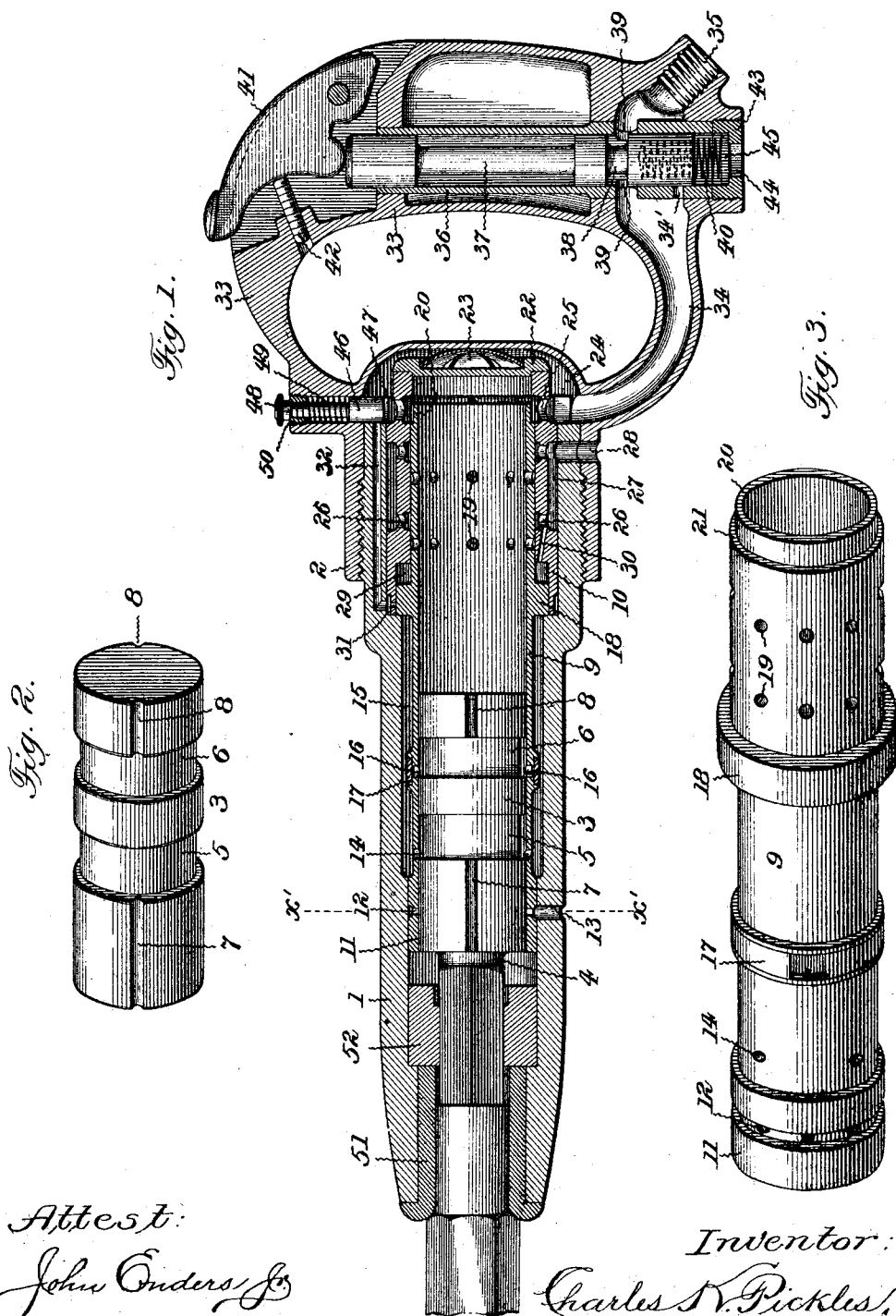


C. K. PICKLES.
PNEUMATIC IMPACT TOOL.
APPLICATION FILED AUG. 27, 1900.

1,029,082.

Patented June 11, 1912.

2 SHEETS—SHEET 1.



Attest:
John Enders, Jr.
Henry A. Nott

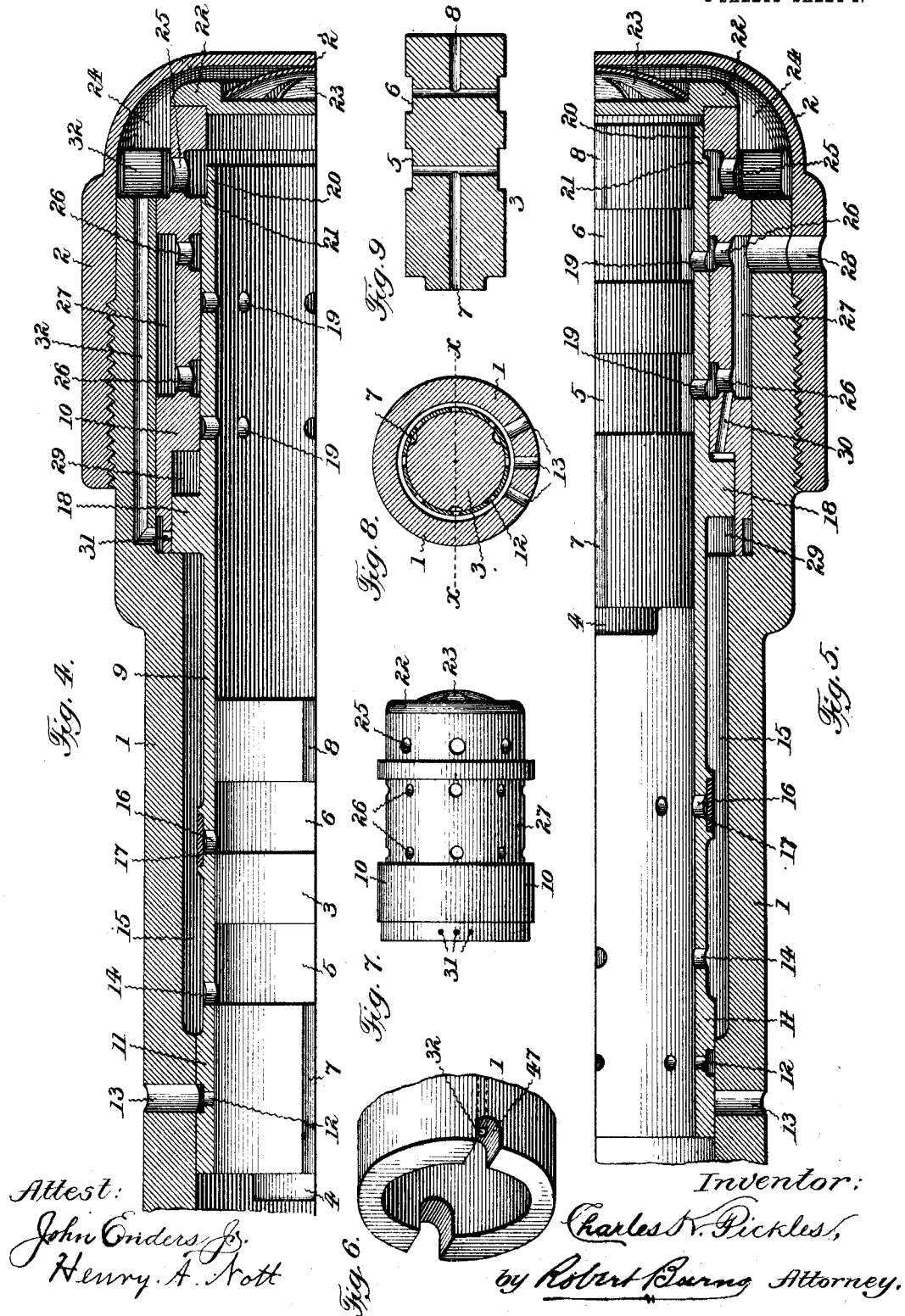
Inventor:
Charles K. Pickles,
by Robert H. Burns, Attorney.

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2 SHEETS—SHEET 2.



Attest:
John Criders, Jr.
Henry A. Kott

Inventor:
Charles V. Pickles,
by Robert R. Loring Attorney.

UNITED STATES PATENT OFFICE.

CHARLES K. PICKLES, OF ST. LOUIS, MISSOURI, ASSIGNOR, BY MESNE ASSIGNMENTS,
TO CHICAGO PNEUMATIC TOOL COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION
OF NEW JERSEY.

PNEUMATIC IMPACT-TOOL.

1,029,082.

Specification of Letters Patent.

Patented June 11, 1912.

Application filed August 27, 1900. Serial No. 28,247.

To all whom it may concern:

Be it known that I, CHARLES K. PICKLES, a citizen of the United States of America, and a resident of the city of St. Louis, in the State of Missouri, have invented certain new and useful Improvements in Pneumatic Impact-Tools, of which the following is a specification.

The present invention relates to that type of portable pneumatic impact tools or hammers in which a pneumatically operated controlling valve is automatically controlled by the impact piston in its movements.

The object of the present improvement is, in the main, to provide a simple, efficient and durable formation and arrangement of the parts of a pneumatic impact tool, which admits of the impact piston having a stroke greater than its own length; and with which an impact tool with any desired stroke can be provided with but very slight changes, and with a minimum length of the main outer casing or housing.

A further object of the present improvement is to provide a durable and effective means for fastening the hand grip or handle to the main casing or housing of the tool.

I attain such objects by the construction and arrangement of parts illustrated in the accompanying drawings, in which:

Figure 1, is a longitudinal sectional elevation at line $x-x$, Fig. 8, of a pneumatic impact tool or hammer, embodying the present improvements, and illustrating the parts in a position in which the impact piston is just ending its forward stroke, with the controlling valve ready to make its rearward reversal movement. Fig. 2, a detail perspective view of the impact piston. Fig. 3, a similar view of the controlling valve. Fig. 4, a detail longitudinal section of the controlling valve and its accessories, with the parts in the same position as in Fig. 1, with the impact piston nearing the end of its forward stroke, and the controlling valve ready to make its rearward reversal movement. Fig. 5, a companion view to Fig. 4, with the impact piston nearing the end of its rearward stroke, and the controlling valve ready to make its forward reversal movement. Fig. 6, a detail perspective view of the upper end of the main housing or casing. Fig. 7, a side elevation of the valve housing and its immediate accessories. Fig.

8, a transverse section at line $x'-x'$, Fig. 1. Fig. 9, an axial section of a modified construction of the impact piston.

Similar numerals of reference indicate like parts in the several views.

Referring to the drawings: 1, represents the main outer casing or housing of the present impact tool, (also commonly designated the barrel or cylinder) having the usual contracted forward end for receiving the shank of the cutting chisel or other tool, and a screw threaded exterior at its rear end upon which is screwed a closure cap 2, which with the present invention applied to a pneumatic hammer may be the attaching hub portion or socket of the hand grip or handle of such pneumatic hammer.

3, is the impact piston or plunger, of the usual solid cylindrical form, and having at its forward end the usual impact extension 4; in the present improvement such piston is formed with the forward and rearward annular grooves or recesses 5 and 6, and forward and rearward longitudinal passages 7 and 8, connecting in an individual manner the grooves 5 and 6, with the forward and rearward portions of the piston chamber of the impact tool for purposes hereinafter set forth. These portions are referred to in the claims for convenience as forward and rearward piston chambers respectively. In the practical construction of the impact piston it is immaterial whether the longitudinal passages 7 and 8, above described be formed in the periphery of the piston as illustrated in Figs. 1, 4, and 5, or in the body of the same as illustrated in Fig. 9, their functions and actions being identical in either construction.

In the preferred form of the present invention as illustrated in the accompanying drawings, the cylinder proper for the impact piston 3, also constitutes a controlling valve 9, by which the alternate reversal of the motive fluid pressure to the opposite ends of the impact piston is automatically attained, and to this end the said cylinder and valve 9, is capable of a limited longitudinal movement in the main outer casing 1, and in the stationary valve block 10, that is arranged in the rear end of such main casing. In the particular construction shown the said cylinder and controlling valve 9, as a cylinder for the impact piston will have a

cylindrical open ended bore fitting the piston in a fluid tight manner, and be of sufficient length to constitute the sole guide for the piston in its normal reciprocation in practical use; and as a controlling valve will involve features of construction as follows: 11, is a forward guide head, fitting a corresponding bore in the main housing 1, and provided with a series of radial ports 12, that are adapted in the forward position of said controlling valve to register the forward piston chamber with the lateral exhaust port 13, in the main housing to permit of an exhaust of the motive fluid from the forward piston chamber to the atmosphere, and in a rearward position of the valve to move out of register with the exhaust port 13, so that no inward suction can be induced therethrough by the rearward movement of the impact piston. 14, are a series of radial ports arranged back of the radial exhaust ports 12, above described, and adapted to register the interior of the combined valve and cylinder 9, with the longitudinally arranged annular chamber 15, between the inner wall of the main casing 1 and the periphery of said valve and cylinder, as shown in Figs. 1, 4 and 5. 16, are a series of radial ports arranged back of the radial ports 14, just described, and adapted to register the interior of the combined valve and cylinder 9, with the annular longitudinal chamber 15. 17, is a trap gate or valve controlling communication between the rearward piston chamber and the annular chamber 15, and preventing a back flow of motive fluid from such annular chamber into such rearward piston chamber; this valve may be located in any suitable position to effect the described result preferably on the exterior of the valve as shown in Figs. 1, 3, 4 and 5, and preferably consisting of a spring leaf closing over the series of ports 16; the object being to trap a portion of the expansible motive fluid from the rearward piston chamber in the annular chamber 15, for the purpose hereinafter set forth in the description of the operation of the present pneumatic impact tool. The relative arrangement of the series of ports 14 and 16, will be consonant with the arrangement of the annular grooves or recesses 5 and 6 of the impact piston, so that while the outer series 14, of said ports are in register with the outermost annular recess 5, of the piston, the rearward series 16 of said ports will be in register with the rearward annular recess 6, of said piston, as illustrated in Figs. 1 and 4. 18, is an annular peripheral enlargement or head arranged to the rear to the series of radial ports 16, and constituting a piston head of some area, that has movement in an annular piston chamber of the valve block 10, as hereinafter set forth. 19, are one or more series of radial ports arranged to the rear

of the head or enlargement 18, and adapted in the rearward position of the controlling valve 9, to register the rearward piston chamber with the exhaust passages of the valve block, to permit of an exhaust of the motive fluid from the rearward piston chamber to the atmosphere. In the preferred construction of the present invention as illustrated in the drawings, the rearmost set of the ports 19, will be arranged some distance forward of the extreme rear end of the controlling valve, so that when said ports are closed by the impact piston as it nears the end of its rearward stroke, a body of the motive fluid will be confined behind the piston to act as a cushion therefor, and which confined motive fluid in escaping to the atmosphere through the small longitudinal passages 8, of the piston, acts in a very perfect manner to effect a gradual check of the impact piston in its final backward movement. 20, is an offset extension that is adapted with the controlling valve in its rearward position, to cut off the supply of motive fluid to the rear piston chamber; and 21, an annular shoulder formed by the junction of the offset extension 20, and the body of the valve, and which annular shoulder is exposed to constant motive fluid pressure, in order that the normal tendency of the controlling valve will be to move to its forward position in the absence of other prevailing influences.

In the present construction the annular valve block 10, fits within a counterbore in the rear portion of the main housing 1, in which it is held in a stationary manner by the closure cap 2, heretofore described, through the instrumentality of the removable rear closure head 22, of the valve block, and an interposed spring 23. In addition to the above described functions the main closure cap 2, also provides a main supply chamber 24, at the rear end of the impact tool, which is in constant communication with the source of motive fluid supply during the operation of the tool.

The annular valve block 10, of the present construction is formed with ports and passages as follows: 25, are a series of radial ports adjacent to the rear end of the valve block, which ports are adapted to introduce motive fluid into the rear piston chamber, and are controlled by the rear end of the controlling valve 9. 26, are one or more series of radial ports arranged forward of the supply ports 25, and adapted in the rearward position of the controlling valve, to register with the exhaust ports 19, of such valve, to open communication between the rear piston chamber with the atmosphere. 27, is an annular exhaust chamber connecting with the exhaust ports 26, and with the main lateral exhaust opening 28, that extends through the main hous-

ing and the closure cap, to the atmosphere. 29, is a forward annular piston chamber, in which the annular enlargement or piston head 18, of the main controlling valve has movement in a fluid tight manner. 30, is an exhaust passage connecting the rear end of the piston chamber 29, of the valve block with the main exhaust chamber 27, of such valve block, and adapted to prevent a rapid movement of the main controlling valve in either direction, and thus prevent a hammering action of such valve, as well as any recoil or flutter of the valve. 31, are one or more lateral ports, controlled by the head or enlargement 18, of the main controlling valve, and receiving motive fluid from a longitudinal passage 32, in the main housing, which extends to and is in constant communication with the main motive fluid supply chamber 24.

While a practically efficient impact tool can be constructed without the provisions of the ports and passages 31 and 32, just described, their use is preferred more especially in long stroke impact tools as affording a certain and reliable means for insuring a full backward stroke of the impact piston.

With the present invention applied to yoke riveters and like uses, the rear end closure cap 2, will be in the form of an ordinary closure cap screwing upon the rear end of the main housing to effect a closure of the same; and with the invention applied to portable pneumatic hammers as illustrated in Fig. 1 of the drawings, such cap piece 2, will preferably form an integral part of the hand grip or handle 33, such hand grip in the construction illustrated will comprise features as follows: 34, is a supply passages formed in one of the branches of the hand grip and communicating at one end with the main supply chamber 24, in the rear end of the hammer, and at its other end provided with a projecting neck 35, which is internally screw threaded to receive the attaching nipple of the line of hose through which motive fluid is supplied to the impact tool, as usual in the present type of portable pneumatic tools. 36, is a casing or bushing intersecting the supply passage 33, and forming the cylinder for the manually actuated piston valve 37, by means of which the supply of motive fluid to the tool is controlled; such valve is formed with an annular recess 38, adapted to register with oppositely arranged ports 39, in the valve casing 36, and by its movements control the admission of motive fluid to the tool. 40, is a spring tending to move the valve 37 into its closed position. 41, is a pivoted trigger or thumb lever having engagement with one end of the throttle valve 36, and adapted to impart an opening movement to the same. 42 is a temper screw or other like means arranged in the path of the

thumb lever 41, so as to regulate and limit the amount of opening of the throttle valve 37, to suit the particular work upon which the impact tool is employed. In the present improvement the valve closing spring 40, is held in place by a cup shaped bushing 43, screwing into the hand grip 33, in axial alinement with the valve 37, and provided with a central orifice 44, and a disk shaped piece 45, which forms an abutment for the spring 40, and in addition thereto a spring impelled valve that normally closes the opening 44: with the described construction the nozzle of an oil can may be inserted into the opening 44, to displace the disk valve 45, and introduce a supply of oil into the small chamber between such valve and the adjacent end of the throttle valve 37, which oil will flow into the passage 34, through the lateral port 34', when the throttle valve 37, is in a closed position and in so flowing through the port 34', the oil will be in the path of the incoming motive fluid to be carried thereby to all the active parts of the hammer mechanism.

The hand grip or handle 33, is locked against its jarring loose from its attachment to the main housing 1, by the following means: 46, is a spring dog moving radially in the attaching cap or hub portion 2, of the hand grip; the inner end of said dog being arranged to engage in a notch or recess 47, in the rear end of the main housing to lock the parts in their proper relative position, while its outer and reduced end is screw threaded and provided with an exterior handle 48, by which said dog is capable of convenient rotation by hand. 49, is a spring tending to force said dog inwardly, and 50, is a bushing screwing into the hub or cap 2, and provided with a central screw threaded orifice in which turns the screw threaded outer end of the locking dog 46; the construction being such, that the spring dog must be rotated to effect an unlocking of the parts, the spring 49, tending to hold the said dog in its locking position against a jarring loose during a continued operation of the tool.

51, is the usual hardened bushing at the lower end of the main housing, inserted in the usual manner from the exterior of said housing and constituting a holder and guide for the shank of the cutting or other tool.

52, is a hardened bushing inserted from within the interior of the main housing and fitting against an offset shoulder of the same, to constitute a guide for the extreme upper end of the tool shank, and a removable abutment to receive the impact of the impact piston when the same has an abnormal stroke due to the accidental removal of the tool shank from its proper position in said bushings.

The operation of the present pneumatic

impact tool mechanism, is as follows: Starting with the impact piston and the controlling valve in the position illustrated in Figs. 1 and 4, motive fluid contained in the rear piston chamber, passes through the rearward longitudinal passage 8, of the piston into the rearward annular groove 6, and from thence through the lateral ports 16, and through the trap gate or valve 17, into the annular chamber 15, into which the said fluid pressure is trapped by the valve 17, and exerts its expansive force upon the annular piston enlargement 18, of the main controlling valve to assist in forcing such valve into its rearward position, at the same time such fluid pressure passes through the lateral ports 14, into the forward annular groove 5, and through forward longitudinal passage 7, into the lower piston chamber to press against the lower annular end of the main controlling valve, to also aid in the rearward movement of such valve. Such pressure in the lower piston chamber also operates to impart the initial backward movement to the main impact piston 3, which rearward movement of the impact piston is completed, in my preferred construction illustrated in the drawings, by the valve enlargement 18, uncovering the inlet port 31, of the valve block to admit additional motive fluid into the lower piston chamber through annular chamber 15 and ports 14, from the source of constant pressure supply. The rearward movement of the main controlling valve 9, is preliminary to the rearward movement of the impact piston, and said valve in moving into such rearward position cuts off the supply of motive fluid to the rearward piston chamber, and at the same time opens said rear piston chamber to the atmosphere through radial ports 19 and 26, chamber 27 and passage 28. In a simpler form of the present construction the inlet port 31, and passage 32, may be omitted and reliance placed upon the expansion of the body of motive fluid trapped in the annular chamber 15, as the sole means for effecting the return or backward stroke of the impact piston. As the impact piston nears the end of its rearward stroke and after passing the rearmost series of radial ports 19 said piston will confine a portion of the motive fluid in the rear portion of the rearward piston chamber, which motive fluid can only escape to the exhaust through the small longitudinal passage 8, of the piston and in consequence the final rearward movement of the piston is checked in a very even manner and the usual jarring of the tool due to a sudden rearward stoppage of the piston, is eliminated. With the impact piston in its rearward position, its forward annular groove 5, registers with the forward series of exhaust ports 19, of the valve and the similar series of exhaust ports 26 of the

valve block, and permits of an exhaust of the motive fluid from the forward piston chamber through the longitudinal piston passage 7 and the groove and ports 5, 19 and 26, just mentioned; with a relief of motive fluid pressure in the lower piston chamber and the consequent removal of pressure from the forward and larger pressure area of the main controlling valve 9, constant motive fluid pressure upon the smaller rearward area of controlling valve afforded by the annular shoulder 21, will again force said valve into its forward position to again open the exhaust ports 12 and 13 of the forward piston chamber, and the motive fluid supply to the rearward piston chamber to effect a fresh forward movement to the impact piston, and fresh cycle of the operations just described.

A novel and material feature of the present invention involves the admission by means of the piston of motive fluid pressure from the rear piston chamber into the forward piston chamber to effect a backward stroke of said piston, in whole or part.

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

1. In a pneumatic impact tool having a piston chamber, a piston formed with a pair of independent annular grooves and longitudinal passages extending to opposite ends of the piston, and adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to effect a return movement of the piston, and means for so admitting the motive fluid substantially as set forth.

2. In a pneumatic impact tool, a piston formed with a pair of independent annular grooves and longitudinal passages extending to opposite ends of the piston, and adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to effect a return movement of the piston, and means to prevent a reflux of motive fluid into the rear of piston chamber, and means for so admitting the motive fluid substantially as set forth.

3. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, and an impact piston adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to effect a return movement of the piston, and means for so admitting the motive fluid substantially as set forth.

4. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, and an impact piston adapted to control means for admitting a limited quantity of motive fluid from the rear piston chamber

to the forward piston chamber to impart an initial return movement to the piston, and means for so admitting the motive fluid substantially as set forth.

5 5. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston adapted to control means for admitting motive fluid from the rear
10 piston chamber to the forward piston chamber to effect a return movement of the piston, means for so admitting the motive fluid and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

15 6. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston adapted to control means
20 for admitting a limited quantity of motive fluid from the rear piston chamber to the forward piston chamber to impart an initial return movement of the piston, means for so admitting the motive fluid and means to
25 prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

30 7. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, and an impact piston formed with a pair of independent annular grooves and longitudinal
35 passages extending to opposite ends of the piston, and adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to effect a return movement of the piston, and means for so admitting the motive fluid substantially as set forth.

40 8. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston formed with a pair of independent annular grooves and longitudinal
45 passages extending to opposite ends of the piston, and adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to effect a return movement of the piston,
50 means for so admitting the motive fluid and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

55 9. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve movable longitudinally of the casing, and an impact or hammering piston adapted to control means for admitting motive fluid
60 from the source of pressure supply through the rear to the forward end of the valve to effect a reversal of the same and also to control admission of motive fluid to the front piston chamber, and means for so admitting
65 the motive fluid; substantially as set forth.

10. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston adapted to control means for admitting motive fluid from the source
70 of pressure supply through the rear piston chamber to the larger area of the controlling valve to effect a reversal of the same, means for so admitting the motive fluid and means to prevent a flow of motive fluid from
75 the valve chamber into the rear of piston chamber, substantially as set forth.

11. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact or hammering piston adapted to control means for admitting motive fluid from the source of supply through the rear
80 piston chamber to the forward end of the valve to effect a rearward movement of said valve to cut off communication of the forward piston chamber with the exhaust and
85 open the rear piston chamber to the exhaust, means for so admitting the motive fluid, and means for preventing the reflex of the motive fluid so admitted; substantially as set forth.

12. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston adapted to control means for admitting motive fluid from the source of pressure supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to cut off communication of the forward piston chamber with the exhaust and open the rear piston chamber to the exhaust, means for so admitting the motive fluid and means to prevent a reflux of motive fluid into the rear
105 of piston chamber, substantially as set forth.

13. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve movable longitudinally of the casing, and an impact or hammering piston adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to open communication between the source of constant pressure and the forward piston chamber, said piston being movable within said valve, and means for so admitting the motive fluid; substantially as set forth.

14. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to open communication between the source of con-
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stant pressure and the forward piston chamber, means for so admitting the motive fluid and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

15. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, and an impact piston adapted in its rearward travel to control means for opening the forward piston chamber to the exhaust to permit a forward movement of the controlling valve, said piston being constructed to admit motive fluid to the forward piston chamber, and means for so admitting the motive fluid; substantially as set forth.

16. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston adapted in its rearward travel to control means for opening the forward piston chamber to the exhaust to permit a forward movement of the controlling valve to admit motive fluid to the rear piston chamber and close communication between the source of constant pressure and the forward piston chamber and in its forward travel to admit pressure to the valve to shift the same in the other direction, means for preventing the reflex of the pressure so admitted, and means for so admitting the motive fluid; substantially as set forth.

17. In a pneumatic impact tool in which the stroke of the piston is in excess of length, the combination of a main casing, a cylindrical hammering piston the diameter of which is uniform as to pressure areas, and a valve actuated by the motive fluid pressure controlled by the movement of the piston and having ports governed thereby, substantially as set forth.

18. In a pneumatic impact tool in which the stroke of the piston is in excess of its length, the combination of a main casing, a cylindrical hammering piston the diameter of which is the same at opposite ends, and a fluid actuated controlling valve exposed to constant pressure on one end and to intermittent pressure on the other end, said valve having ports governed by the piston, substantially as set forth.

19. In a pneumatic impact tool, the combination of a main casing, a fluid actuated controlling valve having ports governed by the piston in its reciprocations and an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply to the forward end of the valve to effect a reversal of the same and to the forward end of the piston to effect a reversal of the latter, substantially as set forth.

20. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve,

an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply to the forward end of the valve to effect a reversal of the same, and means to prevent a reflux of motive fluid into the rear of piston chamber, and means for so admitting the motive fluid substantially as set forth.

21. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve movable longitudinally of the casing, and an impact or hammering piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the piston chamber to the forward end of the valve to effect a reversal of the same, means for so admitting the motive fluid, and means for preventing a reflex of the motive fluid so admitted; substantially as set forth.

22. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a reversal of the same, means for so admitting the motive fluid and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

23. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve movable longitudinally of the casing, and an impact or hammering piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the piston chamber to the forward end of the valve to effect a rearward movement of said valve to cut off communication of the forward portion of the piston chamber with the exhaust and to open the rear piston chamber to the exhaust, and means for so admitting the motive fluid, said piston controlling the admission of motive fluid to the front end of the piston chamber; substantially as set forth.

24. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to cut off communication of the forward piston chamber with the exhaust and open the rear piston chamber to the exhaust, means for so admitting the motive fluid and means to pre-

vent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

25. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to open communication between the source of constant pressure and the forward piston chamber, means for so admitting the motive fluid, and means to prevent a reflex of the motive fluid into the rear of the piston chamber, substantially as set forth.

26. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to open communication between the source of constant pressure and the forward piston chamber, means for so admitting the motive fluid, and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

27. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, and an impact piston having a stroke in excess of its length and having a groove adapted in the piston's rearward travel to control means for opening the forward piston chamber to the exhaust to permit a forward movement of the controlling valve, said piston being arranged to admit the motive fluid to the valve to reverse it, and means for so admitting the motive fluid; substantially as set forth.

28. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, and an impact piston having a stroke in excess of its length and carrying means adapted in its rearward travel to control means for opening the forward piston chamber to the exhaust to permit a forward movement of the controlling valve, to admit motive fluid to the rear piston chamber, and close communication between the source of constant pressure and the forward piston chamber, said piston being arranged to admit the motive fluid to the valve to reverse it, and means for so admitting the motive fluid; substantially as set forth.

29. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, and an impact piston having a stroke in ex-

cess of its length and adapted to control means for admitting motive fluid from the rear piston chamber through the piston to the forward piston chamber to effect a return movement of the piston, and means for so admitting the motive fluid, substantially as set forth.

30. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, and an impact piston having a stroke in excess of its length and adapted to control means for admitting a limited quantity of motive fluid from the rear piston chamber through the piston to the forward piston chamber to impart an initial return movement to the piston, and means for so admitting the motive fluid, substantially as set forth.

31. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, and an impact piston having a stroke in excess of its length and formed with a pair of independent annular grooves and longitudinal passages extending to opposite ends of the piston, and adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to impart an initial return movement to the piston and means for so admitting the motive fluid, substantially as set forth.

32. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to effect a return movement of the piston, means for so admitting the motive fluid, and means to prevent a flow of motive fluid from the valve chamber into the rear of piston chamber, substantially as set forth.

33. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston having a stroke in excess of its length and adapted to control means for admitting a limited quantity of motive fluid from the rear piston chamber to the forward piston chamber to impart an initial return movement to the piston, means for so admitting the motive fluid, and means to prevent a flow of motive fluid from the valve chamber into the rear of piston chamber, substantially as set forth.

34. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, and an impact piston adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston

chamber to effect a return movement of the piston, and means for so admitting the motive fluid, substantially as set forth.

35. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, and an impact piston adapted to control means for admitting a limited quantity of motive fluid from the rear piston chamber to the forward piston chamber to impart an initial return movement to the piston, and means for so admitting the motive fluid, substantially as set forth.

36. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to effect a return movement of the piston, means for so admitting the motive fluid and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

37. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston adapted to control means for admitting a limited quantity of motive fluid from the rear piston chamber to the forward piston chamber to impart an initial return movement to the piston, means for so admitting the fluid and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

38. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, and an impact piston formed with a pair of independent annular grooves and longitudinal passages extending to opposite ends of the piston, and adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to effect a return movement of the piston, and means for so admitting the motive fluid, substantially as set forth.

39. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston formed with a pair of independent annular grooves and longitudinal passages extending to opposite ends of the piston, and adapted to control means for admitting motive fluid from the rear piston

chamber to the forward piston chamber to effect a return movement of the same, means for so admitting the motive fluid and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

40. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, and an impact piston adapted to control means for admitting motive fluid from the source of pressure supply through the rear piston chamber to the forward end of the valve to effect a reversal of the same, and means for so admitting the motive fluid, substantially as set forth.

41. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston adapted to control means for admitting motive fluid from the source of pressure supply through the rear piston chamber to the forward end of the valve to effect a reversal of the same, means for so admitting the motive fluid and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

42. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, and an impact piston adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to cut off communication of the forward piston chamber with the exhaust and open the rear piston chamber to the exhaust, and means for so admitting the motive fluid, substantially as set forth.

43. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to cut off communication of the forward piston chamber with the exhaust and open the rear piston chamber to the exhaust, means for so admitting the motive fluid and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

44. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve

having an annular open ended form and constituting the cylinder for the impact piston, and an impact piston adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to open communication between the source of constant pressure and the forward piston chamber, and means for so admitting the motive fluid, substantially as set forth.

45. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to open communication between the source of constant pressure and the forward piston chamber, means for so admitting the motive fluid and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

46. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, and an impact piston adapted in its rearward travel to control means for opening the forward piston chamber to the exhaust to permit a forward movement of the controlling valve, and means for so admitting the motive fluid, substantially as set forth.

47. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, and an impact piston adapted in its rearward travel to control means for opening the forward piston chamber to the exhaust to permit a forward movement of the controlling valve to admit motive fluid to the rear piston chamber and close communication between the source of constant pressure and the forward piston chamber, and means for so admitting the motive fluid, substantially as set forth.

48. In a pneumatic impact tool, the combination of a main casing, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, and an impact piston having a stroke in excess of its length, and arranged to control the pressure to and from the valve for operating the latter; substantially as set forth.

49. In a pneumatic impact tool, the combination of a main casing, a fluid actuated controlling valve having an annular open

ended form and constituting the cylinder for the impact piston and exposed to constant pressure on one end and to intermittent pressure on the other end, and an impact piston having a stroke in excess of its length, substantially as set forth.

50. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for impact piston, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a reversal of the same, and means for so admitting the motive fluid, substantially as set forth.

51. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for impact piston, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a reversal of the same, means for so admitting the motive fluid and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

52. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, and an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to cut off communication of the forward piston chamber with the exhaust and open the rear piston chamber to the exhaust, and means for so admitting the motive fluid, substantially as set forth.

53. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to cut off communication of the forward piston chamber with the exhaust and open the rear piston chamber to the exhaust, means for so admitting the motive fluid and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

54. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, and an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve, to open communication between the source of constant pressure and the forward piston chamber, and means for so admitting the motive fluid, substantially as set forth.

55. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve, to open communication between the source of constant pressure and the forward piston chamber, means for so admitting the motive fluid and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

56. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, and an impact piston having a stroke in excess of its length and adapted in its rearward travel to control means for opening the forward piston chamber to the exhaust to permit a forward movement of the controlling valve, and means for so admitting the motive fluid, substantially as set forth.

57. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, and an impact piston having a stroke in excess of its length and adapted in its rearward travel to control means for opening the forward piston chamber to the exhaust to permit a forward movement of the controlling valve to admit motive fluid to the rear piston chamber and close communication between the source of constant pressure and the forward piston chamber, and means for so admitting the motive fluid, substantially as set forth.

58. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact

piston, and an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to effect a return movement of the piston, and means for so admitting the motive fluid, substantially as set forth.

59. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open-ended form and constituting the cylinder for the impact piston, and an impact piston having a stroke in excess of its length and adapted to control means for admitting a limited quantity of motive fluid from the rear piston chamber to the forward piston chamber to effect an initial return movement of the piston, and means for so admitting the motive fluid, substantially as set forth.

60. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, and an impact piston having a stroke in excess of its length and formed with a pair of independent annular grooves and longitudinal passages extending to opposite ends of the piston, and adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to impart an initial return movement to the piston, and means for so admitting the motive fluid, substantially as set forth.

61. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to effect a return movement of the piston, means for so admitting the motive fluid, and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

62. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston having a stroke in excess of its length and adapted to control means for admitting a limited quantity of motive fluid from the rear piston chamber to the forward piston chamber to impart an initial return movement to piston, means for admitting the motive fluid, and means to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

63. In a pneumatic impact tool, the combination of a main casing having a piston

chamber, a fluid actuated controlling valve, an impact piston adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to effect a return movement of the piston, means for so admitting the motive fluid, and means carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

64. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston formed with a pair of independent annular grooves and longitudinal passages extending to opposite ends of the piston, and adapted to control means for admitting motive fluid from the rear piston chamber to effect a return movement of the piston, means for so admitting the motive fluid, and means carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

65. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston adapted to control means for admitting motive fluid from the source of pressure supply through the rear piston chamber to the forward end of the valve to effect a reversal of the same, means for so admitting the motive fluid and means carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

66. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston adapted to control means for admitting motive fluid from the source of pressure supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to cut off communication of the forward piston chamber with the exhaust and open the rear piston chamber to the exhaust, means for so admitting the motive fluid and means carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

67. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to open communication between the source of constant pressure and the forward piston chamber, means for so admitting the motive fluid and means carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

tive fluid into the rear of piston chamber, substantially as set forth.

68. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a reversal of the same, means for so admitting the motive fluid and means carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

69. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to cut off communication of the forward piston chamber with the exhaust and open the rear piston chamber to the exhaust, means for so admitting the motive fluid and means carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

70. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to open communication between the source of constant pressure and the forward piston chamber, means for so admitting the motive fluid and means carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

71. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to effect a return movement of the piston, means for so admitting the motive fluid and means carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.

72. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston,

- an impact piston adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to effect a return of the piston, means for
- 6 so admitting the motive fluid and means carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.
73. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston adapted to control
- 10 means for admitting motive fluid from the source of pressure supply through the rear piston chamber to the forward end of the valve to effect a reversal of the same, means for so admitting the motive fluid and means
- 15 carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.
74. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston adapted to control
- 25 means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to cut off communication of the forward piston chamber with the exhaust and open the rear piston chamber to the exhaust, means for so admitting the motive fluid and means
- 30 carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.
75. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a
- 35 rearward movement of said valve to open communication between the source of constant pressure and the forward piston chamber, means for so admitting the motive fluid and means carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.
76. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston having a stroke in excess of its length and adapted to control
- 40 means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to cut off communication of the forward piston chamber with the exhaust and open the rear piston chamber to the exhaust, means for so admitting the motive fluid and means
- 45 carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.
77. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to cut off communication of the forward piston chamber with the exhaust and open the rear piston chamber to the exhaust, means for so admitting the motive fluid and means
- 50 carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.
78. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the source of supply through the rear piston chamber to the forward end of the valve to effect a rearward movement of said valve to open communication between the source of constant pressure and the forward piston chamber, means for admitting the motive fluid and means carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.
79. In a pneumatic impact tool, the combination of a main casing having a piston chamber, a fluid actuated controlling valve having an annular open ended form and constituting the cylinder for the impact piston, an impact piston having a stroke in excess of its length and adapted to control means for admitting motive fluid from the rear piston chamber to the forward piston chamber to effect a return movement of the piston, means for admitting the motive fluid and means carried by the controlling valve and adapted to prevent a reflux of motive fluid into the rear of piston chamber, substantially as set forth.
80. In a pneumatic impact tool of the character herein described, the combination of the main housing, the annular valve block, a closure head for the rear end of the valve block, a closure cap for the rear end of the main housing and a spring interposed be-

tween said closure head and closure cap, substantially as set forth.

81. In a pneumatic impact tool of the character herein described, the combination with the main housing provided with an interior shoulder at its lower end, of an interior bushing bearing against said shoulder, and an exteriorly inserted bushing fitting the reduced forward bore of the main housing, substantially as set forth.

82. In a pneumatic impact tool of the character herein described, the combination of the main housing, the annular valve block, a closure cap for the rear end of the main housing, a spring dog adapted to move radially in the closure cap, and engage a recess in the rear end of the housing, and a bushing screwing to the closure cap and provided with a screw threaded orifice, the spring dog being formed with a screw threaded outer end adapted to engage in the aforesaid bushing and with a handled outer end, substantially as set forth.

83. In a pneumatic hammer, the combination of a cylinder, a hammering piston therein, and a single valve structure for controlling the admission and release of pressure to and from the cylinder for reciprocation of the piston and operated by pressure controlled thereby, said valve being a sleeve open at its front end for the passage of the piston and of greater length than the piston and forming the chamber in which the latter reciprocates.

84. In a pneumatic hammer, the combination of a cylinder, a hammering piston therein, and a single valve structure for controlling the admission and release of pressure to and from the cylinder for reciprocation of the piston and operated by pressure controlled thereby, said valve being of greater length than the piston and movable longitudinally of the cylinder and consisting of a sleeve concentric of the piston and open at its front end for the passage of the piston.

85. In a pneumatic hammer, the combination of a cylinder, a hammering piston therein, a single valve structure for controlling the admission and release of pressure to and from the piston chamber, said piston controlling the admission of pressure to the front end of the piston chamber, and said cylinder having at its front end an exhaust port controlled by said valve which moves thereover for exhausting the front end of the piston chamber after the return of the piston is initiated.

86. In a pneumatic hammer, the combination of a cylinder, a piston therein having a length of stroke greater than its own length, and a single valve structure for controlling the admission and release of pressure to and from the cylinder and of greater length than the piston, said valve structure

being arranged concentric of the piston to form the piston chamber proper and being operated in both directions wholly by fluid pressure controlled by such piston.

87. In a pneumatic hammer, the combination of a cylinder, a hammering piston therein having a length of stroke greater than its own length, and a single valve structure for controlling the release of pressure to and from the cylinder and operated in both directions wholly by fluid pressure controlled by such piston, said valve structure being of substantially the same length as the bore of the cylinder and consisting of a sleeve open at its front end for the passage of the piston and concentric of such piston to form the piston chamber proper for the latter.

88. In a pneumatic hammer, the combination of a cylinder, a piston therein, and a valve concentric of the piston and exposed on one side to constant pressure and on the other side to pressure controlled by the piston in its reciprocations, said piston controlling the admission of motive fluid to the front end of the piston chamber.

89. In a pneumatic hammer, the combination of a cylinder, a piston therein, and a valve concentric of the piston and exposed on one side to constant live pressure and on the other side to pressure intermittently admitted by the piston in its reciprocations, said valve controlling the motive fluid to the rear end of the piston chamber and said piston to the front end thereof.

90. In a pneumatic hammer, the combination of a cylinder, a piston therein, and a differential valve moved in one direction by the live fluid pressure and in the other direction by fluid pressure controlled by the piston, said valve forming a chamber in which the piston reciprocates and which together with the cylinder has rear exhaust ports arranged at such distance from the rear end thereof to provide a space for confining the fluid pressure upon the return or rearward stroke of the piston, thereby cushioning the latter.

91. In a pneumatic hammer, the combination of a cylinder, a piston therein, and a differential valve concentric of the piston and moved rearwardly by pressure admitted by the piston against its larger pressure area and forwardly by live or normal pressure acting constantly against its smaller pressure area, said valve having a port governed by the piston and through which the pressure is so admitted.

92. In a pneumatic hammer, the combination of a cylinder, a piston therein, and a hollow differential valve of substantially the same length as the cylinder bore and forming the chamber in which the piston reciprocates, said valve being differential and moved in one direction by live or normal

fluid pressure and in the other direction by fluid pressure controlled by the piston.

93. In a pneumatic hammer, the combination of a cylinder having a pressure chamber for the valve, a piston in the cylinder, a valve concentric of the piston and cooperating with said pressure chamber, said piston being arranged to control fluid pressure to said chamber for moving the valve in one direction and means for preventing the return of such pressure.

94. In a pneumatic hammer, the combination of a cylinder having a pressure chamber extending longitudinally and intermediate the length of the valve, a piston in the cylinder, and a valve cooperating with said pressure chamber which is located between the inner walls of the cylinder and the valve, said piston being arranged to control fluid pressure to said chamber for moving the valve in one direction by the expansion of the fluid pressure admitted to and confined within said chamber.

95. In a pneumatic hammer, the combination of a cylinder having a longitudinal bore or chamber, a differential shell valve sliding therein, and a piston whose diameter equals the internal diameter of the valve and which is arranged to travel there-within, said cylinder having a pressure chamber formed between its inner wall and the valve and adapted to contain fluid pressure to move the valve in one direction by the expansion thereof, said valve being subjected to a constant pressure upon its smaller pressure area and to an intermittent pressure upon its other or larger pressure area as controlled by the piston.

96. In a pneumatic hammer, the combination of a cylinder, a piston therein, and formed as a sleeve within which the piston reciprocates, said cylinder having a pressure chamber located between its inner wall and the valve and adapted to contain fluid pressure to move the valve in one direction.

97. In a pneumatic hammer, the combination of a cylinder, a piston therein and a valve comprising a sleeve in which the piston reciprocates, said cylinder having a pressure chamber formed between its inner wall and the valve and adapted to contain fluid pressure, and said valve being differential with its larger pressure area exposed to said pressure chamber.

98. In a pneumatic hammer, the combination of a cylinder, a piston, a valve of greater length than the piston and within which the latter reciprocates, said cylinder having a pressure chamber formed between its inner wall and the valve and adapted to contain fluid pressure, and said valve being differential with its larger pressure area exposed to said pressure chamber and with its smaller pressure area exposed to constant live or normal pressure.

99. In a pneumatic hammer, the combination of a cylinder, a piston therein, and formed as a sleeve within which the piston reciprocates, said cylinder having a pressure chamber located between its inner wall and the valve and adapted to contain fluid pressure, and said valve being differential with its larger pressure area exposed to said pressure chamber and its smaller pressure area to constant live or normal pressure.

100. In a pneumatic hammer, the combination of a cylinder, a valve for admitting fluid pressure to the rear end of the cylinder to impel the piston forward, and a piston reciprocable within the cylinder and carrying means, which in cooperation with the valve, are arranged to control the admission of pressure from the rearward to the forward end of the piston for its return or rearward stroke.

101. In a pneumatic hammer, the combination of a cylinder, a valve for admitting fluid pressure to the rear end of the cylinder to impel the piston forward, and a piston reciprocable within the cylinder and having passages for the fluid pressure for returning the piston.

102. In a pneumatic hammer, the combination of a cylinder, a valve therein for governing the fluid pressure to and from the rearward end of the cylinder, and a piston reciprocable in the cylinder and carrying means for governing the fluid pressure to the forward end of the cylinder.

103. In a pneumatic hammer, the combination of a cylinder, a valve therein for governing the fluid pressure to and from the rearward end of the cylinder, such cylinder having a pressure chamber between it and the valve, and a piston reciprocable in the cylinder and governing the fluid pressure therethrough to the forward end of the cylinder to impel the piston on its return or rearward stroke.

104. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, and a valve therein controlling fluid pressure to opposite ends of the cylinder, said piston having means for admitting fluid pressure to the forward end of the cylinder preliminarily to the admission of fluid pressure thereto by the valve.

105. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, and a valve therein controlling fluid pressure to opposite ends of the cylinder, said piston having means for admitting fluid pressure from the cylinder or piston chamber to the forward end of the cylinder preliminarily to the admission of fluid pressure thereto by the valve.

106. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, and a valve therein controlling fluid pressure to opposite ends of the cylinder,

said piston having means for admitting fluid pressure to the forward end of the cylinder and also against the valve to shift the latter rearwardly to admit additional
5 fluid pressure to the forward end of the cylinder.

107. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, and a valve therein controlling
10 fluid pressure to opposite ends of the cylinder, said piston having means for admitting fluid pressure from the rear end to the forward end of the cylinder and also
15 against the valve to shift the latter rearwardly to admit live fluid pressure to the forward end of the cylinder and thereby complete the return of the piston initiated by the pressure admitted by the piston.

108. In a pneumatic hammer, the combination of a cylinder, a valve therein for governing the fluid pressure to and from
20 the rearward end of the cylinder, and a piston reciprocable in the cylinder and having ports and passages which, in coöperation with the valve, are arranged to commu-
25 cate between its opposite ends.

109. In a pneumatic hammer, the combination of a cylinder, a valve therein for governing the fluid pressure to and from
30 the rearward end of the cylinder; and a piston reciprocable in the cylinder and having ports and passages which are adapted to coöperate with the valve and communicate between opposite sides of the piston when
35 the latter is at the end of its forward stroke.

110. In a pneumatic hammer, the combination of a cylinder having exhaust ports located at such distance from the rear end as to be closed by the piston in its rearward
40 stroke, a piston reciprocable in the cylinder and having a small port for the gradual escape of fluid pressure trapped by it on its rearward stroke after closing the exhaust ports, and a valve governing the pres-
45 sure to and from the cylinder.

111. In a pneumatic hammer, the combination of a cylinder having exhaust ports located at such distance from the rear end as to be closed by the piston in its rearward
50 stroke, a piston reciprocable in the cylinder, a valve governing the pressure to and from the cylinder, and means for permitting the gradual escape of pressure trapped in the rear end of the cylinder by the piston on its
55 rearward stroke after closing said exhaust ports.

112. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, and a differential valve for control-
60 ling the pressure and arranged concentric of the piston, the smaller pressure area of such valve being constantly exposed to live fluid pressure and the larger pressure area to fluid pressure alternately admitted there-

against, said valve consisting of a sleeve in
65 which the piston travels.

113. In a pneumatic hammer, the combination of a cylinder, a fluid actuated controlling valve therein, exposed on one end to constant pressure, said valve being of a
70 greater length than the piston, and on the other end to intermittent pressure, and an impact piston reciprocable within the valve.

114. In a pneumatic hammer, the combination of a cylinder, a fluid actuated con-
75 trolling valve therein, forming the piston chamber and exposed on one end to constant pressure and on the other end to intermittent pressure, and an impact piston reciprocable in the piston chamber of such
80 valve.

115. In a pneumatic hammer, the combination of a cylinder, a fluid actuated controlling valve therein forming the piston chamber and exposed on one end to constant
85 pressure and on the other end to intermittent pressure, and an impact piston reciprocable in the piston chamber of such valve, and having a length of stroke greater than its own length, said valve being substan-
90 tially of the same length as said piston stroke.

116. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, and a valve having an enlargement
95 forming a pressure area, one side of which is constantly exposed to exhaust through an always open port to atmosphere and the other side of which is intermittently exposed to pressure.
100

117. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, and a valve having intermediate its
length an enlargement against one side of which the pressure is intermittently admit-
105 ted to move the valve rearwardly and whose other side is constantly exposed to atmosphere, the rear end of such valve being constantly exposed to live pressure and having a port governed by the piston and through
110 which the pressure is thus intermittently admitted.

118. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, and a valve forming a chamber for
115 the piston to travel in and having intermediate its length an enlargement against one side of which the pressure is intermittently admitted to move the valve rearwardly, the rear end of such valve being constantly ex-
120 posed to live pressure and the forward end of the valve being intermittently exposed to pressure.

119. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable
125 therein, and a valve having intermediate its length an enlargement against one side of which the pressure is intermittently admit-

ted to move the valve rearwardly, the rear end of such valve being constantly exposed to live pressure and the forward end of the valve being intermittently exposed to pressure controlled by the piston.

120. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, and a valve having an enlargement movable in a chamber in the cylinder and exposed on one side to atmosphere through an always open port and on the other side to pressure intermittently admitted thereagainst, the rear end of said valve being exposed to constant live pressure and the front end thereof being exposed to the front end of the cylinder or piston chamber.

121. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, and a valve having intermediate its length an enlargement movable in a chamber in the cylinder and exposed on one side to pressure intermittently admitted thereagainst, by the piston, the rear end of said valve being exposed to constant live pressure tending to hold the valve to forward position, said valve having a port controlled by the piston through which the pressure is thus intermittently admitted.

122. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, and a valve having an enlargement movable in a chamber in the cylinder and exposed on one side to pressure intermittently admitted thereagainst, and said piston having suitable ports and passages for so admitting the pressure intermittently against said enlargement and also for admitting such pressure intermittently to the forward end of the valve.

123. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, a hollow valve movable in line with the piston and in which the latter is arranged to travel, said valve having an enlargement admitted to move the valve in one direction, and means for moving the valve in the opposite direction.

124. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, a hollow valve movable in line with the piston and in which the latter is arranged to travel, said valve having an enlargement against which the pressure is intermittently admitted to move the valve in one direction, and constantly exposed to live pressure tending to move it in the opposite direction.

125. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, a hollow valve in which the piston travels and which controls the pressure to opposite ends of the cylinder, one end of said valve being constantly exposed to live pressure tending to move it in one direction, and means for shifting the valve in the opposite direction.

126. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, a hollow valve in which the piston travels and which controls the pressure to opposite ends of the cylinder, said valve having differential pressure areas, the smaller one of which is constantly exposed to live pressure and the larger one of which is subject to pressure intermittently acting thereagainst.

127. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, a hollow valve in which the piston travels and which controls the pressure to opposite ends of the cylinder, said valve having differential pressure areas, the smaller one of which is constantly exposed to live pressure and the larger one of which is intermittently acted upon by pressure controlled by the piston.

Signed at Chicago, Ills., this 22nd day of August 1900.

CHARLES K. PICKLES.

Witnesses:

ROBERT BURNS,
HENRY A. NOTT.

ted to move the valve rearwardly, the rear end of such valve being constantly exposed to live pressure and the forward end of the valve being intermittently exposed to pressure controlled by the piston.

120. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, and a valve having an enlargement movable in a chamber in the cylinder and exposed on one side to atmosphere through an always open port and on the other side to pressure intermittently admitted thereagainst, the rear end of said valve being exposed to constant live pressure and the front end thereof being exposed to the front end of the cylinder or piston chamber.

121. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, and a valve having intermediate its length an enlargement movable in a chamber in the cylinder and exposed on one side to pressure intermittently admitted thereagainst, by the piston, the rear end of said valve being exposed to constant live pressure tending to hold the valve to forward position, said valve having a port controlled by the piston through which the pressure is thus intermittently admitted.

122. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, and a valve having an enlargement movable in a chamber in the cylinder and exposed on one side to pressure intermittently admitted thereagainst, and said piston having suitable ports and passages for so admitting the pressure intermittently against said enlargement and also for admitting such pressure intermittently to the forward end of the valve.

123. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, a hollow valve movable in line with the piston and in which the latter is arranged to travel, said valve having an enlargement intermittently admitted to move the valve in one direction, and means for moving the valve in the opposite direction.

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127. In a pneumatic hammer, the combination of a cylinder, a piston reciprocable therein, a hollow valve in which the piston travels and which controls the pressure to opposite ends of the cylinder, said valve having differential pressure areas, the smaller one of which is constantly exposed to live pressure and the larger one of which is intermittently acted upon by pressure controlled by the piston.

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."

Corrections in Letters Patent No. 1,029,082

It is hereby certified that in Letters Patent No. 1,029,082, granted June 11, 1912, upon the application of Charles K. Pickles, of St. Louis, Missouri, for an improvement in "Pneumatic Impact-Tools," errors appear in the printed specification requiring correction as follows: Page 4, line 104, after the word "tool" insert the words *having a piston chamber*; page 12, line 86, after the word "piston" insert the word *chamber*; page 16, after line 44, insert the syllables and words *largement against which the pressure is in-*; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 22nd day of October, A. D., 1912.

[SEAL.]

C. C. BILLINGS,

Acting Commissioner of Patents.

Corrections in Letters Patent No. 1,029,082

Washington, D. C.

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