FASTENER DRIVING TOOL WITH IMPROVED PISTON RETURN

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ABSTRACT

A fastener driving tool in which maximum efficiency is obtained from the air supplied to the tool by using high-pressure air to return the piston to its retracted position only after the tool has been operated. To this end, driving air is directed through the piston and an auxiliary chamber leading to the underside of the piston when the piston is in its fully driven position. Air on top of the piston is subsequently exhausted, which permits the air provided against the underside of the piston to return it.

7 Claims, 5 Drawing Figures
FASTENER DRIVING TOOL WITH IMPROVED PISTON RETURN

BACKGROUND OF THE INVENTION

This invention relates to a fastener driving tool of the type including a piston reciprocable in a cylinder under the influence of a pressurized gas between a retracted position and a driven position. More particularly, it relates to an improved arrangement for returning the piston to the retracted position utilizing a pressurized gas and maintaining the piston in such position until the next cycle.

Pneumatically driven fastener driving tools of many types have become quite common in the art, one example being described in U.S. Pat. No. 3,106,136 to A. Langas for "Fastener Driving Tool," which patent is assigned to the assignee of the present invention. For convenience of description the following will be confined to a tool being operated by high pressure air, it being understood that the invention is equally applicable to gasses other than air.

With the general acceptance of such tools, it has become highly desirable to furnish units that make maximum use of the available pressurized air, both in terms of obtaining maximum driving force from the available pressure, and from the viewpoint of conserving the supply of available pressurized air. Equally important is that this be accomplished with as simple an arrangement as possible to increase the reliability of the unit and ease of manufacture. Earlier fastener driving tools have not been as successful in attaining these goals.

For example, some tools are available which employ pressurized air to return the piston to its retracted position but, during the driving stroke of the piston, the piston is made to work against the pressurized air which is subsequently used to return the piston back to its retracted position. Accordingly, in such arrangements the operating speed and force of the fastener driving action will be reduced compared to the situation wherein the piston does not have to operate against such a back pressure.

It is recognized that other fastener driving tools have adapted arrangements in which pressurized air is supplied to the piston to return the piston to the retracted position after the completion of the actuating stroke but they have required involved arrangements, including various valves in different portions of the tool, with an attendant sacrifice in reliability and simplicity of assembly and design. Such prior arrangements have also required separate mechanisms mounted within the cylinder or the housing of the tool to maintain the piston in its retracted position, once it has been restored to such position.

SUMMARY OF THE INVENTION

The present invention provides an air-operated fastener driving tool accomplishing quick positive restoration of the piston of the tool to its retracted position without detracting from the effect of the air under pressure driving the piston to its driven position.

The novel tool disclosed herein comprises a housing adapted to contain air under pressure and a cylinder disposed within the housing which defines therewith a chamber adapted to receive air under pressure. The cylinder has spaced ports communicating with the chamber, one of which is located immediately adjacent one end of the cylinder. A piston is slidably mounted within the cylinder and is provided with a fastener driver on the side thereof facing said one end of the cylinder.

Also included in the tool is a valve means at the other end of the cylinder for controlling the introduction and exhaust of pressurized air to and from the cylinder above the piston. The piston in response to the pressurized air directed theretof and from the cylinder above the piston. The piston in response to the pressurized air directed thereto is driven from a retracted position at said other end of the cylinder to a driven position at said one end of the cylinder.

To direct the pressurized air from the driven side of the piston to the driven side to return the piston for another cycle, the piston defines a first passageway communicating with the driving pressurized air and positioned so that the driving air is transmitted therethrough through the second port and into the fluid receiving chamber, and then through the first port to the driven side of the piston when the piston is in its driven position. Thus, none of the driving air is permitted to enter the receiving chamber until the driving cycle has already been completed, and no loss of driving force is occasioned by the movement of such air into the chamber.

Also included is a check valve means on the piston for controlling the flow through the passageway defined thereby to prevent fluid in the receiving chamber from returning into the passageway, whereby when the piston is in the driven position and pressurized air moves into the chamber, the air is constrained to move into the cylinder under the piston when it is at the end of the cylinder and upon the exhaust of the driving pressurized air from above the piston the air acts on the driven side of the piston to return it to its retracted position. In this manner piston return is accomplished by an uncomplicated arrangement of superior reliability and with a simplified cycle of operation as compared to prior expedients.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a side elevational view in partial cross-section showing a fastener driving tool prior to actuation, with the piston in a retracted position;

FIG. 2 is a partial side elevational view in cross-section of the fastener driving tool of FIG. 1, showing the tool upon completion of its driving cycle, with the piston having moved from its retracted position to its driven position;

FIG. 3 is a partial side elevational view in cross-section of the tool of FIG. 1, showing partial restoration of the piston to its retracted position;

FIG. 4 is a partial detail view of the piston and cylinder of the tool shown in the driven position of FIG. 2; and

FIG. 5 is a partial detail view of the piston and cylinder shown in the retracted position of FIG. 1, immediately after the arrival of the piston at such position.

DETAILED DESCRIPTION

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail a preferred embodiment of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illus-
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trated. The scope of the invention will be pointed out in the appended claims.

FIG. 1 illustrates a fastener driving tool 10 having a hollow housing 11 and an upright cylinder 12 mounted within a generally cylindrical portion 14 of the housing so as to define a generally annular region therebetween divided into upper and lower chambers 15 and 16. Lower chamber 16 is completely sealed except for ports 18 immediately adjacent the lower end 19 of the cylinder and ports 20 spaced from ports 18 but also near lower cylinder end 19. A piston assembly 22 carrying a fastener driver 23 is slidably mounted within the cylinder so as to be reciprocable between an upper retracted position adjacent the upper end 24 of cylinder 12 and a lower driven position adjacent cylinder end 19 under the influence of pressurized driving air admitted at upper end 24 of cylinder 12 acting against the upper piston side 26.

The admission of pressurized air to cylinder 12 is controlled by a diaphragm valve assembly 27 at upper cylinder end 24. Piston assembly 22 further includes a valved passageway 28 cooperating with cylinder ports 18 and 20 and chamber 16 to provide compressed air acting over the lower piston side 32 to restore the piston to its upper retracted position, and another valved passageway 97 to exhaust such air. When assembly 22 arrives at the retracted position as will be described in greater detail below.

The hollow housing 11 of the tool also includes a graspable elongated portion 34 extending horizontally outwardly from a position generally midway of cylindrical portion 14. Both housing portions 14 and 34 are mounted upon an elongated base 36 extending under both housing portions. Included in base 36 are staple magazine assembly 37 holding a row of staples disposed transverse to the path of fastener driver 23, and a guide assembly 38 directly below cylinder 12 and portion 34. Magazine 37 supplies fasteners serially under driver 23 into guide assembly 38 to be driven when the piston assembly 22 with driver 23 descends to lower cylinder end 19.

Pressurized air for operating the tool and driving the piston assembly 22 from its upper retracted position to its lower driven position is supplied at one end of housing portion 34 by connector 39 from an external supply of such pressurized air. Intermediate chamber 15 is in direct communication with the interior of housing portion 34, which interior acts as a storage chamber 42 for receiving pressurized air from the external supply. However, lower chamber 16 is completely sealed, except for ports 18 and 20, by a projection 44 protruding from the wall of housing portion 14, and an opposed projection 43 protruding outwardly from cylinder 12. The inside edge of lower end 46 of housing portion 14 is reduced in diameter so as to seal firmly against lower end 19 of cylinder 12. The cylinder is closed off at lower end 19 by a nose assembly 49 having a nose closure member 50 secured to cylinder end 19 and housing end 46. Assembly 49 also includes a bumper 51 of resilient material secured upon closure member 50 which piston assembly 22 engages in the driven position, and a vertical passageway 52 to allow driver 23 to slidably pass therethrough, as well as a nose gasket 53 to substantially prevent air from escaping through passageway 52. Cylindrical housing portion 14 is flanged at its upper end 56 to provide an annular rim surface 57, while cylinder 12 is of a height such that its upper end 24 terminates just below rim surface 57. Upper cylinder end 24 is also somewhat enlarged in diameter as compared to the remainder of cylinder 12 for reasons which will later be elaborated.

At upper cylinder end 24, pressurized air is admitted and cut off to and from the interior of cylinder 12 by diaphragm valve assembly 27, which seats against the uppermost surface of the cylinder end 24. Valve 27 has as its principal member a diaphragm 60 supporting the assembly upon rim surface 57 of upper end 56 of housing portion 14. The assembly is secured in position by clamping the generally annular portion of diaphragm 60 overlying rim surface 57 between that surface and a matching lower surface of a cap 61 covering the valve assembly 27. Valve assembly 27 also includes a valve seat plate 63 carried on the lower side thereof, of a diameter equal to that of cylinder end 24, a washer 64 of a diameter less than valve seat plate 63, and a diaphragm back-up plate 65 carried on the upper surface of the diaphragm and of a diameter slightly greater than that of plate 63 and cylinder end 24. Plates 63 and 65 and washer 64 are secured to diaphragm 60 by a hollow bolt 68 extending vertically therethrough the purpose of which will be described hereinafter.

Pressurized air is introduced above diaphragm 60 to bias valve assembly 27 sealingly against cylinder end 24 by a supply arrangement which includes cap 61 and a conduit 79 that extends vertically within housing portion 14 between cap 61 and storage chamber 42 to a control valve 85. Cap 61 provides a lower chamber 70 immediately above valve assembly 27 and an upper chamber 71 above chamber 70 and separated therefrom by a sealing plate 73 secured centrally to cap 61. Lower cap chamber 70 is completely closed except for an opening 78 at one side passing through one portion of upper housing end 56 and diaphragm 60 to communicate with conduit 79, while cap chamber 71 is in direct communication through port 80 with the atmosphere. The arrowed broken lines (FIG. 1) indicate how pressurized air admitted into chamber 70 from conduit 79 biases valve assembly 27 downwardly. An upward bias on the valve assembly also exists by virtue of the presence of pressurized air in chamber 15 acting over an annular area on the underside of diaphragm 60. However, the force of this upward bias is much smaller than that of the downward bias, because the air within chamber 70 acts over a much greater area of the diaphragm 60 than that within chamber 15.

Hollow bolt 68 cooperates with valve assembly 27 to furnish an exhaust for cylinder 12 through chamber 71 and port 80 when valve assembly 27 seats against cylinder end 24 and piston assembly 22 returns from its driven to its retracted position. Bolt 68 has an enlarged flanged head 81, an upper shank portion of enlarged outside diameter equal to that of the aperture of seal plate 63, and a lower shank portion of reduced outside diameter that passes through the central aperture of plate 73 diaphragm 60 and members 63, 65 of valve assembly 27. A helical spring 82 is located in chamber 70 between seal plate 73 and back-up plate 65. Head 83 secures the bolt to the remainder of valve assembly 27 while also securing the assembly together. Spring 82 acts to retain valve assembly 27 against cylinder 12 and aids pressurized air in chamber 70 in providing a downward bias upon valve assembly 27. To prevent high pressure air from escaping when valve 27 is opened, a resilient pad 75 is centrally mounted within the upper
wall of chamber 71 over bolt head 81. As can be appreciated, bolt 68 is slidable upwardly and downwardly within the central aperture of seal plute 73 in accordance with the upward and downward flexing of diaphragm 60. Downward movement of bolt 68 opens an exhaust path through bolt 68 between cylinder 12 and chamber 71 together with port 80, while the upward movement of bolt 68 closes the exhaust path by seating bolt head 81 against pad 75.

Regulating the passage of pressurized air from storage chamber 42 into conduit 79 to cap chamber 70 is control valve 85. Valve 85 includes a control ball 88 in a central control chamber 86 with which conduit 79 communicates via side port 87 and port 90 interconnecting chamber 42 with chamber 86. A trigger pin 91 communicates with chamber 86 from below through a pin passageway 92, with pin 91 moving ball 88 upwardly when engaged by a trigger assembly 94. Pin 91 fits loosely within passageway 92 and is confined therein between trigger assembly 94 and ball 88. When the fastener tool is not being actuated to drive a fastener, air is admitted into conduit 79 from port 90 and thus into cap chamber 70 to bias diaphragm 60 downwardly to close off cylinder 12. Activation of trigger pin 91 by trigger 94 moves ball 88 upwardly to block port 90 while allowing air in conduit 79 and chamber 70 to exhaust to atmosphere through pin passageway 92 about pin 91.

Exhausting chamber 70 to atmosphere removes the downward bias on valve assembly 27 closing cylinder 12. Pressurized air from chamber 15 acting on the underside of valve assembly 27 overcomes spring 82, and moves diaphragm 60 upwardly with the high pressure air then flowing into upper end 24 of cylinder 12 to drive piston assembly 22 downwardly to its driven position against bumper 51. The broken-arrowed lines in FIG. 2 show this exhaust of air above valve assembly 27, and the consequent movement of air into cylinder 12 below the valve assembly 27. With the upward movement of the valve assembly, bolt 68 also moves upwardly to close the exhaust path therethrough from cylinder 12 so that no pressurized air escapes from cylinder 12 as the piston assembly 22 is driven downwardly. With the arrival of piston assembly 22 at its driven position and the release of trigger assembly 94, pin 91 allows ball 88 to again open conduit 79 to storage chamber 42 to restore the bias of valve assembly 27 against cylinder end 24 to cut off pressurized air to cylinder 12. At the same time, diaphragm 60 biases bolt 68 downwardly to open an exhaust path from cylinder end 24 to atmosphere through port 80 as previously described.

When a fastener has been driven and in accordance with the present invention, the unique piston assembly and its operative relationship with chamber 16 then permits pressurized air from cylinder 24 to be directed through passageway 28 in piston assembly 22 and port 20 into chamber 16, from which it is admitted under the piston assembly to effect an automatic pneumatic return of the piston assembly to the retracted position. FIGS. 2 and 4 are particularly helpful in appreciating the manner in which the piston is restored to its retracted position in this novel and simple but highly effective manner without subtracting from the available driving force and without the use of further pressurized air beyond that needed to drive the piston assembly to its driven position. With piston assembly 22 in the driven position, as illustrated in FIGS. 2 and 4, passageway 28 extends horizontally from a central cylindrical depression 96 in the upper side 26 of piston assembly 22 across piston assembly 22 to an opening 98 on the periphery of piston assembly 22 between its upper and lower sides 26 and 32.

The central depression 96 primarily serves to accommodate security of the driver 23 by allowing the securing means therefor to be recessed and is not necessary for purposes of restoring the piston to the retracted position. Thus, the passageway 28 could also be positioned generally transverse to extend directly from upper piston surface 26 to the periphery of the piston assembly. Opening 98 is spaced from piston lower side 32 a lesser distance then the spacing between ports 18 and 20 to insure that when opening 98 is even with ports 20, the lower ports 18 are not blocked by the piston assembly. The height of bumper 51 is chosen to insure that when piston assembly 22 bottoms thereon, passageway 28 and ports 20 are in communicating relationship and consequently, present a continuous path allowing the pressurized air above the piston assembly to move into chamber 16. It will be noted that until such time as passageway 28 and ports 20 come into such communicating relationship in the driven position of the piston assembly, no pressurized air can escape through passageway 28 from upper side 26 of the piston assembly, since passageway 28 has no outlet until such time, and all other possible routes, including that through passageway 97, are blocked, as will later be explained in more detail.

Piston passageway 28 is provided with a one-way check valving arrangement to prevent the return of pressurized air from chamber 16. Such valve arrangement consists of circumferential groove 101 about the periphery of piston assembly 22 intersecting passageway 28, together with a resilient O-ring 103 carried within groove 101 and fitting tightly therewithin to seal the intersecting passageway, but movable in response to pressurized air within passageway 28 to allow such air to pass. Groove 101 is enlarged and recessed so that the O-ring 103 is carried within the periphery of the piston assembly and in a spaced attitude from the wall of cylinder 12. The enlargement of groove 101 helps to insure that the communicating relationship between ports 20 and passageway 28 when the piston assembly is in its driven position is achieved without fail in operation. As can be seen in FIG. 4, enlarged groove 101 also enables O-ring 103 to be pushed aside upwardly or downwardly by pressurized air emerging from opening 98.

Upon the arrival of the piston assembly 22 at its driven position, the pressurized air formerly driving piston assembly 22 follows a path (illustrated best in FIGS. 2 and by the arrowed broken lines) through passageway 28, past O-ring 103, groove 101 and into chamber 16. Meanwhile, as has been described, valve assembly 27 closes off cylinder end 24 and moves bolt 68 downwardly to open the exhaust path therethrough from cylinder 12 above piston assembly 22. At the same time, as pressure drops above piston assembly 22, forces stored in resilient O-ring 103 again tighten the O-ring within groove 101 to close passageway 28 and prevent the escape of pressurized air from chamber 16 through passageway 28. The pressurized air in chamber 16 then expands through lower ports 18 into the space
under piston assembly 22 between the piston assembly and nose assembly 49.

The pressurized air introduced under piston assembly 22 acts over lower surface 32 to move the piston assembly upwardly (see FIG. 3) and restore it to its retracted position at upper cylinder end 24. It will be appreciated that pressurization of chamber 16 and the consequent restoration of piston assembly 22 to its retracted position may only be accomplished when groove 101 is abreast of ports 20 and thus only when the piston assembly 22 is already at the bottom of its stroke. Accordingly, restoration of the piston to the retracted position does not detract from the driving force available to the piston assembly. Nose gasket 53 together with driving tool 23, which is of a length such that a portion is always within passageway 52 regardless of the position of piston assembly 22, effectively prevents any escape of air below piston assembly 22 into driver passageway 52.

To vent the air used to return the piston assembly to its retracted position, piston assembly 22 is provided with passageway 97 having an upper opening 99 on the periphery of the piston assembly adjacent upper side 26 thereof. Passageway 97 is controlled, as is passageway 28, by an O-ring 104 in a circumferential groove 102 about piston assembly 22 that intersects passageway 97. The O-ring acts as a one-way check valve. As stated above, the purpose of valve passageway 97 is to allow pressurized air beneath piston assembly 22 to be exhausted upon its arrival at the restored position, and yet prevent pressurized air admitted during the driving stroke to drive piston assembly 22 downwardly from escaping therethrough to lower piston side 32. At the same time, as piston assembly 22 is moving upwardly, O-ring 104 is trapped between groove 102 and the wall of cylinder 12 (see FIG. 3), so that no pressurized air may escape during movement of the piston assembly to its retracted position.

In order to accommodate the movement of O-ring 104 required to permit exhaust of pressurized air upon arrival of piston assembly 22 at its retracted position, the upper cylinder end 24 is enlarged in inside diameter from its uppermost edge at least down to a level just below the position of upper O-ring 104 when the piston assembly is in its retracted position. Thus, opening 99 of passageway 97 is spaced from piston upper side 26 a lesser distance than the depth of the enlarged end of the cylinder. This allows O-ring 104 to expand outwardly (see FIG. 5) into the annular space defined between the enlarged cylinder portion and the facing upper portion of the piston assembly, under the influence of pressurized air flowing into passageway 97 from the region below piston assembly 22, upon its arrival at its retracted position.

Thus, the pressurized air used to restore the piston assembly upwardly is exhausted through bolt 68 into upper cap chamber 71 to the atmosphere when it is no longer needed to move the piston assembly. As the pressure under the piston assembly drops and equalized with that of the atmosphere, O-ring 104 under its own resilient forces again moves fully into groove 102 to seal passageway 97. Thus, when pressurized air is admitted above piston assembly 22 to drive such assembly downwardly, the driving air cannot escape through passageway 97 to the lower piston side 32. It should be noted that known check valve arrangements other than those described could also be used to perform the same function for piston assembly passageways 28 and 97, and could be mounted within the respective passageways for similar one-way action. Likewise, instead of passageway 28 itself being valve-controlled, the same result could be obtained by placing valves within ports 20.

The piston assembly 22 is also provided with a further circumferential groove 107 and O-ring 108 located on the periphery of the piston assembly near the lower side 32 thereof. This O-ring provides sufficient frictional engagement between the piston assembly and the inside wall of cylinder 12 so that once piston assembly 12 has been restored to its retracted position, it will not move downwardly unless acted upon by pressurized air. Then with such restoration and the re-seating of O-ring 104 within groove 103 as described above, the tool is again ready for another operating cycle.

Such operating cycle, briefly re-stated, begins with the opening of valve 27 upon manipulation of trigger 94 to exhaust pressurized air above valve 27 through control valve 85, admitting pressurized air into upper cylinder end 24 to drive piston assembly 22 down to its driven position. At this point, the pressurized driving air moves through passageway 28 and ports 20 into chamber 16 and then under piston assembly 22. Meanwhile when the trigger is released control valve 85 re-establishes pressurized air above valve 27, to close valve 27 and cut off pressurized air above piston assembly 22. When valve 27 moves downwardly bolt 68 then opens to exhaust the air above the piston. Resilient O-ring 103 thereupon closes passageway 28 to prevent pressurized air in chamber 16 from escaping therethrough and piston assembly 22 moves upwardly under the influence of air received through ports 18 to move piston 22 back to its retracted position. The pressurized air under the cylinder is then exhausted to atmosphere through passageway 97 past O-ring 104 and bolt 68.

In this manner a fastener driving tool has been disclosed with a unique arrangement for the return of the piston assembly to its retracted position. Construction of the tool is very straightforward, and does not entail complex parts or techniques, so that manufacture and assembly is facilitated. The tool effects a return of the piston assembly to its retracted position with superior speed and efficiency, without any loss of available driving force, and without the use of air beyond that already used to drive the piston assembly.

It is, of course, intended to cover by the following claims all modifications and embodiments encompassed by the scope thereof.

**We claim:**

1. A gas-operated fastener driving tool comprising: a housing adapted to contain gas under pressure; a cylinder disposed within said housing and defining with said housing a chamber adapted to receive gas under pressure; a piston slidably mounted within said cylinder and provided with a fastener driver on one side thereof facing one end of said cylinder, said cylinder defining spaced first and second ports communicating with said chamber, with said fastener driver being located immediately adjacent said one end of said cylinder and in communication with said cylinder and second port; a valve means for controlling the introduction and exhaust of pressurized gas to and from said cylinder above said piston, said piston in response to said pressurized gas being driven from a retracted position at the other end of said cylinder to a driven position at said one end of said cyl-
inder, said piston defining a first passageway communicating with said driving pressurized gas and positioned so that said driving gas is transmitted through said second port and into said chamber when said piston is in said driven position; and first check valve means on said piston for controlling said first passageway to prevent said gas in said chamber from returning into said passageway, whereby when said piston is in said driven position and pressurized gas moves into said chamber, said gas is constrained to move through said first port into said cylinder at said one end thereof, and upon the exhaust of said driving pressurized gas from above said piston, to act on said one side of said piston to return said piston to the retracted position; and said piston further provided with a second passageway communicating with said one side of said piston to release pressurized gas from said one side of said piston to said other side of said piston when said piston is restored to said retracted position; and second check valve means on said piston for controlling said second passageway to prevent pressurized gas from flowing into said second passageway from said other side of said piston during the driving action.

2. A fastener tool as in claim 1, in which said first passageway opens at one end thereof on the periphery of the piston between said sides thereof.

3. A fastener tool as in claim 2, in which said first check valve is comprised of a groove about the periphery of said piston intersecting the opening of said first passageway together with an O-ring carried within said groove, said groove being enlarged whereby said O-ring moves away from the said passageway opening upon the arrival of the piston at the driven position to permit pressurized gas to flow into said chamber.

4. A fastener tool as in claim 1, in which said cylinder is enlarged in diameter at said other end thereof so as to define with a portion of said piston an annular space therebetween when said piston is in said retracted position, and in which said second passageway communicates with said annular space when said piston arrives at said retracted position to release said pressurized gas from said one piston side into said space.

5. A fastener tool as in claim 4, in which said second check valve is comprised of a groove about the periphery of said piston together with an O-ring carried within said groove and bearing against said cylinder, said groove intersecting one end of said second passageway and positioned adjacent said other side of said piston, said O-ring expanding into said annular space upon the restoration of said piston to said retracted position to release said pressurized gas from said one piston side.

6. A fastener tool as in claim 1, which further includes means for frictionally supporting said piston within said cylinder to restrain said piston from moving unless positively acted upon by pressurized gas.

7. A gas-operated fastener driving tool, comprising: a housing adapted to contain gas under pressure; an upstanding cylinder disposed within said housing and defining with said housing a chamber adapted to receive gas under pressure, said cylinder defining spaced first and second ports communicating with said chamber, with said first port being located immediately adjacent the lower end of said cylinder; a piston slidably mounted within said cylinder and provided with a fastener driver on the lower side thereof facing said lower cylinder end; valve means for controlling the introduction and exhaust of pressurized gas to and from said cylinder above said piston, said piston in response to said pressurized gas being driven on the upper side thereof from a retracted position at the upper end of said cylinder to a driven position at said lower end of said cylinder, said piston defining a first passageway communicating with said driving pressurized gas and extending transversely across said piston to a first opening on the periphery of said piston between said upper and lower sides thereof, said opening being spaced from said lower side of said piston a lesser distance than the spacing between said first and second ports; bumper means associated with said lower cylinder end for stopping said piston at said driven position, said means being of a height such that said first passageway is at substantially the same level within the cylinder as said second port when said piston is stopped by said bumper means, said driving fluid theretofrom flowing into said storage chamber; first check valve means on said piston for controlling said first passageway to prevent said gas in said chamber from returning into said passageway, whereby when said piston is in said driven position and pressurized gas moves into said chamber, said gas is constrained to move through said first port into said cylinder at said lower end thereof and upon the exhaust of said driving pressurized gas from above said piston to act on said lower side of said piston to return said piston to the retracted position; second check valve means on said piston for controlling said second passageway to prevent pressurized gas from flowing into said second passageway from the upper side of said piston during the driving action, said second passageway communicating with said annular space when said piston is returned to said retracted position, whereby said pressurized gas acting on said lower side of said piston is exhausted.

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