

July 21, 1942.

E. H. SOUTER

2,290,256

PNEUMATIC TOOL

Filed Nov. 4, 1940

2 Sheets-Sheet 1

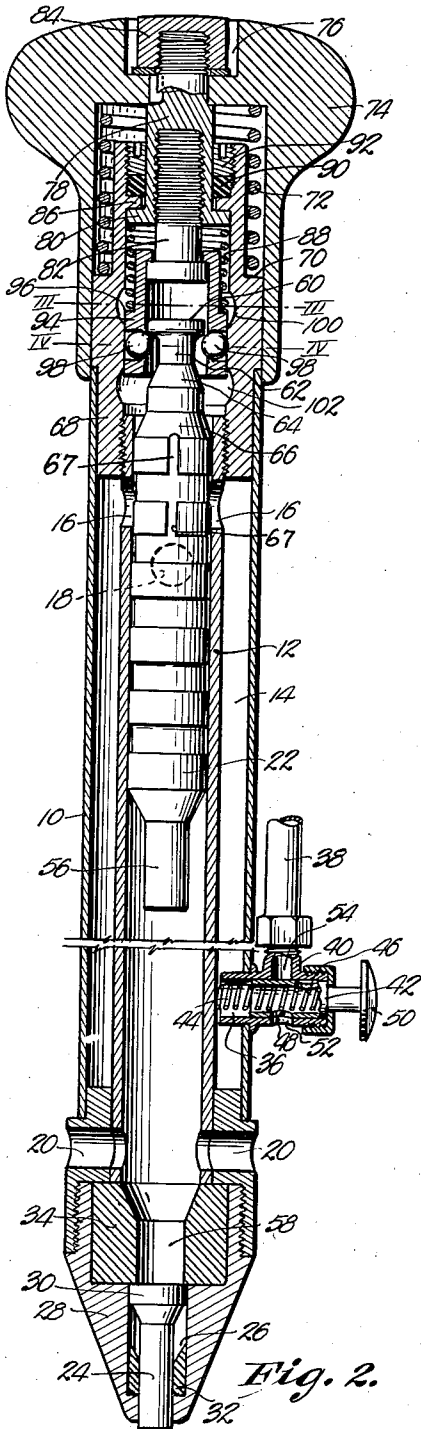


Fig. 2.

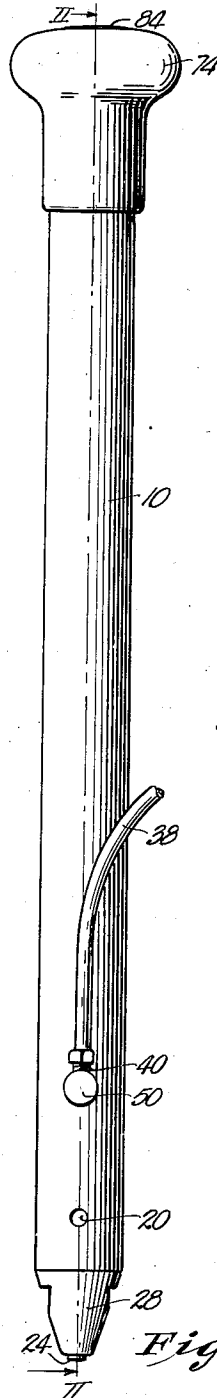


Fig. 1.

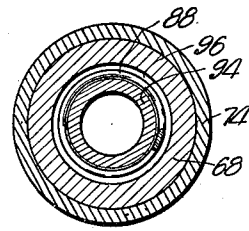


Fig. 3.

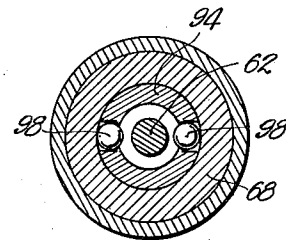


Fig. 4.

INVENTOR.
Eugene H. Souter
BY *Paul H. Hays* ATTORNEYS.

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2 Sheets-Sheet 2

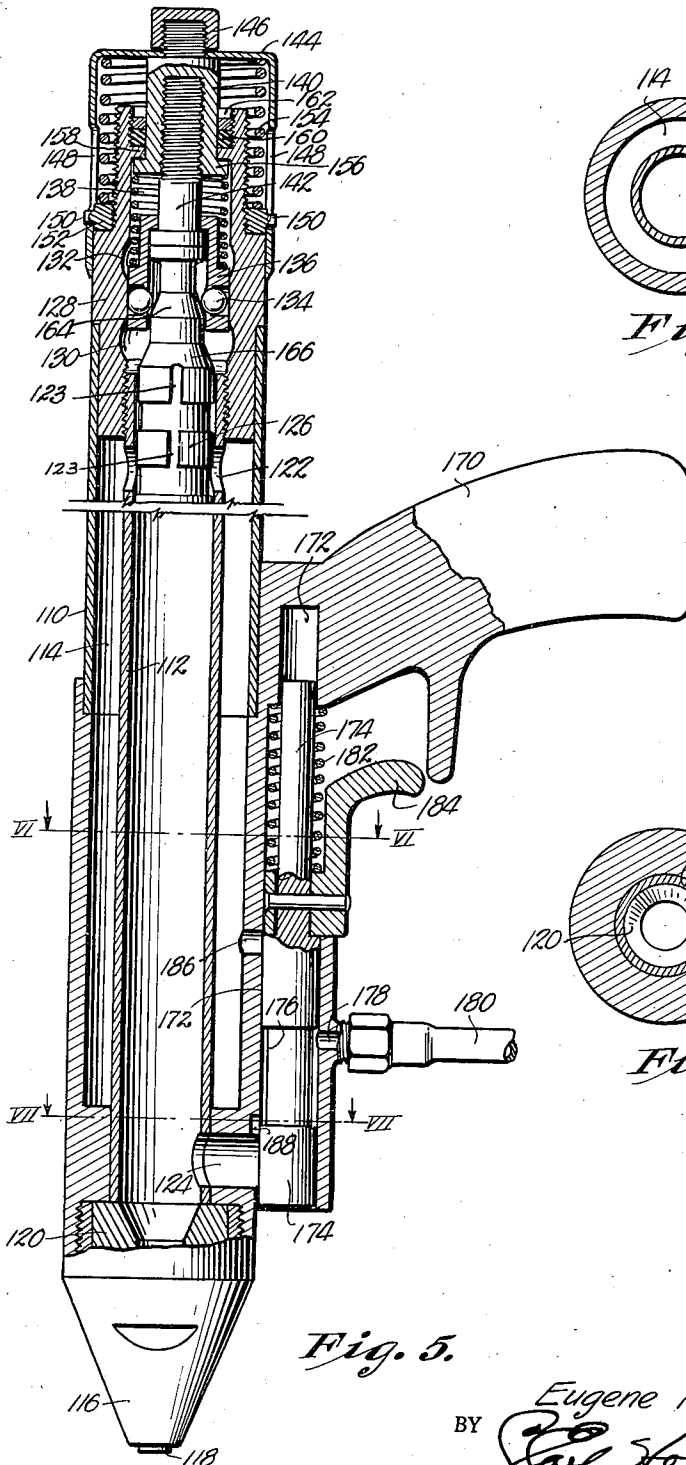


Fig. 5.

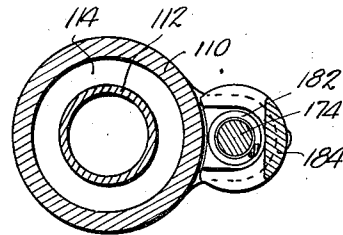


Fig. 6.

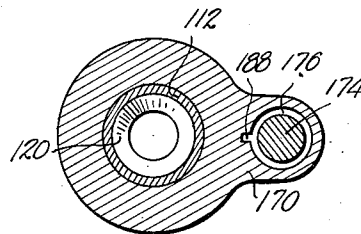


Fig. 7.

INVENTOR.
Eugene H. Souter
BY *Paul H. Souter* ATTORNEY.

UNITED STATES PATENT OFFICE

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PNEUMATIC TOOL

Eugene H. Souter, Independence, Mo.

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10 Claims. (Cl. 121—21)

This invention relates to pneumatic tools and particularly air actuated equipment in the nature of means for imparting effective blows to a part of the tool for the purpose of piercing sheet metal or the like, forming heads on rivets, or otherwise treating the work where speed of movement of the tool part, rather than the amount of power, constitutes the desirable quality.

This invention has for one of its primary aims the provision of a pneumatic tool that is portable in character, compact, and capable of being actuated through the employment of compressed air at normal commercial pressures.

A further object of the invention is to provide a pneumatic tool of the aforementioned character that is particularly useful in piercing sheet metal from one side thereof and without the employment of cooperating means on the other side whereby clean-cut holes of desired diameter may be created in sheet metal, such as automobile body stock, with speed and accuracy.

Another object of the instant invention is to provide a pneumatic tool with unique elements for releasably holding a freely movable hammer at one end of its path of travel, to cause a quick release of said hammer when the air pressure behind the same is raised to a predetermined point.

Some of the most important objects of this invention are embodied in the unique details shown in the accompanying drawings and therefore, the following specification will further indicate additional aims. In said drawings:

Figure 1 is a side elevational view of a pneumatic tool made in accordance with the present invention.

Fig. 2 is an enlarged condensed longitudinal central sectional view through the tool taken on line II—II of Fig. 1.

Fig. 3 is a transverse sectional view through the tool taken on line III—III of Fig. 2.

Fig. 4 is a similar view taken on line IV—IV of Fig. 2.

Fig. 5 is a longitudinal condensed sectional view through a pneumatic tool made to embody a modified form of the invention.

Fig. 6 is a transverse sectional view through the tool shown in Fig. 5 taken on line VI—VI of Fig. 5.

Fig. 7 is a similar view taken on line VII—VII of Fig. 5.

A portable, compact, effective and inexpensive pneumatic tool capable of being operated by air passing through the conventional compressed air hose, is desirable where the operator wishes to affix parts to the sheet metal body of an auto-

mobile. Particularly it is desired to form openings through the fire wall of the automobile body from a place beneath the hood and to the end that metal screws or the like may be inserted from one side without the necessity of entering the passenger compartment of the automobile. The tool is also capable of employment in all sheet metal fabrication both in the factory and field applications.

The pneumatic tool illustrated in the accompanying drawings is capable of piercing comparatively heavy gauge sheet metal without producing an objectionable burr on one side thereof.

The preferred manner of constructing the tool is illustrated in Figs. 1 to 4 inclusive, wherein the numerals 10 and 12 designate outer and inner telescoped tubes between which is provided an air chamber or clearance pocket 14. Inner tube 12 has ports 16 provided near one end thereof and ports 18 formed through its wall at a slightly greater distance from the end of tube 12 than ports 16.

Exhaust ports 20 place tube 12 in communication with the atmosphere for the purpose of allowing the escape of air as hammer 22 moves longitudinally along tube 12 toward punch 24.

Punch 24 mounted in cavity 26 of tip 28 is free to reciprocate. Head 30 on punch 24 limits the length of the path of travel in one direction by striking cellulose bushing 32 in tip 28, while stop 34 engages head 30 when punch 24 is moved inwardly.

An air intake port 36 places air chamber 14 in communication with hose 38 when the tool is made in accordance with one form of the invention and as illustrated in Figs. 1 and 2.

A finger operated valve controls the passage of air from tube 38 to chamber 14. This valve comprises a hollow body 40 wherein thimble-shaped element 42 is reciprocally mounted and held at one end of a path of travel by spring 44. This hollow element 42 has an opening 46 and an opening 48 provided in the wall thereof, which openings are in offset relation for the purpose of placing air chamber 14 in communication with the atmosphere when element 42 is in the normal position, shown in Fig. 2, and in communication with hose 38 when the operator has depressed head 50.

A hole 52 in the side of hollow body 40 is in register with opening 48 to release air from chamber 14. When head 50 is depressed, opening 46 is in register with lateral passage 54 to place chamber 14 in communication with hose 38.

When the latter condition exists, opening 48 is offset from 52 to close the same.

Hammer 22 is of hardened metal and equipped with a stem 59 to enter bore 58 of stop 34 and a head 60 joined to the body by a neck 62.

Inclined annular surfaces 64 and 66 in spaced relation adjacent to head 60, increase the surface area of hammer 22 to a desirable extent, and their location is important as will be fully hereinafter set down.

Section 68 in connection with inner tube 12 and outer tube 10, has an outer annular shoulder 70 thereon against which one end of spring 72 rests, while the other end of said spring engages the bottom of a thimble-shaped handle 74 provided with a counter bore 76 extending inwardly from the outer face on its axis. A stem 78 flanged at one end as at 80 receives the threaded portion of bolt 22 and is held to handle 74 by a nut 84 disposed in counterbore 76. The flange 80 of stem 78 is disposed in section 68 and normally behind an internal annular rib 86.

Packing 90 held in place by screwthreaded plug 92 precludes leakage around stem 78. The head of bolt 22 is confined within holder 94 on the outer face of which is provided an annular shoulder 96 against which bears one end of spring 88, the other end of said spring engaging the flange 80.

Diametrically opposed balls 98 carried by holder 94 are radially movable only when they are opposite either annular groove 100 or 102. These balls 98 rest behind head 60 of hammer 22, as shown in Fig. 2, to preclude its movement toward punch 24 until the operator has depressed handle 74, and if a valve such as illustrated in Fig. 2 is employed, until said valve is opened to allow air from hose 38 to pass into chamber 14.

When handle 74 is so depressed against the force of spring 72, stem 78 will move inwardly and permit holder 94 with balls 98 and hammer 22 to move to a position where balls 98 will move radially outwardly into groove 132 a distance sufficient to release head 60. Hammer 22 follows balls 98 because grooves 67 in hammer 22, being in communication with ports 16 and 18, admit sufficient air into the chamber of section 68 to maintain the head of hammer 22 against balls 98. Air under pressure in chamber 14 will now immediately exert force against hammer 22 to move it longitudinally along inner tube 12 toward punch 24. As hammer 22 so moves, inclined surface 64 will reach a point opposite ports 16 and inclined surface 66 will move inwardly to a place where air entering ports 18 will exert additional force. Manifestly, the full pressure of air in chamber 14 will be exerted against hammer 22 as it passes beyond both ports 16 and 18, whereupon the complete force of air passing through ports 16 and 18 from chamber 14 will be exerted upon the hammer to instantaneously drive the same against punch 24 at great velocity.

Stop 34 is made of cellulose material, or some material that will withstand the blow of hammer 22 after it has performed the work of driving punch 24 through the material, or when hammer 22 is released without punch 24 being in engagement with work.

As hammer 22 travels along inner tube 12 air therefrom will be exhausted through ports 20.

In the form of tool just described and illustrated in Figs. 1 to 4 inclusive, hammer 22 is returned to the normal or set position, shown in Fig. 2, by the action of gravity. The tool is merely positioned so that handle 74 is the lower-

most part thereof, whereupon hammer 22 will slide longitudinally along tube 12, strike balls 98 and thereby compress spring 88 to move holder 94 a distance sufficient to register balls 98 with groove 100. When balls 98 move outwardly into this groove, head 60 of hammer 22 will move beyond the same and before it can return spring 88, will move holder 94 to the position shown in Fig. 2 where balls 98 are again projected inwardly behind head 60.

In the illustrated embodiment of the pneumatic tool shown in Figs. 5, 6 and 7, the parts are similar to a great extent, but the additional feature of rendering the tool automatic is present. In this form, compressed air is employed to return the hammer to the set or normal position.

Referring to the specific details of this modified form, the numerals 110 and 112 designate outer and inner tubes between which air chamber or clearance pocket 114 is created. Tip 116 operably supporting punch 118 and stop 120 is as before described, and ports 122 through the wall of inner tube 112 allows air to pass thereto from chamber 114. Exhaust port 124 places inner tube 112 in communication with the atmosphere under certain conditions, as will be hereinafter described.

Hammer 126 is freely movable in inner tube 112 and the means for releasably retaining hammer 126 at one end of its path of travel, comprises the section 128 having annular grooves 130 and 132 which receive balls 134 operably mounted in a loosely fitting holder 136. Spring 138 lies between holder 136 and stem 140 and the latter carries bolt 142, the head of which limits the movement of holder 136 in one direction.

Stem 140 is secured at one end to cap 144 by nut 146. Cap 144 has diametrically opposed slots 148 through which pass radial stubs 150 integral with ring 152 in screwthreaded engagement with section 128. Spring 154 lies between ring 152 and the closed end of cap 144 whereby upon rotation of the latter, ring 152 will move longitudinally along the screwthreaded portion of holder 128 to vary the tension of spring 154. Stem 140 has the annular flange 156 at one end thereof resting behind internal annular rib 158 of section 128 and packing 160 held in place by a nut 162, renders the joint at this point airtight.

Hammer 126 in this form, is precisely the same as illustrated in Fig. 2 in that its two inclined surfaces 164 and 166 are spaced apart and adjacent to head 168.

Manually operable means to cause hammer 126 to travel through inner tube 112 forms an integral part of the tool embodying the modification illustrated in Figs. 5 to 7 inclusive. This means includes a grip 170 mounted on outer tube 110 and having a bore 172 for the reception of a piston 174. An annular groove 176 in piston 174 is always in communication with inlet port 178 through which air under pressure from hose 180 is admitted.

A spring 182 operably coiled about a portion of piston 174 is compressed when the operator moves trigger 184 against the force of spring 182. Inlet port 186 formed through the wall of outer tube 110 is in communication with bore 172.

In the normal or set position the parts of the pneumatic tool are as clearly seen in Fig. 5.

Air from hose 180 is admitted through inlet port 178, annular groove 176 and into inner tube

112 through port 124 and relatively small way 188.

When trigger 134 is pulled, annular groove 176 will place into communication, ports 178 and 186 and open the port 124. Air under pressure will immediately enter air chamber 114, pass into inner tube 112 through ports 122, thence through grooves 123 in hammer 126 to a place in section 128 behind inclined faces 164 and 166 of hammer 126 to move holder and balls 136 and 134 respectively downwardly, as viewed in Fig. 5, against the force exerted by spring 154. When annular groove 130 is reached, balls 134 will move radially to release hammer 126. The force of air passing into inner tube 112, as just described, will immediately and instantaneously drive hammer 126 through the length of tube 112 and against punch 118. When the operator releases trigger 134, piston 174 will return to the position shown in Fig. 5 and air entering port 124 will move hammer 126 back to the point of beginning with sufficient force to compress spring 138 and move balls 134 outwardly into groove 132.

The inertia of hammer 126 combined with the force of air entering way 188 and port 124 is sufficient to reset the parts but spring 138 is strong enough to maintain holder 136 in the normal position until desired pressure is reached depending upon the position of ring 152.

To insure unretarded movement of the hammer 126, port 124 exhausts air from tube 112 as the hammer is forced toward punch 118. While hammer 126 is being moved back to the normal position, air escapes from within inner tube 112 by way of ports 122 and 186, it being important that piston 174 not completely close port 186 when trigger 134 is normally set.

The adjustments permitted by the form of cap 144 and associated parts, will allow the operator to meet any conditions with respect to air pressure. This adjustment enables the operator to set the tension of spring 154 for releasing hammer 126 at various air pressures depending upon the force of blow necessary to perform a particular duty.

The materials from which this pneumatic tool are made should be strong enough to withstand the forces exerted by the movement of hammer 22 or 126, as the case may be, but because diameters are relatively small and the high velocity of the hammer is the actuating factor and the force of such velocity is directed against the work engaging elements 24 or 118, as the case may be, the materials may be light in weight.

A tool made in accordance with the foregoing specification has been used to punch a clean hole $\frac{3}{8}$ in. in diameter in sheet steel up to .070 in. in thickness with an air pressure of 150 lbs. per sq. in. The hammer was $\frac{3}{4}$ in. in diameter, weighed $4\frac{1}{4}$ oz. and the travel was 12 in.

Air storage capacity in chambers 14 and 114, as the case may be, should be a minimum of twice the displacement of the respective hammers as they move the full length of their path of travel. The ports permitting entrance of air from the air chambers of the tool should be sufficiently large to provide instantaneous equalization of pressure between the inner tube and the air chamber wherein a volume of air is maintained.

Deviations from these figures might be made so long as the relative proportions are maintained.

Having thus described the invention, what is

claimed as new and desired to be secured by Letters Patent is:

1. A pneumatic tool of the character described comprising telescoped inner and outer tubes forming a double walled barrel having an air chamber between said tubes; a freely movable hammer reciprocally carried by the inner tube, said inner tube having intake ports at one end thereof for admitting air thereto from the chamber; and means releasably retaining the hammer in a set position at said one end of the inner tube, said ports being sufficiently large to provide instantaneous equalization of pressure between the inner tube and air chamber during the travel of the hammer.

2. A pneumatic tool of the character described comprising telescoped inner and outer tubes forming a double walled barrel having an air chamber between said tubes; a freely movable hammer reciprocally carried by the inner tube; a work-engaging member at one end of the inner tube disposed to be struck by the hammer, said inner tube having intake ports at the other end thereof for admitting air thereto from the chamber; and a latch retaining the hammer in a set position at said other end of the inner tube including a structure for releasing the hammer when a predetermined pressure is reached in the cylinder.

3. A pneumatic tool of the character described comprising telescoped inner and outer tubes forming a double walled barrel having an air chamber between said tubes; a freely movable hammer reciprocally carried by the inner tube; a work-engaging member at one end of the inner tube disposed to be struck by the hammer, said inner tube having intake ports at the other end thereof for admitting air thereto from the chamber; and spring retained means for releasably holding the hammer in a set position at said other end of the inner tube, the spring in said retaining means being strong enough to overcome the pressure of air against the hammer.

4. A pneumatic tool of the character described comprising telescoped inner and outer tubes forming a double walled barrel having an air chamber between said tubes; a freely movable hammer reciprocally carried by the inner tube; a work-engaging member at one end of the inner tube disposed to be struck by the hammer, said inner tube having intake ports at the other end thereof for admitting air thereto from the chamber; and spring retained means for releasably holding the hammer in a set position at said other end of the inner tube, the spring in said retaining means being strong enough to overcome the pressure of air against the hammer, said holding means having elements securing the hammer against the action of the air until after the force of the spring has been overcome.

5. A pneumatic tool of the character described comprising telescoped inner and outer tubes forming a double walled barrel having an air chamber between said tubes; a freely movable hammer reciprocally carried by the inner tube; a work-engaging member at one end of the inner tube disposed to be struck by the hammer, said inner tube having intake ports at the other end thereof for admitting air thereto from the chamber; and means retaining the hammer in a set position at said other end of the inner tube comprising an internally grooved section, a holder provided with radially movable balls, and a head on the hammer engagable by the balls.

6. A pneumatic tool of the character described

comprising telescoped inner and outer tubes forming a double walled barrel having an air chamber between said tubes; a freely movable hammer reciprocally carried by the inner tube; a work-engaging member at one end of the inner tube disposed to be struck by the hammer, said inner tube having intake ports at the other end thereof for admitting air thereto from the chamber; and means retaining the hammer in a set position at said other end of the inner tube comprising a section having a cam face, a holder provided with radially movable balls, a head on the hammer engageable by the balls, and a spring to yieldably maintain the balls in positions on the cam face to engage the head.

7. A pneumatic tool of the character described comprising telescoped inner and outer tubes forming a double walled barrel having an air chamber between said tubes; a freely movable hammer reciprocally carried by the inner tube; a work-engaging member at one end of the inner tube disposed to be struck by the hammer, said inner tube having intake ports at the other end thereof for admitting air thereto from the chamber; and means retaining the hammer in a set position at said other end of the inner tube comprising a section having a pair of spaced apart, annular, internal grooves, a holder provided with radially movable balls shiftable across the grooves, a head on the hammer engageable by the balls when in positions other than in the grooves, and pressure responsive means for moving the balls into one of the grooves to release the hammer from the set position.

8. A pneumatic tool of the character described comprising telescoped inner and outer tubes forming a double walled barrel having an air chamber between said tubes; a freely movable hammer reciprocally carried by the inner tube; a work-engaging member at one end of the inner tube disposed to be struck by the hammer, said inner tube having intake ports at the other end thereof for admitting air thereto from the chamber; and means retaining the hammer in a set

position at said other end of the inner tube comprising a section having a pair of spaced apart, annular, internal grooves, a holder, provided with radially movable balls, shiftable across the grooves, a head on the hammer engageable by the balls when in positions other than in the grooves, and pressure responsive means for moving the balls into one of the grooves to release the hammer from the set position, said pressure responsive means being shiftable by movement of the hammer thereagainst to force the balls into the other groove during the setting operation.

9. A pneumatic tool of the character described comprising a housing having a cylinder and a clearance pocket formed therein; a piston freely operating in the cylinder; a valve for admitting motive fluid to the clearance pocket; a pressure operated latch reciprocally mounted in the cylinder at one end thereof for releasably holding the piston against movement; and means for releasing the piston upon movement of the latch toward one end of its path of travel, said latch being moved to the releasing position by a predetermined pressure in the cylinder, said cylinder and the clearance pocket being interconnected adjacent the latch.

10. A pneumatic tool of the character described comprising a housing having a cylinder and a clearance pocket formed therein; a piston freely operating in the cylinder; a valve for admitting motive fluid to the clearance pocket; a pressure operated latch reciprocally mounted in the cylinder at one end thereof for releasably holding the piston against movement; and means for releasing the piston upon movement of the latch toward one end of its path of travel, said latch and piston being simultaneously moved to a position, where the piston is released for travel along, by a predetermined pressure in the cylinder, said cylinder and the clearance pocket being interconnected adjacent the latch.

EUGENE H. SOUTER.