C. H. HAESELER.

PNEUMATIC PERCUSSIVE TOOL.

APPLICATION FILED MAY 12, 1916.

1,240,708.

Patented Sept. 18, 1917.

3 SHEETS—SHEET 1.

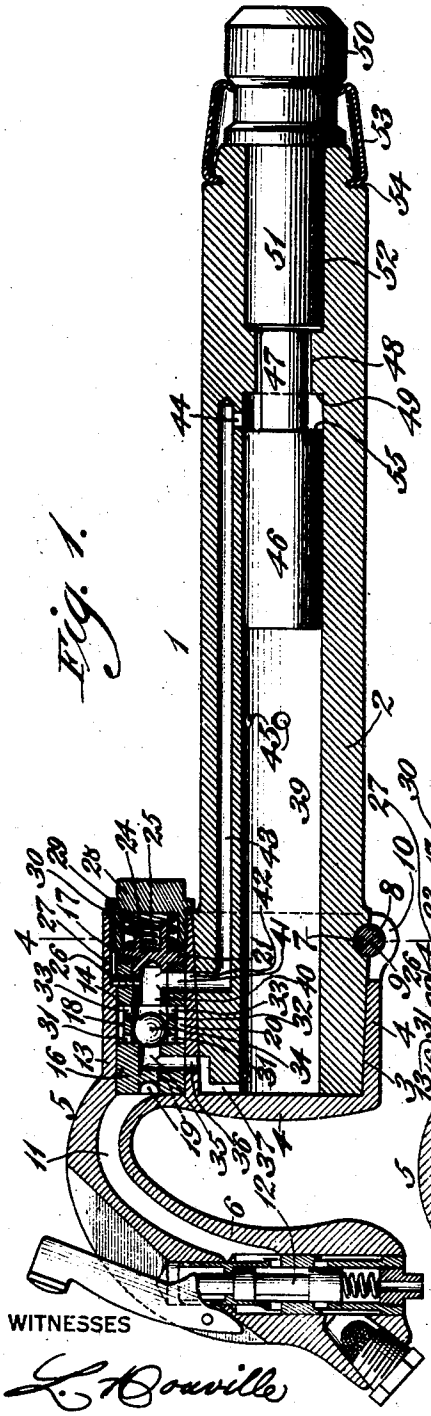


Fig. 1.

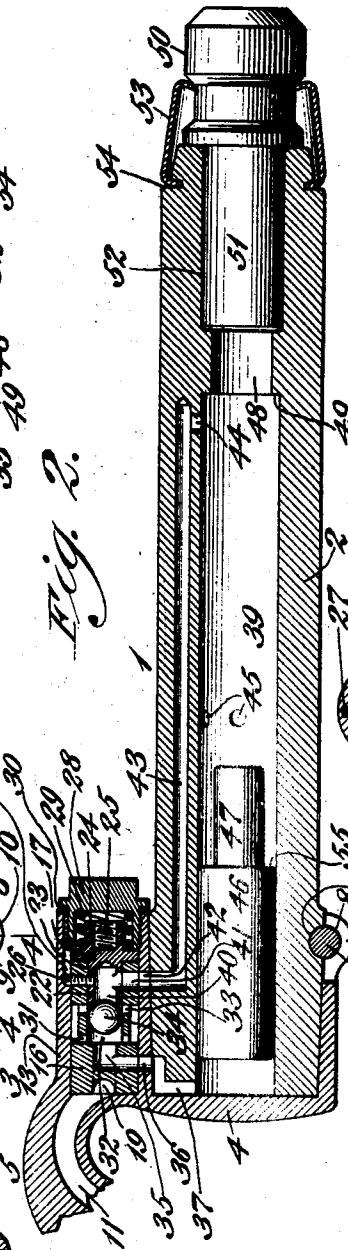


Fig. 2.

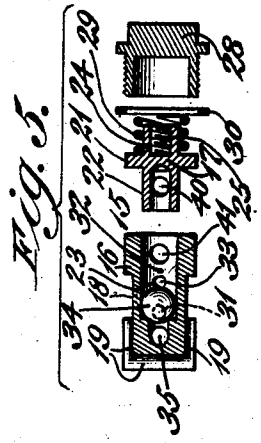


Fig. 5.

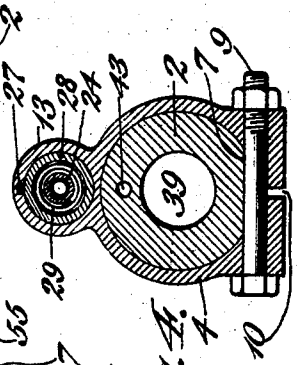


Fig. 4.

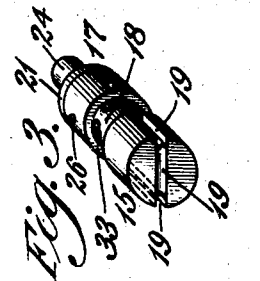


Fig. 3.

WITNESSES

L. Bonville

H. G. Dieterich

INVENTOR

Charles H. Haeseler.

BY Wiedersheim & Fairbanks.

ATTORNEYS

C. H. HAESELER.

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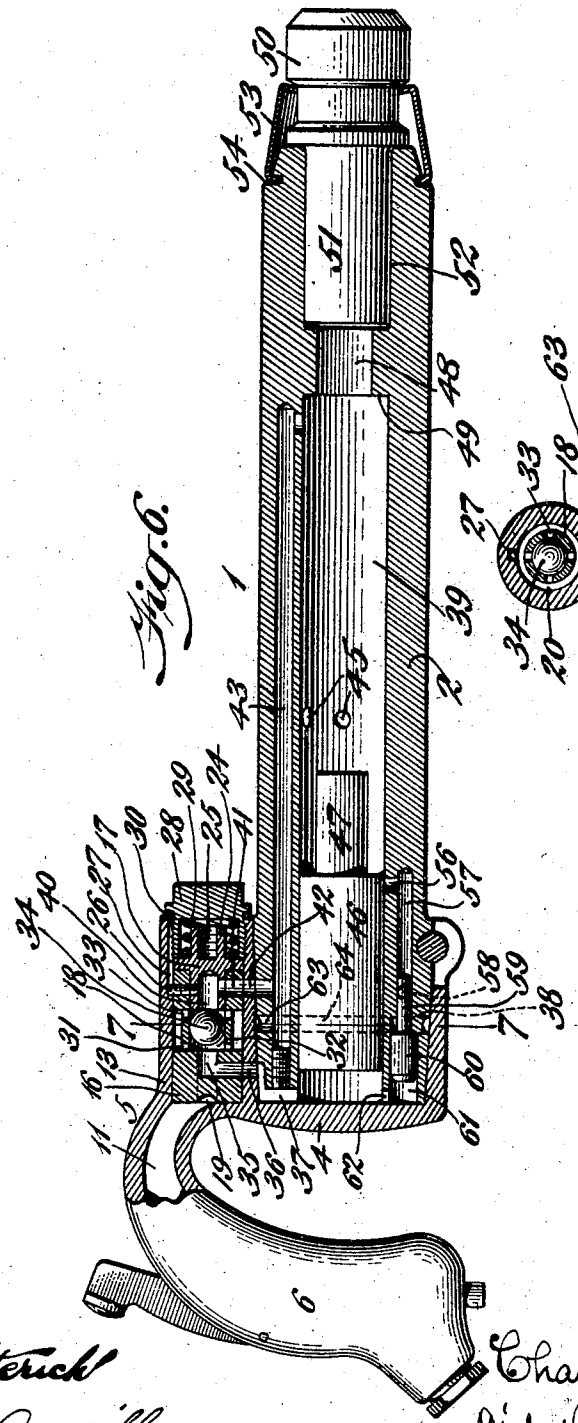


Fig. 6.

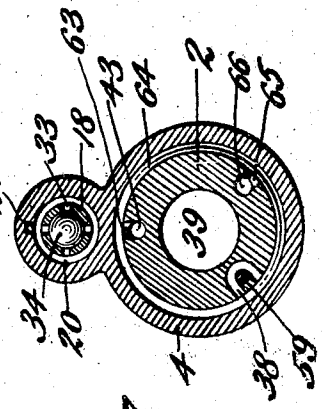


Fig. 7.

WITNESSES

H. E. Dieterich

L. Dourville

INVENTOR

Charles H. Haeseler.

BY Wiedersheim & Fairbank.

ATTORNEYS

C. H. HAESELER.

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3 SHEETS—SHEET 3.

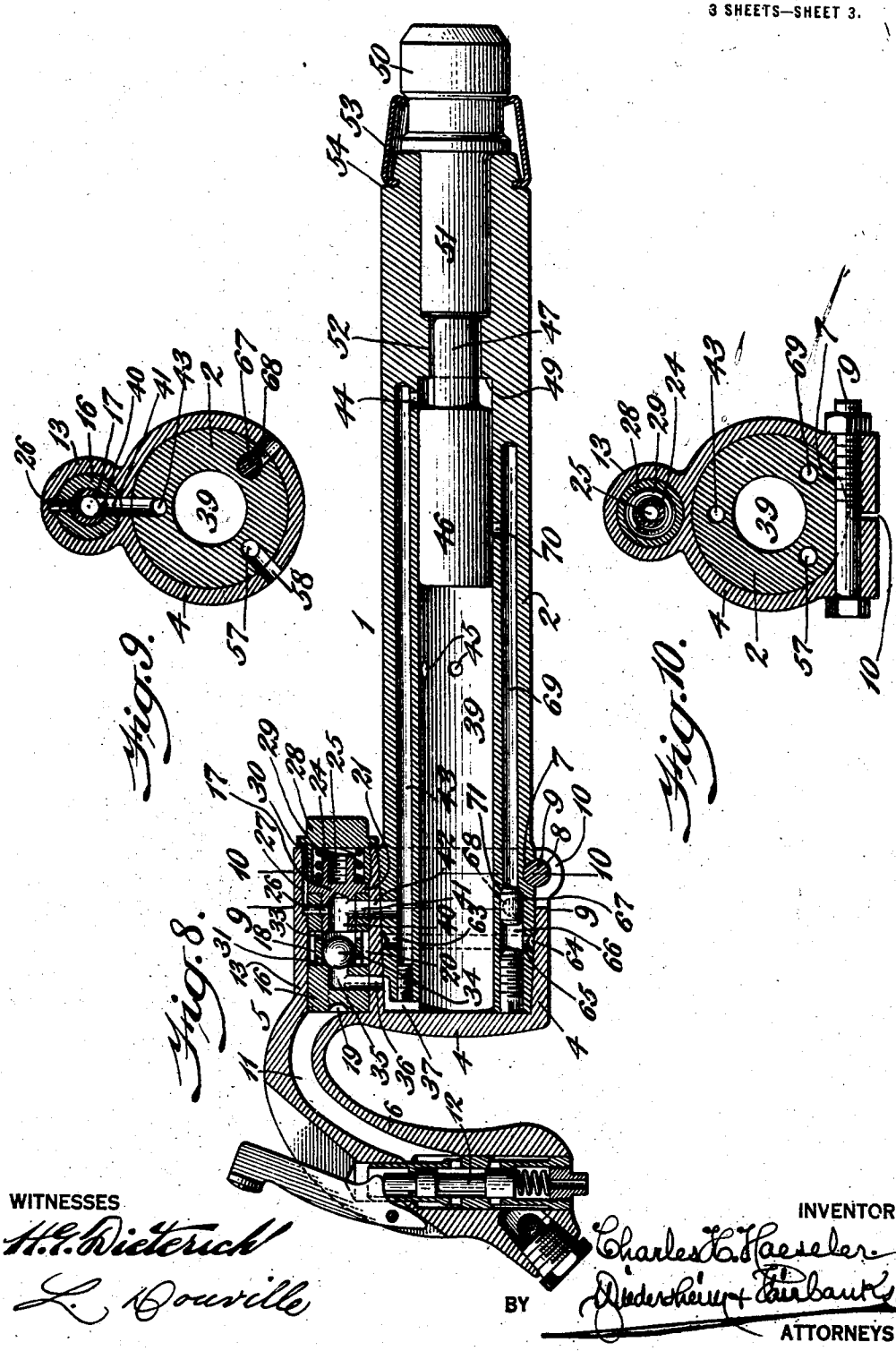


Fig. 9.

Fig. 10.

Fig. 8.

WITNESSES

H. E. Dieterich

L. Douville

INVENTOR

Charles H. Haeseler.

BY Underwood & Fairbanks.

ATTORNEYS

UNITED STATES PATENT OFFICE.

CHARLES H. HAESELER, OF PHILADELPHIA, PENNSYLVANIA.

PNEUMATIC PERCUSSIVE TOOL.

1,240,708. Specification of Letters Patent. Patented Sept. 18, 1917.

Application filed May 12, 1916. Serial No. 97,014.

To all whom it may concern:

Be it known that I, CHARLES H. HAESELER, a citizen of the United States, residing in the city and county of Philadelphia, State of Pennsylvania, have invented a new and useful Pneumatic Percussive Tool, of which the following is a specification.

The object of my invention is to provide a pneumatic percussive tool construction that makes for the greatest utility by a combination that produces sustained efficiency, simplicity, ease of operation, low cost of upkeep, accessibility for repair and reduced cost of manufacture.

A further object of my invention is to provide in combination with such a tool a valve arrangement independent of the distribution valve to relieve the compression of air in the ends of the piston casing by which the speed and force of blow of the hammering piston may be varied to better accomplish desired results according to the different character of work upon which such tools are usually employed.

To the above ends my invention consists of a novel percussive tool wherein is employed a novel construction and arrangement of a fluid distribution valve preferably carried by the head block and located out of alinement with the hammering piston, the valve cage of such fluid distribution valve being constructed in such a manner that it may be assembled to bring its ports and passages into proper alinement with the ports and passages with which it coöperates and wherein the valve cage may be connected and disconnected as a unit of structure when desired without necessitating the removal of the head block from the casing. The fluid distribution valve is located so that its housing will least obstruct the proper manipulation of the tool when working in close quarters and at the same time its location is such that it serves to reinforce and strengthen the neck of the grasping handle with which it is connected in cases where such form of handle is used.

It further consists of a novel construction and arrangement of a head block and novel means for interlocking it with the casing so that leakage between the inlet ports is prevented.

It further consists of a novel construction and arrangement of a casing having preferably but a single passage therein for the live motive fluid, said passage extending to the forward end of the piston chamber to effect the return of the reciprocatory piston.

It further consists of novel means to reduce the compression at one or both ends of the piston chamber.

It further consists of a novel construction and arrangement of a fluid distribution valve.

It further consists of a novel construction of a casing.

It further consists of a novel construction of a compression valve and novel means for actuating it whereby it is moved in opposite directions by live motive fluid.

It further consists of a novel construction of a compression valve and novel means for actuating it whereby it is moved in one direction by live motive fluid and in a reverse direction by compressed motive fluid.

It further consists of a novel construction and arrangement of ports and passages to effect the shifting of the main distribution valve and of the compression valves, if employed, and to effect the reciprocations of the hammering piston.

Other novel features of construction and advantage will hereinafter more clearly appear in the detailed description of the invention and in the appended claims.

For the purpose of illustrating my invention, I have shown in the accompanying drawings those forms thereof which are at present preferred by me, since the same will give in practice satisfactory and reliable results, although it is to be understood that the various intrumentalities of which my invention consists can be variously arranged and organized and that my invention is not limited except by the scope of the appended claims to the precise arrangement and organization of these instrumentalities as herein shown and described.

Figure 1 represents a longitudinal section of a pneumatic hammer embodying my invention.

Fig. 2 represents a longitudinal section of the hammer seen in Fig. 1 but showing the parts in a different relation from that seen in said figure.

Fig. 3 represents a perspective view of the fluid distribution valve, in detached position.

Fig. 4 represents a section on line 4—4 of Fig. 1.

Fig. 5 represents in section the different parts of the fluid distributing valve as ready for assembling.

Fig. 6 represents a side elevation, partly in section, of another embodiment of my invention.

Fig. 7 represents a transverse section on line 7—7 of Fig. 6.

Fig. 8 represents a longitudinal section of the hammer with the fluid distribution valve and the piston in a different position from that seen in Fig. 6.

Fig. 9 represents a transverse section on line 9—9 of Fig. 8.

Fig. 10 represents a transverse section on line 10—10 of Fig. 8.

Similar numerals of reference indicate corresponding parts in the figures.

Referring to the drawings:

1 designates a pneumatic hammer embodying my invention, said hammer comprising a casing 2, which at its rear end is tapered or converges rearwardly, as at 3, in order to receive the sleeve or head block 4 connected as shown with a handle 5, which latter is provided with a grasping portion 6. The casing 2 is provided with a groove 7, which is adapted to register with a corresponding groove or recess 8 in the handle sleeve 4, so that when such parts are in register an aperture is formed to receive the fastening device 9, consisting of a bolt and nut, whereby when the fastening device is tightened, the split sleeve 4 will be securely locked with respect to the casing 2, it being noted that the handle sleeve is split, as indicated at 10. The handle 6 is provided with an inlet passage 11 for the motive fluid, the admission of which from the motive fluid supply to said passage is controlled by means of a manually actuated valve 12 of any desired or conventional type. The sleeve of the handle 5 is provided with a boss 13 having a valve cage pocket 14 formed therein and communicating with the passage 11.

15 designates the valve cage of the fluid distribution valve, which is formed of two telescopic sections 16 and 17, respectively. The cage section 16 is provided with an annular groove 18 and the sides and rear face end of the cage section 16 are grooved as at 19, in order to form passages through which the motive fluid passes from the passage 11 into the chamber 20 formed by the annular groove 18. The cage section 17 is formed with an annular flange 21 intermediate its ends and with a tubular extension 22, which is adapted to pass into the aperture 23 of the cage section 16. The opposite end of the cage section 17 is provided with a lug 24, the inner periphery of which is internally threaded, as at 25, in order to receive an extracting device, as will be hereinafter pointed out.

The cage sections are secured in assembled position by means of a locking and registering device 26, the outer end of which extends beyond the periphery of the cage sections 16 and 17, so that it will extend into the longitudinal key way 27 and be guided by the walls thereof during the insertion and removal of the valve cage into or from the pocket 14. The valve cage pocket 14 at its forward end is threaded to receive a recessed cap 28 which contains a spring 29, which latter is also adapted to encircle the lug 24 when the parts are in assembled position, as will be understood by reference to Fig. 1. A lock ring 30 is preferably employed between a flanged portion of the cap 28 and the boss 13. The cage section 16 is provided with a series of ports 31 communicating with the chamber 20 and with the valve chamber 32, and it is also provided with a series of ports 33 which also communicate with the chamber 20 and with the valve chamber 32. The valve chamber 32 contains a valve 34 preferably of the ball type, which controls a port 35, which registers with a port 36 in the handle sleeve 4. This port 36 communicates with a passage 37 formed by a recess in the outer periphery of the casing 2 at its rear end, so that live motive fluid may pass into the piston chamber 39. The cage section 17 is provided with a port 40 controlled by the valve 34, and said port registers with a port 41 in the cage section 16, and the port 41 registers with a port 42 in the handle sleeve, said latter port communicating with a passage 43 which extends longitudinally through the barrel and communicates by means of a port 44 with the forward end of the piston chamber 39.

Intermediate the ends of the piston chamber 39 one or more exhaust ports 45 are provided, which extend through the side wall of the casing 2 and communicate with the atmosphere.

46 designates a reciprocatory piston which comprises a cylindrical bolt having at its forward end an extension or striker 47 of reduced diameter adapted to pass through the aperture 48, which forms a continuation of the piston chamber 39, and which is of less diameter than the diameter of said piston chamber 39, thereby forming a shoulder 49, at the forward end of the piston chamber. It will be seen that by such construction, the piston is prevented from passing through the forward end of the casing 2 and can only be removed by first removing the handle 5 from the casing 2.

50 designates a working tool which for purpose of illustration, I have shown as comprising a rivet set of a conventional type, although it will be understood that it is within the scope of my invention to employ any desired type of a working tool in ac-

cordance with the character of work which is to be performed. The working tool 50 is provided with a shank 51 of uniform diameter in the present instance and adapted to be received in the aperture 52, which opens through the forward end of the casing 2 and which communicates at its rear end with the aperture 48. The working tool 50 is recessed to receive a deflected portion of a split ring 53, the rear end of which interlocks with a recess 54 in the outer periphery of the casing 2.

In the operation of this embodiment of my invention, the proper manipulation of the manually actuated main inlet valve 12 permits the motive fluid to pass through the passage 11 through the passages formed by the grooves 19 into the chamber 20, and assuming that the parts are in the position seen in Fig. 2, the live motive fluid will pass through the ports 31 into the valve chamber 32, and since the valve 34 is now in its forward position, the live motive fluid may pass through the port 35, the ports 36 and 37 and into the piston chamber 39 in rear of the piston 46, and causes the piston to move from the position seen in Fig. 2 into that seen in Fig. 1, and to impact against the inner end of the shank 51 of the working tool 50. As soon as the piston 46 in its forward stroke passes beyond the ports 45, the motive fluid in rear of the piston may exhaust through the ports 45 directly into the atmosphere, thereby reducing the pressure in rear of the valve 34, whereupon the valve changes from the position seen in Fig. 2 to that seen in Fig. 1, due to the action of the live motive fluid against the forward portion of the valve. The live motive fluid now passes through the ports 33 into the valve chamber 32, and therefrom through the port 40 and through the ports 41 and 42 into the passage 43 and through the port 44 into the piston chamber 39 in front of the shoulder 55 on the piston and acting on this pressure area, causes the piston 46 to move rearwardly and to be returned to its initial position.

During this rearward movement, as soon as the shoulder 55 passes the port 45, the motive fluid may exhaust through such ports into the atmosphere, thereby reducing the pressure at the forward end of the valve, whereupon the valve instantly changes and moves from the position seen in Fig. 1 into that seen in Fig. 2. The cycle of the operation as just described is then repeated.

In the embodiment seen in Figs. 6 to 10 inclusive the construction above described is present in these figures, and I have therefore given the corresponding parts the same reference characters. In this embodiment, I have provided means whereby the compression of motive fluid at the forward and at the rear end of the piston chamber may be automatically controlled.

Referring first to Fig. 6, it will be seen that the piston chamber 39 communicates by means of a compression port 56 with a passage 57 which extends rearwardly through the casing 2 and communicates with an exhaust port 58, which is controlled by means of the stem 59 of a valve 60, the rear end of which is of a different diameter than the valve stem 59 and reciprocates in a chamber 61 which opens into the rear end of the piston chamber 39 by means of a port 62. The passage 43 at its rear end communicates by means of a port 63 with a peripheral groove 64 of the casing 2. This groove 64 communicates by means of a port 65 with a valve chamber 66 in which is located a cylindrical valve 67, said valve controlling a port 68 which leads through the casing 2 and the handle sleeve 4 to the atmosphere.

69 designates a passage which communicates with the piston chamber 39 by means of the compression port 70, said port 70 being located a desired distance from the forward end of the piston chamber 39. The passage 69 communicates with the passage 66 and is of a different diameter than said passage thereby forming a seat 71 for the valve 67. The groove 64 communicates by means of a port 38 with the forward end of the valve chamber 61.

In this embodiment of my invention, seen in Figs. 6 to 10 inclusive, the reciprocation of the piston is effected in a similar manner to that described with reference to Figs. 1 and 2, except that I provide compression relief valves in order to vary the amount of compression at each end of the stroke of the piston.

Assuming that the parts are in the position seen in Fig. 6, the live motive fluid passes into the piston chamber 39 in rear of the piston 46 to effect the forward movement of the piston. At the same time, the live motive fluid passes through the port 62 into the valve chamber 61 and owing to the greater pressure area at the rear end of the valve 60, such valve will be retained during the forward stroke of the piston 46 in the position seen in Fig. 6 and after the piston passes the port 56, the live motive fluid cannot pass through said port and the passage 57 to the exhaust port 58 as the valve at this time closes this port. This port 58 is kept closed during practically the entire forward movement of the piston according to the time at which the distribution valve changes its position. After the shoulder 55 of the piston 46 passes the ports 45 such ports are closed and the compression in advance of the piston is reduced, due to the air which is being compressed, passing through the port 70, passage 69, and

the port 68, it being understood that this compression causes the valve 67 to uncover said port 68 since the pressure has previously been relieved in rear of the valve 67.

Assuming now that the fluid distribution valve 34 is in the position seen in Fig. 8, the live motive fluid passes through the passage 43 and the port 44 in front of the piston 46 and causes it to move rearwardly. The live motive fluid also passes through the passage 43, the groove 64 and the port 38 and causes the compression valve 60 to be moved rearwardly so that the compressed fluid is free to exhaust to the atmosphere through the port 56, the passage 57 and the exhaust port 58. The live motive fluid at this time in the groove 64 also passes through the port 65 into the valve chamber 66 in rear of the valve 67 and owing to the live motive fluid pressure at the rear end of the valve 67, the latter is maintained against its seat 71 during the rearward movement of the piston 46.

The cycle of the operation as above described is then repeated.

It will of course be understood that it is within the scope of my invention to locate the port 56 and the port 70 at any desired distance from the ends of the piston chamber in order to vary the amount of compression at the forward and rear strokes of the piston and in some cases one or both of the compression and relief valves and their ports and passages may be dispensed with in accordance with the character of work which is to be accomplished.

It is also to be understood that while I show the compression and relief valves, for purposes of illustration, as located in the walls of the casing, I do not desire to be limited to this location, since in many cases arising in practice they will be preferably located in the handle sleeve or the head block at the end of the piston casing. It is also within the scope of my invention to employ the principle herein involved in connection with pneumatic percussive tools of any type, such as for example, rock drills and pneumatic hammers and it will of course be apparent that by the proper location of the ports and passages, the hammering piston may have a length of stroke greater or less than its own length in accordance with the character of the work which is to be accomplished and the speed and the force of the hammering action of the piston will be correspondingly varied.

When it is desired to remove the valve cage for the purpose of inspection or repair, it is simply necessary to remove the cap 28 and to insert an extracting device, such as for example, a standard screw threaded bolt, into the threaded lug 24, whereupon the entire valve cage with the valve can be removed from the valve cage pocket in which it is located. The locking and registering device 26 is then removed whereupon the valve cage sections 16 and 17 may be readily taken apart and the valve removed if desired. Owing to the provision of the locking and registering device 26, the ports 35 and 41 in the valve cage will be accurately alined with respect to the ports 36 and 42, respectively, in the sleeve or head block 4.

It will also be seen that owing to the manner in which the fastening device 9 interlocks with both the casing 2 and the sleeve or head block 4, that the ports 36 and 42 will be brought into accurate register with corresponding ports in the casing and the relative rotation of the sleeve or head block and the casing is positively prevented, so that such parts are locked to prevent not only their relative rotation but also so as to prevent their relative longitudinal movement.

The coacting faces of the sleeve or head block and the casing are preferably tapered, but this is not necessary in all cases arising in practice and these faces may be made straight, if desired. It is preferable to have such parts tapered for ease of connecting or disconnecting such parts.

In case the handle becomes fixed to the casing so that it is not readily removable, the working tool may be removed and a bar inserted through the front end of the tool, so as to contact with the front end of the piston, so that the piston may be pushed rearwardly until its rear end abuts against a solid portion of the sleeve or head block and the requisite pressure can then be exerted to remove the sleeve or head block from the casing without any injury whatever to the fluid distribution valve or its adjuncts or injury to the handle or the casing.

It will also be seen that the valve cage may be removed or inserted in position without necessitating the removal of the handle from the casing and that the handle may be removed from the casing without necessitating the removal of the valve mechanism.

A pneumatic percussive tool constructed in accordance with my present invention conforms to the laws of those States which render it compulsory to employ in conjunction with devices of this character means to prevent the ejection of the piston from the casing, since in my present construction the piston can be removed only from the rear end of the casing.

Another important feature of my invention is the arrangement of ports and passages so that if the working tool has been removed the piston will not reciprocate when the hammer is held in a horizontal or downward direction and when held upwardly the piston will not advance far enough to strike the retaining wall or shoulder at the forward end of the piston chamber. This is a

particularly desirable feature as it prevents abuse of the tool by the piston battering the retaining wall if the hammer is allowed to operate by stupid or careless workmen when the working tool is not in place.

Many pneumatic tools have heretofore been seriously injured by such practice.

For the purpose of illustration the casing is shown as adapted to be manually held by the operator and the head block is therefore shown with a grasping handle provided with a manually controlled valve but it is to be understood that my invention is not limited to such construction since in many cases in practice the casing is not provided with a grasping portion, as for example, in some types of rock drills, sand rammers, riveting hammers of large size, rivet busters, and other devices.

I make no claim herein *per se* to the coacting tapered faces of the head block and casing since such features are described and generically claimed in my copending application Serial No. 83,470, filed March 11th, 1916.

It will now be apparent that I have devised a novel and useful construction of a pneumatic percussive tool which embodies the features of advantage enumerated as desirable in the statement of the invention and the above description, and while I have, in the present instance, shown and described preferred embodiments thereof which will give in practice satisfactory and reliable results, it is to be understood that the same are susceptible of modification in various particulars without departing from the spirit or scope of the invention or sacrificing any of its advantages.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. A percussive tool, comprising a casing having a piston chamber with exhaust ports intermediate the ends thereof, a head block having a split sleeve recessed to receive the rear end of said casing, inlet ports common to said head block and the side wall of said casing to alternately introduce live motive fluid to opposite ends of said piston chamber, and means to clamp said sleeve to said casing to form a fluid tight joint between said inlet ports.

2. A percussive tool, comprising a one piece casing having a piston chamber, an inlet port at its rear end opening into the rear end of the piston chamber, an inlet port near its rear end leading to the forward end of the piston chamber, a head block having a split sleeve recessed to receive the rear end of the casing and having inlet ports to register with the ports in the casing, the coacting faces of the casing and head block being smooth and unobstructed but provided with a common transversely extending aperture, a locking device in said aperture serving to maintain the register of said ports and to clamp said sleeve to the casing to form a fluid tight joint between its inlet ports, a piston in the piston chamber, and means to alternately admit motive fluid to said inlet ports.

3. A percussive tool, comprising a casing having a piston chamber, a reciprocatory piston in said piston chamber, a head block receiving one end of the casing and provided with a valve cage pocket having a key-way, valve mechanism in the cage pocket and having means to engage the key-way, ports and passages common to the head block and casing to control said piston and controlled by said valve, and means to lock the head block and casing to prevent their relative rotation and their relative longitudinal movement.

4. A percussive tool, comprising a casing having a piston chamber, a reciprocatory piston in said piston chamber, a head block receiving one end of the casing and provided with a valve cage pocket having a key-way, valve mechanism in the cage pocket and having means to engage the key-way, ports and passages common to the head block and casing to control said piston and controlled by said valve, means to lock the head block and casing to prevent their relative rotation and their relative longitudinal movement, and said valve mechanism having means to engage an extracting tool whereby the valve mechanism may be removed as a unit of structure from said valve cage pocket.

5. In a percussive tool, a head block having a valve cage pocket and means to pass motive fluid thereto, a ported valve cage to fit said pocket and consisting of sections forming a valve chamber, a locking and alining member serving to secure the cage sections together and interlocking with the wall of the valve cage pocket to aline the valve cage, and a valve to control the ports in the valve cage.

6. In a percussive tool, a head block having a valve cage pocket and means to pass motive fluid thereto, a ported valve cage to fit said pocket and consisting of sections forming a valve chamber, a locking and alining member serving to secure the cage sections together and interlocking with the wall of the valve cage pocket to aline the valve cage, and a ball valve to control the ports in the valve cage.

7. In a percussive tool, a head block having a valve cage pocket and means to pass motive fluid thereto, a ported valve cage to fit said pocket and consisting of sections forming a valve chamber, a locking and alining member serving to secure the cage sections together and interlocking with the wall of the valve cage pocket to aline the valve cage, means to close the open end of

said pocket, and a valve to control the ports in the valve cage.

8. In a percussive tool, a head block having a valve cage pocket and means to pass motive fluid thereto, a ported valve cage to fit said pocket and consisting of sections forming a valve chamber, a locking and alining member serving to secure the cage sections together and interlocking with the wall of the valve cage pocket to aline the valve cage, a cap secured to the head block and covering the pocket, a spring between the cap and the valve cage, and a valve to control the ports in the valve cage.

9. In a percussive tool, a head block having a valve cage pocket and means to pass motive fluid thereto, a ported valve cage to fit said pocket and consisting of telescopic sections forming a valve chamber, a locking and alining member serving to secure the cage sections together and interlocking with the wall of the valve cage pocket to aline the valve cage, and a valve to control the ports in the valve cage.

10. A percussive tool, comprising a casing having a piston chamber with exhaust ports intermediate its ends, a passage leading from the rear portion of the casing to communicate with the forward end of the piston chamber and with a peripheral groove in communication with said passage, a compression exhaust port communicating with the piston chamber near the rear end thereof, a valve chamber having a port communicating with said groove and having a port communicating with the rear end of said piston chamber, said valve controlling said compression exhaust port.

11. A percussive tool, comprising a casing having a piston chamber with exhaust ports, a piston in the piston chamber, means to introduce live motive fluid to opposite ends of the piston chamber, means to reduce the compression at one end of the piston chamber and including a valve actuated in both directions by live motive fluid, and devices to reduce the compression at the outward end of the piston chamber and including a valve actuated in one direction by live motive fluid and in the reverse direction by compression of motive fluid between the piston and the end of the piston chamber.

12. A percussive tool, comprising a casing having a piston chamber with main exhaust ports, a piston for said piston chamber, a compression exhaust port communicating with the piston chamber near its rear end, a valve controlling said port, means to close said valve during the forward stroke of the piston, means to open said valve during the return stroke of the piston, a second compression exhaust port opening into the piston chamber near its forward end, a second valve controlling the second compression exhaust port, means to move said second valve in one direction by live motive fluid and in the opposite direction by motive fluid compressed between the piston and the end of the piston chamber.

13. The combination of a casing having ports and passages for the admission and exhaust of motive fluid, a piston reciprocable in the casing, and valve mechanism controlling said admission ports and passages, comprising a cage formed in two separable sections, each of which forms a valve seat, a valve to control said seats, and a locking and alining member to secure the sections together.

14. The combination of a casing having ports and passages for the admission and exhaust of motive fluid, a piston reciprocable in the casing, valve mechanism controlling said admission ports and passages, comprising a cage formed in two separable sections, each of which forms a valve seat, one of said sections forming a valve chamber, a valve in said valve chamber, means to admit motive fluid to the valve chamber, and means to rigidly lock the sections together, said means serving also as an alining device for said cage.

15. The combination of a casing having ports and passages for the admission and exhaust of motive fluid, a piston reciprocable in the casing, valve mechanism controlling said admission ports and passages, comprising a cage formed in two separable sections, each of which forms a valve seat, one of said sections forming a valve chamber and provided with an annular groove communicating by ports with said valve chamber, a valve in said valve chamber, and means to lock the cage sections together whereby they may be inserted in and removed from place as a unit of structure.

16. The combination of a casing having ports and passages for the admission and exhaust of motive fluid, a piston reciprocable in the casing, valve mechanism controlling said admission ports and passages, comprising a cage formed in two separable sections, each of which forms a valve seat, a port in each cage section communicating with a casing admission port, a valve controlling said ports and seats, a locking device for the cage sections, and one of said sections having a lug adapted to be engaged by an extracting device whereby the valve mechanism may be inserted into and removed from place as a unit.

17. The combination of a casing having ports and passages for the admission and exhaust of motive fluid, a piston reciprocable in the casing, valve mechanism controlling said admission ports and passages, comprising a cage formed in two separable sections, each of which forms a valve seat, each section having a port to register with each other and having ports to register with

the casing admission ports, one of the sections forming a valve chamber, a valve in the valve chamber, and a locking and alining device for said sections to secure them together and to bring certain of their ports into alinement with the casing admission ports.

18. The combination of a casing having ports and passages for the admission and exhaust of motive fluid, a piston reciprocable in the casing, valve mechanism controlling said admission ports and passages, comprising a cage formed in two separable sections, each of which forms a valve seat, one of the cage sections having an annular groove and a longitudinal groove in its periphery leading from said groove and open at one end, such cage section forming a valve chamber, and a valve in the valve chamber.

19. The combination of a casing having ports and passages for the admission and exhaust of motive fluid, a piston reciprocable in the casing, valve mechanism controlling said admission ports and passages, comprising a cage formed in two separable sections, each of which forms a valve seat, one of the cage sections forming a valve chamber and the other cage section forming a closure for the valve chamber, one of said sections having a threaded lug adapted to receive a standard screw threaded bolt, and a valve in the valve chamber.

20. The combination of a casing having ports and passages for the admission and exhaust of motive fluid, a piston reciprocable in the casing, valve mechanism controlling said admission ports and passages, comprising a cage formed in two separable sections, each of which forms a valve seat, a valve to control said seats, a locking and alining member to secure the sections together, said casing having a valve cage pocket, and a spring to retain the valve cage in the valve cage pocket.

21. The combination of a casing having ports and passages for the admission and exhaust of motive fluid, a piston reciprocable in the casing, valve mechanism controlling said admission ports and passages, comprising a cage formed in two separable sections, each of which forms a valve seat, a valve to control said seats, a locking and alining member to secure the sections together, said casing having a valve cage pocket to receive the valve cage, a cap closing said pocket, and a spring between said valve cage and said cap.

CHARLES H. HAESELER.

Witnesses:
H. S. FAIRBANKS,
C. D. MCVAY.