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3,040,709

FASTENER DRIVING APPARATUS

Filed Aug. 10, 1959

2 Sheets-Sheet 1

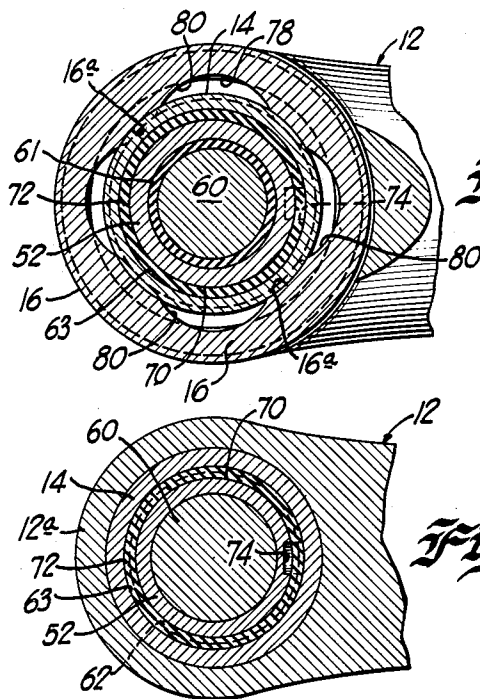
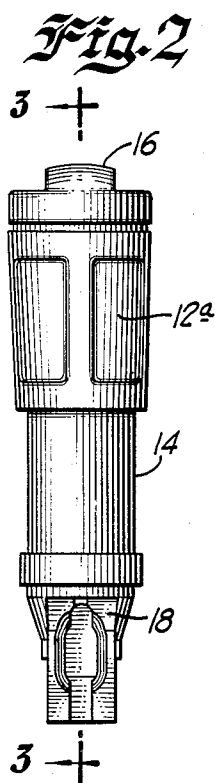
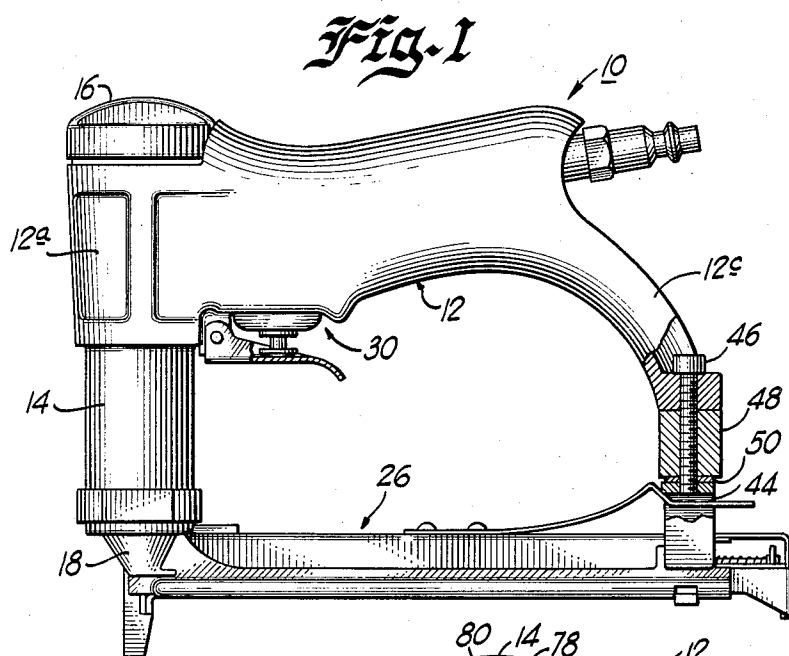


Fig. 4

Fig. 7

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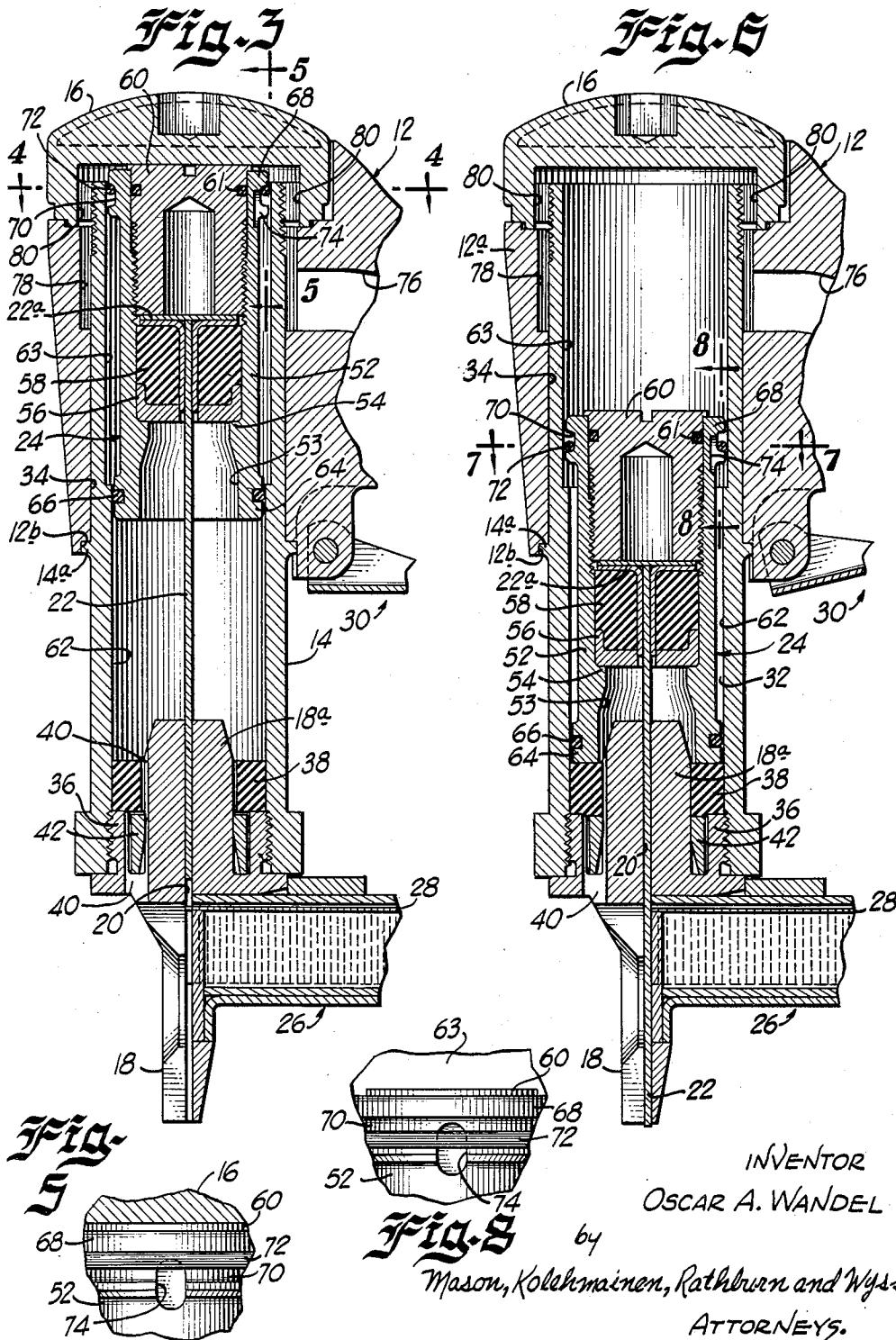
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2 Sheets-Sheet 2



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3,040,709

FASTENER DRIVING APPARATUS

Oscar A. Wandel, Mundelein, Ill., assignor to Fastener Corporation, Chicago, Ill., a corporation of Illinois
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4 Claims. (Cl. 121-13)

This invention relates to a fastener driving apparatus and, more particularly, to a pneumatically operated stapler including a new and improved piston construction and pneumatic return means therefor.

In prior pneumatic fastener driving tools, pneumatically operated means have been provided for returning a blade actuating piston to a normal position at the conclusion of a fastener driving stroke. These arrangements generally comprise passageways, either valve controlled or unobstructed, for supplying compressed air to a lower surface of the drive piston so that the piston is elevated to a normal position and held therein when compressed air is exhausted from the portion of the cylinder disposed above the drive piston. These prior constructions can not be as easily and economically constructed as would be desirable, and many of these prior piston return arrangements occupy an excessive amount of physical space with the attendant increase in the weight and size of the tool.

Accordingly, one object of the present invention is to provide a new and improved fastener driving tool.

Another object is to provide a pneumatically actuated fastener driving tool including new and improved pneumatic piston return means.

A further object is to provide a fastener driving tool including a new and improved piston construction.

In accordance with these and many other objects, an embodiment of the present invention comprises a pneumatically actuated fastener driving tool including a housing having both a cylindrical opening at its front end within which a cylinder is mounted and a rearwardly extending hollow handle providing a reservoir of compressed air. The upper end of the cylinder is closed by a closure cap which also serves to secure the cylinder on the housing, and the lower end of the cylinder is closed by a nosepiece in which is formed a drive track for receiving a driver blade connected to a piston which is slidably mounted within the cylinder. A staple magazine, which is secured between the nosepiece and a downwardly extending rear portion of the handle, supplies staples to the drive track for setting by the driver blade.

To provide pneumatic return means for the piston and driver blade, the cylinder is formed with an offset portion substantially midway along the axial length thereof so that the cylinder comprises an upper portion of greater diameter and a lower portion of lesser diameter. The piston construction comprises a piston sleeve having an upper portion of greater diameter slidably mounted within the upper portion of the cylinder and a lower portion of lesser diameter slidably mounted in the lower portion of the cylinder. The lower portion of the piston sleeve carries a sealing O-ring in engagement with the wall of the lower portion of the cylinder, and the upper portion of the piston sleeve is provided with an enlarged annular groove in which another O-ring is movably mounted. The lower lip of the enlarged annular groove is provided with a slot which places the annular groove in communication with a recessed area which is formed in the piston and which extends between the upper and lower portions of the piston to provide, in conjunction with the walls of the cylinder, an annular piston return chamber. The driver blade, which is provided with a generally T-shaped upper end portion, is secured to the piston sleeve by means of a resilient cushion which engages the lower surface of the T-shaped end portion and a member which is threadedly

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mounted in the upper portion of the opening in the piston sleeve.

In operation, when a valve assembly carried on the handle of the housing is operated to admit compressed air to the upper end of the cylinder, the piston is driven downwardly so that the lower end of the driver blade engages and sets a staple supplied by the magazine. This compressed air also leaks around the interface between the upper portion of the piston and the inner wall of the cylinder to displace the upper O-ring downwardly to uncover the slot. Thus, the air that passes through the interface between the upper portion of the piston and the inner wall of the upper portion of the cylinder flows through the slot in the lower lip of the annular groove to be accumulated in the annular piston return chamber. When the upper portion of the cylinder is connected to the atmosphere by the release of the valve assembly at the end of the fastener driving stroke, the compressed air entrapped in the air return chamber moves the O-ring in the enlarged annular groove upwardly to seal off the interface between the upper portion of the piston and the adjacent wall of the upper portion of the cylinder. The compressed air in the piston return chamber then expands and, by virtue of difference in the effective area between the upper and lower portions of the piston, provides an upwardly directed force that is effective to return the piston to its upper position and to retract the drive blade to condition it for another fastener driving stroke. Thus, the use of a cylinder and a piston including portions of different diameters and the use of the sealing O-ring carried on the upper portion of the piston provides an easily constructed and efficiently operated pneumatic return system for the piston. Further, by the use of the sleeve for the piston construction, the lower end of the piston construction can be made unobstructed to permit the use of an air return chamber of greater axial length without increasing the height of the fastener driving tool.

Many other objects and advantages of the present invention will become apparent from the following detailed description when considered in conjunction with the drawings in which:

FIG. 1 is a side elevational view in partial section of a fastener driving tool embodying the present invention;

FIG. 2 is an end elevational view of the tool shown in FIG. 1;

FIG. 3 is an enlarged fragmentary sectional view taken along line 3-3 in FIG. 2 and showing the tool in its normal or released condition;

FIG. 4 is a sectional view taken along line 4-4 in FIG. 3 assuming that the complete construction is shown therein;

FIG. 5 is an enlarged fragmentary sectional view taken along line 5-5 in FIG. 3 again assuming that the complete construction is shown therein;

FIG. 6 is a view visilar to FIG. 3, but illustrating the tool in an operated condition;

FIG. 7 is a sectional view taken along line 7-7 in FIG. 6 assuming that the complete construction is illustrated therein, and;

FIG. 8 is an enlarged sectional view taken along line 8-8 in FIG. 6 again assuming that a complete construction is shown therein.

Referring now more specifically to FIGS. 1, 2 and 3 of the drawings, therein is shown a pneumatically actuated stapler, indicated generally as 10, including a housing 12 on which a cylinder 14 is detachably mounted. The open upper end of the cylinder 14 is closed and the cylinder 14 is secured to the housing 12 by a closure cap 16. The lower end of the cylinder 14 is closed by a nosepiece structure 18 defining a drive track 20 in which is slidably mounted the lower end of a fastener driving

blade 22. The upper end of the blade 22 is secured to a piston assembly, indicated generally as 24, which is slidably mounted within the cylinder 14. A magazine assembly, indicated generally at 26, is secured to the nose-piece structure 18 and the housing 12 at its opposite ends and serves to supply staples 28 to the drive track 20.

When the tacker is to be actuated, a control valve assembly 30 is manually actuated to supply air to the open upper end of the cylinder 14. This compressed air drives the piston assembly 24 and the driver blade 22 downwardly so that the fastener 28 supplied by the magazine assembly 26 is driven into a workpiece. Some of the compressed air that is admitted to the upper end of the cylinder 14 flows through the interface between the upper end of the piston 24 and the wall of the cylinder 14 to be accumulated within an annular piston return chamber 32 (FIG. 6). Thus, when the valve assembly 30 is released to connect the upper end of the cylinder 14 to the atmosphere, the air entrapped within the annular return chamber 32 develops an upwardly directed force which returns the piston assembly 24 and the driver blade 22 from the position shown in FIG. 6 to its normal position shown in FIG. 3.

In general, the tacker construction 10 is identical to the pneumatically operated stapler shown and described in detail in the copending application of Oscar A. Wandel, Serial No. 527,697, filed August 11, 1955, which application is assigned to the same assignee as the present application. As illustrated therein, the housing 12 comprises a forward portion 12a which defines a cylindrical opening 34 in which the upper end of the cylinder 14 is slidably mounted so that a flange 14a on the cylinder is received within an annular recess 12b in the lower edge of the front portion 12a of the housing 12. The upper end of the cylinder 14 is threaded to be engaged by four peripherally spaced and radially inwardly projecting threaded portions 16a (FIG. 4) on the closure cap 16. Thus, when the cap 16 is threaded onto the upper end of the cylinder 14, the flange 14a is clamped against the front portion 12a of the housing 12 and the lower edge of the closure cap 16 is drawn into engagement with the upper end thereof.

The lower end of the cylinder 14 is closed by the nosepiece structure 18 (FIGS. 3 and 6) which includes an upwardly extending and externally threaded annular flange 36 for threadedly engaging an inner surface on the lower end of the cylinder 14. An annular resilient ring 38 is mounted on the upper edge of the flange 36 to provide a buffer for arresting downward movement of the piston assembly 24. The nosepiece structure 18 also includes an upwardly extending boss 18a which increases the length of the guide track 20 to provide a greater effective guiding surface for the driver blade 22 to insure that this blade does not become "cocked" during movement. The length of the portion of the drive track 20 which is provided by the boss 18a and which is located above the point at which the staples 28 are supplied to the drive track 20 preferably is more than one-half of the distance through which the piston 24 moves during a fastener driving stroke. A slot 40 formed in nosepiece structure 18 and in the boss 18a provides a passage for connecting the lower portion of the cylinder 14 to the atmosphere. A spacer ring 42 is positioned within the annular groove formed between the boss 18a and the annular flange 36.

To provide means for successively feeding individual staples 28 from a strip thereof into the drive track 20, the magazine assembly 26 is provided. This magazine assembly can be of any of the constructions well known in the art although it preferably comprises a magazine assembly of the type shown and described in detail in the above identified Wandel application. The front end of the magazine assembly 26 is secured to the nosepiece structure 18, and the rear end of this assembly is secured to a depending portion 12c (FIG. 1) of the housing 12.

To accomplish this, the rear end of the magazine assembly 26 is secured to the arms of a U-shaped bracket 44, and the bight portion of this bracket is connected to the depending portion 12c of the housing 12 by a machine screw 46. A spacer 48 and a washer 50 are interposed between the upper surface of the bracket 44 and the lower surface of the depending portion 12c of the housing. The spacer 48 is used in the pneumatic tacker 10 inasmuch as the housing 12 thereof is identical to the similar housing used in the fastener driving apparatus disclosed in the above identified Wandel application in which a resilient piston return arrangement is used. In the pneumatic piston return means embodied in the present invention, the cylinder 14 is somewhat longer than the cylinder used in the prior application. Thus, by the use of the spacer 48, the spring returned piston and driver assembly shown in the prior Wandel application can be converted to a pneumatic return system merely by replacing the cylinder, the piston and the driver blade used in the prior application with the cylinder 14 and the piston 24 of the present invention.

Referring now more specifically to the piston assembly 24, this assembly includes a piston sleeve 52 (FIGS. 3 and 6) having an axially extending inner opening 53 provided with a shoulder 54 on which a retaining plate 56 is mounted. To resiliently interconnect the driver blade 22 with the piston assembly 24, a resilient member 58 is disposed between the retaining plate 56 and a T-shaped head 22a formed on the driver blade 22. A member 60 is threadedly mounted in the upper end of the opening 53 to engage the upper surface of the T-shaped portion 22a and thus hold the blade 22 adjacent the resilient member 58. Since the retaining plate 56 is positioned above the lower end of the piston sleeve 52, the lower end of the opening 53 provides means for freely receiving the upper end of the boss 18a on the nosepiece structure 18. Thus, the length of the piston assembly 24 can be increased without reducing the effective length of the guiding surface afforded by the drive track 20 formed in the nosepiece 18.

To provide a pneumatic return means for the driver blade 22 and the piston assembly 24, the cylinder 14 is provided with a lower portion 62 of lesser diameter and an upper portion 63 of greater diameter. The lower end of the piston sleeve 52 is formed with a radially projecting flange 64 of lesser diameter which carries a sealing O-ring 66 that slides in engagement with the inner surface of the lower portion 62 of the cylinder 14. The upper end of the piston sleeve 52 is provided with an annular flange 68 of greater diameter which is provided with an enlarged annular groove 70. A resilient O-ring 72 is movably mounted within the groove 70 and slidably engages the inner wall of the upper portion 63 of the cylinder 14. The body of the piston sleeve 52 is recessed between the upper and lower flanges 64 and 68 to cooperate with the inner wall of the cylinder 14 to define the air return chamber 32.

To provide means for selectively supplying compressed air to the air return chamber 32, the bottom wall of the groove 70 and a portion of the lower lip of this groove are recessed to provide a slot 74 (FIGS. 3, 5, 6 and 8) which places the air return chamber 32 in communication with the annular groove 70. Thus, when compressed air is supplied to the upper end of the cylinder 14, the air passing through the interface between the upper flange 68 and the inner wall of the upper portion 63 of the cylinder 14 enters the groove 70 and passes through the slot 74 to be accumulated in the air return chamber 32.

When a fastener 28 is to be driven, the control valve assembly 30 is manually operated to supply air from the compressed air reservoir formed by the hollow handle of the housing 12 through a passageway 76, an enlarged portion 78 formed in the opening 34 and four peripherally spaced passageways 80 in the closure cap 16 to the

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open upper end of the cylinder 14. This compressed air acts on the upper surface of the piston assembly 24 to move this assembly and the driver blade 22 downwardly. During this movement, the lower end of the blade 22 moves downwardly through the guide track 20 to engage and set the staple 28 supplied by the magazine assembly 26. When compressed air is admitted to the upper end of the cylinder 14, a portion of this air passes through the interface at the upper end of the piston assembly 24 or around the upper lip of the groove 70 and into this groove to move the O-ring 72 to the lower position illustrated in FIGS. 6 and 8. With the O-ring 72 in this position, the compressed air entering the annular groove 70 is permitted to flow through the slot 74 into the air return chamber 32. Because of the recessed outer surface of the piston sleeve 52, an appreciable volume of compressed air can be accumulated between the outer surface of the piston assembly 24 and the inner wall of the cylinder 14.

When the control valve assembly 30 is released so that the passageway 16 and the interior of the upper portion 63 of the cylinder 14 are connected to atmosphere, the compressed air within the air return chamber 32 acts on the O-ring 72 to displace this O-ring to the position illustrated in FIGS. 3 and 5. In this position, the O-ring 72 engages the upper lip of the groove 70 and seals the interface between the upper flange 68 and the inner wall of the upper portion 63 of the cylinder 14. The compressed air in the air return chamber 32 expands and, because of the difference in the effective areas of the lower flange 64 and the upper flange 68, provides an upwardly directed force for returning the piston assembly 24 and the driver blade 22 to their normal positions (FIG. 3) in which the upper end of the element 60 engages the lower surface of the closure cap 16.

Accordingly, the pneumatic piston return means of the present invention is easily and economically fabricated in requiring only a minimum number of parts and, by the provision of the improved piston assembly construction including the axially extending opening, reduces the height of the cylinder and piston assembly to a minimum while providing an air return chamber 32 of substantial size. Although the present invention has been described with reference to a particular embodiment thereof, it should be understood that those skilled in the art may make other modifications and embodiments which will fall within the spirit and scope of the principles of this invention.

What is claimed and desired to be secured by Letters Patent of the United States is:

1. In a fastener driving tool, a cylinder having an offset portion dividing the interior of said cylinder into a first portion of greater diameter and a second portion of lesser diameter, a piston in said cylinder and including a greater diameter upper portion slidably mounted in said first portion and a lesser diameter lower portion slidably mounted in said second portion, fastener driving means connected to said piston, first sealing means carried on said lower portion and slidably engaging the inner wall of said second portion of said cylinder, said upper portion including an enlarged peripheral groove and a passageway extending from said peripheral groove, second sealing means movably mounted in said enlarged groove, said first and second sealing means engaging the inner wall of said cylinder and the outer wall of said piston being spaced from the inner wall of said cylinder to define an air return chamber, means for supplying compressed air to the first portion of said cylinder to drive said piston downwardly, said compressed air in said cylinder acting on and moving said second sealing means to portion of said piston and the inner wall of said first portion can leak through the interface between said upper portion of said piston and the inner wall of said first portion of said cylinder and pass through said groove and

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said passageway into said air return chamber, and means for exhausting the compressed air from the first portion of said cylinder so that the compressed air in said air return chamber acts on and displaces said second sealing means to a second position in which said interface is sealed, thereby permitting the compressed air in said air return chamber to act on said upper portion of said piston to move said piston.

2. In a fastener driving tool, a cylinder having an offset portion dividing the interior of said cylinder into a first portion of greater diameter and a second portion of lesser diameter; a piston in said cylinder and including a greater diameter upper flange slidably mounted in said first portion and a lesser diameter lower flange slidably mounted in said second portion, the outer surface of said piston between said upper and lower flanges defining an annular recessed area, said upper and lower flanges of said piston, said outer surface of said piston and the inner wall of said cylinder forming an air return chamber; fastener driving means connected to said piston; first sealing means carried on said lower flange and slidably engaging the inner wall of said second portion of said cylinder to seal the lower end of said chamber; said upper flange including both an enlarged peripheral groove defined by upper and lower lips and a recessed area in said lower lip providing a passageway extending from said peripheral groove into said air return chamber; second sealing means movably mounted in said enlarged groove; means for supplying compressed air to the first portion of said cylinder to drive said piston downwardly, said compressed air in said cylinder acting on and moving said second sealing means to a first position engaging said lower lip so that compressed air flows around said upper lip and through said groove and said passageway into said air return chamber; and means for exhausting the compressed air from the first portion of said cylinder so that the compressed air in said air return chamber acts on and displaces said second sealing means to a second position in which said second sealing means engages said upper lip thereby permitting the compressed air in said air return chamber to act on said upper flange of said piston to move said piston.

3. A fastener driving apparatus comprising a housing; a cylinder carried on said housing and including upper and lower portions of different diameters; a piston sleeve disposed in said cylinder and including an axially extending opening and upper and lower portions of different diameters slidably mounted in the different diameter portions of said cylinder, said different diameter portions of said cylinder and said piston sleeve defining an air return chamber surrounding said piston sleeve; annular valve means encircling and carried on said upper portion of said piston sleeve for controlling communication between said air return chamber and the interior of said cylinder, said annular valve means engaging the wall of said upper portion of said chamber both to provide a sealing means for the upper end of said piston sleeve and to control the flow of compressed air to said air return chamber along the interface between said wall and the upper portion of said piston sleeve; a fastener driving element; and securing means mounted in said axial opening for connecting said driving element to said piston sleeve at a point spaced between said upper and lower portions of said piston sleeve, said securing means being spaced above said lower portion of said piston sleeve to maintain the lower end of said axial opening substantially free of obstructions.

4. A fastener driving apparatus comprising a housing; a cylinder carried on said housing and including upper and lower portions of different diameters; a piston sleeve disposed in said cylinder and including an axially extending opening and upper and lower portions of different diameters slidably mounted in the different diameter portions of said cylinder, said different diameter portions of said cylinder and said piston sleeve defining an air return

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chamber surrounding said piston sleeve; annular valve means encircling and carried on said upper portion of said piston sleeve, said annular valve means slidably engaging the wall of said upper portion of said cylinder to provide sealing means for the upper portion of said piston sleeve and to provide means for controlling communication between said air return chamber and the interior of said cylinder; a fastener driving element; a nosepiece structure closing the lower end of said cylinder and including a driving element guiding portion extending upwardly into the lower portion of said cylinder, said guiding portion slidably receiving said driving element; and securing means mounted in said opening in said piston sleeve for connecting said driving element to said piston sleeve at a point spaced between said upper and lower portions of said piston sleeve, said securing means being

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spaced above said lower portion of said piston sleeve to maintain the lower end of said axial opening substantially free of obstructions to permit the entrance of said guiding portion into said opening when said apparatus is operated.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,040,709

June 26, 1962

Oscar A. Wandel

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 2, line 47, for "sectioal" read -- sectional --;
line 56, for "visilar" read -- similar --; column 5, line
72, for "portion of said piston and the inner wall of"
read -- a first position in which compressed air from --;
line 74, for "innner" read -- inner --.

Signed and sealed this 30th day of October 1962

(SEAL)

Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents