No. 704,912. Patented July 15, 1902.

S. OLDHAM.

PNEUMATIC IMPACT TOOL.

(Application filed Nov. 4, 1901.)

(No Model.) 2 Sheets—Sheet 1.

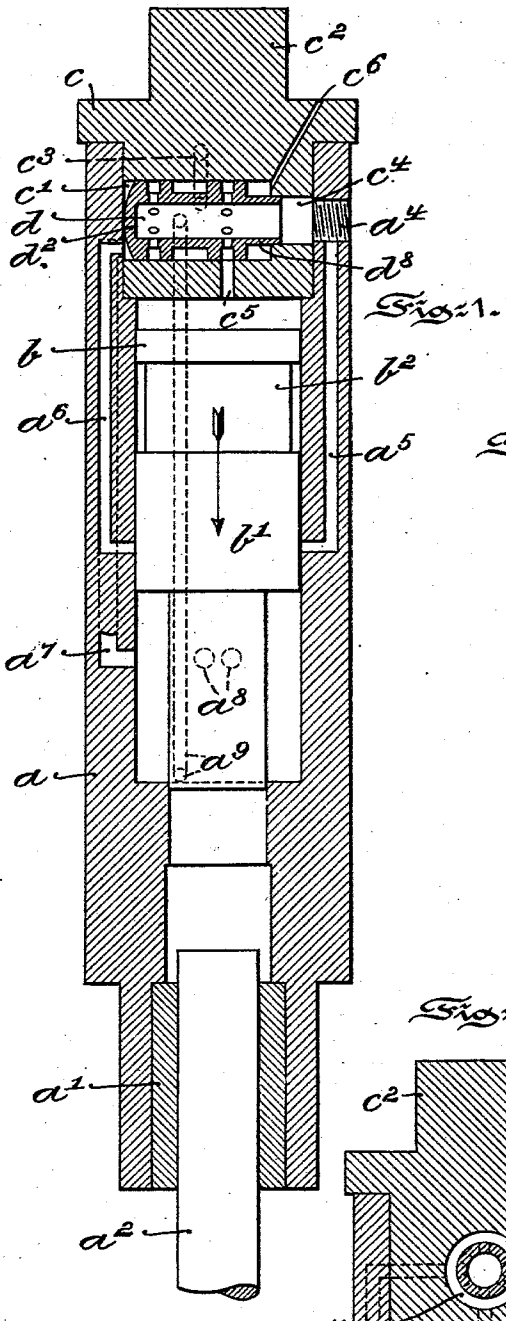


Fig. 1.

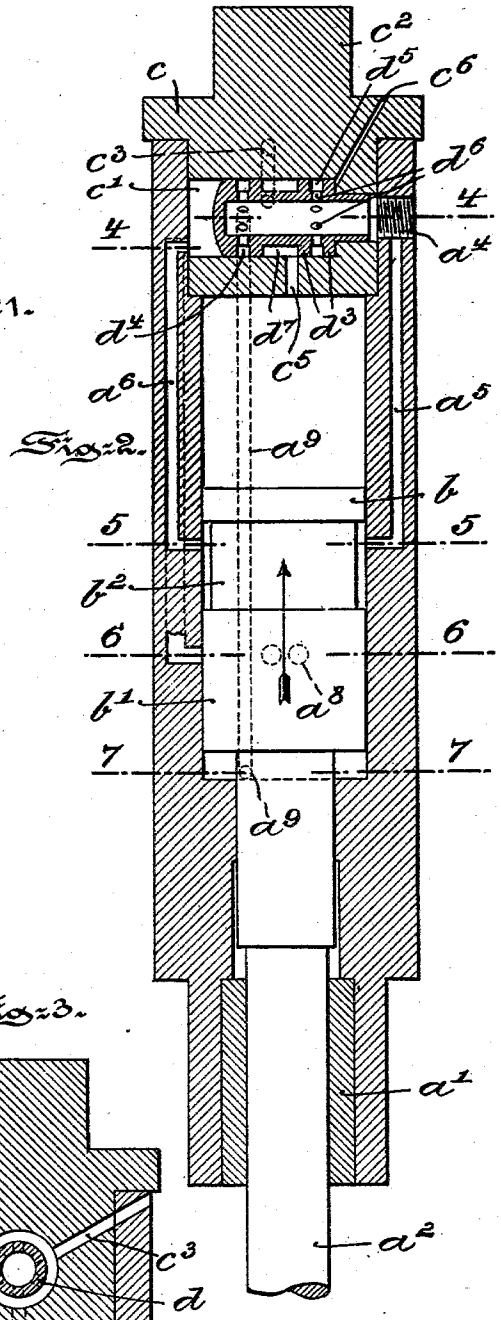
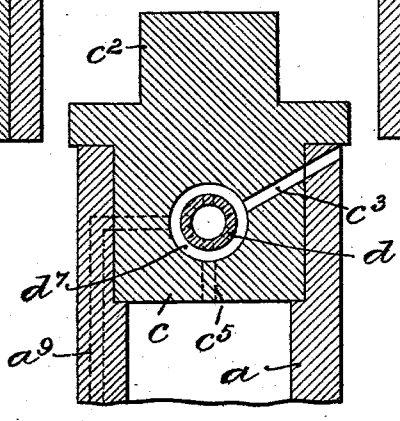


Fig. 2.

Fig. 3.



Witnesses:
Wilhelm Vogt
Thomas M. Smith.

Inventor:
Samuel Oldham,
by J. Walter Douglas
Attorney.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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Fig. 4.

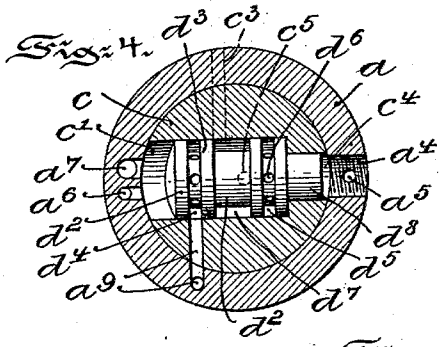


Fig. 5.

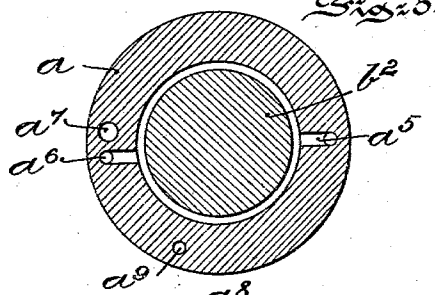


Fig. 6.

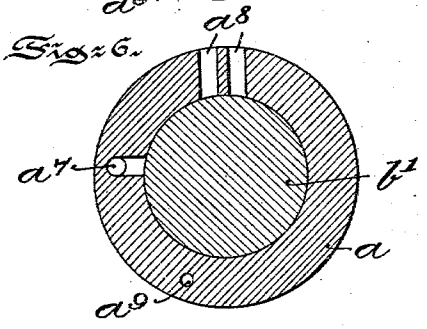


Fig. 7.

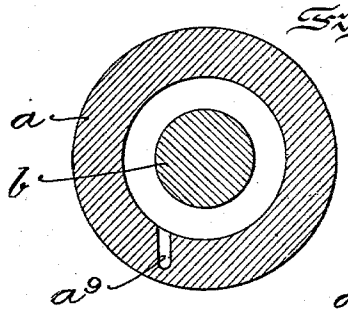


Fig. 8.

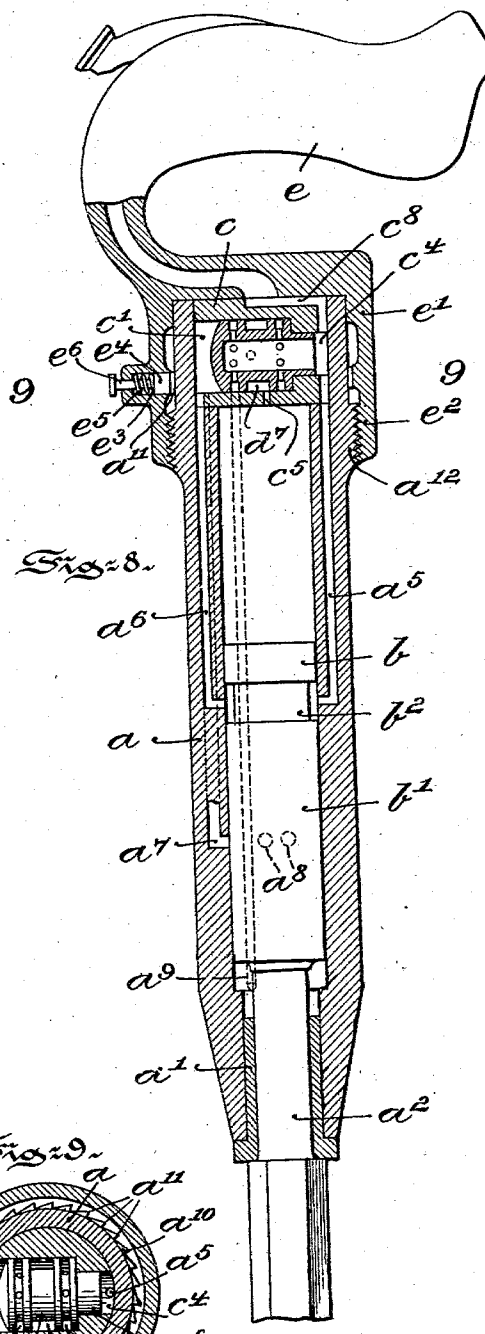
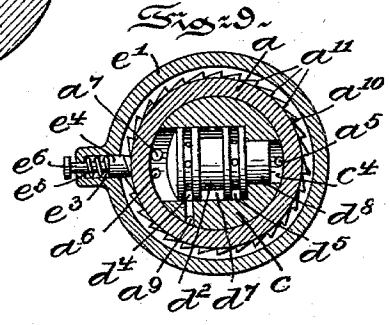


Fig. 9.



Witnesses:
Wilhelm Vogt
Thomas M. Smith.

Inventor:
Samuel Oldham,
by J. Walter Douglass
Attorney.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

SAMUEL OLDHAM, OF PHILADELPHIA, PENNSYLVANIA.

PNEUMATIC IMPACT-TOOL.

SPECIFICATION forming part of Letters Patent No. 704,912, dated July 15, 1902.

Application filed November 4, 1901. Serial No. 80,969. (No model.)

To all whom it may concern:

Be it known that I, SAMUEL OLDHAM, a citizen of the United States, residing at Frankford, in the city of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Pneumatic Impact-Tools, of which the following is a specification.

My invention has relation to that class of pneumatic impact tools or hammers which are mainly employed in dressing stone or rock, chipping stone or iron, as well as in riveting, calking, or hammering operations in general, and in such connection it relates to the construction and arrangement of such a tool or hammer.

The principal objects of my invention are, first, to provide in a pneumatic impact-tool a reciprocating piston or hammer traversing the interior of a cylinder and a valve having a range of movement in the upper end of said cylinder transversely to the movement of the hammer or piston, said valve and piston controlling the entrance of live air or fluid into the cylinder, so that upon the downstroke of the piston the piston or hammer will move for a certain distance solely through the intervention of live air and then complete its stroke by the expansion of the air and by the momentum of the hammer after the live air has been cut off, thus saving a considerable quantity of air in the operation of the pneumatic tool and allowing the tool to work uneven surfaces of stone or rock either with live air alone or live air, the expansion thereof, and momentum of the hammer; second, to provide in a tool of the character described means controlled by the piston or hammer to allow live air to actuate the valve after completion of a portion of the downward stroke of the hammer, so as to move the valve slowly to first cut off the live air to the hammer and then to allow of the expansion of the air in the cylinder to complete the downward stroke of the hammer; third, to provide a tool of the character described with means whereby the upstroke of the hammer or piston is checked at or near the end of the stroke by the introduction of live air into the cylinder, so as to allow the valve to move quickly in reversing the movement of the piston or hammer to thus prevent vibration of the tool; fourth, to provide in a tool of the character described a limited number of ports and passages for live and exhaust air partially controlled by the piston and partially controlled by the valve, so as to operate the valve with different speeds in the downward and upward movements of the piston or hammer to permit the same to complete the downward stroke partially by live air and partially by the expansion thereof and to prevent shock and vibration of the hammer or piston within the casing of the tool and without impairing the force exerted by the hammer; fifth, to provide in a tool of the character described a valve consisting of a tube closed at one end and into which the live air is conducted and from which the same is centrally distributed, said valve being sensitive to the action of the live air to thus accelerate the speed of the valve, and consequently increase the speed of the hammer; sixth, to provide a tubular valve with a projecting head and rings or flanges adapted to guide the same within a housing and also forming chambers of small size for live air and a large chamber for the exhaust-air; seventh, to provide a hollow valve with two areas of different sizes so arranged that live air acts constantly upon the small area and acts at intervals upon the large area to overcome the pressure of the live air on the small area to thus actuate the valve against the direct pressure of the live air, and, eighth, to provide in a tool of the character described a locking device connecting the handle of the tool with the cylinder or body thereof and which is adapted to be readily disengaged by hand from a shoulder of the cylinder having teeth on its periphery.

The nature and scope of my invention will be more fully understood from the following description, taken in connection with the accompanying drawings, forming part hereof, in which—

Figure 1 is a longitudinal sectional view of a pneumatic tool or hammer embodying main features of my invention and illustrating the piston or hammer at the beginning of its downward movement. Fig. 2 is a similar view illustrating the piston or hammer at the beginning of its upward movement, the valve occupying a position to allow the exhaust-air to escape from the upper portion of the cyl-

inder and conducting the live air into the lower portion of the cylinder below the hammer. Fig. 3 is a transverse sectional view of the upper portion of the pneumatic impact-tool. Figs. 4, 5, 6, and 7 are cross-sectional views taken, respectively, on the lines 4 4, 5 5, 6 6, and 7 7 of Fig. 2. Fig. 8 is a view, partially in elevation and partially in longitudinal section, illustrating a modified form of the pneumatic impact tool or hammer; and Fig. 9 is a cross-sectional view on the line 9 9 of Fig. 8.

Referring to the drawings, *a* represents the cylinder of the pneumatic impact tool or hammer in which the hammer or piston *b* is adapted to travel, and *c* represents a block adapted to close the upper end of the cylinder and to serve as a housing or receptacle for a valve *d*. This valve *d* has a range of reciprocatory movement within a chamber *c'* of said housing, and which chamber *c'* is arranged transversely to the cylinder *a*. This block *c* may be provided with an extension c^2, as shown in Figs. 1, 2, and 3, to connect the tool or hammer with a tool-holder of a machine, (not shown,) or the said block may be solely used to close the upper end of the cylinder *a* and to serve as the housing for the valve *d*, in which instance the cylinder *a* is engaged by the tubular extension *e'* of a handle *e*, as shown in Fig. 8. The lower end of the cylinder *a* carries a sleeve or tool-holder *a'*, in which the shank a^2 of the tool is held in any well-understood manner.

The valve *d* consists of a tube *d'*, closed, as at d^2, at one end and provided with projecting flanges or rings d^3, adapted to guide the tubular body in the chamber *c'*. These rings or flanges d^3 also serve to form small annular chambers d^4 and d^5 on the exterior of the valve *d*, which are in constant communication with the interior of the valve *d* by means of openings d^6. The innermost flanges also form between them a large annular chamber d^7, which is not in communication with the interior of the valve *d*, but is adapted to act as an exhaust-chamber and communicates at all times by a port or conduit c^3 with the atmosphere, as shown in dotted lines in Figs. 1 and 2 and in full lines in Fig. 3. The open end portion d^8 of the valve *d* slides in a contracted portion c^4 of the chamber *c'* and, in connection with the last flange or ring d^3, forms a chamber which by a duct c^6 is in constant communication with the atmosphere to prevent the formation of an air-cushion which would interfere with the proper operation of the valve *d*. The contracted portion c^4 of the chamber *c'* serves to receive the open end d^8 of the valve *d* and is located opposite an opening a^4 in the cylinder *a*, through which live air or fluid is introduced into the interior of the valve *d* and from which it is radially distributed into the chambers d^4 and d^5 and into the upper and lower ends of the cylinder *a*, as will be hereinafter explained. The opening a^4 by means of the conduits a^5 and a^6, arranged within the wall of the cylinder *a*, is also in direct communication with the chamber *c'*, which communication is, however, interrupted by the part *b'* of the piston or hammer *b*, as shown in Fig. 1, or freed by the contracted part b^2 of said hammer, as shown in Figs. 2 and 8. If, however, the tool is used with a handle *e*, through which live air or fluid is introduced into the tool, the valve-housing *c* is provided with a conduit c^8, communicating with the contracted portion or throat c^4 of the chamber *c'* and with the valve *d*, as well as with the conduits a^5 and a^6, as illustrated in Fig. 8.

Preferably adjacent to the conduit a^6 in the wall of the cylinder *a* is arranged a conduit a^7 of comparatively large area, which at its upper end terminates in the chamber *c'* opposite the head d^2 of the valve *d* and at its lower end in the lower portion of the cylinder *a*. The opening from the conduit a^7 into the lower portion of the cylinder *a* is controlled by the part *b'* of the piston or hammer *b*. This conduit or port a^7 serves to conduct the live air of the chamber *c'* quickly into the lower portion of the interior of the cylinder *a* and from the same quickly to the atmosphere through, preferably, double ports a^8, arranged in alinement with the conduit a^7 in the wall of the lower portion of the cylinder *a*, as illustrated in Figs. 1, 2, 6, and 8. These exhaust-ports a^8 are also controlled by the piston *b'*, and by reason of their combined area are adapted to accelerate the exit of the exhaust-air from the lower portion of the cylinder *a*. The difference in the area of the conduits a^5 and a^6, conducting live air to the chamber *c'*, and the conduit a^7, exhausting the air from said chamber, is of the greatest importance, since this difference in the area, in conjunction with that of the valve *d*, constantly acted upon by the live air, constitutes the means to impart to the valve *d* a slow movement from left to right in Figs. 1, 2, and 8 and a quick movement from right to left in said figures. In other words, to the valve *d* is imparted a slow movement from left to right during the downward stroke of the piston or hammer *b* and a quick movement from right to left during the upward stroke of the piston or hammer.

From the lowermost portion of the cylinder *a* leads a conduit a^9 into the valve-chamber *c'*, which by the annular chamber d^4 of the valve *d* is in communication with the interior of the valve *d* by means of the openings d^6, and thereby with the live-air supply when the valve occupies the position illustrated in Figs. 2 and 8. When the said valve occupies the position illustrated in Fig. 1, the conduit a^9 communicates with the large annular exhaust-chamber d^7 of the valve *d* and through said chamber d^7 and the conduit c^3 communicates with the atmosphere. The block or valve-housing *c* is also provided with a conduit or port c^5, which connects the upper portion of the cylinder *a* with the valve-cham-

ber c'. In the position of the valve shown in Fig. 1 this conduit c^5 communicates with the annular chamber d^5 of the valve d, and by the openings d^6 it also communicates with the interior of the valve and with the live-air supply, while in the position shown in Figs. 2 and 8 this conduit c^5 communicates with the large annular exhaust-chamber d^7 of the valve d and by the conduit c^3 with the atmosphere.

From the foregoing description it will be readily seen that there are only two conduits or channels arranged in the valve block or housing c, which serve alternately as live-air conduits or exhaust ports, and one conduit or port e^3, which serves as an exhaust-port only and exhausts the air from both the upper and lower portions of the piston or hammer. By limiting the number of conduits or ports which control the movement of the hammer or piston to three only a more simple construction of the valve-housing is obtained and the danger of disarrangement avoided, besides the expense of construction of the tool is appreciably lessened. Furthermore, the construction of the valve d in the form of a tube with projecting flanges or rings, so that it is light in weight, yet great in strength, makes the valve very sensitive to the action of the live air or fluid, which sensitiveness naturally increases the speed with which the valve is adapted to be operated. The speed of the valve influences the speed of the piston or hammer, and when the valve speed is increased naturally the speed of the hammer is correspondingly increased. The distribution of the live air by the valve centrally and radially therefrom and the conducting of the live air to the closed end of the cylinder a, at either side thereof, serve to prevent any side motion of the valve in its housing, and thereby the wear upon the valve and housing is diminished.

The operation of the pneumatic tool is as follows: If the valve d occupies the position to the right in the valve-chamber c', as shown in Figs. 2 and 8, the piston or hammer will at the same time occupy a position at or near the lower end of the cylinder a and the large annular chamber d^7 will be in open communication through the conduit or port c^5 with the upper portion of the cylinder a and through the conduit c^3 will be in open communication with the outside air. The live air or fluid entering the tool through the opening a^4 will first enter the interior of the valve d and by acting on the smaller or interior area of the head d^2 thereof will force the valve toward the left, or into the position illustrated in Fig. 1. By thus shifting the valve d forward in its chamber c' the annular chamber d^4 is brought into alinement with the upper end of the conduit a^9, and live air is now conducted into the lower portion of the cylinder a to act upon the lower face of the piston or hammer b, and thus to raise the same. By the upward movement of the piston or hammer b the lower end of the conduit a^7 is first uncovered and the live air behind the valve d in the chamber c' is then permitted to escape through the conduit d^7 into the lower portion of the cylinder a and from thence through the ports a^8 into the outside air. On account of the relatively large area of the conduit a^7 and ports a^8 the air is permitted to escape quickly from said valve-chamber c', and the conduits a^5 and a^6, conducting air to the chamber c', are then closed during the upward movement of the piston or hammer b by the portion b' thereof, as shown in Fig. 1. This quick exhausting of the air from the valve-chamber c' allows a rapid movement of the valve d from right to left, since the pressure of the live air is brought to bear solely against the smaller area of the head of the valve. The pressure of live air upon the larger or exterior surface of the head of the valve having been, as before stated, exhausted, the valve d will therefore complete its movement from right to left before the piston or hammer has completed its upward movement, and the annular chamber d^5 will then be in alinement with the conduit or port c^5 in the valve-housing. Live air will therefore be introduced into the upper end of the cylinder a through the openings d^6 of the valve d, and the upward movement of the piston or hammer b will be checked or will complete its movement without shock imparted to the tool. The impact of the live air upon the upper face of the hammer or piston will force the same downward, and as soon as the contracted portion b^2 of the piston comes into alinement with the lower end of the conduits a^5 and a^6 the live air will be conducted through the same into the valve-chamber c' and will here act upon the large area of the head d^2 of the valve d. The conduits a^5 and a^6 are, however, of such an area that the volume of live air introduced into the valve-chamber c', although acting upon a large area of the valve d, is only able to gradually overcome the pressure of the live air acting directly upon the small area of the head d^2 of the valve, and the valve will therefore move slowly from left to right during the downward movement of the piston or hammer. This slow movement allows a movement for a certain distance of the piston or hammer b by the live air, which air before the downward stroke of the hammer is completed is cut off by closing the conduit c^5 by the valve d. The hammer is now driven downward and completes its stroke by the expansive force of the live air in the cylinder and also the momentum acquired by the hammer in its downward movement. This feature of completing the downward movement by expansion and momentum saves a considerable amount of live air in the operation of the tool, and it is also very important when the tool is employed for dressing stone or rock, in which the surface to be dressed is usually very uneven. Thus when the tool operated by the

piston or hammer strikes a projecting portion of the stone or rock the piston or hammer is allowed to recede within the cylinder *a* without causing vibration of the tool. The piston or hammer *b* can operate in this manner for different lengths of stroke without in the least interfering with the proper or required operation of the valve *d*, and when a low portion of the stone or rock is encountered by the tool both the expansion of the air and the momentum of the piston or hammer are utilized. On high places of the stone or rock, however, the live air alone drives the tool.

If the pneumatic tool is used in connection with a handle *e*, as shown in Fig. 8, the cylinder *a* of the same is provided with a shoulder a^{10}, having teeth a^{11} arranged over the periphery of the shoulder, and with a threaded portion a^{12}, engaged by the threaded portion e^2 of the tubular extension e' of the handle *e*. The tubular extension e' is provided with a chamber e^3, traversed by a bolt e^4. This bolt e^4, by means of a spring e^5, is normally held in engagement with the teeth a^{11} of the shoulder a^{10} of the cylinder *a*, as shown in Fig 9. This bolt and toothed shoulder form a locking mechanism between the handle and the cylinder *a* of the pneumatic tool, and the handle and cylinder can be readily disengaged from each other by drawing the bolt e^4 outward by means of an extension e^6 on the same. The arrangement of the teeth over the entire periphery of the shoulder allows for the ready adjustment necessitated through the wear of the cylinder *a* and handle *e* and the secure locking of the same.

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

1. In a pneumatic impact-tool, a cylinder, a piston or hammer adapted to reciprocate in said cylinder, a housing adapted to close said cylinder at one end thereof, a chamber arranged in said housing transversely to said cylinder, a valve adapted to reciprocate in the chamber of said housing, means adapted to conduct live air or fluid to the interior of said valve, and means controlled by the movement of the piston for admitting live air or fluid to the valve-chamber in rear of said valve, substantially as and for the purposes described.

2. In a pneumatic impact-tool, a cylinder, a piston or hammer adapted to reciprocate in said cylinder, a housing adapted to close the upper end of said cylinder, a chamber arranged in said housing transversely of said cylinder, a hollow valve open at one end and adapted to reciprocate in said chamber, and means adapted to conduct live air or fluid directly and constantly into the interior of said valve and indirectly in rear of said valve, substantially as and for the purposes described.

3. In a pneumatic impact-tool, a cylinder, a piston or hammer adapted to reciprocate in a portion of said cylinder, a housing adapted to fill the upper portion of said cylinder to close the same at its upper end, a chamber arranged in said housing transversely of said cylinder, a tubular valve closed at one end and adapted to reciprocate in said chamber in a plane transversely to the reciprocation of said hammer or piston, means adapted to conduct live air or fluid into the valve to act constantly upon the interior of the closed end thereof, and means controlled by the piston or hammer adapted to alternately admit live air or fluid into said valve-chamber and to the rear of said valve, and to exhaust said live air from said chamber, substantially as and for the purposes described.

4. In a pneumatic impact-tool, a cylinder, a piston or hammer adapted to reciprocate in said cylinder, a housing adapted to close the upper end of said cylinder, a chamber arranged in said housing transversely of said cylinder, a hollow valve closed at one end and adapted to reciprocate in said chamber, an inlet port or conduit for live air or fluid arranged opposite said chamber and valve in said cylinder, ports or conduits leading from said inlet-port into said chamber to conduct live air or fluid thereto and an exhaust port or conduit of relatively large area connecting said valve-chamber with the open air, said ports connecting the valve-chamber with the live-air inlet being controlled directly by the piston or hammer independently of the valve in said chamber, substantially as and for the purposes described.

5. In a pneumatic impact-tool, a cylinder, a piston or hammer having a range of movement therein, a housing closing one end of said cylinder, a chamber arranged in said housing, a hollow valve closed at one end and located within the chamber of said housing, means adapted to move said valve slowly in one and quickly in the other direction, said means comprising a main inlet-port for live air or fluid centrally arranged opposite the open end of said hollow valve and conducting live air or fluid into the interior of said valve to act constantly upon the small head thereof, a branch inlet-port of small area leading from said main inlet-port and adapted to conduct live air or fluid into said chamber in rear and in front of the large head of said valve, and exhaust-ports of large area connecting said chamber with the atmosphere to permit of rapid discharge of live air or fluid from said chamber, substantially as and for the purposes described.

6. In a pneumatic impact-tool, a cylinder wherein the hammer or piston is adapted to reciprocate, a housing wherein a valve is adapted to reciprocate transversely to the reciprocation of said piston or hammer, said valve consisting of a hollow cylinder closed at one end and adapted to reciprocate in said housing, chambers arranged on the exterior of said valve, openings arranged in the body of said valve and adapted to communicate with the chambers located on the exterior of said

valve, the closed head of said valve and chambers controlling the actuation of the hammer or piston and the piston or hammer in conjunction with the closed end of the valve controlling the operation of said valve, substantially as and for the purposes described.

7. The combination, in a pneumatic impact-tool, of a cylinder, a piston reciprocable therein, a housing fixed in the upper end of said cylinder, a chamber arranged in said housing, passages for the motive fluid at the front and rear of said chamber, inlet and exhaust passages from each end of said cylinder and terminating and leading from said chamber, a valve having a range of movement within said housing, said piston adapted to permit of the entrance of live air or fluid in rear of said valve to cause the air or fluid to act on different areas of said valve at the same time, to retard the movement of said valve, and said valve adapted to centrally receive the motive fluid or air and to distribute the same from its center radially, substantially as and for the purposes described.

8. A pneumatic impact tool or hammer, comprising a cylinder, a piston reciprocable therein, a hollow valve, a valve-housing adapted to close the cylinder at its upper end, motive-fluid inlets opposite said hollow valve at either end of said housing in said cylinder and arranged at right angles to said valve, admission and exhaust ports and passages intermediate of said inlets in said housing, annular chambers in the exterior of said valve, openings in the body of said valve, a centrally-arranged chamber in the interior of said valve and said openings connecting said interior chamber with certain of the annular chambers of said valve, substantially as and for the purposes described.

9. In a pneumatic impact-tool, a cylinder, a piston or hammer adapted to reciprocate therein, a housing adapted to close the upper end of said cylinder, a hollow valve closed at one end and having a range of movement within said housing and with a centrally-arranged chamber in the interior and annular chambers in the exterior thereof, said valve-housing having two combined admission and exhaust ports and one exhaust-port, the end annular chambers adapted to be brought alternately into alinement with one of said admission and exhaust ports and the intermediate annular chamber adapted to constantly communicate with said exhaust-port and one of said combined admission and exhaust ports to move said piston or hammer slowly in one direction and quickly in the other direction, substantially as and for the purposes described.

10. The combination, in a pneumatic impact tool or hammer, of a cylinder, a piston reciprocable therein, a housing adapted to close said cylinder at one end thereof, a chamber arranged in said housing, a handle, a tubular extension of said handle adapted to engage the upper end of said cylinder, a shoulder arranged on said cylinder and having teeth on its entire periphery, a spring-controlled bolt arranged in the tubular extension of said handle and adapted to engage the teeth of said shoulder to lock and to prevent the disconnecting of said handle from said cylinder and to compensate for wear between said cylinder and handle.

In testimony whereof I have hereunto set my signature in the presence of two subscribing witnesses.

SAMUEL OLDHAM.

Witnesses:
J. WALTER DOUGLASS,
THOMAS M. SMITH.