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FASTENER DRIVING APPARATUS

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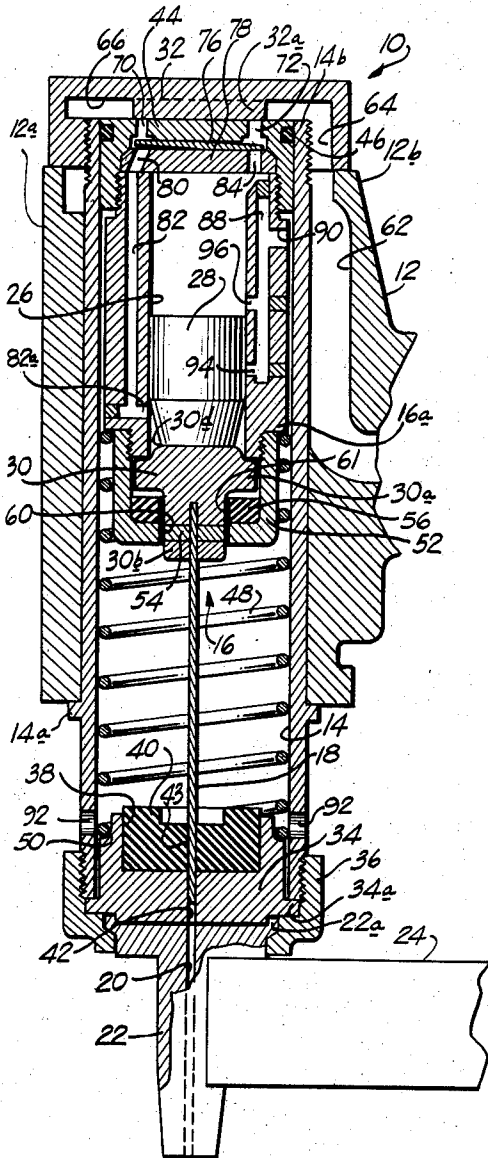


Fig. 1

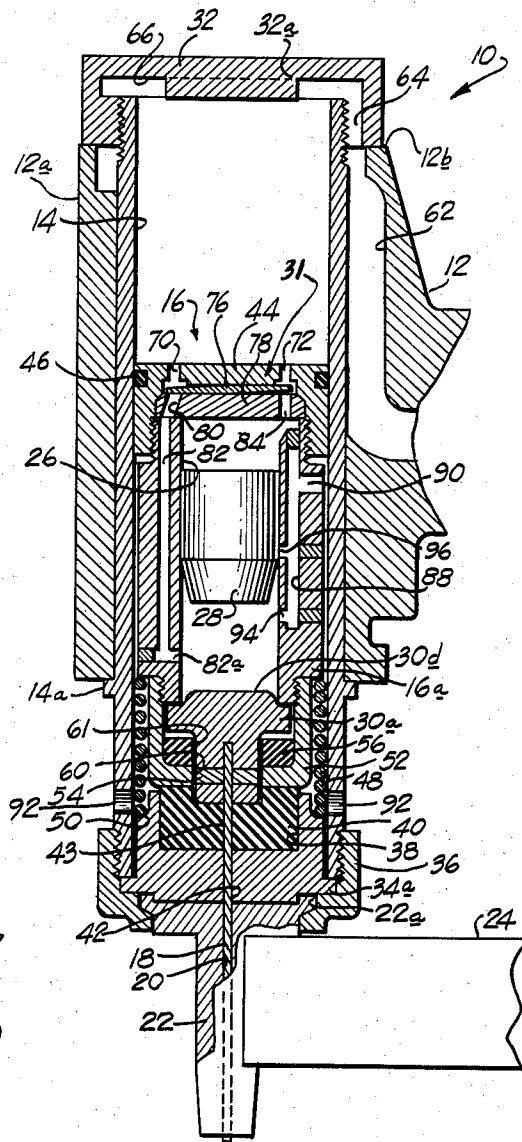


Fig. 2

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FASTENER DRIVING APPARATUS

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9 Claims. (Cl. 1—44.4)

This invention relates to a fastener driving apparatus and, more particularly, to a pneumatically operated nailer.

Although some of the smaller size staples or similar fasteners can be satisfactorily driven into workpieces by the use of hand or bench tools utilizing a single power stroke, it is generally rather difficult to fully drive staples of the larger sizes or nails into materials such as the hard woods encountered in, for instance, the furniture industry. An improved fastener driving device of the type disclosed in the copending application of Oscar A. Wandel and Richard H. Doyle, Serial No. 546,377, filed November 14, 1955, which application is assigned to the same assignee as the present invention, has been designed for driving staples into hard substances by the use of a single power stroke. However, the resistance encountered in pneumatically driven elongated fasteners, such as nails, is often so high that adequate driving power is not available from the compressed air power source in a single working stroke or cycle. Some prior devices have obviated this deficiency by utilizing the compressed air to provide a series of repetitive blows for driving a fastener much in the manner that rivets are headed or swaged. These prior devices generally are subject to the difficulty that the nail driving device cannot be held in a fixed position relative to a workpiece during the driving operation but, rather, must be manually manipulated or adjusted so that driving engagement with the fastener is maintained as the fastener is driven. This manipulation generally consists of adjusting resiliently connected portions of the driving device relative to each other as the fastener is driven.

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

Another object is to provide fastener driving means which obviate the use of separate components which are connected by resilient links, such as springs.

A further object is to provide a nailer of the repetitive power stroke type which includes new and improved means for driving nails or similar fasteners.

Another object is to provide a fastener driving device which can be held in a selected position without movement or manipulation during a fastener driving operation, thereby to increase the ease of operating the device.

In accordance with these and many other objects, an embodiment of the invention comprises a hand tool housing including both structure defining a first cylinder supplied with compressed air and structure defining a drive track. A hollow piston, which is movably mounted in the first cylinder, supports a driving blade which is slidably received in the drive track to engage and drive fasteners which are supplied to the drive track from a magazine or other fastener feeding means disposed adjacent thereto. The hollow piston defines a second cylinder having a hammer slidably mounted therein which is adapted to provide repetitive blows on an anvil element which is mounted in one end of the piston and to which is connected the fastener driving blade. The other end of the hollow piston includes periodically operated valve means

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for placing the spaced portions of the second cylinder in fluid communication with the first cylinder so that the hammer is reciprocated to deliver a series of blows to the anvil element which drives the fastener.

When compressed air is admitted to the first cylinder, the piston is advanced until the driving blade engages the fastener or nail and sets the nail in the workpiece. The compressed air in the first cylinder is alternately admitted to and exhausted from the second cylinder by the valve means to reciprocate the hammer to deliver a series of sharp blows to the anvil element, thereby to drive the fastener in the workpiece. As the fastener is driven into the workpiece, the piston is advanced in the first chamber by the compressed air so that the driving blade remains in continuous engagement therewith. In this manner, an improved tacking and stapling apparatus is provided for driving nails or similar fasteners into workpieces in which the driving apparatus can be maintained in a fixed position relative to the workpiece without manipulation or movement during the driving operation.

The invention, both as to its construction and method of operation, together with further objects and advantages thereof, is best understood by reference to the following detailed description when taken in conjunction with the accompanying drawings wherein:

Fig. 1 is a side elevational view, in partial section, of a pneumatically operated tacker or nailer embodying the present invention showing the nailer in a normal position; and

Fig. 2 is a side elevational view, in partial section, illustrating one position of the nailer during operation thereof.

Referring now to Figs. 1 and 2 of the drawings, the present invention comprises a pneumatically operated nailer or tacker 10 for driving nails or similar fasteners. In its general construction, the nailer 10 may be similar to the apparatus disclosed in the copending application of Oscar A. Wandel, Serial No. 527,697, filed August 11, 1955, which is assigned to the same assignee as the present application, in providing a housing 12 having a handle portion defining an air reservoir which is supplied with air under pressure. A trigger actuated valve, which may also be of the type disclosed in the above identified copending Wandel application, admits air to a power cylinder 14 so that a hollow piston assembly 16 is moved to advance a fastener driving blade 18 through a drive track 20 formed in a nosepiece 22. The fasteners to be driven are supplied to the drive track 20 from a magazine or fastener feeding means 24 which may be of any of the many types well known in the art.

In order to increase the driving effectiveness of the nailer or tacker 10, the hollow piston assembly 16 includes structure defining a cylinder 26 within which a hammer 28 is slidably mounted. A control valve means, indicated generally as 31, which is formed in the piston assembly 16, places spaced portions of the cylinder 26 in intermittent fluid communication with the power cylinder 14 to alternately raise and lower the hammer 28 so that a series of sharp blows is applied to an anvil element 30 which is directly connected to the driving blade 18. As the fastener is driven into the workpiece, the compressed air in the cylinder 14, in addition to supplying a power medium for the cylinder 26, also advances the piston 16 so that the driver blade 18 is maintained in continuous engagement with the upper end of the fastener being driven. Therefore, the nailer or tacker 10 can be maintained in a fixed position relative to the workpiece during a fastener driving operation in addition to providing a hand tool which is capable of driving large fasteners, such as nails, into relatively hard materials.

As indicated above, the housing 12 may be of the general type disclosed and described in detail in the above

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identified Wandel application and includes a generally vertically extending and elongated cylindrical portion 12a defining a cylindrical opening within which the cylinder 14 is disposed, the cylinder 14 being located in a predetermined position relative to the housing 12 by an annular flange 14a which engages a lower end of the cylindrical portion 12a of the housing 12. In order to close the upper end of the cylinder 14, a cylinder cap 32 is provided which threadedly engages an upper extremity 14b of the cylinder 14 and which bears against a flat annular upper edge 12b of the housing 12, thereby to seal the upper end of the cylinder 14.

The lower end of the cylinder 14 is closed by an annular member 34 having a flanged portion 34a which is secured to the lower end of the cylinder 14 by a collar 36. The closure member 34 includes a centrally located recess 38 for receiving a resilient piston bumper 40 which cushions the piston assembly 16 at the end of its power stroke. The member 34 is also provided with a centrally located slot or opening 42 which is aligned with a slot 43 in the bumper 40 to provide a passageway for receiving the lower free end of the blade 18.

The nosepiece 22 includes an offset annular flanged portion 22a which is engaged by the collar 36 to secure the nosepiece 22 to a lower extremity of the cylinder 14. In addition to defining the drive track 20 through which the driving means 18 extends, the nosepiece 22 supports the magazine or fastener feeding means 24, which may be either permanently or detachably secured to the nosepiece 22. The magazine 24, which is of any of the types well known in the art, sequentially feeds tacks, nails, or staples into the drive track 20 through an opening connecting it with the magazine 24 to permit them to be engaged and driven by the blade 18.

Since various types of fasteners can be supplied by the magazine 24, the configuration of the drive track 20 can be differently formed to accommodate the varying shapes of these fasteners. The driving element 18 can also be so designed that the end surface thereof substantially conforms with the upper configuration of the type of fastener being driven, and, accordingly, the driving element 18 may assume a variety of forms other than the blade shown in Figs. 1 and 2. Further, the openings 42 and 43 in the bumper 40 and the closure member 34 have cross sectional configurations in accordance with the varying configurations of the fastener driving blade 18.

The cylinder 26 in the piston assembly 16 is closed at its upper end by a plate 44 having a sealing O-ring 46 which slidably engages the inner wall of the cylinder 14. In order to return the piston 16 to its normal position (Fig. 1) at the end of the power stroke, a compression spring 48 is interposed between a lower shouldered edge 16a on the piston 16 and an annular shoulder 50 formed in the closure member 34.

To provide a means for securing the fastener driving blade or element 18 to the lower end of the piston assembly 16, an annular cap 52 is provided which is threadedly secured to a lower end 16a of the piston 16. The anvil element 30 includes an end portion 30b which is rigidly secured to one end of the blade 18 by a pin 54 and an annular flanged portion 30a which is loosely positioned within the recess defined by the lower end of the piston 16 and the cap 52 to provide for limited movement of the anvil 30 and the blade 18 relative to the piston 16. An annular bumper 56 formed of resilient material is interposed between the upper surface of the end wall of the cap 52 and the lower surface of the flanged portion 30a of the anvil 30 to cushion the impact of the anvil element 30. To aid in guiding the limited movement of the anvil 30 relative to the piston assembly 16, the elongated projecting portion 30b is slidably mounted within an opening 60 formed in the cap 52 and an opening 61 in the bumper 56. The anvil element 30 is also provided with a projecting portion 30d located in align-

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ment with the cylinder 26 to provide a striking surface for the hammer 28.

To provide means for admitting air to the cylinders 14 and 26, the housing 12 includes a passageway 62 to which air under pressure is selectively supplied from the reservoir under the control of a manually actuated valve assembly, which may be of the type described in detail in the above identified Wandel application. The cylinder cup 32 includes both an axially extending passage 64 in its side wall which is in communication with the passageway 62 and an annular passageway 66 formed in the end wall which places the passageway 64 in communication with the chamber 14. The return spring 48 normally urges the piston assembly 16 to the position shown in Fig. 1 so that the upper surface of the closure plate 44 normally engages a circular projecting portion 32a of the cylinder cap 32 which is defined by the annular recess 66.

When the manually actuated valve is opened, compressed air is admitted to the connected passageways 62, 64, and 66 to flow into the cylinder 14 to move the piston 16 against the action of the spring 48 so that the blade 18 engages and moves the fastener in the drive track 20. Movement of the piston 16 away from the position shown in Fig. 1 renders the control valve means 31 effective to reciprocate the hammer 28 so that repeated blows are applied to the anvil 30 and the driving blade 18.

The valve means 31 controls reciprocation of the hammer 28 within the cylinder 26 by alternately admitting compressed air to spaced portions of the cylinder 26 from the cylinder 14 and by alternately venting these portions of the cylinder 26 to atmosphere. More specifically, the control valve assembly 31 includes a pair of compressed air inlet passageways 70 and 72 formed in the plate 44, alternate ones of which are closed by a flapper valve element or diaphragm 76. The valve element 76 is held in engagement with an underside of the closure plate 44 by a valve seat 78 which is held in place by the upper end of the piston 16 and the lower wall of the closure plate 44.

To provide compressed air for moving the hammer 28 upwardly within the cylinder 26, the valve element 76 (Fig. 1) is displaced to place the passageway 70 in communication with a passageway 80 formed in the valve seat 78 and a passageway 82 formed in the wall of the piston 16, the passageway 82 terminating in a port 82a adjacent the lower end of the cylinder 26. When the passageway 70 is opened to supply compressed air to the passageways 80 and 82, the hammer 28 is moved upwardly by the air pressure, and the passageway 72 is closed by the valve element 76 so that compressed air is not supplied through a passageway 84 in the valve seat 78 to the upper end portion of the cylinder 26.

Air is periodically exhausted from the cylinder 26 by a longitudinally extending passageway 88 formed in the wall of the piston 16, a transverse bore 90 in the wall of the piston 16 placing the passageway 88 in fluid communication with the atmosphere through the lower portion of the power cylinder 14 and a plurality of apertures 92 formed in the wall thereof. The passageway 88 is placed in communication with the cylinder 26 by a pair of transverse bores 94 and 96 so that when, as described above, the hammer 28 is moved upwardly within the cylinder 26, the air confined to the rear of the hammer 28 is exhausted through the connected passageways 96, 88, and 90 until such time as the bore 96 is closed by the hammer 28. Continuing upward movement of the hammer 28 compresses the air in the upper portion of the cylinder 26.

Upward movement of the hammer 28 is terminated when the transverse bore 94 is uncovered to exhaust the compressed air in the cylinder 26 through the passageways 94, 88 and 90. Exhausting this lower portion of the cylinder 26 also tends to increase the flow of compressed air through the passageways 70 and 80 around the adjacent end of the valve element 76. This increased flow of

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air and the increased pressure of the air confined within the upper portion of the cylinder 26 due to the upward movement of the hammer 28 displaces the valve element 76 so that communication between the passageways 70 and 80 is closed and the passageways 72 and 84 are placed in fluid communication to admit compressed air into the upper portion of the cylinder 26. This compressed air drives the hammer 28 downwardly so that it delivers a sharp blow to the anvil element 30, the force of which is transmitted through the blade 18 to the fastener being driven. During this downward movement of the hammer 28, the air trapped beneath the lower end of this hammer is exhausted to atmosphere through the bore 94, the passageway 88, and the transverse bore 90.

Downward movement of the hammer 28 under the force of the compressed air supplied to the upper portion of the cylinder 26 is terminated when the bore 96 is uncovered so that the compressed air in the upper portion of the cylinder 26 is exhausted directly to atmosphere through the bores 90 and 96, the passageway 88, and the openings 92. Further, when the lower end of the hammer 28 seals off communication with the bore 94, the air trapped beneath the lower end of the hammer is compressed to increase the air pressure in the connected passageways 82 and 80, thereby tending to displace the valve element 76 to the position shown in the Fig. 1 of the drawings, this tendency to be displaced being increased by the compressed air flowing through the connected passageways 72 and 84 when the upper portion of the cylinder 26 is vented to atmosphere. Shifting the valve to the position shown in Fig. 1 of the drawings initiates upward movement of the hammer 28, as described above.

In operation, the nailer or tacker 10 is moved so that the lower end of the nosepiece 22 rests upon the workpiece to be fastened and a manually controlled valve assembly, similar to that disclosed in the above identified Wandel application, is actuated to provide compressed air which flows through the passageways 62, 64, and 66 to be applied to the upper end of the cylinder 14. This compressed air moves the piston construction 16 downwardly from the position shown in Fig. 1 until the lower end of the drive blade 18 enters the drive track 20 and engages and at least sets the fastener supplied by the magazine 24. At this time, the initial downward movement of the piston assembly 16 is terminated.

The compressed air provided by the passageways 62, 64, and 66 is also supplied to the passageways 70 and 72 to place the hammer 28 in operation so that repeated blows are delivered to the driving blade 18 to continue the driving of the engaged fastener. More specifically, assuming that the control valve assembly 31 is in the position shown in Fig. 1 at the time that the piston 16 is moved from its normal home position against the resilient force of the return spring 48, compressed air flows through the passageways 70, 80, and 82 to be supplied to the lower portion of the cylinder 26 to initiate movement of the hammer 28 upwardly relative to the cylinder 26. This upward movement continues until such time as the compressed air in the upper portion of the cylinder 26 and the rush of air through the passageways 70 and 80 due to venting the lower portion of the cylinder 26 through the bore 94 displace the position of the valve element 76 so that communication between the passageways 70 and 80 is closed off (Fig. 2) and the passageways 72 and 84 are placed in communication to supply compressed air to the upper portion of the cylinder 26.

The expansion of this compressed air forces the hammer 28 downwardly within the cylinder 26 at a high rate of speed so that the hammer 28 strikes the anvil element 30 to transmit driving force to the engaged fastener through the pin 54 and the blade 18. During a first portion of this propelled downward movement of the hammer 28, the air trapped in the lower portion of the cylinder 26 is exhausted to atmosphere through the bore 94 and, following downward movement of the hammer 28 beyond

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the bore 94, the air in the lower portion of the cylinder 26 is trapped to increase the pressure of the air applied through the passages 82 and 80 to one side of the valve element 76. The opening of the bore 96, together with the increased pressure in the passageway 80, tips the valve element 76 so that once again the communication between the passageways 72 and 84 is closed off and that between the passageways 70 and 80 is opened to initiate the next cycle of reciprocation of the hammer 28.

The successive blows applied by the hammer 28 to the anvil 30 and the driving blade 18 progressively drive the engaged fastener deeper into the workpiece. However, as the fastener is driven into the workpiece, the compressed air within the cylinder 14 acts on the closure plate 44 of the piston 16 so that the entire piston assembly 16 is moved downwardly within the cylinder 14 to maintain the lower end of the drive blade 18 in continuous engagement with the upper end of the engaged fastener without requiring any manipulation of the nailer or tacker 10 relative to the workpiece. The intermittent operation of the hammer 28 under the control of the compressed air supplied to the cylinder 26 under the control of the valve assembly 31 continues until such time as the fastener has been completely driven into the workpiece. Thereafter, the manually controlled valve assembly is released to terminate the supply of compressed air through the passageways 62, 64, and 66 to the power or work cylinder 14, and this valve assembly also provides a means for exhausting the cylinder 14. As the air pressure within the upper portion of the cylinder 14 is thus decreased, the spring 48 returns the piston assembly 16 to the position shown in Fig. 1 of the drawings in which it is conditioned for a cycle of operation identical to that described above. Incident to withdrawing the driving blade 18 from the drive track 20, the magazine 24 advances an additional fastener into the drive track to be engaged and driven during the next cycle of operation of the tacker or nailer 10.

While the invention has been described with reference to a particular embodiment thereof, it will be understood that those skilled in the art may make changes and modifications without departing from the principles of the invention. Therefore, it is intended in the appended claims to cover all changes and modifications which fall within the spirit and scope of the principles of this invention.

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

1. A fastener driving apparatus comprising a rigid unitary housing defining a first cylinder and a drive track, a piston slidably mounted in and completely contained within said first cylinder, said piston defining a second cylinder, hammer means movably mounted in said second cylinder, fastener driving means carried by said piston and movable in said drive track, said drive track being adapted to receive said fasteners, means for introducing a medium under pressure into said first cylinder to move said piston so that the driving means enters said drive track and engages a fastener therein, and valve means for alternately admitting a medium under pressure into opposite ends of said second cylinder to reciprocate said hammer within said second cylinder to drive said fastener, said medium under pressure in said first cylinder continuously biasing said piston to advance said driving means in said drive track as said fastener is driven by said hammer means.

2. The apparatus set forth in claim 1 in which said valve means is carried on said piston and controls the fluid interconnection of said first and second cylinders.

3. A fastener driving tool adapted to remain in a fixed position relative to a workpiece comprising a rigid unitary housing defining a first cylinder and having structure forming a drive track and terminating in a surface adapted to engage said workpiece, a piston movably mounted in and completely contained within said first cylinder, said piston both defining a second cylinder including movable hammer means and supporting a fastener

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driving means, means for supplying a fastener to said drive track, means for supplying compressed air to said first cylinder to move said piston, movement of said piston advancing said driving means relative to said drive track to engage and set said fastener, and valve means for admitting compressed air into said second cylinder to reciprocate said hammer means so that the engaged fastener is driven in said workpiece, the compressed air in said first cylinder moving said piston and advancing said driving means into said drive track during the driving of said fastener to maintain said driving means in a driving relationship with said fastener during reciprocation of said hammer means while permitting said surface to remain in engagement with said workpiece.

4. An apparatus for driving fasteners into a workpiece comprising a rigid unitary housing defining a first cylinder, a structure rigidly secured to one end of said housing and defining a drive track in communication with said first cylinder and adapted to receive fasteners to be driven, said structure having an end surface flush with the end of said drive track adapted to engage said workpiece, piston means movably mounted in and completely contained within said first cylinder and including structure defining a second cylinder, a fastener driving blade supported on said piston adjacent one end of said second cylinder, one end of said driving blade extending into said drive track to be normally spaced from contact with a fastener located in said track, hammer means slidably mounted in said second cylinder and movable into engagement with said element, and control means for supplying compressed air to said first cylinder to move said piston so that said one end of said blade engages the fastener disposed in said drive track and for supplying compressed air to said second cylinder so that said hammer means is reciprocated in said second cylinder to deliver repeated blows to said blade to drive the engaged fastener into the workpiece, the compressed air supplied to said first cylinder by said control means advancing said piston as said engaged fastener is driven to maintain said one end of said blade in engagement with said driven fastener while permitting said end surface to remain in engagement with said workpiece.

5. The fastener driving apparatus set forth in claim 4 in which the end of said piston remote from said driving blade includes valve means for placing said first and second cylinders in fluid communication.

6. The fastener driving apparatus set forth in claim 5 in which the valve means comprises a pair of spaced passageways interconnecting the first cylinder with the second cylinder at points located adjacent the ends of said

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second cylinder and a common valve element for controlling the flow of air through said passageways.

7. The fastener driving apparatus set forth in claim 4 in which the end of the driving blade supported on the piston is secured to an enlarged member, and in which the said one end of said piston is provided with structure defining a recess for loosely receiving said enlarged member to support said enlarged member on said piston in alignment with said second cylinder to receive the repeated blows of said hammer means.

8. A fastener driving tool comprising a rigid unitary housing defining a first cylinder and including structure closing one end of said first cylinder and having a drive track in communication with said first cylinder to which fasteners to be driven are supplied; and a piston structure movably mounted in and completely contained within said first cylinder and having a drive element slidably mounted in said track for engaging and driving said fasteners; said piston comprising a hollow cylindrical structure defining a second cylinder, hammer means movably mounted in said second cylinder, a cap members mounted on one end of said cylindrical structure and defining an opening, said cap cooperating with said cylindrical structure to define a shouldered recess, a flanged anvil element rigidly secured to said drive element and disposed within said recess with said drive element extending outwardly through said opening, said anvil element extending in part into said second cylinder to be periodically engaged by said hammer means for limited movement relative to said piston, and means for alternately admitting compressed air to and exhausting air from opposite ends of said second cylinder for operating said hammer means to strike repeated blows on said anvil element.

9. The tool set forth in claim 8 in which the anvil means is provided with an enlarged portion embracing one end of said drive element and extending outwardly through said opening in said cap.

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