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2,870,743

AIR FLOW AND PISTON DRIVE FOR PNEUMATIC STAPLERS

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1 Claim. (Cl. 121—21)

My invention resides in the provision of novel means for admitting air into the cylinder behind the driving piston in order to actuate same and thereby drive the staple driver into contact with a staple so as to set it properly.

Specifically, my invention comprises an improvement over the arrangement shown in issued Patent No. 2,585,940 entitled Valve Control System For Portable Pneumatic Staplers. In this latter patent there is shown and claimed an arrangement wherein air is brought behind the piston by means of a small longitudinal groove provided in the interior face of the cylinder wall. Although the arrangement of this patent has been generally satisfactory certain difficulties have been experienced including uneven wear of the cylinder wall and a limited driving power.

Accordingly, it is a specific object of my invention to provide an arrangement which insures a longer useful life for pneumatic staplers to which the invention is applied.

Another object of my invention is to provide a better and faster drive for the stapler.

Yet another object of this invention is to provide for more consistent operation of tackers and staplers employing the invention.

Briefly, I accomplish these and other objects of the invention which will become more apparent to those skilled in the art during the course of the following description and from reference to the accompanying drawings by floating the piston centrally of the cylinder within which it operates, the piston in a sense being air lubricated. The crux of this invention lies in introducing the air so that it will be distributed about the piston equally, the piston thus being air-balanced.

All of the above will become more apparent from the following description and from the drawings in which like numerals are employed to designate like parts throughout and in which

Figure 1 is a side elevation of a pneumatic stapler or tacker employing the invention,

Figure 2 is a vertical section taken through the center of the tacker of Figure 1,

Figure 3 is a fragmentary section corresponding to the tacker of Figures 1 and 2 but showing the piston during a different stage in its drive stroke.

Referring now to Figure 1, I have illustrated the tacker or pneumatic stapler of this invention as comprising a handle section 10, a body 11, having a staple discharge nose 12 and a staple feed magazine 13. An air line has a swivel connection to the handle section as at 14 and there is a trigger 15 to actuate the valve 16 by which air is admitted from the chamber 17 of the handle 10 into the passageway 18. A spring 19 normally keeps the valve member 16 in the position shown in Figures 1 and 2 in which position the passageway 18 is opened to the exhaust chamber 20.

The body 11 of the tacker defines a cylinder 21 in which there is a drive piston 22. A plug or cap 23 is threaded into the top of the staple gun or tacker and this serves as a cylinder head against which the piston is urged by

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the spring 24. As shown and claimed in United States Patent No. 2,671,214, I prefer that the piston 22 be recessed so as to receive not only the spring 24 but also a member 25 to which the driver 26 is fastened, the driver 26 and its member 25 being capable of longitudinal movement with respect to piston 22.

In the lower end of the tacker there is a resilient pad or cushion 27 against which the piston 22 will abut upon completion of its driving stroke. Because the driver 26 and its member 25 are free of the piston 22 such driver is free to advance under the influence of inertia upon final stopping of the piston 22 by the cushion 27. A member 28 having an air vent therein aids in the formation of an air cushion to aid in the stopping of the piston 22 and this is also taught in Patent No. 2,671,214 as well as in other Juilfs' patents.

The staple feed magazine 13 may include means upon which a strip of staples 29 may rest and be urged to the drive track 30 by means of a spring-actuated follower 31. It will be understood that the particular feed magazine shown and thus briefly described does not constitute a limitation upon this invention. All that is needed is some sort of mechanism to insure a succession of staples being placed ahead of the driver 26 so that it may drive such staples through the track 30 into the work.

It is to be further understood that while I have shown a preferred arrangement of the piston 22 and driver 26 the instant invention is not to be construed as limited only to this arrangement. It is quite possible and probable that the invention would apply equally as well to a stapler such as shown in Patent 2,682,052 wherein the driver and its member 25 are fastened to the piston 22 rather than free thereof as shown herein.

As stated above, in the prior patents referred to, a small longitudinal groove is provided in the interior face of the cylinder wall 21 which groove extends from the port 32 or terminus of the passage 18 to a point behind the piston when at rest against the head or cap 23. To this end a suitable clearance or the like 33 is provided and this might consist merely of an extra thread of those which receive the cap or a protuberance might be given to the cap. In any event such a clearance 33 behind the piston 22 is also provided in the instant arrangement.

The critical difference between this invention and the arrangement discussed as employed in the patents referred to resides in the elimination of the small groove and in the addition of an annular groove or recess 34 extending completely around the inner wall of the cylinder 21. This groove 34 corresponds in width substantially to that of the port 32 or the passage 18.

By eliminating the small groove above referred to and by employing in its stead the annular groove or passageway 34 I ensure that air introduced within the passageway 18 by manipulation of the trigger 15 contacts the piston on all sides substantially simultaneously. Air so introduced within the groove 34 then seeps between the piston and cylinder wall. That air which moves towards the cushion 27 simply escapes from the device and that air which moves towards the cap 23 collects in the area 33 behind the piston so as to drive same forwardly toward the cushion 27. I prefer that the distance from the passageway or groove 34 to the area 33 be shorter than the distance from such groove to the lower end of the piston 22 so that a bare minimum of air is wasted. Air which collects in the area 33 acts to move the piston relatively slowly towards the cushion 27 until such time as it clears the port 32 of the passageway 18 whereupon the full strength of the air will be active behind the piston so as to drive it rapidly towards the cushion 27.

Formerly, in those devices which employed the small groove referred to, after some time there was a noticeable wear on that portion of the cylinder wall opposite

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the passage 18 since the air striking the piston initially acted against one side thereof only. This resulted in the piston being forced away from the cylinder entrance port and small longitudinal groove against the opposite cylinder wall thus creating a drag on the piston and wear in the cylinder. In this manner the piston was also slowed in its movement. In addition air escaped in varying degree thus making the operation of the device, especially after prolonged use, somewhat inconsistent.

By introducing the air about all sides of the piston substantially simultaneously as is accomplished by providing the groove 34, the piston 22 is air-balanced, that is such piston is floated within the center of the cylinder 21. Since the drag above referred to is thus eliminated the piston will travel at a greater speed even though the air pressures used are identical and even though the staplers used are the same except for this substitution of the annular groove 34 for the small longitudinal groove formerly employed. The driving power is so improved, for example, that a pneumatic tacker which formerly could drive only a half-inch staple under a given air pressure can now drive a five-eighths inch staple under the same pressure. This is a considerable improvement for it enables the use of the same model tackers and standard air pressures to accomplish the driving of different size staples as is often demanded by various jobs. Thus instead of employing two or more different lines and sizes of tackers one such tacker will suffice for a greater number of needs.

The operation of the device embodying my invention is as follows. Squeezing of the trigger 15 against the valve member 16 in opposition to the spring 19 opens the passageway 18 to air from the chamber 17. This air flowing in the passageway 18 is introduced within the circular groove or channel 34 provided in the interior face of the cylinder wall 21, this channel 34 filling with air so that the piston 22 is completely surrounded thereby.

In this manner the piston is floated in air and is air-balanced. Air seeps from the channel 34 and collects behind the piston 22 in the region of the clearance 33. Air thus building up in back of the piston 22 will cause such piston to move forwardly in the direction of the bumper 27. When the piston has moved sufficiently to pass the port 32 leading from the channel 18 to the groove 34 the full pressure of the air introduced within the device is then behind the piston 22 with the result that it is driven hard and fast towards the bumper 27.

As the piston is moved in the manner just described the driver 26 will contact a staple 29 brought into position within the drive track 30 by the feed mechanism 13 and follower 31. This driver will force such staple through the nose 12 into the work being stapled. Movement of the drive piston 22 is slowed up by the air cushion which builds up ahead of the piston 22 and which is controlled by the member 28, final stopping of the piston occurring when it strikes the bumper 27. The spring 24 returns the driver and piston to the position of Figure 2 whereupon another pull of the trigger 15 will cause a repeat of the operations just described.

It is to be understood that all of the actions just described in connection with the driving of the piston take

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place extremely rapidly. This makes it that much more important that air be introduced within the cylinder 21 by means of the channel 34 above described for this insures consistent operation of the piston 22 and much longer life of the staple gun or tacker since there is no uneven wear. Balancing the piston centrally of the cylinder as is accomplished by introducing the air completely about the piston not only insures a longer life for the tacker and more consistent operation but it also results in a better drive and increased power. These advantages are realized by introducing the air within the annular groove or channel 34 and this, as stated, constitutes the crux of the instant invention.

It will be understood by those skilled in the art that certain modifications may be made in the invention disclosed without departing from its scope and spirit and although I have shown the invention as embodied in certain structure I do not intend to be limited to such structure except in so far as it is specifically set forth in the subjoined claim. Obviously other feed mechanisms and driving arrangements can be made without departing from the principal teaching of introducing the air on all sides of the piston as is accomplished by the annular groove or channel 34.

Having thus described my invention what I claim as new and what I desire to protect by way of United States Letters Patent is:

In a pneumatic stapling machine having a staple driver actuated by a solid-wall piston reciprocating within a cylinder having a cylinder head, said piston being driven by air and returned by a spring, said piston at rest abutting said head, said cylinder and said head providing a clearance behind said piston at rest, and said machine including a trigger actuated valve controlling the admission of air to said cylinder, the improvement which comprises: an annular groove extending completely around the inner wall of said cylinder, said groove being spaced from said clearance, said groove being positioned in that part of said cylinder occupied by said piston at rest whereby said groove is covered by said piston at rest, and an air passageway extending from said valve to said annular groove whereby air is uniformly distributed about the periphery of said piston, said annular groove constituting the entire means in said cylinder wall for the passage of air from said valve to said clearance, air from said groove being free to seep evenly between the periphery of said solid-wall piston and said cylinder wall to said clearance whereby said piston is air balanced within the center of said cylinder and drag of said piston against said cylinder wall is eliminated, air which seeps between said solid-wall piston and said cylinder wall away from said clearance being free to exhaust, whereby pressure is built up in said clearance behind said piston to move said piston from said head on the drive stroke of said said piston.

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