. 3 to 13, inclusive, comprises a valve-stem 30, carrying valves at its ends, which are capable of being rocked by the contact of the reciprocating hammer 25 with the edges of the blades 50 and 51 for the purpose of opening and closing air-passages 48 and 49, whereby air under pressure is alternately admitted to the upper and lower ends of the valve-cylinder in order to impart a reciprocating motion to the valves to open and close the outlet and inlet ports communicating with the hammer-cylinder 1.

In Figs. 15 to 20, inclusive, I have shown a modified form of the valve mechanism, in which the valves and valve-cylinder are provided with outlet and inlet ports consisting of slots which are arranged parallel to the axis of the valve-cylinder instead of transversely thereto, as shown in Figs. 3 to 13, and are opened and closed by the rocking motion of the valve-stem. The valve-stem 30 is provided with heads 31 32 at one end, carrying a sleeve 33, which is provided with slots 52, arranged to be brought opposite corresponding slots 53 in the valve-cylinder, and with slots 54, arranged to be brought opposite slots 55 in the valve-cylinder by the rocking motion of the valve-stem as actuated by the contact of the reciprocating hammer with the edges of the blades 50 51, as already described.

The lower end of the valve-stem is provided with heads 40 41, carrying a sleeve 43, provided with slots 56, arranged to be brought opposite slots 57 in the valve-cylinder, and slots 58, which are brought opposite slots 59 in the valve-cylinder by the rotation of the valve-stem. The slots 52 and 53 constitute the inlet-ports at the upper end and the slots 56 57 the inlet-ports at the lower end of the valve-cylinder. The slots 54 and 55 constitute the outlet-ports at the upper end and the slots 58 and 59 the outlet-ports at the lower end of the valve-cylinder, and the slots are so arranged that the outlet-ports at each end will be opened simultaneouly with the closing of the inlet-ports at the opposite end of the valve-cylinder, and vice versa.

By the construction represented in Figs. 16 to 20 I do away with the reciprocating motion of the valves and the small air-passages 48

and 49, and I actuate the valves wholly by the reciprocating hammer, which in its upward motion against the blade 50 rocks the valves slightly in one direction and at its downward movement against the edge of the blade 51 reverses the motion of the valves.

In case the socket 14 should be pushed upwardly by the insertion of the shank 23 or by any other means when the tool 22 is not supported upon the work a sufficient amount of air will pass around the flange 20 to form an air-cushion between the flange 20 and the thimble 18, so that in case the intermediate block 24 is driven against the shoulder 28 by the movement of the hammer the thimble 18 will be partially relieved from the force of the blow.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a pneumatic tool the combination of a hammer-cylinder, a sliding tool-holding socket held in said cylinder and an air-passage leading from a source of air-supply to said cylinder and arranged to be opened and closed by the sliding movement of said socket, substantially as described.

2. In a pneumatic tool the combination of a hammer-cylinder, a sliding socket held in said cylinder and having a neck forming an annular chamber, said annular chamber constituting a part of an air-passage leading from an air-supply to said hammer-cylinder, whereby said air-passage is opened or closed by the sliding of said socket, substantially as described.

3. The combination with a hammer-cylinder and a reciprocating hammer, of an air-supply passage, a tool-holding socket held in said cylinder and capable of a sliding motion in said cylinder and having an air-passage which is brought into alinement with said supply-passage by the pressure against the end of the tool held in said socket, substantially as described.

4. The combination with a hammer-cylinder and a reciprocating hammer contained therein, and a valve-cylinder of an air-supply passage, a sleeve 14 sliding in said cylinder and adapted to hold a tool, said sleeve having an air-passage adapted to communicate with said supply-passage and said valve-cylinder, means for applying pressure to said sleeve to slide the same and close said supply-passage, substantially as described.

5. The combination with a hammer-cylinder, of a sleeve held in said hammer-cylinder and adapted to receive the shank of a tool, an intermediate sliding block held in said sleeve, and a reciprocating hammer contained in said hammer-cylinder, and having a reduced section adapted to enter said sleeve and deliver a blow upon said intermediate block said reduced section fitting said sleeve, whereby an air-cushion is formed beneath the end of said hammer.

6. The combination of a hammer-cylinder, a reciprocating hammer, a valve-cylinder, an air-passage leading to said valve cylinder, a sleeve capable of a sliding motion in said hammer-cylinder and adapted to hold a tool, means for forcing said sleeve toward the end of said hammer-cylinder, whereby said air-passage is closed, and a tool held in said sleeve, whereby said sleeve is pushed inwardly by a pressure against said tool, and the air-passage opened, substantially as described.

7. The combination with a hammer-cylinder and a reciprocating hammer contained therein, of a valve-cylinder having an air-passage by which air under pressure is supplied to the central section of said valve-cylinder, valves arranged at each end of said valve-cylinder and communicating with said hammer-cylinder on opposite sides of said hammer, a valve-stem connecting said valves whereby said valves are operated synchronously and means whereby said valve-stem is actuated by the reciprocating movement of said hammer, substantially as described.

8. The combination with a hammer-cylinder and a reciprocating hammer held therein, of a valve-cylinder communicating at its ends with the ends of said hammer-cylinder, valves contained in the ends of said valve-cylinder whereby the openings between said cylinders are alternately opened, or closed, a valve-stem uniting said valves, an air-supply whereby air under pressure is supplied to the central portion of said valve-cylinder, means whereby said valve-stem is operatively connected with said hammer, and means whereby the air-supply to said valve-cylinder is controlled, substantially as described.

9. The combination of a hammer-cylinder, a valve-cylinder communicating at its ends with said hammer-cylinder, valves at the ends of said valve-cylinder, a valve-stem uniting said valves, a reciprocating hammer, means by which said valve-stem is rocked by the reciprocating motion of said hammer, an air-passage connecting said valve-cylinder with an air-supply, and means for controlling the area of said air-passage, substantially as described.

10. The combination with a hammer-cylinder and a reciprocating hammer contained therein, of a socket 14 capable of a limited sliding movement and adapted to receive the shank of a tool, a closed annular chamber 19 surrounding said socket, and a flange 20 projecting from said socket and inclosed in said annular chamber, whereby an air-cushion is formed to receive the force of a blow imparted to said socket by the reciprocating hammer, substantially as described.

Dated this 25th day of June, 1896.

FRANK E. HARTHAN.

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