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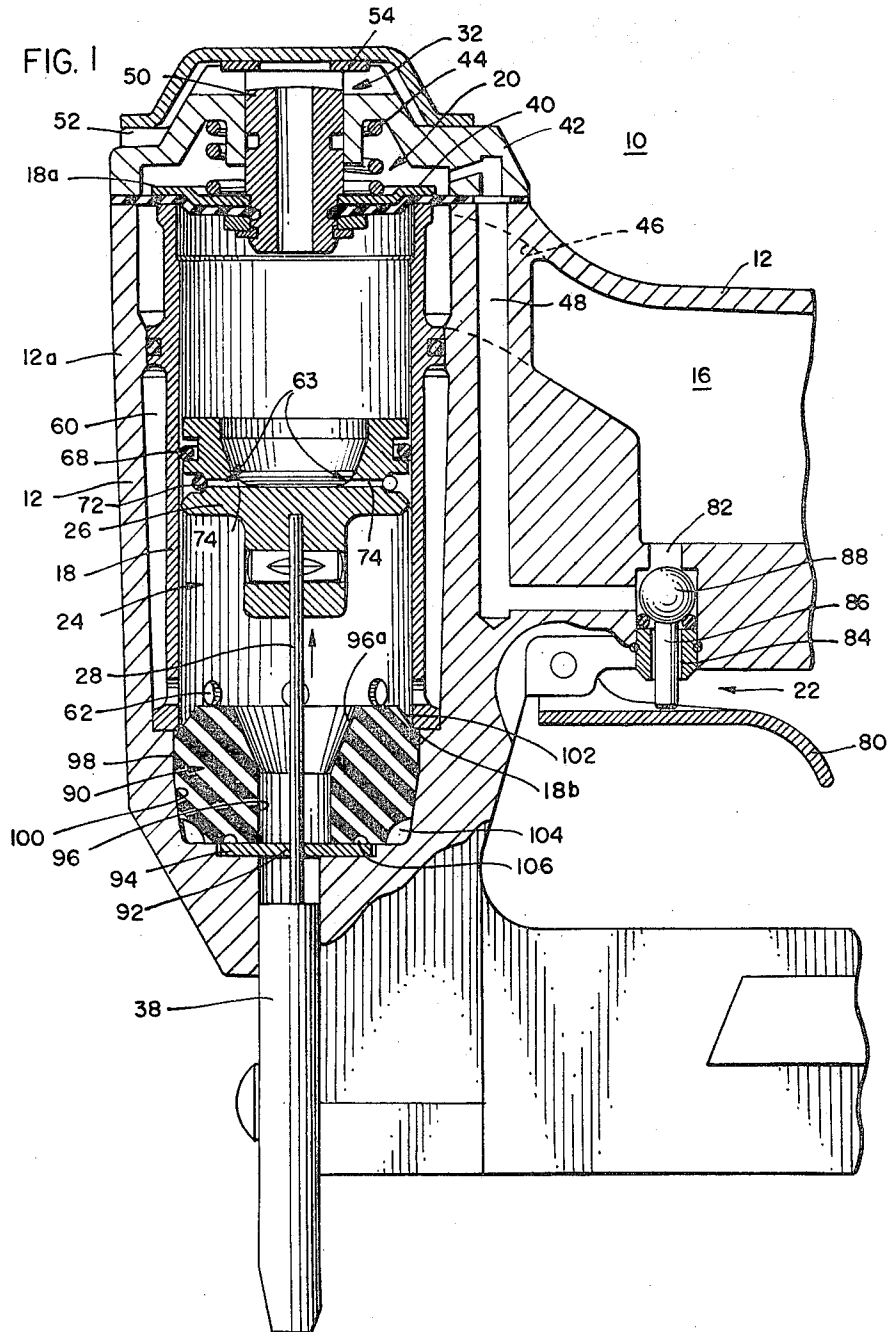
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3,496,840

FASTENER DRIVING APPARATUS

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2 Sheets-Sheet 1



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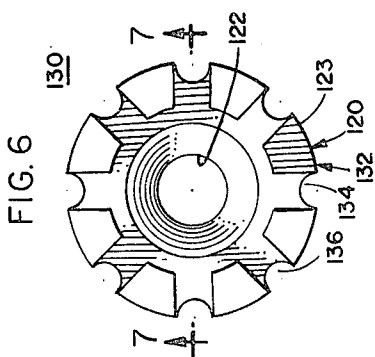
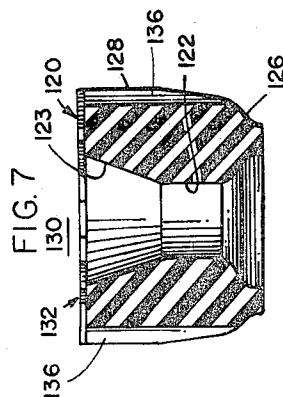
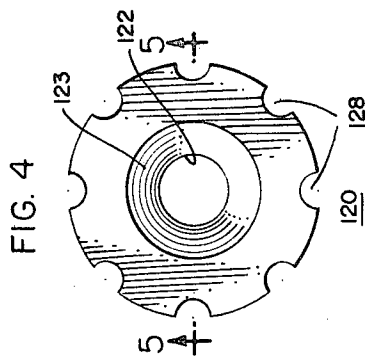
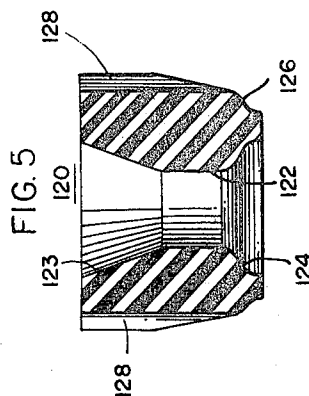
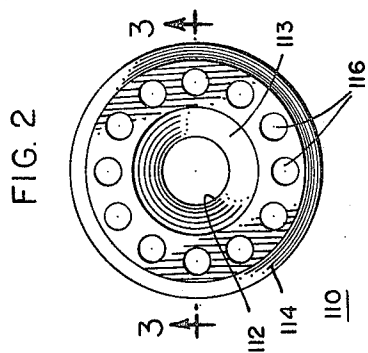
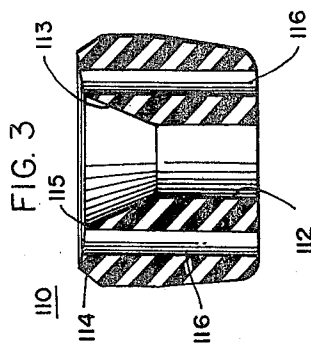
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FASTENER DRIVING APPARATUS

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2 Sheets-Sheet 2



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3,496,840

FASTENER DRIVING APPARATUS

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3 Claims

ABSTRACT OF THE DISCLOSURE

There is provided a fastener driving apparatus having improved means for arresting movement of the piston. The fastener driving apparatus is of the type having a cylinder within a housing and a piston slideably mounted in the cylinder movable through the fastener driving stroke toward one end of the cylinder. An annular resilient bumper forming a stop or arrester is provided to arrest movement of the piston at the end of the cylinder. Such resilient bumper is provided with relieved areas in the form of chamfers or openings to provide additional flexibility in the relieved areas, avoid chipping and breakdown, and achieve longer life by improving circulation.

This invention relates to a fastener driving apparatus, and, more particularly, to a fastener driving apparatus including new and improved means for arresting movement of a piston.

Fastener driving tools of the type in which a fastener driving element is moved through a power stroke by a fluid or pneumatically actuated drive piston commonly include bumper means cushioning the termination of the power stroke of the drive piston. These bumpers or bumper assemblies generally have been formed of resilient material, such as one or more bodies of natural or synthetic rubber, disposed in the path of movement of the drive piston adjacent the lower end of the cylinder. Although these assemblies function properly throughout an operating life commensurate with the expected useful life of prior tools, the present design of tools for driving larger fasteners, such as common nails, and for longer life has made it necessary to obtain greater energy from the drive piston during the power stroke. This means that greater and more force must be damped or absorbed from the drive piston at the termination of the power stroke. Moreover there is an increasing use of automatically recycling fastener driving tools which continuously and repetitively operate so long as the control valve or trigger is maintained depressed. Such rapid repetitive operation of the fastener driving required rapid dissipation of the heat developed in the bumper to prevent excessive build-up of the operating temperature. Heretofore the rubber or resilient body or bumper has not been entirely satisfactory in withstanding increased forces or the greater number of repeated forces over extended periods of time.

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

Another object of the present invention is to provide a fastener driving apparatus including a new and improved bumper assembly.

Another object of the present invention is to provide a fastener driving tool including new and improved means for cushioning the termination of the power stroke of the drive piston in the tool.

In accordance with these and other objects, there is provided a new and improved fastener driving tool having improved means for arresting movement of the piston at the termination of its power stroke. More specifically there is provided an annular or ring shaped resilient bumper in the path of movement of the drive piston adjacent to lower end of the cylinder. In accordance with

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the present invention the annular bumper is provided with relieved areas which may be in the form of tapers, grooves, longitudinal passageways, and the like. Such relieved areas contribute to longer life of the bumper by providing improved cooling effects and permitting the working fluid or air to circulate around and through the relief. Additionally chamfers, tapers and other reliefs avoid chipping and breakdown of the bumper at relieved points. Moreover the bumpers according to the present invention provide additional flexibility in the relieved areas and therefore improved cushioning effect of the drive piston.

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

FIG. 1 is a fragmentary cross sectional view of a fastener driving tool incorporating the improved arrester assembly according to the present invention;

FIG. 2 is a plan view of a modified bumper assembly according to the present invention;

FIG. 3 is a cross sectional view of the bumper assembly of FIG. 2, taken along line 3-3 of FIG. 2;

FIG. 4 is a plan view of yet another embodiment of a bumper assembly according to the present invention;

FIG. 5 is a cross sectional view of the bumper assembly of FIG. 4, taken along line 5-5 of FIG. 4;

FIG. 6 illustrates in plan view yet another embodiment of a bumper assembly according to the present invention; and

FIG. 7 is a cross sectional view of the bumper assembly of FIG. 6, taken along line 7-7 of FIG. 6.

Referring now to the drawings, and particularly to the embodiment of FIG. 1, there is illustrated a fastener driving tool generally illustrated as 10, which embodies an improved bumper or arrester according to the present invention. The tool 10 may be of known construction and, as illustrated, is similar to that shown and described in the application for Letters Patent of the United States, Ser. No. 602,728, filed Dec. 19, 1966, of the invention of Richard H. Doyle. However the improved bumper arrangement may be incorporated into other fastener driving tools, such as those illustrated in Letters Patent of the United States No. 3,173,340 issued Mar. 16, 1965 to Richard H. Doyle and in Letters Patent of the United States No. 3,043,272 issued July 10, 1962 to Oscar A. Wandel et al. Accordingly the fastener driving tool 10 is described only briefly. The tool 10 comprises a housing 12 including a generally vertically extending head or forward portion 12a and a rearwardly extending hollow handle portion 12b defining a fluid reservoir 16. Pressurized fluid such as compressed air is supplied to the fluid reservoir of the tool by a suitable flexible line. The drive system for the tool 10 includes a main or power cylinder 18 mounted within the head portion 12a having an open upper end 18a that is adapted to be selectively connected to the reservoir 16. The open upper end of the cylinder 18 is in engagement with a diaphragm type main or cylinder valve assembly 20, here shown of the poppet type, under the control of a control valve assembly 22 according to the present invention. A fastener driving assembly 24 slideably mounted within the cylinder 18 includes a work or drive piston 26 and has connected thereto a depending driver blade member 28. The fastener driving assembly 24 is normally biased to a position with the piston 26 adjacent the cylinder valve assembly 20. An exhaust valve assembly indicated generally as 32 is provided for controlling the selective connection at the upper end of the cylinder 18 to the atmosphere.

When the tool 10 is to be operated compressed fluid from the reservoir 16 enters the upper open end 18a of the cylinder 18 and drives the fastener driving assembly 24 downwardly to engage and set a fastener or nail sup-

plied to a drive track in a nosepiece or nosepiece structure 38. The flow of compressed fluid into the upper end of the cylinder 18 is controlled by the main valve assembly 20 which includes a diaphragm 40, the periphery of which is clamped between a cap 42 and the head portion 12a of the housing 12 and which seats against the upper edge 18a of the cylinder 18. The diaphragm 40 is resiliently biased against the upper edge surface 18a by a spring 44 located between the cap 42 and the diaphragm 40. The cylinder side of the diaphragm 40 is continuously in connection with the fluid reservoir 16 through a suitable passageway 46 so that the pressurized fluid continuously acts against the cylinder side of the diaphragm 40 to displace the diaphragm 40 from the edge 18a of the cylinder 18. However pressurized fluid is also introduced to the opposite side of the diaphragm 40 through a passageway 48 while the fastener driving tool 10 is in a static or at rest position. The pressure acting on the diaphragm 40 is effective to maintain the diaphragm 40 in a closed position. If the pressurized fluid above the diaphragm 40 is discharged, the pressurized fluid acting through the passageway 46 is then effective to unseat the diaphragm 40 from the edge 18a of the cylinder 18 to dump pressurized fluid into the top of the main cylinder 18 and to drive the piston 26 through a drive stroke.

When the fastener driving tool 10 is at rest, or during the return stroke of the drive piston, the open upper end of the cylinder 18 is exhausted to the atmosphere through the exhaust valve assembly 32. In the illustrated embodiment the exhaust valve assembly comprises a hollow valve stem 50 secured to the diaphragm connecting the upper end of the cylinder 18 to the atmosphere through a suitable exhaust passageway 52. However when the drive piston is operated through a fired or drive stroke, it is necessary for the upper end of the cylinder 18 to be closed, and to this end there is provided a valve seat 54 disposed adjacent the end of the valve stem 50 remote from the cylinder 18 and adapted to be engaged by the valve stem 50 when the diaphragm 40 is raised at the initiation of a drive stroke, thereby closing off the upper end of the cylinder 18 to the atmosphere.

To provide for the return drive of the fastener driving assembly 24, there is provided a return chamber 60 communicating with the lower end of the cylinder 18 through a plurality of ports 62. The drive piston 26 is provided with suitable one way valve means 63, which may be of the type more fully described in the above mentioned application Ser. No. 602,728. Briefly the piston 26 is provided with spaced O-rings including an upper O-ring 68 which functions as a sealing member effecting a pneumatic seal between the piston 26 and the inner wall of the cylinder 18, and a lower O-ring 72 expandable upon a selected pressure differential between the upper and lower ends of the cylinder through the piston 26 so as to unseat and provide for fluid to bypass the piston 26 through fluid passageways 74 and around the O-ring 72 and to supply air to the air return chamber 60.

The operation of the tool is controlled through the control or trigger valve 22. In the illustrated embodiment the control valve 22 functions as a three way valve effective when a trigger 80 is released to connect the cylinder valve 20 to the fluid reservoir 16 through the passageway 48 and an additional passageway 82, and effective when depressed to seal off the passageway 82 and to exhaust the cylinder valve 20 to the atmosphere through the passageway 48 and through a passageway 84 defined around the stem 86 of a valve member 88.

To cushion or arrest the drive stroke of the piston 26, there is provided a resilient annular bumper 90, in accordance with the present invention, and positioned at the lower end of the cylinder 18 which is engageable by the piston 26 as it reaches the end of its drive stroke.

It will be understood in operation of the illustrated tool 10 that so long as the trigger 80 is released, pressure from the reservoir is maintained above the cylinder valve

40 maintaining the piston 26 in its upper or static position. This pressure is maintained above the diaphragm 40 through the passageways 48 and 82. However upon depression of the trigger 80 so as to move the valve member 88 to close the passageway 82, the pressure above the diaphragm 40 is exhausted through the passageways 48 and 84. At this time a pressure below the diaphragm 40 will unseat the diaphragm and dump pressurized fluid into the cylinder 18 driving the piston 26 downwardly through a drive stroke. When the piston 26 reaches the end of section is provided in the lower surface of the bumper 90, so as to arrest its downward movement. Moreover as soon as the piston 26 engages the bumper 90, an exhaust 92 defined between the driver blade 28 and a washer member 94 is sealed from communication with the lower end of the cylinder 18, and the pressure buildup occurring above the piston 26 will be effective to unseat the O-ring 72 thus creating a pressure buildup in the return air chamber 60. As soon as the trigger 80 is released, so as to close the cylinder valve 20, the pressurized fluid in the air return chamber 60 will return the piston 26 back to its static or normal position.

Referring now to the annular resilient bumper 90 defining a stop or arrester for the piston 26, the bumper 90 is generally ring shaped with an inner or central opening 96 through which the driver blade 28 passes. Moreover the outer surface 98 of the bumper 90 is contained within a suitable circular recess 100 in the housing 12. The inner central opening 96 is relieved by the provision of a tapered central opening portion 96a extending upwardly toward the piston. Additionally the upper outer corners are chamfered, as at 102 to provide the necessary relief and to provide engagement with a shoulder 18b on the cylinder 18 to retain the bumper 90 in place. The lower or outer corners of the bumper 90 are relieved by a semicircular grooved outer edge portion 104 and an annular or ring shaped groove 106 of semicircular cross section is provided in the lower surface of the bumper 90.

Thus the bumper 90 is provided with a configuration which considerably contributes to the life of the bumper. Additionally the bumper 90 is substantially more flexible in the relieved areas providing improved cushioning for the piston 26. The chamfers and relieved edge portions avoid chipping and breakdown at the respective points. Moreover the relieving of the bumper in the particular areas contributes to longer life by providing improved cooling effects and permitting better air circulation around the bumper.

FIGS. 2 and 3 illustrate another embodiment of a bumper 110 according to the present invention. As therein illustrated there is provided the bumper 110 of generally ring shape having a central opening 112 forming a passageway for the blade 28 of a fastener driving tool 10. The upper end of the opening 112 is chamfered upwardly and outwardly as indicated at 113. An additional chamfer along the upper and outer edge 114 is provided, and a further chamfer 115 of greater taper than the surface 113 may extend outwardly from the upper end of the taper 113. A plurality of passages 116 extend longitudinally of the bumper 110, and specifically comprise through apertures in the body of the bumper 110. It has been found that such longitudinally extending passages greatly contribute to the circulation of air and the cooling of the bumper 110 thus contributing to the life of the bumper.

Although the embodiment of FIG. 1 illustrates a tool having a lower pressure chamber so that the lower end of the bumper is restricted, the bumpers according to the present invention may also be used with fastener driving tools having a vented lower cylinder end and in such instance the ventilation passages 116 can be vented to the atmosphere if desired to provide further circulation of air.

FIGS. 4 and 5 illustrate yet another embodiment of a bumper 120 according to the present invention wherein the bumper 120 is provided with a central opening 122 for the passage of a blade, having an upwardly and

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outwardly extending taper 123 as well as a lower enlarged flare 124, FIG. 5. The lower outer edge of the bumper 120 is grooved, as illustrated at 126. In accordance with the embodiment of FIGS. 4 and 5, there is provided a plurality of longitudinally extending passageways in the form of flutes 128 defined in the outer surface of the bumper.

The bumper illustrated in the embodiments of FIGS. 6 and 7 is generally similar to that of FIGS. 4 and 5, and includes the bumper member 120 of generally resilient material, having the central opening 122, the tapered portion 123, the forward portion 124, the grooved portion 126, and the flutes 128. Additionally however the bumper 130 includes a spider shaped washer 132 having a plurality of radially extending arms 134 each terminating in a semicircular outer grooved edge 136 aligned with one of the flutes 128 to provide the desired ventilation and cushioning of the bumper 130.

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

1. In a fastener driving tool of the type having a cylinder means defined within a housing means and a piston slideably mounted in the cylinder means with a fastener driving blade extending from one end of the piston, the piston and fastener driving blade assembly being movable through a fastener driving stroke toward one end of said cylinder means, the improvement comprising an annular resilient bumper forming a stop for said piston at said one end positioned within and engaging a circular recess defined at least partially in one of said means and having a central opening tapering outwardly at its inner end through which the driving blade is adapted to move, said bumper being provided with a plurality of circumferential-

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ly spaced apart longitudinal semi-circular flutes in its outer surface.

2. A fastener driving tool as set forth in claim 1 wherein said central opening has a lower enlarged flare extending outwardly away from the piston.

3. A fastener driving tool as set forth in claim 1 wherein the lower outer edge of said bumper is relieved.

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