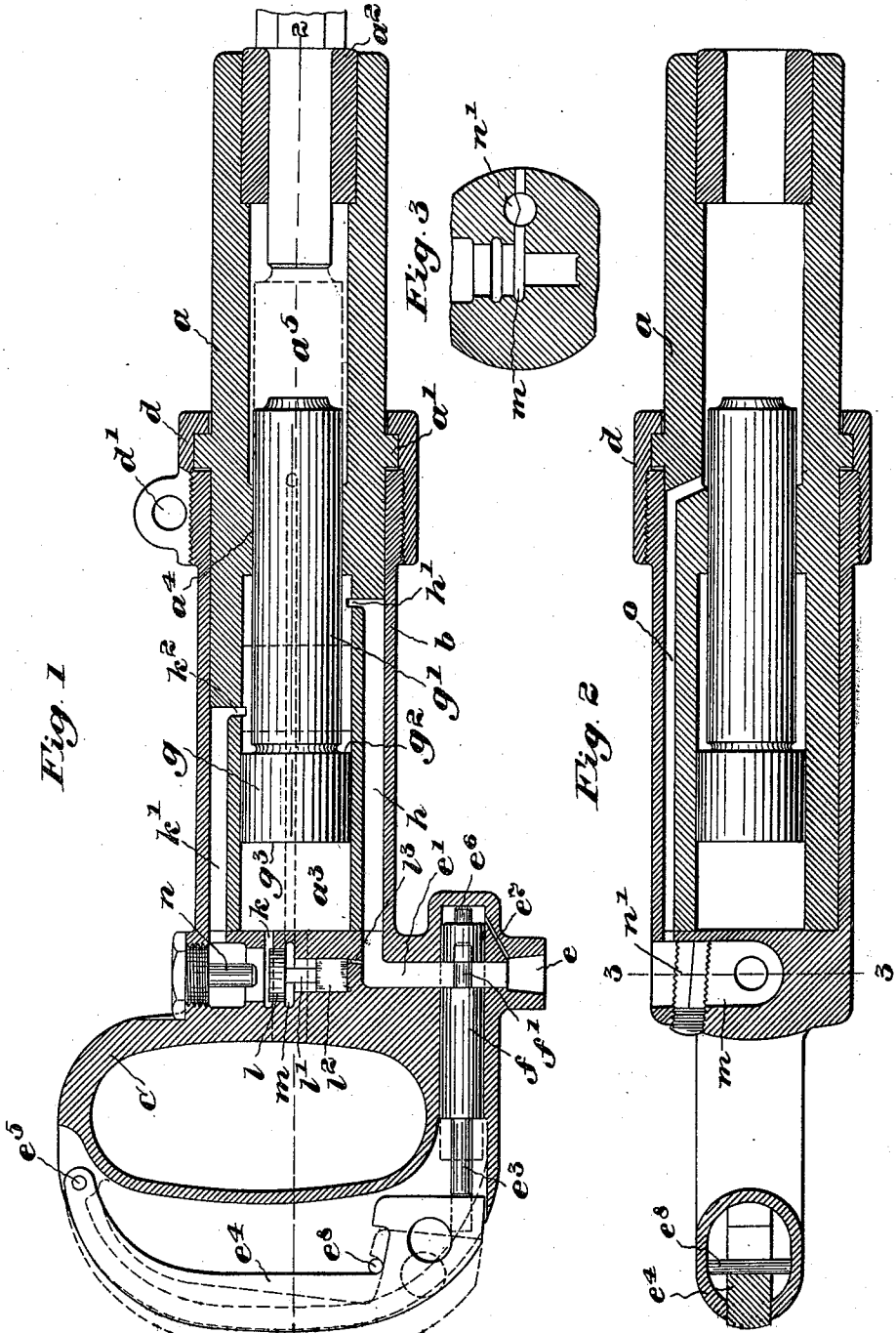


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 PNEUMATIC TOOL.  
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1,000,884.

Patented Aug. 15, 1911.



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# UNITED STATES PATENT OFFICE.

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## PNEUMATIC TOOL.

1,000,884.

Specification of Letters Patent. Patented Aug. 15, 1911.

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To all whom it may concern:

Be it known that I, ALBERT BALL, a citizen of the United States, residing at Claremont, in the county of Sullivan and State of New Hampshire, have invented an Improvement in Pneumatic Tools, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention relates to pneumatic tools consisting more particularly in a simple but effective construction of controlling and actuating means.

My invention will be best understood by reference to the following description when taken in connection with the accompanying illustration of one specific embodiment thereof, submitted for illustrative purposes, while its scope will be pointed out in the appended claims.

In the drawings:—Figure 1 is a central sectional view taken on a plane passing through the handle; Fig. 2 is a sectional view taken on the plane at right angles to the handle; and, Fig. 3 is a transverse section, partially broken away, taken on the line 3—3 in Fig. 2.

Referring to the drawings, the tool there illustrated comprises primarily the cylinder *a*, the casing *b*, and the grasping handle *c*, the latter being here formed in one piece with the casing. The cylinder for about half its length enters within the casing, to which it is secured by means of the threaded collar *d*, engaging the shoulder *a'* upon the cylinder. The collar is split and provided with a bolt *d'*, by means of which it is securely clamped after being firmly screwed up. The cylinder is provided at its mouth with the usual bushing or sleeve *a<sup>2</sup>*, which is adapted to hold the shank of the drill hammer or other tool piece employed.

Fluid pressure is admitted through the pressure inlet *e* to the pressure chamber *e'*, the admission thereto being controlled by means of the piston throttle valve *f*. The latter has the contracted portion *f'*, which in the open or full line position of the valve, registers with the pressure inlet and the pressure chamber *e'*, freely admitting the pressure thereto. The throttle valve at its upper end has the stem *e<sup>3</sup>*, which contacts

with the end of the throttle valve lever *e<sup>4</sup>*, the latter being pivoted at *e<sup>5</sup>* and conforming to the outline of the grasping handle, so that when the latter is grasped, the lever is pressed to and maintained in the full line position shown in Fig. 1, the throttle valve being held in its open position with its contracted end *e<sup>6</sup>* in contact with the interior walls of the handle base. This is the normal position of the valve and its lever when the tool is in use.

When the grasp is released upon the handle, the pressure which is constantly admitted to the lower end of the throttle valve through the small pressure duct *e<sup>7</sup>*, raises the valve into the dotted line position shown, forcing the valve lever out and causing it to project beyond the handle, as is also shown in dotted lines in Fig. 1. The stop pin *e<sup>8</sup>* prevents the movement of the valve lever beyond what is required for opening and closing the valve.

The piston is provided with a piston head *g*, working in the main pressure chamber *a<sup>3</sup>* of the cylinder and also with the reduced portion *g*; which has a sliding fit in the contracted cylinder portion *a<sup>4</sup>*, and projects therethrough into the tool space *a<sup>5</sup>*. The piston is thereby provided with differential pressure areas, the smaller of which *g<sup>2</sup>*, on one side of the piston head *g* is constantly acted upon by fluid pressure received from the pressure chamber *e'* through the port *h* and opening *h'*. The larger differential pressure area *g<sup>3</sup>*, at the opposite end of the piston head, is intermittently acted upon by pressure received through the cylinder port *k*, the passage *k'* and opening *k<sup>2</sup>*, the latter being alternately covered and uncovered by the moving piston.

Communication between the cylinder port *k* and the passage *k'*, is controlled by a piston valve having the enlarged head *l* joined by the contracted neck *l'* to the smaller head *l<sup>2</sup>*. The larger head *l* is exposed to the pressure in the passage *k'* and the smaller head *l<sup>2</sup>* to the pressure in the pressure chamber *e'* through the small pressure duct *l<sup>3</sup>*. The valve, therefore, acts differentially, being held in the position shown in Fig. 1, as long as the opening *k<sup>2</sup>* in the cylinder is uncovered and in communication with the pressure opening *k'*, for under

these conditions live pressure is received directly upon the head  $l$ . When pressure is cut off from the passage  $k'$ , however, as the piston moves to cover the opening  $k^2$ , the piston valve is moved by the pressure acting through the duct  $l^3$  to shut off the cylinder port  $k$ , from the passage  $k'$  and open the same to the exhaust passage  $m$  the latter leading directly from the valve chamber into the atmosphere as shown in Fig. 2. In its exhausting position the valve rests against the abutment  $n$  threaded into the end of the valve chamber.

The available cross sectional area of the exhaust passage may be varied by means of the gate  $n'$ , best shown in Figs. 2 and 3, this gate being threaded into the hand piece  $c$  and having a cut-away portion, which may be made more or less to intercept the escape of the exhaust air through the passage  $m$ . This gate may therefore be adjusted in different angular positions and the exhaust thereby more or less throttled. This materially lessens the vibration of the tool, and the adjustability of the gate makes it possible to adapt the cushion to different conditions of work and different pressures in connection with which the tool may be employed.

The operation of the tool is as follows:— The handle being grasped, the hand lever, conforming, as it does, to the palm of the hand, will be moved in registration with the handle and the throttle valve will be opened, providing a constant supply of pressure fluid to the cylinder through the passage  $h$  and the opening  $h'$ . Starting with the piston near the upper end of the cylinder chamber, the pressure fluid passes freely from the opening  $h'$  through the opening  $k^2$ , passage  $k'$  and cylinder port  $k$  into the upper end of the cylinder and, acting upon the greater effective area  $g^3$  of the piston head forces the same forward to deliver the blow upon the tool, the forward limit of piston travel being indicated by dotted lines in Fig. 1.

During forward travel of the piston the valve is held in the position shown in Fig. 1 by the pressure received upon the larger head  $l$ . When the piston has moved far enough to cover the opening  $k^2$ , the flow of pressure fluid to the upper or head end of the piston will cease. The piston will continue to travel, however, under its own momentum and under the expansion of the fluid remaining in the head end of the cylinder until it is brought to rest by delivering its blow against the end of the tool. In the meantime the controlling valve has moved to its exhaust position, this occurring as soon as the air remaining at the head end of the cylinder expands to a point where it can no longer maintain a pressure on the end  $l$  of the piston valve sufficient

to overbalance the pressure acting through the duct  $l'$  upon the smaller end of the valve. This movement of the valve shuts off the port  $k$  from the passage  $k'$  and opens it to the exhaust passage  $m$ .

The head end of the piston being now open to the exhaust, the pressure acting at the tool end of the cylinder upon the smaller differential area  $g^2$ , starts the piston upon its return stroke, this occurring the instant the latter is brought to rest by impact against the tool shank. The piston moves with increasing momentum until the opening  $k^2$  is uncovered, whereupon the controlling valve will be moved back again to its position of admission as shown in Fig. 1. On approaching its backward limit of travel the piston will be gradually brought to rest by the fresh admission of air through the cylinder port  $k$ , and again started upon its forward stroke, as above described.

The critical point determining the timing of the exhaust will obviously depend upon the relative areas of the differential valve heads  $l$  and  $l^2$ ; increasing the difference of the areas will retard the opening of the exhaust passages, while decreasing the difference in the areas will advance the exhaust. By suitably proportioning the differential valve, the exhaust may be timed to occur earlier or later as desired. Obviously, some mechanical force, such as a spring, might be employed to supplement or replace the constant pressure acting upon the differential valve, or, such pressure might be caused to act upon the valve at some predetermined point of piston travel, but the use of differential pressure as described, is simple and effective and variations in one pressure are substantially neutralized by variations in the other. The pressure port  $h'$  enters the cylinder a short distance from the bottom of the main cylinder chamber, so that the air entering therefrom may be trapped by the piston head and act to cushion the blow in case the piston exceeds its normal limit of travel. The tool space  $a^5$  in the cylinder is connected to the exhaust passage by means of the passage  $o$ , through which any air leaking into the said space may escape, thereby avoiding the formation of a cushion at that point.

The operation of the described tool permits a very simple arrangement as well as construction of pressure passages. The valve chamber, and the inlet and exhaust ports, all are easily formed in the base of the handle  $c$ , and the two pressure passages in the cylinder; namely, passages  $h$  and  $h'$ ; can be milled or otherwise formed in the cylinder periphery.

In accordance with the requirements of the statutes I have illustrated my invention by the particular embodiment and application thereof here disclosed without reference

to the numerous modifications and various applications thereof which will be obvious to those skilled in the art.

Claims—

- 5 1. In a pneumatic tool having a grasping handle, a cylinder attached thereto, a piston within said cylinder having a greater effective area at the head end than at the tool end thereof, means for constantly admitting  
10 pressure to the tool end of said piston, a passage opening into the cylinder chamber and adapted to be covered and uncovered in the travel of the piston and communicating with the head end of the piston, and a dif-  
15 ferential valve for alternately connecting the head end of said piston to the said passage and to the exhaust.
2. A pneumatic tool having a grasping handle, a cylinder, a piston movable therein, means for constantly admitting pressure at the tool end of said cylinder, means for alternately connecting the head end of the cylinder with pressure and the exhaust, and means for varying the cross sectional area of  
25 the exhaust passage.
3. A pneumatic tool having a grasping handle provided with a hub integral therewith and extending therefrom, the base of said handle being provided with a valve controlled pressure supplying passage, a cylinder disposed within said hub and having a piston mounted therein, a longitudinal passage cut in the outer face of said cylinder for constantly admitting pressure to the tool end of said piston, and a longitudinal passage also cut in the outer face of said cylinder and communicating with said cylinder at the head end of said piston and at a point whereat it is adapted to be covered and un-  
40 covered in the travel of the piston to permit pressure to pass from the tool end of the piston to the head end thereof.
4. A pneumatic tool having a grasping handle provided with a hub integral therewith and extending therefrom, the base of said handle being provided with a valve controlled pressure supplying passage, a cylinder disposed within said hub and having a piston mounted therein, a longitudinal passage cut in the outer face of said cylinder for constantly admitting pressure to the tool end of said piston, and a longitudinal passage also cut in the outer face of said cylinder and communicating with said cylinder at the head end of said piston and at a point whereat it is adapted to be covered and un-  
55 covered in the travel of the piston to permit pressure to pass from the tool end of the

piston to the head end thereof and a differential valve for alternately connecting the head end of said piston to the last named longitudinal passage and to the exhaust. 60

5. A pneumatic tool having a grasping handle provided with an integral hub extending therefrom, the base of said handle being provided with a valve controlled pressure inlet and an exhaust passage and a piston head end supply passage, a differential valve located in the base of said handle and controlling said exhaust and piston head end supply passage and a cylinder located within said hub and provided with a piston and having a longitudinal pressure passage cut in the outer face thereof and communicating with the tool end of said piston and a longitudinal pressure passage likewise cut in the outer face thereof and adapted to be placed in communication with said piston head end supply passage, the opposite end of said passage communicating with the interior of the cylinder and adapted to be covered and uncovered in the travel of the piston. 65 70 75 80

6. A pneumatic tool having a grasping handle provided with an integral hub extending therefrom, the base of said handle being provided with a valve controlled pressure inlet and an exhaust passage and a piston head end supply passage, a differential valve located in the base of said handle and controlling said exhaust and piston head end supply passage and a cylinder located within said hub and provided with a piston and having a longitudinal pressure passage cut in the outer face thereof and communicating with the tool end of said piston and a longitudinal pressure passage likewise cut in the outer face thereof and adapted to be placed in communication with said piston head end supply passage, the opposite end of said passage communicating with the interior of the cylinder and adapted to be covered and uncovered in the travel of the piston and means for admitting pressure to the smaller head of the differential valve. 85 90 95 100 105

7. In a pneumatic tool, the combination with the cylinder *a*, of the valve *l*, the constant pressure passage *h*, the run-about port *h'* and the piston *g*.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses. 110

ALBERT BALL.

Witnesses:

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MORRIS P. HOLMES.