United States Patent

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[54] **TRAPPED AIR RETURN SYSTEM FOR FLUID ACTUATED FASTENER DRIVING MACHINES**
4 Claims, 6 Drawing Figs.

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[51] Int. Cl. F15b 15/17, F15b 13/42, F01b 11/02
[50] Field of Search 91/416; 91/LAV; 92/85; 91/461; 91/469

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ABSTRACT: A fluid actuated fastener driving machine is shown which is provided with a body having a drive chamber therewithin. A piston has a plurality of vertical laterally spaced openings therewithin. A bumper is provided with a number of openings and is impingeable with the piston at the completion of the drive stroke thereof. A return chamber is connected to the drive chamber through the openings within the bumper.

A lower poppet control chamber and an upper poppet control chamber are provided. An upwardly movable poppet valve has a lower face disposed within the lower poppet control chamber and an upper face disposed within the upper poppet control chamber. The lower face is a smaller operational area than the upper face. A first conduit is provided to conduct pressure air into the lower poppet control chamber and a second conduit is provided to conduct pressure air into the upper poppet control chamber. A trigger housing is connected to said second conduit. An exhaust conduit is connected with the trigger housing. A trigger is disposed within the trigger housing which can selectively block either the second conduit or the exhaust conduit. The poppet valve is provided with an opening which normally abuts the upper face of the piston. Above the opening in the poppet is a seal which is normally spaced therefrom and a second exhaust conduit which is open to atmosphere. A spring normally biases the poppet into its normal position.

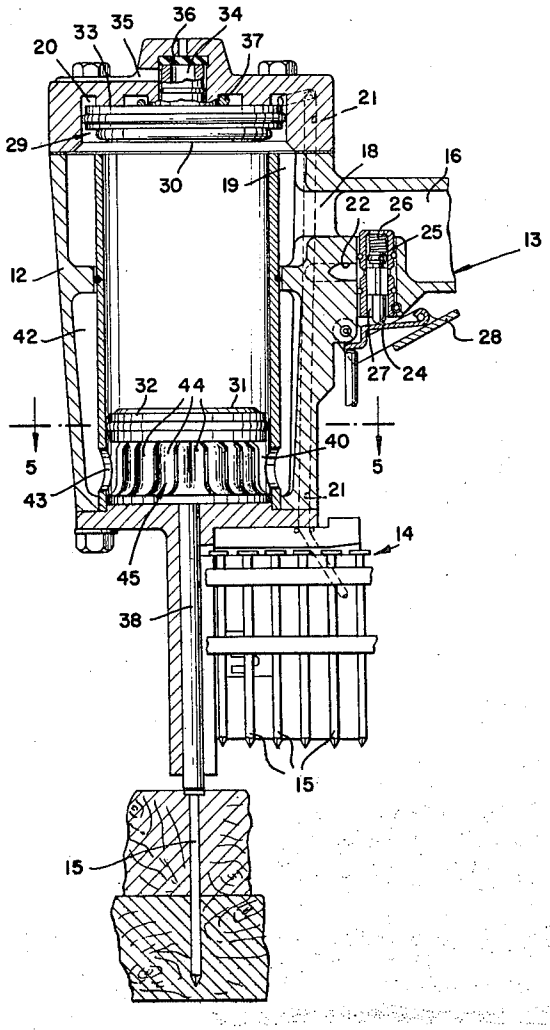
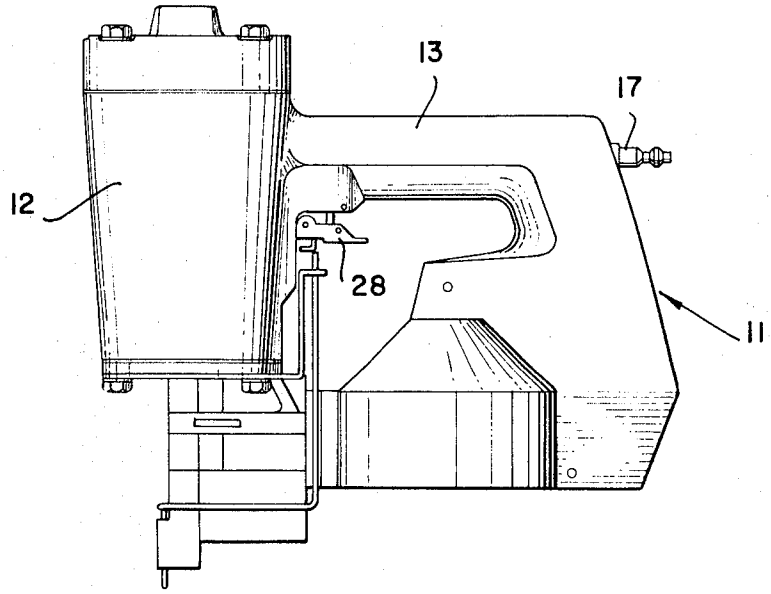


FIG. 1



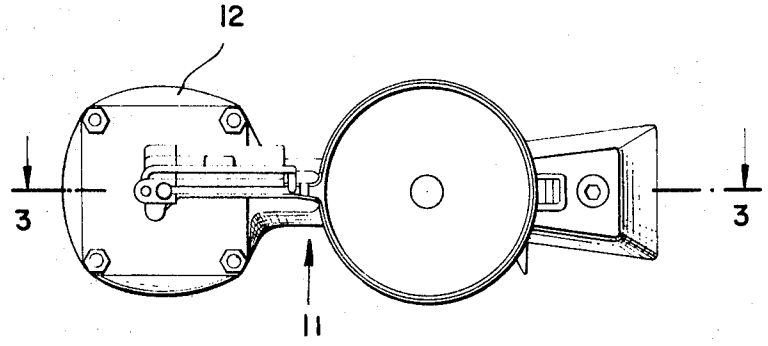


FIG. 2

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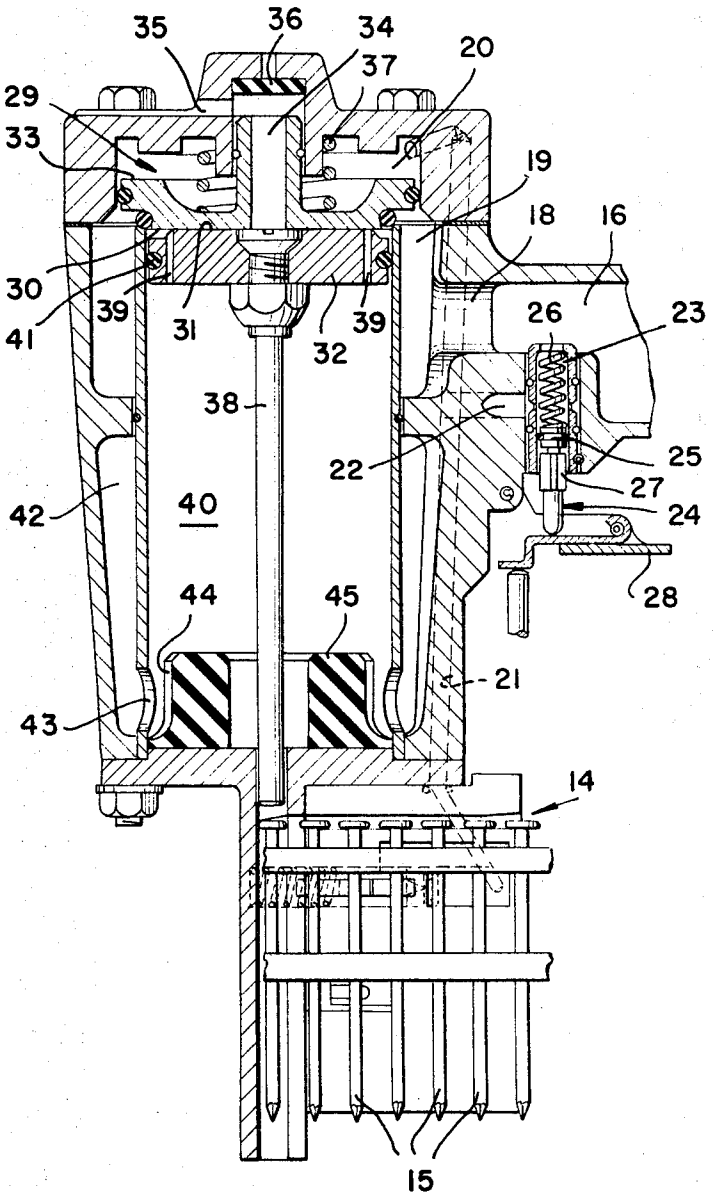
FIG. 3



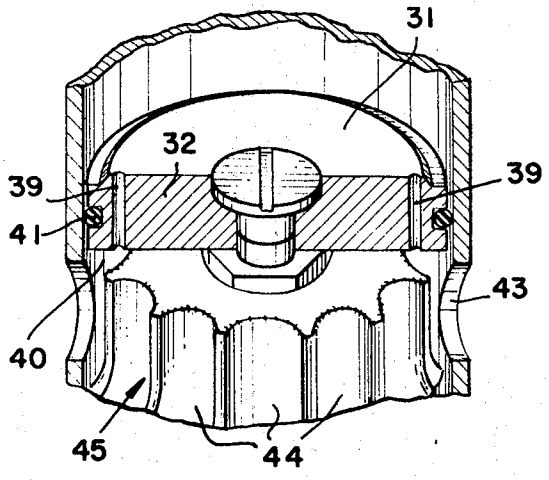


FIG. 6

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FIG. 4

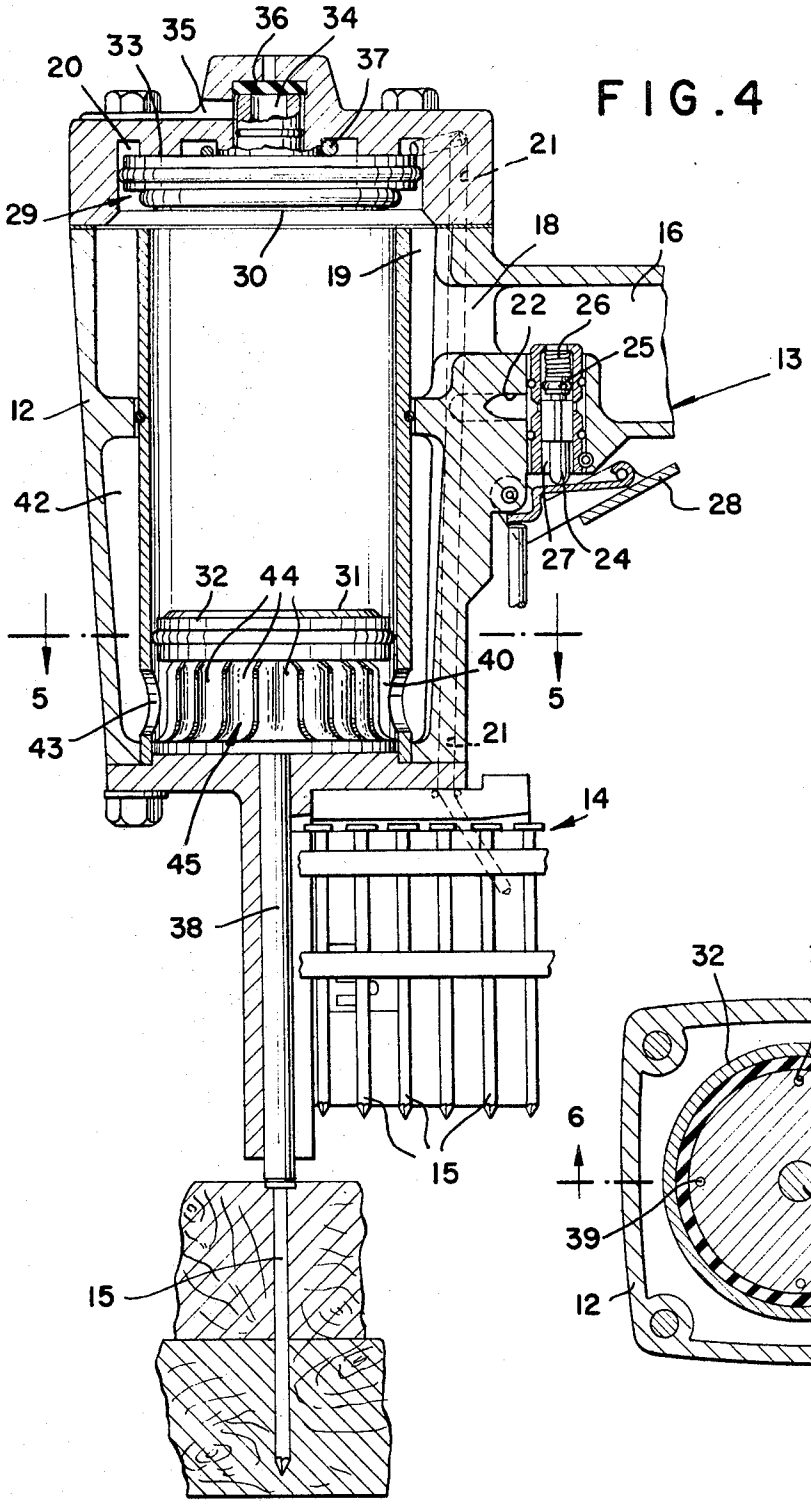
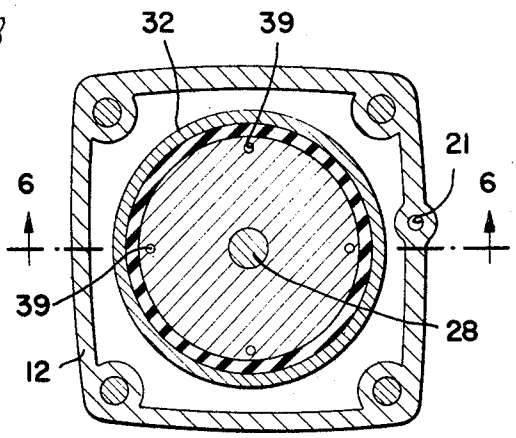


FIG. 5



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TRAPPED AIR RETURN SYSTEM FOR FLUID ACTUATED FASTENER DRIVING MACHINES

DESCRIPTION OF THE INVENTION

This invention relates to a fluid actuated fastener driving machine having a novel system for returning the piston to normal position.

Conventionally there are two (2) types of return systems utilized in fluid actuator fastener driving machines. These can be generally described as "spring return" systems or "air return" systems. Air return systems are further divided into two (2) general types which are "single spool" types and "double spool" types. The air return system of this invention is a "single spool" type.

The air return system of this invention can be further particularized as the "trapped air" type. In this type of return system a "trapped air" chamber is provided which is designed to be filled with pressurized air on the "down stroke" of the piston. When the piston reaches the completion of its drive stroke the air within the trapped air chamber is now pressurized and, when the pressurized air is removed from the driving portion of the piston, will return the piston to its normal position.

The air return system of this invention is further employed in connection with the novel poppet valve system which has been utilized by the assignee of this application in various other fastener driving devices of similar type.

Conventional trapped air systems for returning the piston have had a number of disadvantages. In conventional systems the trapped air chamber, upon the completion of the driving stroke of the piston, exerts a severe compressive force to return the piston to its normal position. As a result the piston is returned rather violently. If such a system is employed in connection with the type of poppet valve system utilized in this invention wherein the poppet valve normally lies adjacent the upper face of the piston the violent return will, in a relatively short time, damage the poppet valve and cause the machine to become inoperative. Furthermore, in conventional systems of this type, the air is introduced into the return chamber through an opening in the side of the piston. Therefore, of course, a seal must be provided to normally seal the opening. As the machine is operated during its service life the seal will eventually be destroyed and the machine will be rendered inoperative. In the device of this invention the openings are provided within the piston and are spaced from the sides thereof. Therefore there is no necessity for sealing these openings.

A further advantage of the construction of this invention lies in the fact that the parts are relatively simple and the number of seals required is relatively small. Hence there is very little friction of the piston during its travels making for greater efficiency and less wear upon the parts.

The above constitutes a brief description of this invention and some of the objects and advantages thereof. Other objects and advantages of this invention will become apparent to the reader of this specification as the description proceeds.

The invention will now be further described by reference to the accompanying drawings which are made a part of this specification.

FIG. 1 is a side elevational view of a fastener driving device made in accordance with this invention.

FIG. 2 is a plan view of the device shown in **FIG.** 1.

FIG. 3 is a cross-sectional view of the device shown in **FIG.** 2 taken along lines **3-3** of **FIG.** 2. In this view the parts are shown in the normal rest position.

FIG. 4 is a side elevational view, partly in section, showing the position of the parts when the machine is operated and the piston has reached its extreme drive position.

FIG. 5 is a detail cross-sectional view taken along lines **5-5** of **FIG.** 4.

FIG. 6 is a fragmentary cross-sectional view taken along lines **6-6** of **FIG.** 5.

The invention will now be further described by reference to the specific form thereof as shown in the accompanying drawings. In this connection, however, the reader is cautioned to note that the specific form of this invention as shown in the specification herein is merely for illustrative purposes and for purposes of example. Various changes and modifications could obviously be made within the spirit and scope of this invention.

The fastener driving machine **11** of this invention is formed with a housing **12** to which is attached a handle **13**. A magazine **14** is adapted to hold a plurality of nails **15** which are sequentially driven into work. In order to feed the nails sequentially a feeding mechanism is employed but, in this invention, the feeding mechanism for the nails and the magazine thereof form no part. A feeding mechanism and magazine which could be operative in this invention are described in the patent application now pending Serial No. **695,538** filed December **4, 1967**. Other feeding mechanisms and magazine constructions could also be employed.

Within handle **13** is an air chamber **16** which is connected to a source of pressure air through a connector **17**.

Chamber **16** is connected through conduit **18** to lower poppet control chamber **19**. Chamber **19** is pressurized throughout the operating cycle of the device.

Upper poppet control chamber **20** is also provided. Connected to upper poppet control **20** is conduit **21** which is joined to conduit **22** which in turn is joined to trigger housing **23**. A trigger member **24** bears a spool portion **25** which is normally biased in down postion by coil spring **26**.

Trigger housing **23** is open to atmosphere at **27** but such opening to atmosphere is normally blocked by spool **25**.

A link **28** is employed to actuate trigger **24**.

A poppet valve **29** is formed with a lower face **30** which normally abuts the upper face **31** of piston **32**. Poppet **29** also bears an upper face **33**.

Lower face **30** of poppet valve **29** has a smaller operational area than upper face **33** thereof.

Poppet valve **29** is also provided with an opening **34**. Opening **34** normally impinges conduit **35** which is open to atmosphere and is spaced from seal **36**. A coil spring **37** is provided which normally biases poppet valve **29** into the position shown in **FIG.** 3.

A driver **38** depends downwardly from piston **32** and is utilized to selectively drive nails **15** into work.

Piston **32** is provided with a plurality of openings **39** therewithin. Piston **32** is sealingly and reciprocatingly movable within drive chamber **40**. Piston **32** is sealed within drive chamber **40** by O-ring **41**.

A return chamber **42** is also provided within housing **12**. Return chamber **42** is provided with an opening **43** which in turn is connected to corresponding openings **44** within bumper **45**. Bumper **45** is impingeable with piston **32** at the termination of the drive stroke of the piston.

In the preferred modification of this invention, in order to obtain maximum efficiency, the volume of return chamber **42** should be the same as that of drive chamber **40**. Also, it can be noted, the size of the openings **39** in the piston must bear some relationship to the operational area of the piston itself. Obviously if the openings are too small the device will not properly return since return chamber **42** will not be filled with pressure air. Conversely if the openings are too large the device will not properly operate since the pressure air, instead of driving the piston, will bleed through the openings into the return chamber and the piston will likewise not properly return because the pressure air will bleed out of the openings within the piston. While the relationship between the parts may be varied there is a certain ratio which will not operate.

Preferably, in the preferred modification of this invention, the piston has a diameter of two and five eighth (**2-5/8**) inches and each of the holes within the piston have a diameter of three thirty-seconds (**3/32**) of an inch. I believe that if the total diameter of the openings within the piston are more than twenty-five (**25%**) percent of the operational area of the

piston satisfactory operation will not be obtained. Furthermore if the total area of the openings within the piston is less than five (5%) percent of the total operational area of the piston I also believe that satisfactory operation will not be obtained.

The operation of this invention will now be explained.

Pressure air is caused to flow into the device through connector **17** into space **16** and chamber **19**. Likewise because of the position of trigger **24** pressure air flows through conduit **22**, conduit **21** and into chamber **20**. At this point poppet valve **29** is biased downwardly through spring **37**. While face **33** of poppet valve **29** has a greater operational area than face **30** thereof the difference in operational area is not sufficient to bias the valve in the "down' position without the intervention of spring **37**.

In this position of the poppet the lower face **30** bears against piston **32** and therefore piston **32** is in its normal position. Furthermore opening **35** is connected to opening **34** of poppet **29** causing this structure to be open to atmosphere. When trigger **24** is depressed by the movement of link **28** spool **25** is moved into the position shown in **FIG.** 4. This causes conduit **22** to be open to atmosphere and pressure air can no longer flow into trigger housing **23** since spool **25** now blocks the entrance of pressure air therein. This causes exhaust of chamber **20** to atmosphere. Such exhaust removes pressure from face **33** of poppet **29** and therefore the pressure within chamber **19** causes poppet **29** to rise as shown in **FIG.** 4 now sealing opening **34** against seal **36** and blocking communication between space **34** and conduit **35**. Pressure air now flows from chamber **19** into drive chamber **40** and causes piston **32** to be moved downwardly thereby causing driver blade **38** to strike a nail **15** and drive it into work. At the same time pressure air flows through openings **39** in piston **32** thereby passing through openings **44** in bumper **45** through openings **43** and thereby filling chamber **42** with pressure air. This movement of pressure air also serves to cool bumper **45** and thereby increase its life.

The final stage of this movement is shown in **FIG.** 4 where piston **32** now abuts bumper **45**.

As pressure is released from trigger **24** spring **26** now biases trigger **24** into its normal position. At this point spool **25** blocks communication between trigger housing **23** and atmosphere but permits pressure air to flow into conduits **22** and **21**. This causes space **20** to be pressurized and, since the operational area of face **33** of poppet **29** is greater than the operational area of face **30** poppet **29** now moves into the position shown in **FIG.** 3. At this stage opening **34** is spaced from seal **36** and communicates with opening **35** which is open to atmosphere. Pressure air then exhausts above piston **32** to atmosphere. However chamber **42** is now filled with pressure air. This pressure air now exerts an upward thrust on piston **32** thereby returning it to its normal position. The pressure air, as the piston is returned, also bleeds through openings **39** and exhausts to atmosphere through opening **34** in poppet **29** and opening **35** to atmosphere. Therefore, by the time piston **32** reaches the position shown in **FIG.** 3, the return is extremely gentle and poppet **29** is not damaged.

In the preferred modification of this invention element **38** is not sealingly connected to bumper **45** nor is it sealingly connected to the outer housing. There is a certain amount of air leakage around the lower portion of element **38**. This is not sufficient to render the return system inoperative but will serve to remove any excess pressure air remaining after return of piston **32** to the normal position shown in **FIG.** 3.

The foregoing sets forth the manner in which the objects of this invention are achieved.

I claim:

1. A fluid actuated fastener driving machine comprising, in combination, a body, a drive chamber within said body, a piston within said body including an upper face portion, and a lower face portion, a downwardly depending driver blade secured to said piston, said piston also provided with a plurality of laterally spaced openings therethrough, said piston being slidably, sealingly and reciprocatingly movable within said drive chamber, a return chamber having the same fluid capacity as said drive chamber connected to said drive chamber through said openings within said piston, a first poppet control chamber, a second poppet control chamber, a poppet valve provided with an opening therewithin normally impinging against said piston, said poppet valve also having a first face within said first poppet control chamber and a second face within said second poppet control chamber, the first face of said poppet valve having a smaller operational area than said second face of said poppet valve and normally being sealingly connected in line with said piston so that pressure fluid does not normally abut the upper face portion of said piston, first means for conducting pressure fluid into said first poppet control chamber, second means for selectively conducting pressure fluid into said second poppet control chamber when said piston means are in normal rest position, third means for selectively exhausting pressure fluid from said second poppet control chamber, a trigger housing connected to said second means and to said third means, a trigger member within said trigger housing, said trigger selectively blocking either said second means or said third means, bumper means normally impingeable with said piston on the completion of the drive actuation thereof, said bumper means provided with an opening therein connected with the openings within said piston, the openings within said piston being of a size permitting pressure fluid to enter said return chamber upon the stroke drive of said piston and for said pressure fluid to be retained within said chamber, said openings being also of a size to permit said pressure fluid to actuate return of said piston on the return stroke thereof and thence to be exhausted from said chamber.

2. A fastener driving tool as described in Claim **1**, the openings within said piston being substantially vertical and spaced from the sides thereof.

3. A fluid actuated fastener driving machine as described in Claim **1** including a seal normally spaced from said poppet but selectively engageable with said opening therewithin, and an exhaust conduit normally open but selectively blockable by said poppet.

4. A fluid actuated fastener driving machine as described in Claim **3** including spring means normally biasing said poppet into engaged position with the face of said piston.