Jan. 20, 1970 W. LANGE ETAL 3,490,545

SAFETY MECHANISM FOR PNEUMATIC FASTENER DRIVING MACHINES

Filed Feb. 26, 1968 3 Sheets-Sheet 1

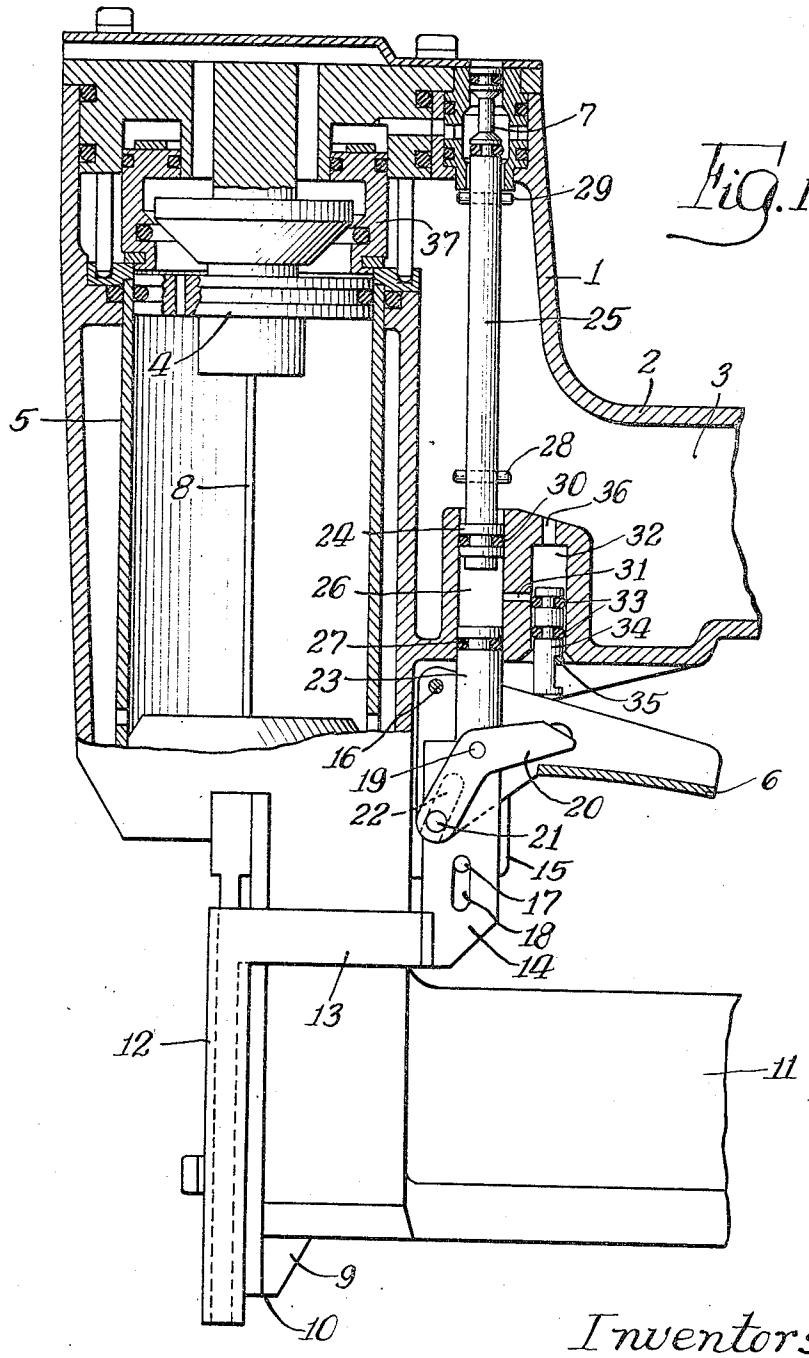

Fig. 1.

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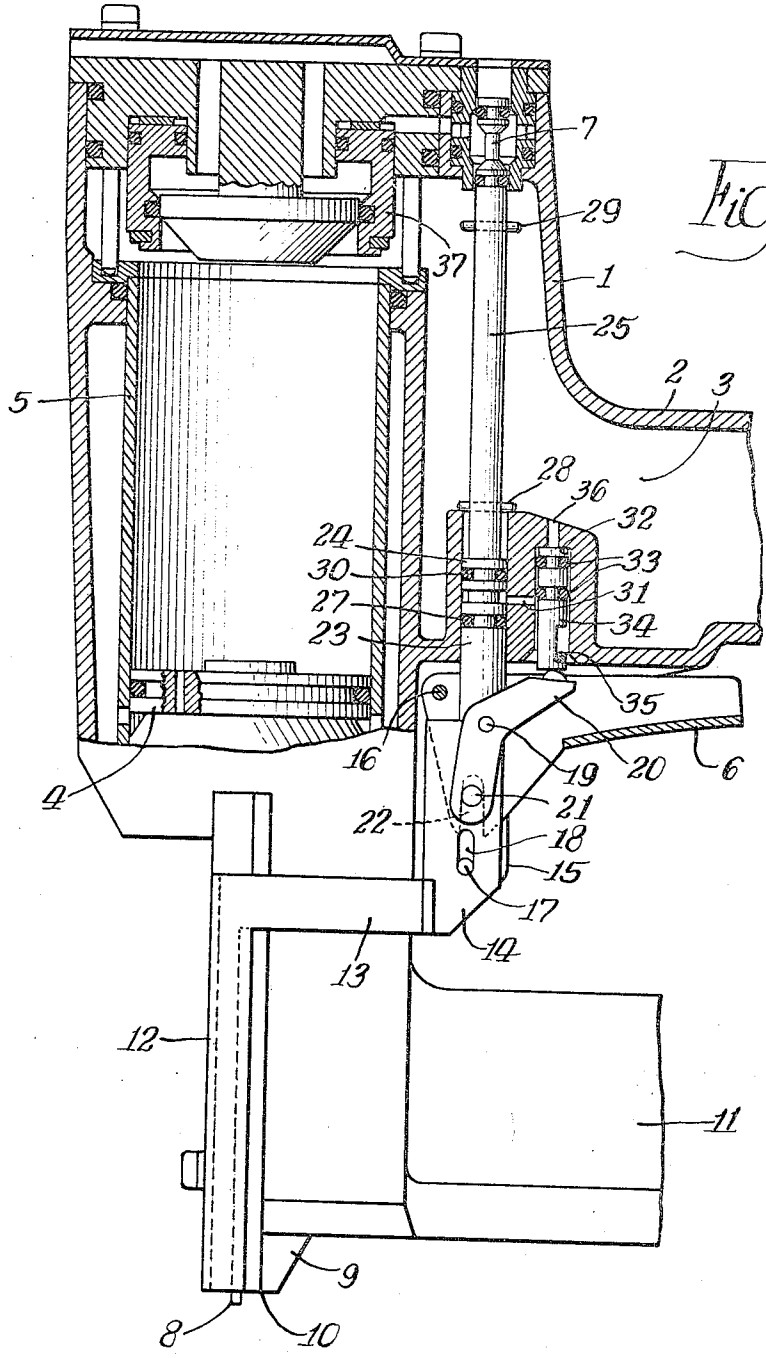

Fig. 2.

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Fig. 3.

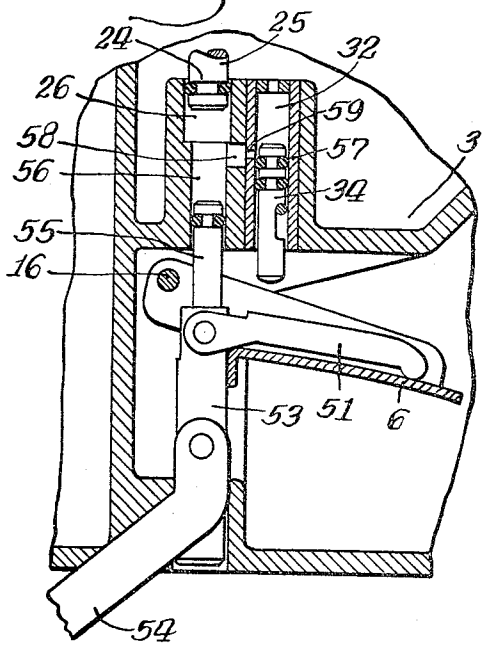


Fig. 5.

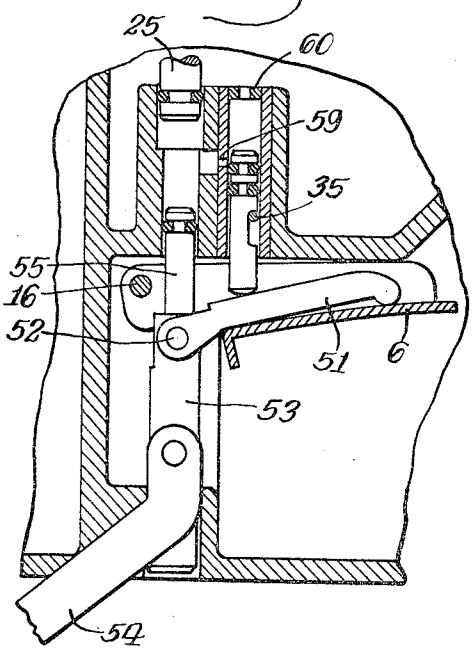


Fig. 4.

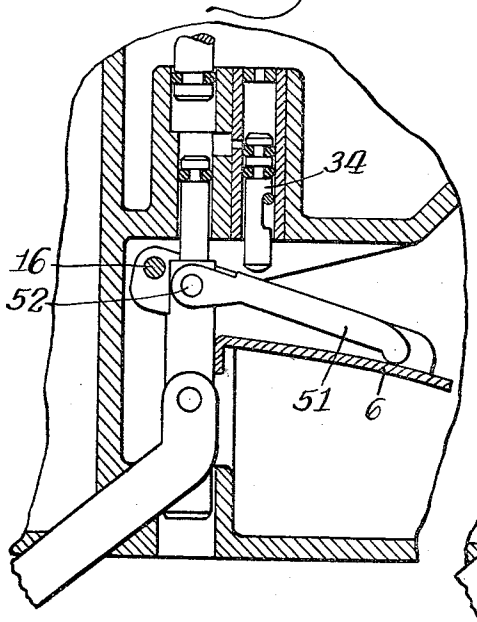
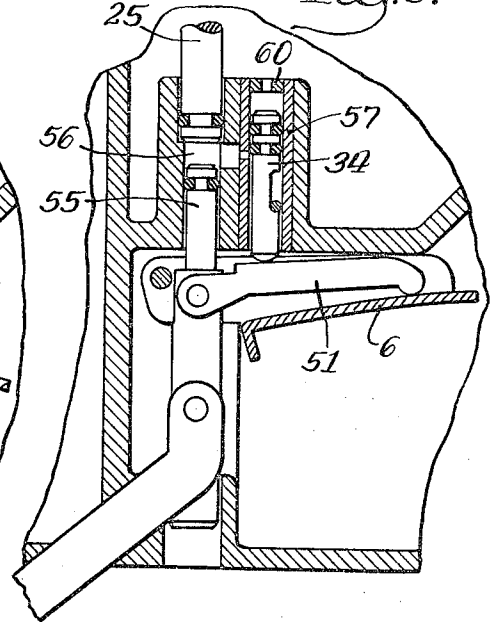


Fig. 6.



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SAFETY MECHANISM FOR PNEUMATIC FASTENER DRIVING MACHINES

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U.S. Cl. 173—2 8 Claims

ABSTRACT OF THE DISCLOSURE

In a compressed air operated hand tool for driving staples and similar fasteners having a safety trip member for the manually actuable trigger of the control valve, the trip member is controlled by placing the tool against a workpiece, and its upper end being provided with a piston in the inoperable position of the tool is under the influence of compressed air and keeps the trip member in the position in which the trigger is blocked, whereby when the trip member gets in operative position the control valve is pneumatically opened by a slight movement of the trigger.

DESCRIPTION

The present invention relates to a safety mechanism for pneumatically operated hand tools for driving fasteners, such as staples, nails, pins, and the like.

It is common practice to provide pneumatic driving machines with a safety mechanism, which blocks the manually actuated control valve and prevents it from being accidentally operated unless the machine is in its operative position and placed with its ejector against a workpiece, into which the fastener is to be driven. The prior art safety mechanisms comprise lever means and require a large effort for releasing and actuating the control valve, thus reducing the efficiency and speed of operation of the machine.

Accordingly, it is an important object of the present invention to provide a simple and easily operable safety mechanism which enables a high working capacity of the machine as well as a quick sequence of driving strokes.

Another object of the invention is to provide a pneumatic actuation of the safety mechanism, in order to produce a working stroke also when moving the trigger assembly of the control valve with low finger force and small stroke, as soon as the safety trip member has been rendered ineffective by placing the ejector against the workpiece.

Still a further object of the invention is the provision of a safety mechanism of the above-mentioned kind which is of simple and practically trouble-free construction.

These and other objects of the invention will be readily apparent from the following detailed description in conjunction with the accompanying drawings, in which:

FIGURE 1 is a fragmentary side elevational view of a pneumatic fastener driving hand tool embodying features of the invention and with certain parts thereof broken away and in section, showing the machine in its initial or inoperative position,

FIGURE 2 is the machine of FIG. 1 in its operative position after completed working stroke,

FIGURES 3, 4, 5 and 6 are fragmentary sectional views of a modified arrangement of the safety mechanism shown in different positions.

The invention pertains to a compressed air actuated hand tool comprising a cylinder being, by way of a control valve, connected with a source of compressed air and having a reciprocable piston which actuates a driver

for driving the fasteners into a workpiece. The cylinder has a bottom section with a fastener guiding nose structure. A shiftable trip means is arranged at the bottom section and normally projects a predetermined distance below the fastener guiding nose of the tool. This trip means releases the trigger of the control valve only if the nose structure of the machine in its operative position is pressed against the workpiece into which the fastener is to be driven.

According to the invention this trip means has an upper end shaped like a piston, which in the inoperative position of the machine is under the influence of compressed air to keep the trip means in its blocking position, and in the operative position communicates with the atmosphere whereby the trigger lever means of the control valve is released to allow the manual actuation of the trigger lever. The control valve, too, is pneumatically actuated.

Referring now to the drawings the invention will be described in detail.

The hand tool shown in FIGURES 1 and 2 of the drawings and which embodies the invention is operated by compressed air and is adapted to drive staples, nails, pins or similar fastening means into a workpiece. The machine comprises a housing **1** consisting for instance of lightweight metal and having a handle **2**, which in its interior is constructed as compressed air reservoir **3**. In the head portion of housing **1** a cylinder **5** containing a working piston **4** is arranged in a conventional manner. The compressed air from reservoir **3** is through a control valve assembly **7** introduced into cylinder **5**. The control valve assembly **7** is pneumatically operated by means of a trigger lever means **6**. Connected to the working piston **4** is a driver **8**, which is guided in a drive track. At its bottom section **9** the drive track has a fastener guiding nose **10**. The drive track communicates in the usual manner with a magazine **11**, in which the fasteners to be driven are housed. At the working stroke of the driver **8** the fasteners are driven into a workpiece through the fastener guiding nose **10** which is then placed immediately adjacent the workpiece.

A trip member **12** consisting of a plate with a U-shaped profile is shiftably arranged at the front wall of the drive track. This trip member projects in its inoperative position a predetermined distance below the fastener guiding nose **10** and is by way of a transverse arm **13** connected with an extension piece **14**. This extension piece **14** is enclosed by a housing plate **15**, in which a pivot **16** for the trigger lever assembly **6** and a pin **17** are located. The pin **17** engages an elongated hole **18** which is located in the extension piece **14**. On a pin **19** of the extension piece **14** an angle lever **20** is pivotally mounted, at the lower end of which two coaxial pins **21** are arranged, which engage into longitudinal grooves **22** at the lower end of trigger lever **6**. The trigger lever **6** has a U-shaped cross-section.

The upper end of extension piece **14** is shaped as a piston **23** which is arranged coaxially with the piston shaped lower end **24** of the valve stem **25** of control valve **7**, which piston shaped lower end **24** is shiftably located in a bore **26** passing through a partition of housing **1**.

The piston shaped upper end **23** of extension piece **14** in all positions closes the bore **26** and is sealed against the bore by a packing ring **27**. The valve stem **25** extends across the compressed air reservoir **3** of the housing and carries a lower stop means **28** and an upper stop means **29** for limiting its movement. The piston shaped lower end **24** of the valve stem **25** is sealed against the bore **26** by a packing ring **30**. The bore **26** communicates through a cross channel **31** and a bore **32**, which is arranged parallel to bore **26**, with the compressed air reservoir **3**. Cross channel **31** is controlled by a preliminary valve, the control member of which consists of a valve piston **34**, which

is movable in the bore 32 and is sealed against same by two O-rings 33, and which is resting in the initial position on a stop pin 35. The bore 32 is through a passage 36 in open communication with the compressed air reservoir 3. The lower portion of valve piston 34 has a larger clearance in bore 32 and is provided with a longitudinal groove into which the stop pin 35 engages.

The control valve assembly 7 actuates, in a known manner which is not explained in detail, a piston-like main inlet valve 37 for introduction of compressed air to the working cylinder 5.

In the inoperative position of the tool, shown in FIGURE 1, the several parts have the illustrated position. Trip member 12 projects beneath the fastener guiding nose 10 of the drive track. Trigger lever assembly 6 and working piston 4 are in their initial position. The preliminary valve piston 34 is in its lower final position, in which it rests on the stop means 35 so that the cross channel 31 is open. Thereby cross channel 31 connects the air space in bore 26 between both pistons 23 and 24 through bore 32 and passage 36 with compressed air reservoir 3.

The compressed air from the reservoir 3 on the one hand presses piston 23 and thus trip means 12, 13, 14 downwards, and on the other hand valve stem 25 upwards, in which position control valve assembly 7 keeps closed the main inlet valve 37 of the working cylinder 5.

In this position of trip means 12, 13, 14, the trigger lever assembly 6 cannot move valve stem 25 of control valve 7 because angle lever 20 cannot lift preliminary valve piston 34, so that compressed air from the air reservoir 3 flows into bore 26 and pushes both pistons 23, 24 apart from each other.

When the tool is placed in the operative position, in which the fastener guiding nose 10 is pressed against the workpiece and thereby the feeler plate, i.e. trip member 12, is moved upwards, the extension piece 14 with its piston 23 reaches its upper final position shown in FIGURE 2. When the trigger lever assembly 6 is shifted in its operative position it carries along the angle lever 20, the upper end of which is adjacent the preliminary valve piston 34 and raises same until its lower end contacts stop pin 35. In this position preliminary valve piston 34 closes cross channel 31 against compressed air reservoir 3.

Thus the air space of bore 26 through cross channel 31 and the annular clearance between the lower portion of preliminary valve piston 34 and bore 32 communicates with the atmosphere. Due to the exhaustion of bore 26 the valve stem 25 moves downwards, until its stop means 28 abuts against housing 1. Thereby the control valve assembly 7 is operated and simultaneously causes actuation of the main inlet valve 37. Compressed air from the air reservior 3 is admitted to the working cylinder 5 and actuates working piston 4, which effects firing of its working stroke and moves into the lower final position, shown in FIGURE 2, in which position the driver 8 has driven a fastener out of magazine 11 into the workpiece.

When the tool is in its operative position with its fastener guiding nose placed adjacent the workpiece, immediately after manual actuation of the trigger lever assembly 6, control valve 7 pneumatically shifts the main inlet valve 37 into its open position whereby the compressed air is instantly admitted to the working cylinder 5 and actuates the piston 4 to force the driver 8 downwardly through the drive track so that a fastener is driven into the workpiece with a high stroke efficiency.

On the other hand the working stroke can be fired also by moving the tool adjacent the workpiece with the trigger lever assembly manually pivoted in its operative position, whereby a sequence of working strokes may be fired by simply placing the tool adjacent the workpiece. In this manner a high efficiency of the fastener applying tool may be performed.

The safety mechanism may also comprise the structure shown in FIGURES 3 to 6, in which in lieu of the angle lever 20 an intermediate arm 51 is provided on a pin 52 of the extension piece 53 for the trip member 54. The upper end of extension piece 53 is shaped as a piston 55, which is guided in a bore 56. Bore 56 forms the lower portion of the coaxial bore 26 receiving the piston-like lower end 24 of valve stem 25 of the control valve assembly. Parallel with bore 26 is arranged the bore 32 containing the preliminary valve piston 34, which bore is surrounded by a sleeve 57 being inserted into the corresponding portion of the housing 1. Bore 56 communicates with bore 32 by a duct 58 in the wall of the housing and by several cross bores 59 arranged in the same radial plane of sleeve 57. Bore 32 also communicates with the compressed air reservoir 3 via a nozzle 60.

When the trip member 54 is moved in its operative position as shown in FIGURES 4 and 6 by placing the fastener guiding nose of the tool against the workpiece, the trigger lever assembly 6 can be shifted quickly for actuating the control valve 7 as the intermediate arm 51 is closely adjacent trigger lever 6 and is moved along without retardation when the trigger lever is manually actuated and moved from the inoperative position of FIGURE 4 into the operative position of FIGURE 6, which movement by the intermediate arm 51 immediately is transferred to the preliminary valve piston 34. This piston is then moved upwardly and interrupts the communication of the air space of bore 56 between the two pistons 24 and 55 with the air reservoir 3. The air space of bore 56 is then exhausted through the annular clearance of the lower portion of preliminary valve piston 34 and its sleeve 67, so that the valve stem 25 due to the exhaustion of bore 56 reaches instantly its lower final position, in which the control valve 7 is actuated so as to pneumatically open the main inlet valve 37, whereby compressed air is admitted to the working cylinder 5.

The embodiment of FIGURES 3 to 6 in the same manner as the embodiment of FIGURES 1 and 2 can be operated either by placing the fastener guiding nose of the tool against the workpiece or by manually actuating the trigger lever assembly.

The nozzle 60 of the bore 32 causes the preliminary valve piston 34 to be retracted to its initial position with retardation after a firing stroke so that an exact sequence of strokes is achieved and an actuation of the control valve 7 is prevented before the working stroke of piston 4 is finished. Therefore the control valve 7 cannot be actuated before a fastener is completely driven into the workpiece.

In a preferred embodiment the nozzle 60 is exchangeably secured in the corresponding housing portion, whereby a change in the stroke sequence of the working piston 4 can be obtained in a simple manner. The smaller the passage cross section of nozzle 60, the more the rearward movement of the preliminary valve piston 34 in its initial position is retarded and thus the stroke sequence of the machine reduced. If a larger cross section of the nozzle is chosen, the stroke sequence can be increased.

Besides, an optimum of reliability of operation is achieved by inserting the nozzle 60 into the bore 32 of preliminary valve, as the stroke speed of the preliminary valve is adjusted to the speed of the working piston and detrimental double strokes are avoided. Working with this machine is thus considerably improved, as the machine works calmly and practically without recoil.

It will be understood that other modifications and embodiments may be provided by those skilled in the art without departing from the spirit and scope of the present invention.

Our claims are:

1. In a pneumatic fastener driving tool having a body containing a working cylinder and piston and a compressed air reservoir, control valve means for regulating the passage of compressed air between said reservoir and said working cylinder, a manually operable trigger for effecting operation of said control valve means, and trip means movable between operative and inoperative positions, said trip means being cooperable with said trigger

for preventing operation of said control valve means except when said trip means is in said operative position in response to pressing of the tool against a workpiece; the improvement which comprises:

means defining a cylindrical air chamber in said body;

a pair of piston members at opposite ends of said chamber, one of said piston members being connected to said trip means and the other of said piston members being connected to said control valve means; and

preliminary valve means regulating the passage of compressed air between said reservoir and said chamber;

said chamber communicating with said reservoir through said preliminary valve means in the inoperative position of said trip means for urging said piston members apart, and said preliminary valve means being shiftable by said trigger in the operative position of said trip means for blocking communication between said chamber and said reservoir and for exhausting said chamber to the atmosphere.

2. The tool as claimed in claim **1**, wherein said one piston member comprises a piston-shaped extension portion of said trip means, said control valve means includes an elongated valve stem, said other piston member comprises a piston-shaped end portion of said valve stem, and said piston members are in opposed coaxial relation in said chamber.

3. The tool as claimed in claim **1**, wherein said preliminary valve means comprises means in said body defining a bore parallel to said chamber, said bore communincating with said reservoir and with the atmosphere, air passage means extending between said chamber and said bore, and a valve piston movable in said bore in response to movement of said trigger.

4. The tool as claimed in claim **3**, wherein said valve piston has one portion sealed against said bore and another portion having a clearance with said bore.

5. The tool as claimed in claim **4**, wherein said air

passage means comprises a cross channel extending between a central portion of said bore and a central portion of said chamber intermediate said piston members, said bore having one end portion in communication with said reservoir and its other end portion in communication with the atmosphere, whereby, in one position of said valve piston, said chamber communicates with said reservoir through said cross channel and said one end portion of said bore, and, in another position of said valve piston, said chamber communicates with the atmosphere through said cross channel, said clearance, and said other end portion of said bore.

6. The tool as claimed in claim **5**, wherein stop means is provided for limiting the movement of said valve piston between said one position and said other position.

7. The tool as claimed in claim **3**, wherein a removable nozzle is provided in said bore for regulating the flow of air between said reservoir and said bore, said nozzle being replaceable to vary the size of the air passage between said reservoir and said bore whereby to vary the stroke sequence of the tool.

8. The tool as claimed in claim **3**, wherein said bore is provided with a sleeve, said valve piston is reciprocable in said sleeve, and said air passage means comprises at least one cross bore in the wall of said sleeve.

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U.S. Cl. X.R.

173—15; 91—461