

[54] **ANNULAR PISTON STOP STRUCTURE**

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[52] **U.S. Cl.** **92/85**

[51] **Int. Cl.** **F01b 11/02**

[58] **Field of Search** **92/85**

[56] **References Cited**

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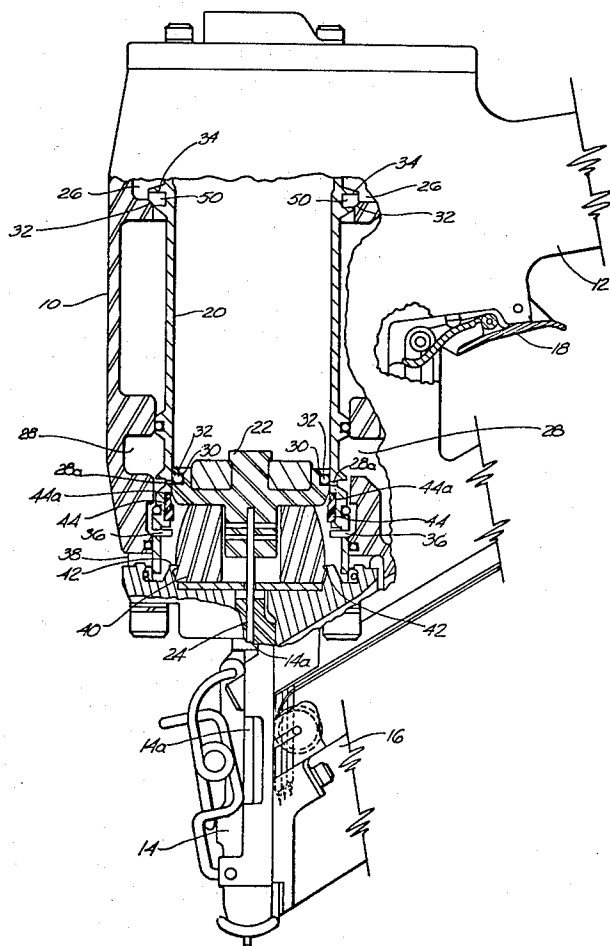
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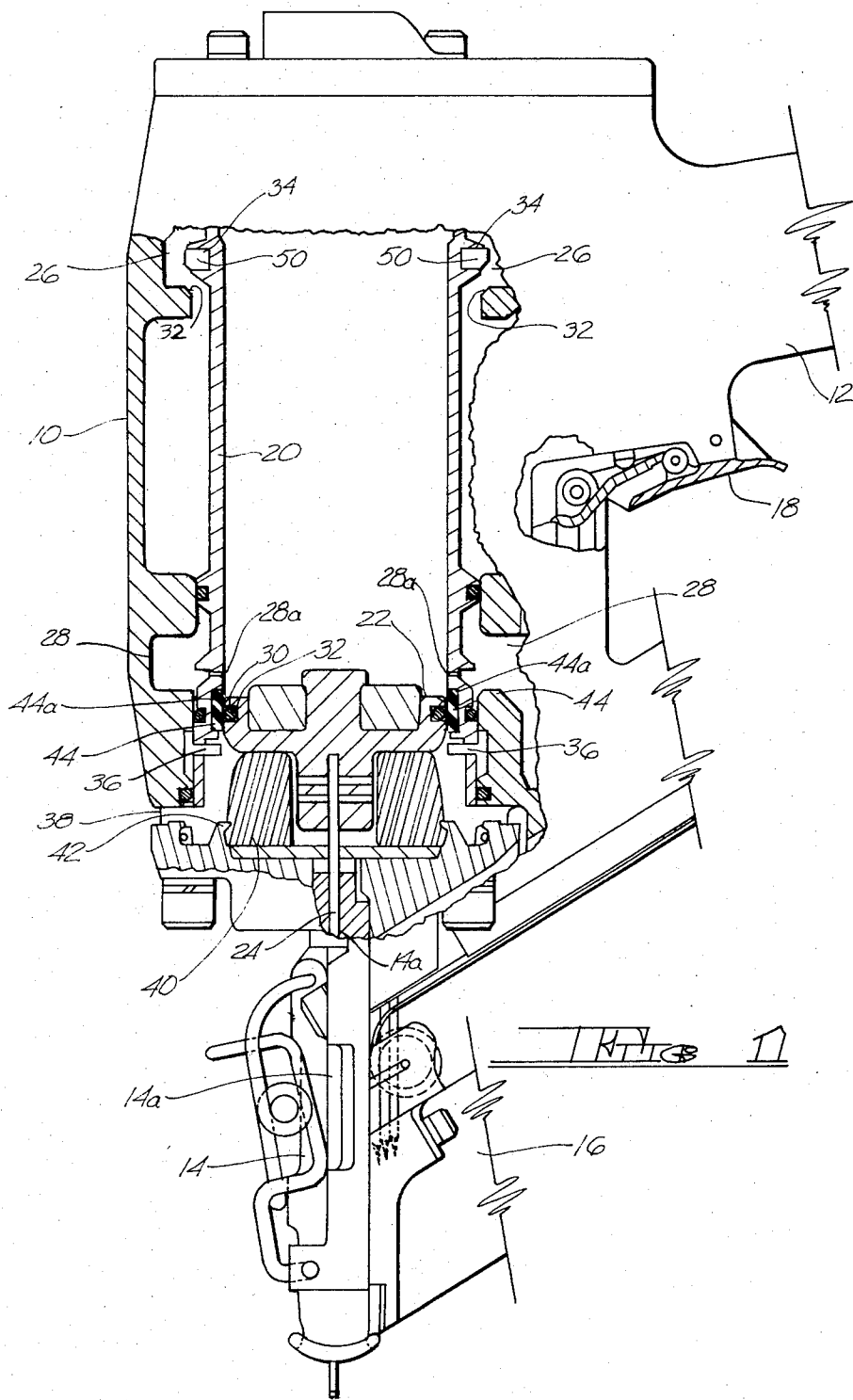
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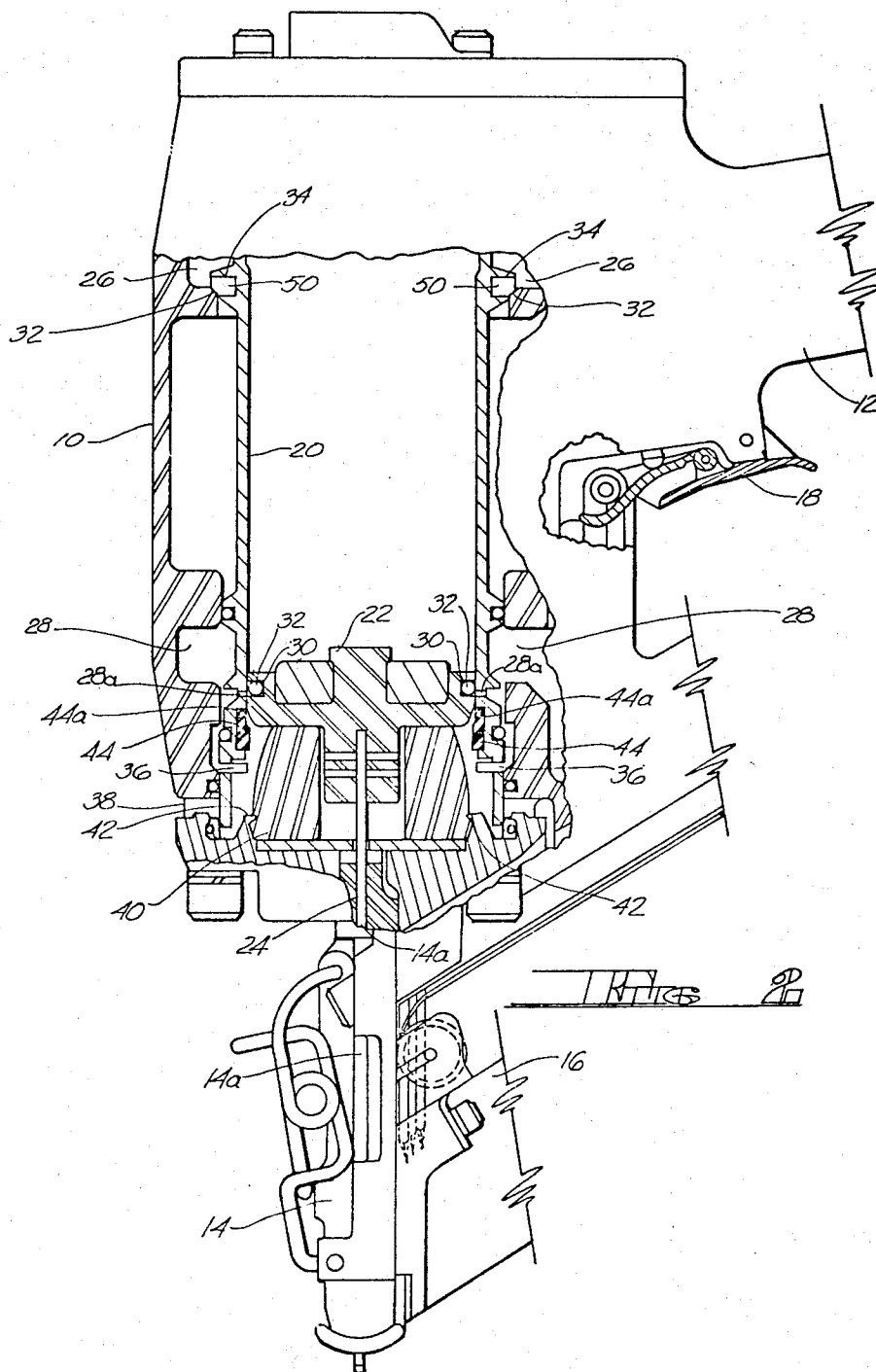
[57] **ABSTRACT**

A structure for stopping a high energy piston, operating within a cylinder, in a short distance at the end of its stroke. There is provided an annulus of resilient material secured to said cylinder and extending slopingly into the path of said piston. As the piston nears the bottom of its stroke, the interference between the piston and annulus, which gradually increases by virtue of said sloping arrangement, brings the piston to a stop in a short distance.

4 Claims, 2 Drawing Figures







ANNULAR PISTON STOP STRUCTURE

BACKGROUND OF THE INVENTION

This invention relates to a resilient piston stop for stopping a high energy piston in a very short distance. It is particularly useful in connection with fluid actuated fastener driving devices and the invention will be described in connection with such devices. It will of course be understood that it has utility in other applications as well.

Fluid actuated fastener driving devices include a working cylinder within which a piston reciprocates. When suitable fluid power, such as for example air under pressure, is admitted, the piston is driven rapidly downward in a working stroke. The piston carries a fastener driver which is effective during the working stroke to drive a fastener fully into a work piece.

In the early days of the fluid actuated fastener driving devices, a spring was used for returning the piston to its original position at the end of the working stroke. An example of such a structure may be found in U.S. Pat. No. 2,585,939 issued Feb. 19, 1952 in the name of A. G. Juilfs. In this and similar devices the space in the cylinder above the piston was vented to atmosphere, and an ordinary spring was used to move the piston upwardly in a return stroke. In tools of this type no significant problem was presented in connection with a piston stop. In part, this was because the early tools were quite small and the piston did not develop a great amount of energy. Furthermore, the piston during its entire working stroke was working against the force of the spring which also tended to retard the velocity of the piston.

A great deal of trouble was encountered with springs as a result of breakage and the like, and U.S. Pat. No. RE. 26,262 in the name of A. G. Juilfs, dated Sept. 5, 1967, taught an air return system. According to this last mentioned patent, at the end of the working stroke of the piston a part of the air under pressure from the working cylinder was admitted into a return reservoir, and this air under pressure was used to return the piston in its upward stroke. The need for a suitable resilient piston stop in a pneumatic fastener driving device actually arose when the spring return system was eliminated.

Since the early days, fluid actuated fastener driving devices have been built which have been ever larger and ever more powerful. Thus, for example, certain commercial tools may be found today which will drive 3 inch staples or 10d common nails into hard wood. Under these conditions, it will be clear that the problems of providing a suitable piston stop are increasingly difficult.

It has been found that these fastener driving devices are so powerful that the resistance afforded by the fastener penetrating the work piece has very little effect in stopping the piston. In other words, the fully driven position of the fastener is determined almost entirely by the relative position between the end of the fastener driver and the nose piece of the tool when the piston is at its bottom position.

The problem which has to be solved, therefore, is to bring a very high energy piston to a full stop adjacent the end of its working stroke in a space between about 0.09 inch to 0.125 inch. While various types of resilient piston stops have been developed, all of them are subject to extreme wear and rapid deterioration or total

destruction when they are used with the current, more efficient, high energy fluid actuated tools.

One solution to the problem is disclosed in the copending application of Robert G. Rothfuss, Ser. No. 230,569 filed Mar. 1, 1972. According to said copending application, the resilient stop is divided into two parts with one part being disposed at the bottom of the cylinder and the other part being secured to the underside of the piston. This arrangement has many advantages with certain types of fluid actuated fastener driving devices; but because of the thicknesses of the two resilient members, the height of the tool is of necessity a bit greater. The main objection to this structure, however, is that the mass of the piston is substantially increased, and this results in decreased performance. Thus, the structure of said application would not be appropriate for situations where a relatively small tool is involved and it is desired to minimize the height of the tool.

With the foregoing considerations in mind, it is an object of the present invention to provide an annular resilient piston stop which in some instances may serve as the sole element for stopping the piston, but which in other tools of larger capacity and greater energy may serve as an assist to a resilient bottom stop member.

BRIEF SUMMARY OF THE INVENTION

The invention contemplates the provision of an annulus of resilient material secured to the cylinder wall adjacent the bottom of the cylinder and extending slopingly radially inward into said cylinder into a position where it interferes with said piston as the latter nears the bottom of its stroke. It will be understood that where the piston is a relatively low energy piston, such an annulus alone may suffice to stop the piston in a very short distance, while with a high energy piston the collar or annulus may serve as an assist to a resilient stop against which the piston abuts at the end of its stroke.

In the present application, the invention will be explained primarily in its action as a stop assist in a very high energy fastening tool since this is a much more complex problem.

BRIEF DESCRIPTION OF THE FIGURES OF THE DRAWING

FIG. 1 is a fragmentary cross sectional view of a fastener driving device showing the position of the parts when the piston is near the end of its down stroke.

FIG. 2 is a view similar to FIG. 1 showing the position of the parts at the beginning of the return stroke.

DESCRIPTION OF THE PREFERRED EMBODIMENT

For purposes of disclosure, the present invention has been disclosed in connection with a fastener driving device such as is disclosed and claimed in the copending application of Rothfuss and Becht, filed Dec. 22, 1971 under Ser. No. 210,812. The operation of the tool is described in detail in said application and since the tool itself forms no part of the present invention, it will only be described very briefly herein.

Basically, the tool comprises a head portion indicated generally at 10, a rearwardly extending handle portion indicated generally at 12, a nose piece or guide body indicated generally at 14, a magazine structure indi-

cated generally at 16 and a manually actuated trigger 18.

Within the head portion 10 there is provided a main working cylinder sleeve indicated generally at 20. Slid-able within the cylinder sleeve 20 is the piston indicated generally at 22. It will be understood that the piston at the start of its stroke is disposed at the upper end of the cylinder sleeve 20; and in the views of the drawing it is shown near the end of its down stroke in FIG. 1 and at the beginning of its return stroke in FIG. 2. The piston has secured to it a fastener driver 24 by means of which the fasteners will be driven into the work. The magazine 16 is loaded with a supply of fasteners in strip form, and the fasteners are urged by the magazine toward an internal passage or drive track 14a in the nose piece of the tool. It will be understood that with the piston in its "up" position, the lowermost end of the driver 24 will be disposed slightly above the head of the fastener which is positioned in the drive track 14a.

When the trigger 18 is actuated, and by virtue of a valving structure disclosed in said copending application Ser. No. 210,812, and which does not form a part of the present invention, air under pressure will be admitted through the space 26 into the cylinder sleeve above the piston 22. This air under pressure rapidly drives the piston 22 and its driver 24 downwardly in a working stroke toward the position of FIG. 1. At this time, a portion of the air under pressure in the working cylinder is conducted through the ports 28a into a return reservoir 28 where it serves to return the piston to its "up" position.

In normal operation, when the manual trigger 18 is released by the operator, it is effective to prevent further air under pressure from entering the area 26 and to vent the upper portion of the cylinder sleeve 20 to atmosphere. Under these conditions, air under pressure in the return reservoir acts on the underside of the piston 22 through the ports 36 to force it upwardly to its original position.

Plenum type return systems for fastener driving tools are disclosed in detail in U.S. Pat. No. RE. 26,262 in the name of A. G. Juilfs, dated Sept. 5, 1967 and entitled "Portable Stapler With Pneumatic Drive and Return." The specific valving structure and return operation of the device shown in this application are explained in detail in the copending application Ser. No. 210,812 referred to above.

As shown in the Figures, the piston is provided with an annular groove 30 within which an O-ring 32 is seated for the purpose of maintaining a sealing relationship with the cylinder sleeve 20 during both the drive and return strokes. The driver assembly is secured to the piston in any conventional manner.

It must be understood that in the particular tool here under consideration as described in Ser. No. 210,812, the cylinder 20 also constitutes a main valve. Thus, the housing 10 has an internal annular valve seat 32 and the cylinder 20 has a projection 34 having a groove to seat a resilient valve member 50. The details of the operation of this valve are described in said copending application and it will be clear therefrom that when the valve is in its open position as shown in FIG. 1, the piston will be driven downwardly in its driving stroke. During this movement there is an upward bias on the cylinder 20, as described in said copending application. At the end of the working stroke, and by the valving de-

scribed in said copending application, the sleeve 20 will be caused to move downwardly to the position of FIG. 2, which closes the valve 32, 50 and at the same time it closes the bottom vent 38 and also exhausts the space above the piston to atmosphere and opens the ports 36 so that the compressed air in the plenum chamber 28 can act on the bottom of the piston to return it to its "up" position.

A conventional resilient bottom stop member is provided at 40 and is secured to the bottom of the housing 10 by the flange 42 formed in the bottom of the housing. Secured in the cylinder wall 20 is the resilient annulus 44. The annulus 44 has an annular flange which is seated in the groove 44a formed on the inside of the cylinder. By reference to FIG. 2, it will be seen that the element 44 is more or less wedge-shaped, and extends radially inwardly in the path of the piston slopingly so that it interferes with the movement of the piston. It will be observed that the lower edge of the piston is rounded for cooperation with the annulus 44. Bearing in mind that the particular tool in connection with which this invention is being described is a very high energy tool, it will be seen that the annulus 44 immediately begins to slow down the piston at about the instant that it abuts the annular resilient stop 40 and therefore assists the latter in bringing the piston to a stop. During this slow-down period, and until the piston reaches the end of its stroke, the upward bias on the cylinder, and therefore on the annulus, is being maintained. It must be noted that in addition to the downward wedging action produced by the piston, there is an outward wedging action which maintains the flange of the annulus 44 in its groove 44a and prevents its being pulled out. In an actual tool, the piston may travel a distance between about 0.090 inch and 0.125 inch from the point of contact with the stop member until it has come completely to rest.

The assist annulus 44 not only assists the bottom stop 40 in bringing the piston to rest, but takes some of the impact off the bottom stop 40 and therefore contributes to the longevity of the latter. One of the principal difficulties with these high energy tools has been that the resilient stops are destroyed after relatively short usage. By means of the annulus of the present invention, the life of the bottom stop is greatly extended. It should also be understood that in low energy tools the annulus 44 alone may in many cases be sufficient and permit the elimination of a resilient bottom stop entirely.

It will be understood that the disclosure herein is exemplary; and that therefore no limitation not expressly set forth in the claims is intended and no such limitation should be implied.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a fastener applying device having a cylinder, a piston reciprocable in said cylinder, a piston stop structure for said piston, a fastener driver, and means for moving said piston and fastener driver in a driving stroke to drive a fastener into a work piece; said piston stop structure comprising:

- a. a groove in the longitudinal wall of the cylinder above the bottom thereof, an annulus of resilient material secured in said groove,
- b. said annulus being generally wedge-shaped in cross section, and extending slopingly, radially into said

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cylinder into a position of interference with said piston as the latter nears the bottom of its stroke, said piston, as it enters into said annulus, squeezing said annulus radially outward, and being circumferentially frictionally retarded thereby, whereby to

bring said piston to rest in a short distance.
2. The device of claim 1, wherein the lower edge of said piston is rounded for contact with said annulus.

3. The device of claim 2, wherein a resilient bottom

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stop element is fixedly mounted adjacent the lower end of said cylinder, and said annulus assists said bottom stop element in bringing said piston to rest.

4. The device of claim 3, wherein the axial location of said annulus and the height of said resilient bottom stop element are such, that the piston, in its downward travel, abuts both at substantially the same time.

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