March 25, 1969 A. E. CAIRATTI 3,434,393

NAILING MACHINE

Filed March 2, 1967 Sheet 1 of 3

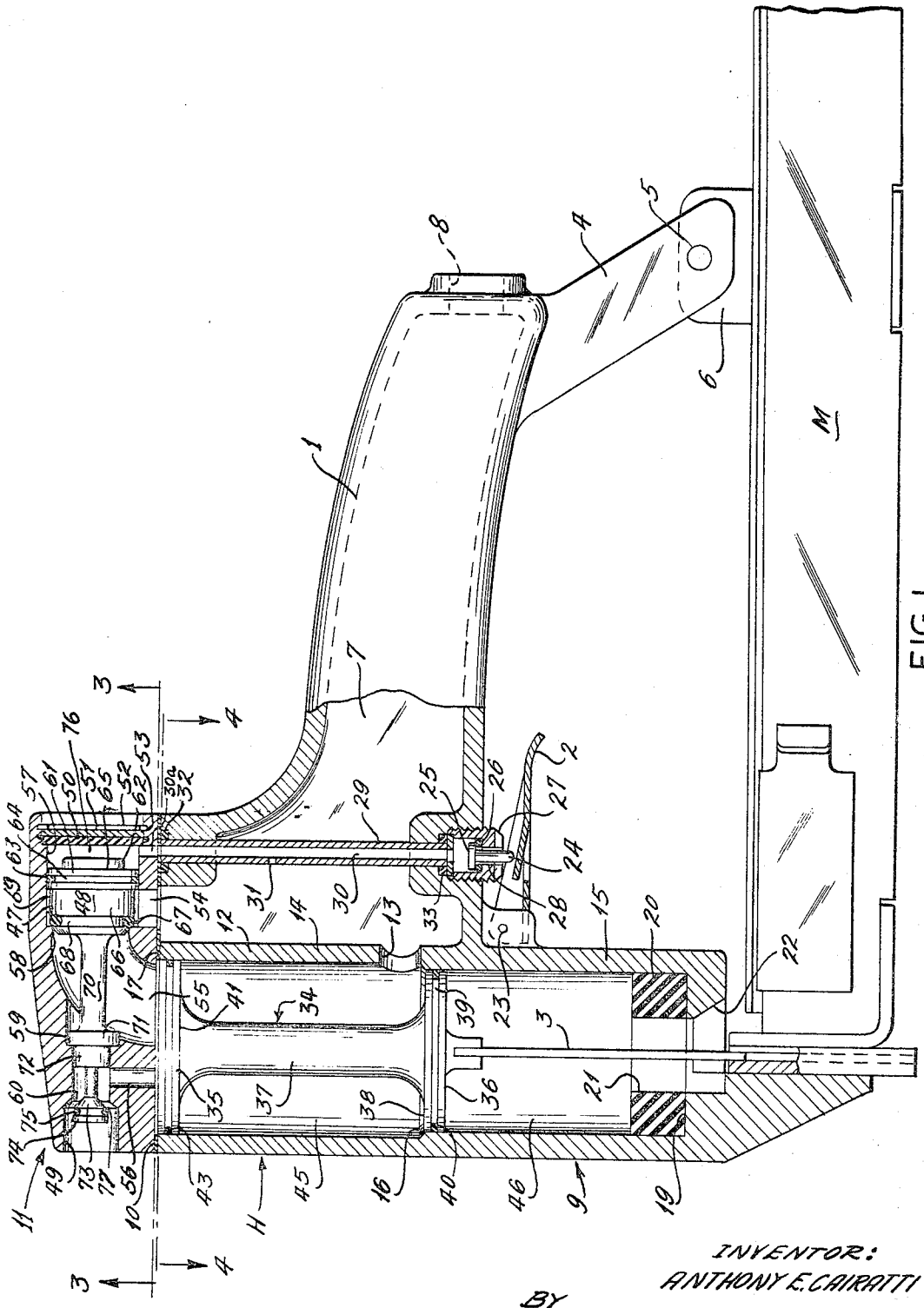


FIG. 1

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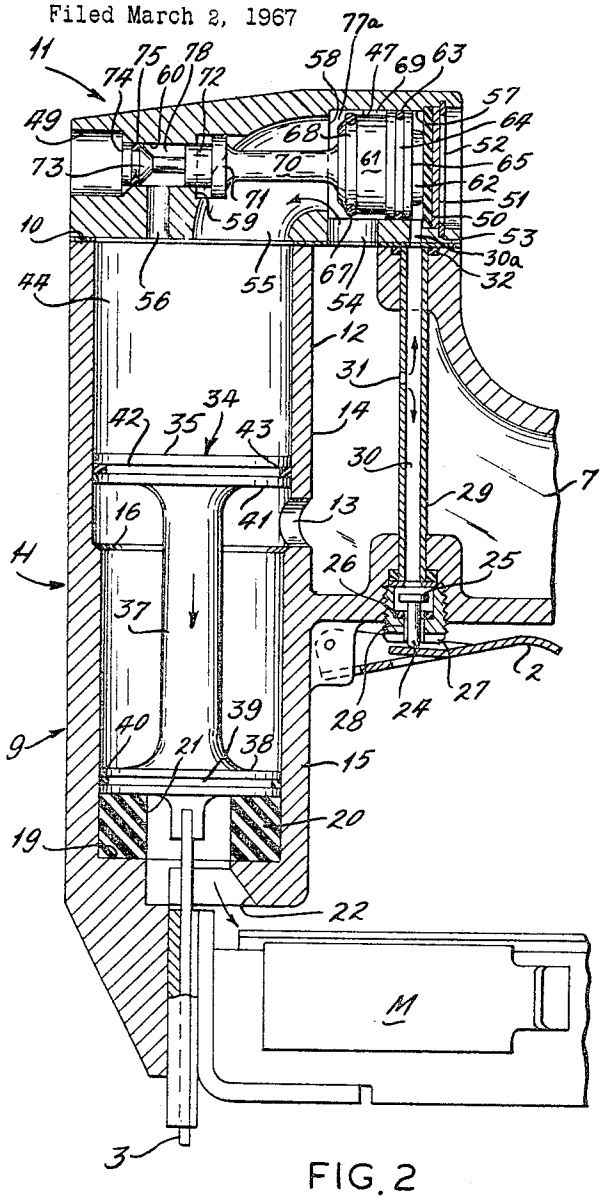



FIG. 2

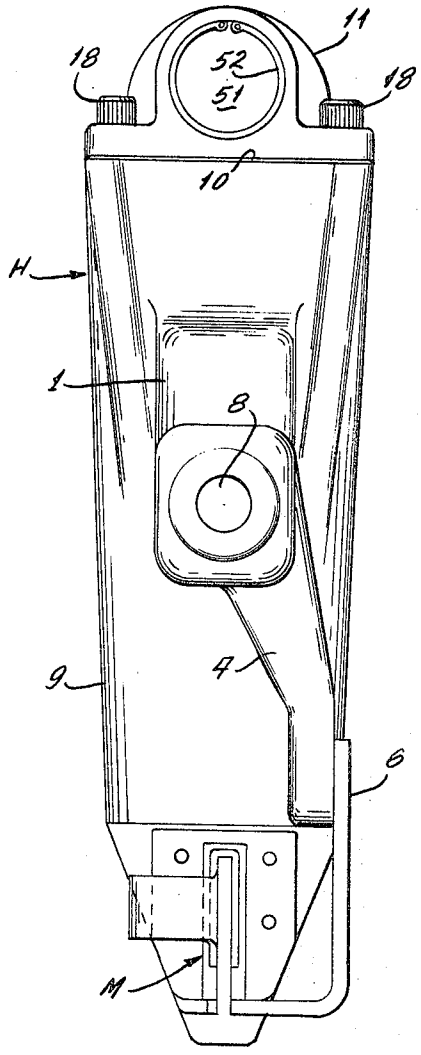



FIG. 5

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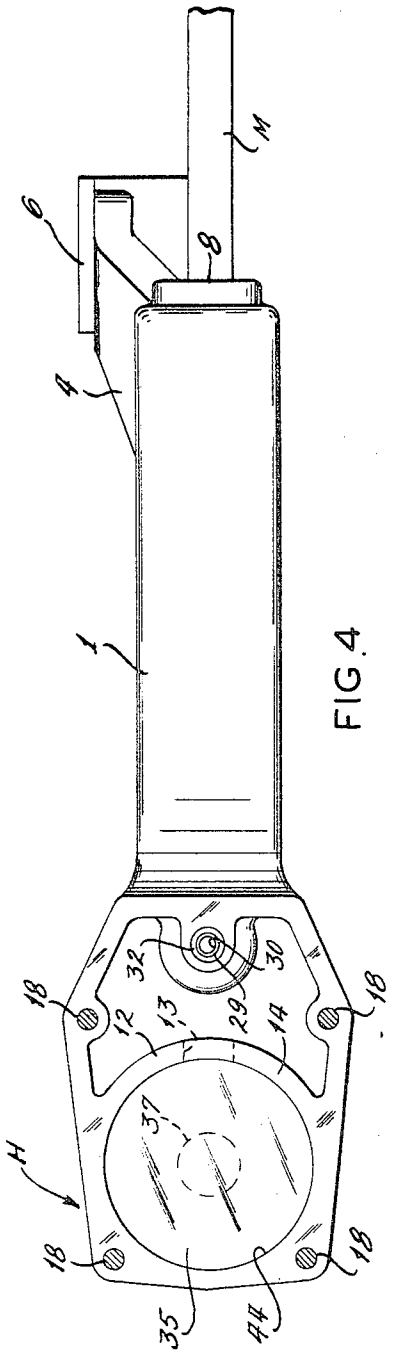



FIG. 4

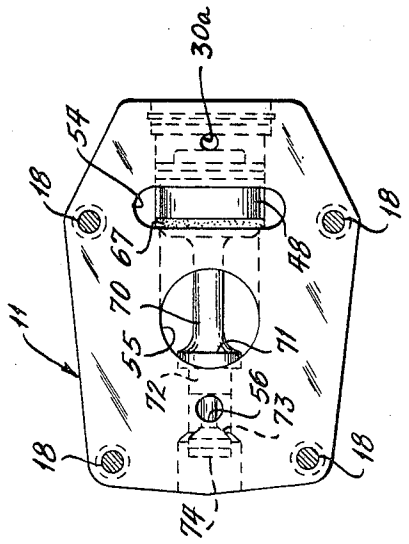



FIG. 3

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United States Patent Office

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3,434,393

# NAILING MACHINE

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U.S. Cl. 91—417
13 Claims

## ABSTRACT OF THE DISCLOSURE

A nailing machine in which the main valve is mounted horizontally above the housing and completely within the cap and in which the driving piston mounted in a stationary cylinder over whose top no pressure fluid is directed to force the piston downwardly, so that pressure fluid does not spill in over the top of the cylinder and the cylinder does not move in a vertical direction, but the piston moves down because of the main valve positioned within the cap.

This invention relates to an improved nailing machine, and in particular, to a power actuated nailing machine whose head is relatively short in height. Such a machine may be used to drive nails, corrugated fasteners, or heavy and long staples. Power actuated nailing machines have been used in the past, but such machines have been relatively tall with numerous parts therein. Many of such past machines contained a cylinder which moved vertically and many operated through the movement of valve means to open the entire top of said cylinder to allow pressure fluid to spill over the top edge thereof into the cylinder to drive the piston downwardly. Others with cylinders which did not open at the top had the main valve positioned with the housing adjacent to the cylinder and within the reservoir.

One of the principal objects of the present invention is to provide a nailing machine having its main valve mounted completely within the cap above the housing. Another object is to provide a main valve which moves horizontally. Another object is to provide a machine of relatively short height having the main valve within the cap so as to avoid having the valve means reduce the volume of the reservoir. Another object is to provide a horizontal valve within the cap to allow exhausted air from the cylinder to be directed out of the machine from the exhaust valve without changing its direction. Another object is to provide a main valve of relatively few parts which are easily assembled without disassembling the machine and without removing the cap therefrom.

These and other objects and advantages will become apparent hereinafter.

The present invention is embodied in a nailing machine having a main valve mounted horizontally above the housing and completely within the cap, said machine having a stationary cylinder whose top edges are closed at all times to driving fluid.

The invention also consists in the parts and in the arrangements and combinations of parts hereinafter described and claimed. In the accompanying drawings which form part of this specification and wherein like numerals and symbols refer to like parts wherever they occur:

FIG. 1 is a vertical longitudinal cross-sectional view of a nailing machine embodying the present invention showing the trigger in its lower position and the piston in its upper position,



FIG. 2 is a view similar to FIG. 1, but showing the trigger in its upper position and the piston in its lower position,

FIG. 3 is a cross-sectional view taken along the line 3—3 of FIG. 1 showing the underside of the cap,

FIG. 4 is a fragmentary cross-sectional view taken along the line 4—4 of FIG. 1 looking down on the housing with the cap and gasket removed, and

FIG. 5 is a rear view of the machine.

The nailing machine N which embodies the present invention is provided with the usual safety means (not shown) and a magazine M. These may be of the type well-known and used in the past, such as shown in the Schafroth and Cairatti copending applications Ser. No. 399,152, now U.S. Patent No. 3,342,110 and 413,045, now U.S. Patent No. 3,301,456. Their details will not be shown or described here, since they are well-known in the art.

The nailing machine N has a head H with a handle 1 and a trigger 2, and a magazine M for feeding nails to the head H in order to be driven by a power actuated driving blade 3. The handle 1 has a leg 4 mounted on a pin 5 on a bracket 6 secured to the magazine M. The handle 1 is hollow to form a storage reservoir 7 with an opening 8 in its rear portion for receiving a source of compressed air or pressure fluid. The hollow handle 1 forms a substantial portion of the reservoir 7.

The head H comprises an upstanding housing or casing 9 with a cap 11 sealably secured thereto with a gasket 10 therebetween. The head H contains a stationary vertical cylinder 12 having an opening 13 therein near the central portion of the cylinder 12. This opening 13 is slightly above the median line in the form of the invention illustrated. The cylinder 12 has an upper wall 14 whose diameter is slightly greater than the diameter of the lower wall 15, there being a shoulder 16 therebetween adjacent to said opening 13. The gasket 10 and cap 11 close the upper end 17 of the upper wall 14 and are secured to the casing 9 by four screws or bolts 18.

The bottom 19 of the cylinder 12 is provided with a bumper 20, made from a suitable cushioning material such as rubber. The bumper 20 has an opening 21 therein aligned with an exhaust opening 22 in the casing 9.

The trigger 2 is pivotally mounted on a pivot pin 23 on the casing 9 and is adapted to move a plunger 24 upwardly. The plunger 24 has a head 25 thereon adapted to seat on an O-ring seat 26 mounted in a valve body 27 positioned in the casing 9. The plunger 24 fits loosely within the valve body 27 to provide a vertical annular exhaust passage 28 therebetween. A hollow stem 29 having a passage 30 is vertically mounted in the casing 9. The stem 29 has a restricted orifice or small hole 31 therein so that there is constant communication between the passage 30 and the reservoir 7. The stem 29 has an upper O-ring 32 and a lower O-ring 33 therearound to seal it in leakproof relation in the reservoir 7. The sizes are such that more air escapes from the annular exhaust passage 28 when it is open than comes into the stem 29 through the small hole 31.

A piston or drive means 34 is mounted within the cylinder 12. The piston 34 comprises an upper piston or portion 35 and a lower piston or portion 36 of smaller diameter connected by a connector 37. The lower piston 36 has an upper surface 38 and an annular groove 39, which receives an O-ring 40 therein. The downwardly

extending driving blade 3 is connected to the lower piston 36. The connector 37 supports the upper piston 35 which has a lower surface 41 and an annular groove 42 which receives an O-ring 43. The effective area on the underside 41 of the upper piston 35 is greater than the effective area on the upperside 38 of the lower piston 36, so that if said areas are exposed to the same pressure, the piston 34 moves upwardly to its upper position and remains in its upper position, as shown in FIG. 1. The cylinder 12 contains an upper chamber 44 above the upper piston 35, a middle chamber 45 between the upper piston 35 and lower piston 36, and a lower chamber 46 beneath the lower piston 36.

The cap 11 serves as a valve block and contains a horizontal opening 47 therethrough which receives the slidable main valve 48. The opening 47 in the cap 11 is open at its forward end to form an exhaust port 49 and is closed at its rearward end by a rubber disc 50, a metal disc 51, and a retaining ring 52 mounted in a groove 53. The cap 11 contains an opening 54 in communication with the reservoir 7 outwardly of the upper cylinder wall 14. The cap 11 also contains a curved chamber or passage 55 above the cylinder 12 to pour pressure fluid from the reservoir 7 into the cylinder 12, and an exhaust passage 56 above the cylinder 12 to allow pressure fluid to escape from the upper chamber 44 above the piston 34 as the piston 34 is raising. The exhaust passage 56 is part of the opening 47 whose axis extends in the direction in which it is most desirable to exhaust the air from the cylinder 12. The opening 47 is provided with a smooth bore 57, a main valve seat 58, a perpendicular shoulder or stop 59, and an exhaust valve seat 60.

The main valve 48 includes a cap or valve piston 61 having a bumper 62 thereon. The piston 61 is slidably mounted in the bore 57 in sealed relation by an O-ring 63 in a groove 64 in its large diametered right portion or head 65. The piston 61 has a reduced central portion 66 with an O-ring 67 mounted in a groove 68 thereon and adapted to contact the main valve seat 58. There is a space 69 between the bore 57 and the reduced portion 66. The main valve 48 contains a rod 70 which extends from the reduced portion 66 and a stop or collar 71, which abuts against the stop 59 to limit leftward or forward motion of the main valve 48. In the leftward position, the O-ring 67 is not fully collapsed so as to give it greater life. A bearing portion 72 is positioned near the collar 71 to support the main valve 48 at one end while the piston 61 supports it at the other end. An exhaust valve 73 is mounted forwardly of the collar 71 and contains an exhaust valve head 74 with an O-ring 75 adapted to contact the exhaust valve seat 60. The main valve 48 is limited in its rightward movement by the bumper 62 contacting the rubber disc 50. The left surface of the piston 61 is greater in diameter than the left surface of the central portion 66. Except for the bumper 62 and the O-rings 63, 67, and 75, the main valve 48 is a unitary member in the form of a stem which moves horizontally within limits within the cap 11 and can easily be installed in and removed from said cap 11. A valve or cap chamber 76 is positioned in the cap 11 above the passage 30 in the stem 29 and between the rear of the main valve 48 and the rear closure or rubber disc 50 in the opening 47 of the cap 11. When the exhaust valve 73 is open, an annular opening 77 is formed between the exhaust valve seat 60 and the O-ring 75. This opening 77 leads to the exhaust port 49 which is at the top forward portion of the machine N.

In operation, the nailing machine N is suitably attached to a source of compressed air at about 80 pounds per square inch and the magazine is loaded with the proper nails or fasteners. The parts are shown in their inoperative position in FIG. 1. In this position, compressed air from the reservoir 7 is free to enter the middle chamber 45 in the cylinder 12 through the opening 13 and is free to enter the small hole 31 in the stem 29. Pressure within the stem 29 keeps the plunger 24 in its downward position seated on the O-ring 26 to prevent escape through the exhaust passage 28. Pressure fluid within the stem 29 also moves upwardly through the opening 30*a* in the cap 11 and into the cap chamber 76 rearwardly of the main valve 48. The pressure in the cap chamber 76 maintains the main valve 48 in its leftward or forward position limited by the collar 71 and stop 59. In this position, the O-ring 67 is seated against the seat 58 to close the annular opening 77*a*. In this position, the exhaust valve 73 is open, thereby permitting the upper chamber 44 above the piston 35 to exhaust to atmosphere through the vertical and horizontal exhaust passages 56 and 78 in the cap 11. Pressure in the cap chamber 76 causes the main valve 48 to move to the left because the effective area of the central portion 66 and piston 61 is reduced by the diameter of the rod 70, since the exhaust valve 73 is closed. Once the main valve 48 is closed when its O-ring 67 contacts the main valve seat 58, the pressure differential between the cap chamber 76 and the chamber 55 becomes even greater.

When the trigger 2 is lifted (FIG. 2) the plunger 24 is raised from its O-ring 26 which allows pressure in the stem 29 and cap chamber 76 to escape to atmosphere through the annular exhaust passage 28 surrounding the plunger 24. Thus, the plunger 24, the stem 29, and the passage 28 form vent means for the chamber 76. This reduces the pressure in the stem 29 and cap chamber 76, which are being continuously fed from the reservoir 7 through the small hole 31. However, pressure escapes faster through the exhaust passage 28 than it builds up from the small hole 31. When the pressure in the cap chamber 76 is reduced to a minimum, reservoir pressure acting in the space 69 on the large diametered piston 61 moves the main valve 48 horizontally rearwardly. This removes the O-ring 67 from its main valve seat 58 and closes the exhaust valve 73 substantially at the same time, which allows pressure fluid from the reservoir 7 to move through the hole 54 in the cap 11 through tthe annular passage 77*a* adjacent to the open piston 61 into the curved cap chamber 55 and into the upper chamber 44 above the piston 34 in the cylinder 12. This causes the piston 34 and driving blade 3 to be driven downwardly to drive a nail. The downward movement continues until the lower piston 36 contacts the bumper 20. As the lower piston 36 moves downwardly, air beneath it is expelled through the bottom and exhaust openings 21 and 22. The parts remain in the lower position as long as the trigger 2 is lifted.

When the trigger 2 is released, the plunger 24 is free to move downwardly thereby closing the opening 28 and allowing pressure fluid from the reservoir 7, which continuously moves through the small hole 31 in the stem 29, to build up pressure in the cap chamber 76 to move the main valve 48 leftwardly, thereby opening the exhaust valve 73 and closing the main valve 48. The pressure in the reservoir 7 also acts on the under surface 41 of the upper piston 35, which has a greater area than the upper surface 38 of the lower piston 36, so that the piston 34 and driving blade 3 are returned to their normal upper position by the pressure in the middle chamber 45.

Thus, the cylinder 12 does not move and the cylinder wall 14 is always closed at its upper end 17. There is no valve which moves up and down on the top of the cylinder 12 to allow pressure fluid to enter the cylinder 12. There is no main valve or other means occupying substantial volume within the reservoir 7. The main valve 48 is mounted entirely within the cap 11, which is secured to the housing 9 by four screws 18. The main valve 48 can be removed from the cap 11 by removing the retaining ring 52 from the groove 53, which allows the discs 51 and 50 to be removed thereby exposing the main valve 48 which is free to be moved out of the opening 47.

The relative size of the reservoir 7, the cylinder 12, and the various passages, as well as the amount of movement

by the main valve 48 are important for the most efficient operation of the machine. These should be substantially in the same relative size as shown in the patent drawings for this most efficient driving operation.

This invention is intended to cover all changes and modifications of the example of the invention herein chosen for purposes of the disclosure which do not constitute departures from the spirit and scope of the invention.

What is claimed is:

1. In a fastener driving apparatus comprising a housing defining a reservoir to which pressure fluid is continuously applied, a stationary cylinder mounted in said housing, an opening in said cylinder connecting said cylinder and said reservoir, piston means slidably mounted within said cylinder with a driving blade therebelow, said piston means having an upper portion and a lower portion with a connector connected therebetween, said lower portion always being positioned below said opening, said housing having a cap thereon closing the upper end of the cylinder, a main valve mounted in said cap for shifting movement between open and closed positions along an axis which is located at an angle with respect to the axis of said cylinder, said main valve being open when said piston means is being driven downwardly to permit pressure fluid from said reservoir to act on the upper surface of said upper portion of said piston, said main valve being closed when said piston means is being moved upwardly to return said piston means to its upper inoperative position, the effective area of the lower surface of said upper portion of said piston being greater than the effective area of the upper surface of said lower portion of said piston, said main valve mounted within said cap externally of said housing, said cap having a valve chamber therein, said main valve being closed when said pressure in said valve chamber is substantially the same pressure as the pressure in said reservoir, said main valve being open when said valve chamber is connected to atmosphere, said cylinder having an exhaust port therein in the bottom portion thereof below said cylinder to exhaust air below said piston means during its downward movement.

2. The combination set forth in claim 1 wherein said main valve is movable horizontally, and said cap is mounted directly above the cylinder and the upper open end of the reservoir.

3. The combination set forth in claim 2 wherein said cap can be removed as a unit from the housing.

4. The combination set forth in claim 1 wherein said cap has an opening at one end to permit removal of the main valve therefrom as a unit.

5. The combination set forth in claim 1 wherein the main valve moves horizontally within limits in the cap and has a cap piston and an exhaust valve connected thereto, said main valve and said exhaust valve moving as a unit between open and closed positions and being in fixed relation to and movable with said cap piston.

6. The combination set forth in claim 5 wherein said cap has a horizontal opening therethrough for receiving the main valve in sliding relation, said horizontal opening forming an exhaust port at its forward end and a large opening at its rearward end through which the main valve, including the cap piston and the exhaust valve, may be removed.

7. A fastener driver comprising a housing having a cylindrical cavity, drive means for engaging and driving fasteners and including a piston engaging the walls of the cavity, the piston being shiftible axially within the cavity, a reservoir in the housing and adapted for connection to a source of high pressure fluid, a valve block carried by the housing and having a valve chamber therein and a supply passageway extending therethrough, the supply passageway communicating at one end with the cylindrical cavity beyond the piston and at the other end with the reservoir, a valve element shiftable within the valve block from a closed position wherein the valve element blocks the supply passageway to an open position wherein the valve element permits fluid from the reservoir to flow through the supply passageway into the cylindrical cavity, the valve element having a first face exposed to the valve chamber and a second face exposed to fluid at substantially the same pressure as the fluid in the reservoir, the first face being greater in effective area than the second face and being oriented such that the force generated by the pressure of the fluid in the valve chamber urges the valve element toward the closed position, the second face being oriented such that the force generated by pressure of the fluid acting upon the second face urges the valve element toward the open position, vent means for optionally venting the valve chamber, and an unobstructed passage for establishing communication between the reservoir and the valve chamber and having a restricted portion therein which along with the passage is continuously open irrespective of the position of the valve element, the size of the restricted portion being such that the pressure of the fluid in the reservoir is not substantially reduced when the valve chamber is vented, whereby when the valve chamber is vented the force exerted by the fluid on the second face will be substantially greater than the force exerted by the fluid on the first face and the valve element will move to its open position.

8. A fastener driver according to claim 7 wherein the valve block is provided with an exhaust passage communicating with the cylindrical cavity, and wherein the valve element blocks the exhaust passage when said valve element is in the open position and allows passage of fluid through the exhaust passage when in the closed position.

9. In a fastener driving apparatus comprising a housing defining a reservoir to which pressure fluid is continuously applied, a stationary cylinder mounted in said housing, an opening in said cylinder wall connecting said cylinder and said reservoir, piston means slidably mounted within said cylinder with a driving blade therebelow, said piston means having an upper portion and a lower portion with a connector connected therebetween, said lower portion always being positioned below said opening, said housing having a cap thereon closing the upper end of the cylinder, a main valve mounted in the cap, said main valve being open when said piston means is being driven downwardly to permit pressure fluid from said reservoir to act on the upper surface of said upper portion of said piston, said main valve being closed when said piston means is being moved upwardly to return said piston means to its upper inoperative position, the effective area of the lower surface of said upper portion of said piston being greater than the effective area of the upper surface of said lower portion of said piston, said main valve mounted within said cap externally of said housing, said cap having a valve chamber therein which constantly receives a limited amount of pressure fluid from the reservoir, said main valve being closed when said pressure in said valve chamber is substantially the same pressure as the pressure in said reservoir, said main valve being open when said valve chamber is connected to atmosphere, said cylinder having an exhaust port therein in the bottom portion thereof below said cylinder to exhaust air below said piston means during its downward movement.

10. The combination set forth in claim 9 wherein said valve chamber is adapted to be opened to atmosphere to reduce the pressure therein below that of the reservoir pressure, thereby resulting in movement of the main valve to establish connection between the reservoir and the top of the cylinder above the piston to drive the piston and driving blade downwardly.

11. The combination set forth in claim 9 wherein said housing is provided with trigger means, passage means extending from said trigger means to said cap, said passage means constantly receiving a limited amount of

pressure fluid from said reservoir, said passage means being in constant communication with said cap chamber.

**12.** The combination set forth in claim **11** wherein said passage means comprises a tube extending from said trigger means to said cap chamber, said tube having a small hole therein for constantly receiving the limited amount of pressure fluid from said reservoir.

**13.** In a fastener driving apparatus of the kind set forth in claim **9** means for exhausing said valve chamber to atmosphere thereby allowing pressure from said reservoir to open said main valve to effect the driving of a nail.



**References Cited**

UNITED STATES PATENTS

3,242,825 3/1966 Roosa ..... 91—417

PAUL E. MASLOUSKY, *Primary Examiner.*

U.S. Cl. X.R.

91—461, 469