United States Patent

[11] 3,563,438

[72] Inventors **Richard H. Doyle**
Mount Prospect;
Edward J. Novak, Franklin Park, Ill.

[21] Appl. No. **781,433**
[22] Filed **Dec. 5, 1968**
[45] Patented **Feb. 16, 1971**

[73] Assignee **Fastener Corporation**
Franklin Park, Ill.
a corporation Illinois

[54] **FASTENER DRIVING TOOL**
24 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** **227/8,** 227/130, 227/136
[51] **Int. Cl.** **B25c 1/04**
[50] **Field of Search** 227/8, 112, 130, 136

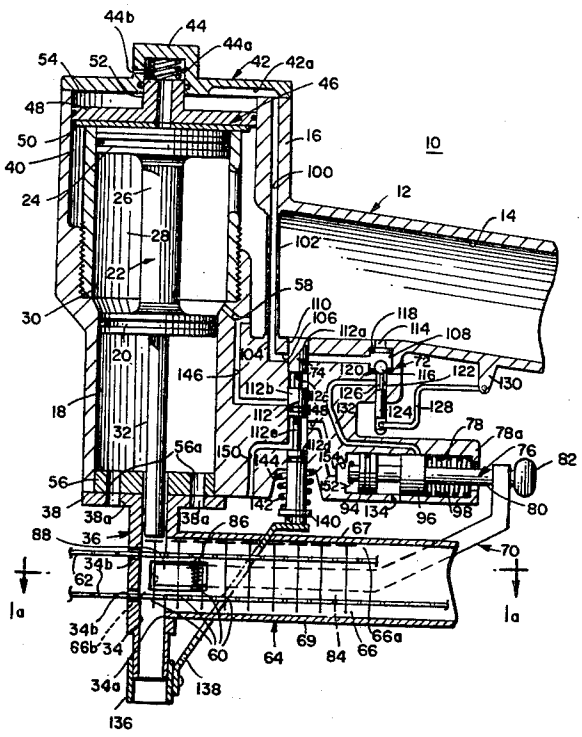
[56] **References Cited**

UNITED STATES PATENTS

2,979,725	4/1961	Wandel et al.	227/130X
3,099,837	8/1963	Heilman et al.	227/136
3,172,124	3/1965	Kremiller	227/8
3,232,511	2/1966	Crooks	227/130

Primary Examiner—Granville Y. Custer, Jr.
Attorney—Mason, Kolehmainen, Rathburn and Wyss

ABSTRACT: A fastener driving tool comprising a drive track for guiding fasteners as they are driven, a driver slidable in said track and movable on a power stroke to drive fasteners and return stroke in the opposite direction, pusher means for feeding fasteners into the lower end of said drive track and movable between a forward position projecting into said drive track and a rearward position rearwardly retracted therefrom, initiating a power stroke of the driver, and means for retracting said pusher means from said drive track operable to prevent a power stroke of said driver until said pusher means is clear of said drive track.



PATENTED FEB 16 1971

3,563,438

SHEET 1 OF 4

FIG. 1

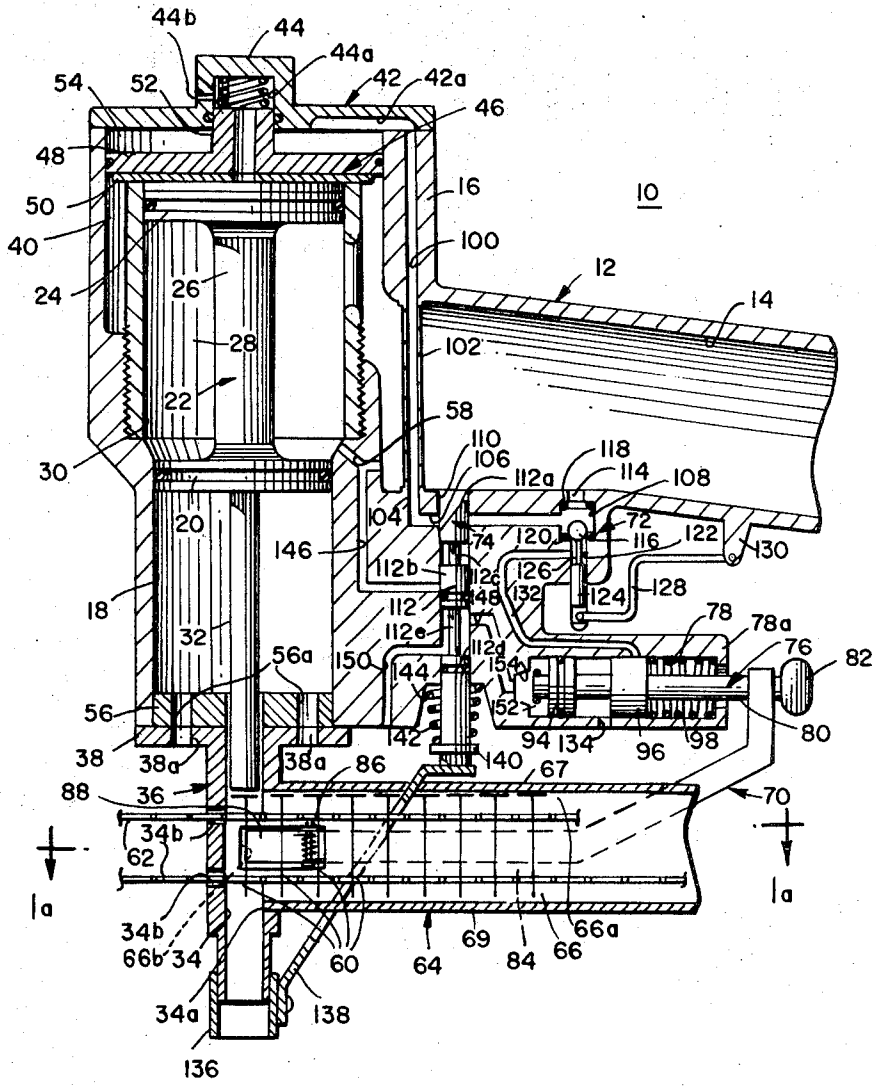
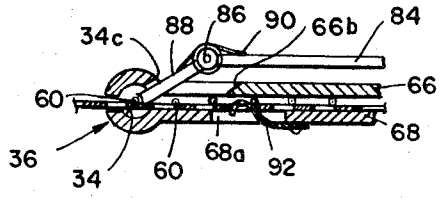


FIG. 1a



INVENTORS:

RICHARD H. DOYLE
EDWARD J. NOVAK

BY: Mason, Kolehmainen, Rathbury & Wyss
ATT'YS

FIG. 2

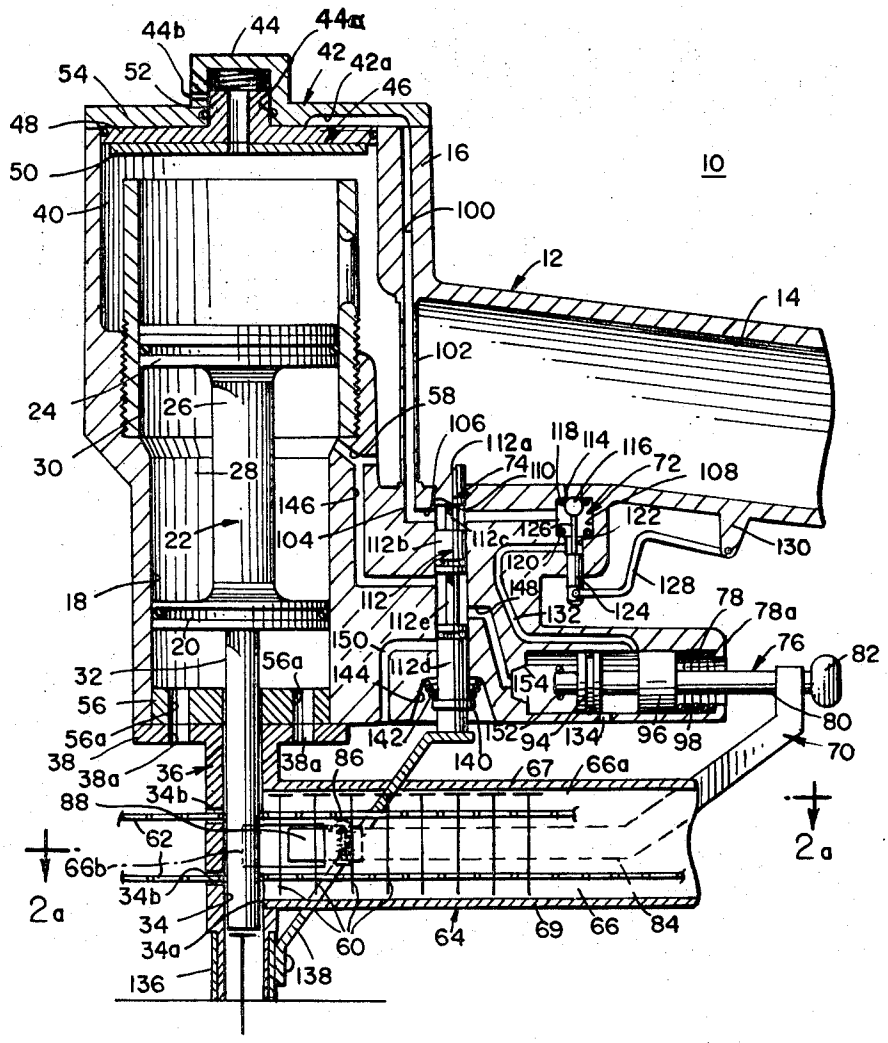
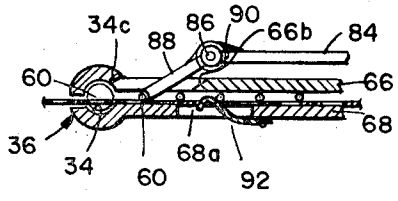


FIG. 2a



INVENTORS:
RICHARD H. DOYLE
EDWARD J. NOVAK
BY: Mason, Kolehmainen, Rathburn & Wyss
ATT'YS

FIG. 3

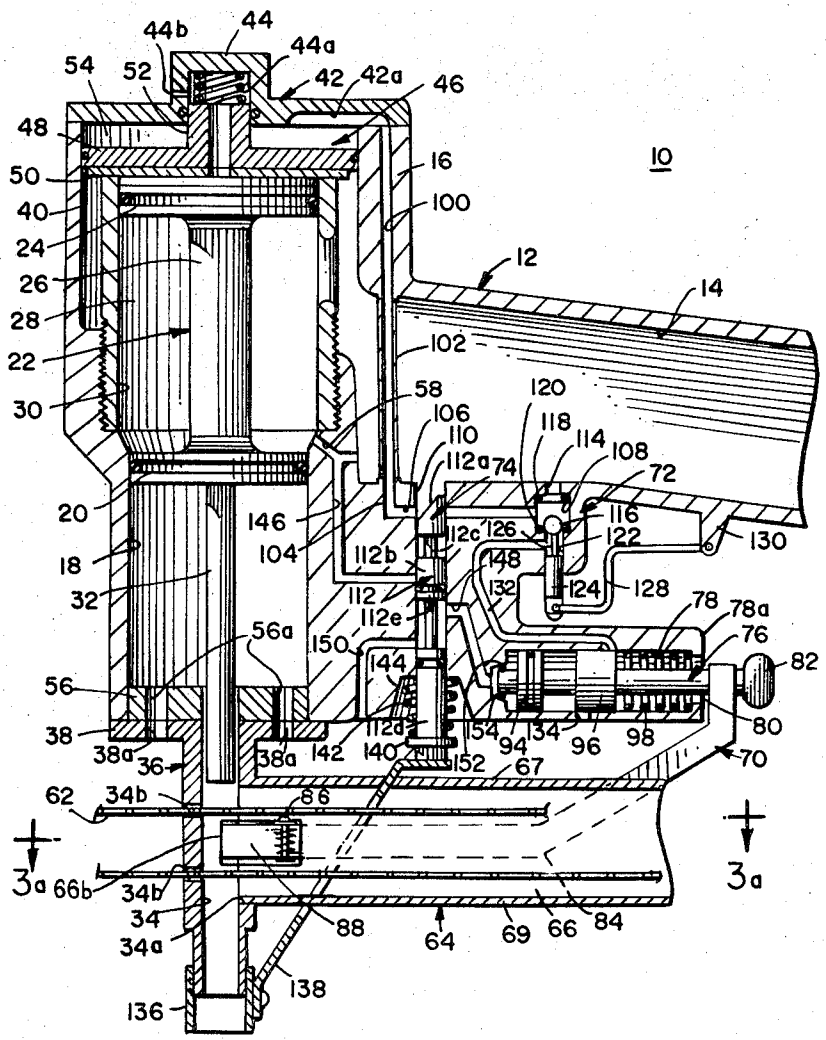
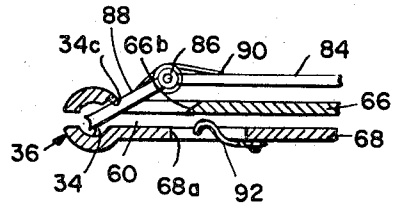


FIG. 3a

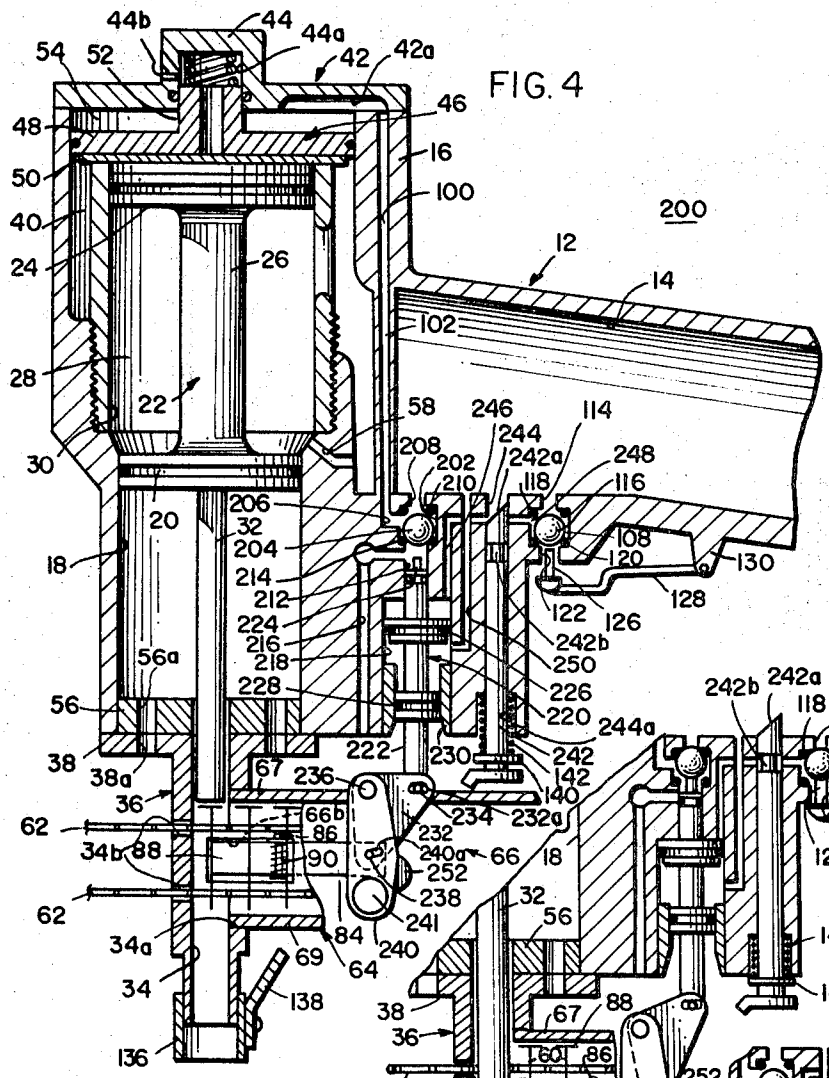


INVENTORS:

RICHARD H. DOYLE
EDWARD J. NOVAK

BY: Mason, Kolehmainen, Rathburn & Wyss
ATT'YS

FIG. 4



INVENTORS:
RICHARD H. DOYLE
EDWARD J. NOVAK

BY: Mason, Kolehmainen, Rathburn & Wyss
ATT'YS

FASTENER DRIVING TOOL

The present invention relates to a new and improved power operated fastener driving tool and, more especially, to a tool of the type capable of driving relatively large fasteners, such as common nails and the like.

With the increased demand for power driven fastener driving tools which are capable of handling the larger fasteners, such as 8*d* common nails and the like, it is desirable to provide feeding means for positively feeding or positioning successive nails into the drive track for driving by the reciprocating driver on a single power stroke. One of the problems with these types of tools is that if the pusher means is not fully retracted from the drive track when a power stroke is commenced, the driver may engage the forward end portion of the pusher means while in the drive track and cause severe damage to the tool.

Therefore, it is an object of the invention to provide a new and improved power driven fastener driving tool.

It is also an object of the invention to provide a new and improved power driven fastener driving tool which eliminates the foregoing difficulties of prior tools of this type.

Another object of the present invention is to provide a new and improved fastener driving tool employing pusher means for feeding fasteners into the drive track movable between a forward position projecting into the drive track and a rearward position retracted therefrom, including means operable to positively retract the pusher means from the drive track before initiation of a power stroke of the driver is permitted.

Another object of the present invention is to provide a new and improved fastener driving tool of the character described employing means for disabling the tool from firing until the pusher has been fully retracted from and is clear of the drive track.

Yet another object of the present invention is the provision of a new and improved fastener driving tool having means for automatically returning the driver after the completion of a power stroke and positively advancing another fastener into the drive track.

Yet another object of the present invention is the provision of a new and improved fastener driving tool of the character described having a safety valve means operable to prevent a drive stroke of the driver until the nosepiece of the tool is pressed against a workpiece and the pusher means has been fully retracted from the drive track.

Another object of the present invention is the provision of a new and improved fastener driving tool employing new and improved safety valve means operable to initiate the feeding of a new fastener into the drive track after each power stroke has been completed.

Yet another object of the present invention is the provision of a new and improved fastener driving tool employing means for automatically initiating a power stroke of the driver followed by a return stroke but preventing the power stroke from commencing until the pusher means has been positively retracted clear of the drive track.

Another object of the invention is to provide a new and improved fastener driving tool of the character described including means for positively retracting the pusher from the drive track before a driving stroke is commenced and including plural means for operating or cycling the tool on successive power strokes.

Another object of the invention is to provide a new and improved fastener driving tool of the character described in the preceding object wherein the plural means includes a manually depressible trigger and presser foot means mounted adjacent the lower end of the drive track for direct engagement with the workpiece.

Still another object of the invention is the provision of a new and improved fastener driving tool having means operable to prevent the initiation of driving strokes when the supply of fasteners in the tool is exhausted.

These and other objects of the present invention are accomplished in one illustrative embodiment thereof comprising a power actuated fastener driving tool having a drive track and a driver slidably disposed therein for movement on a power stroke and a return stroke in an opposite direction. Pusher means are provided for feeding fasteners supplied on a carrier strip one at a time directly into the drive track. The pusher means is movable between a forward position, wherein the forward end portion projects into the drive track, and a rearward or retracted position, wherein the pusher is completely clear of the drive track. Means are provided for initiating successive power and return strokes of the driver and control means are provided for positively retracting the pusher means from the drive track before a power stroke can commence. After each power stroke has been completed, the pusher means is operable to feed another fastener into position in the drive track and the tool is then ready for its next cycle of operation.

For a better understanding of the present invention, reference should be had to the following detailed description and the appended claims, taken in conjunction with the drawings, in which:

FIG. 1 is a cross-sectional view taken on a longitudinal plane of a new and improved fastener driving tool constructed in accordance with the features of the present invention;

FIG. 1*a* is a transverse cross-sectional view of the magazine feeding assembly of the tool taken substantially along line 1*a* of FIG. 1;

FIG. 2 is a cross-sectional view similar to FIG. 1 illustrating operative components of the tool in different operative positions wherein the driver is moving downwardly on a power stroke to drive a fastener positioned in the drive track;

FIG. 2*a* is a cross-sectional view similar to FIG. 1*a* and taken substantially along lines 2*a* of FIG. 2;

FIG. 3 is a cross-sectional view similar to FIG. 1 illustrating the operative components of the tool in another operative position, wherein the driver is in an upper or rest position after a return stroke has been completed;

FIG. 3*a* is a cross-sectional view similar to FIG. 1*a* taken substantially along the lines 3*a* of FIG. 3;

FIG. 4 is a cross-sectional view taken along a longitudinal center plane of another embodiment of a fastener driving tool constructed in accordance with the features of the invention;

FIG. 5 is a fragmentary cross-sectional view of the tool similar to FIG. 4 illustrating the operating components thereof as a drive stroke is proceeding; and

FIG. 6 is a fragmentary cross-sectional view of the tool similar to FIG. 5 illustrating the operative components thereof when the supply of fasteners is exhausted.

Referring now, more particularly, to the drawings and FIGS. 1, 1*a*, 2, 2*a* 3, and 3*a*, therein is illustrated one embodiment of a new and improved pneumatically operated fastener driving tool constructed in accordance with the features of the present invention and referred to generally by the reference numeral **10**. The tool **10** includes a main body **12** formed with a hollow, rearwardly extending handle portion **14** which serves as a reservoir for holding a volume of compressed air for operation of the tool, the compressed air being supplied to the rear end of the handle portion through a suitable air line and disconnect fitting (not shown). The forward end of the handle portion **14** is integrally joined and in communication with a cylindrical head portion **16** extending generally transverse to the handle and projecting upwardly and downwardly thereof.

The head portion **16** is formed with a cylindrical bore **18** at the lower end, in which is slidably disposed the lower piston head **20** of a spoollike, reciprocably movable piston assembly **22**. The piston assembly **22** includes an upper piston head **24** having a diameter slightly greater than the lower head **20**, and a stem **26** of reduced diameter integrally interconnecting the upper and lower piston heads. An open, annular air space or piston chamber **28** is formed around the stem between the piston heads and is continuously supplied with compressed air from the handle **14** through a port **58** adjacent the upper end of the bore **18**. The upper piston head **24** is slidable within a

cylindrical insert 30 which is threaded externally at its lower end and seated within a threaded portion formed in the head portion 16 of the tool above the upper end of the lower cylindrical bore 18.

The internal diameter of the cylinder insert 30 is slightly larger than the diameter of the lower bore 18, and when pressurized fluid is present in the annular space or piston chamber 28 around the stem 26, a net resultant, upward force acts on the piston assembly 22 urging the assembly upwardly on a return stroke towards an upper or rest position, as shown in FIGS. 1 and 3, wherein the piston is at the top end of the head portion of the tool body.

The piston assembly 22 is connected at its lower end to a downwardly depending driver or drive rod 32, which is disposed for sliding movement within a cylindrical drive track 34 formed in a nosepiece 36 secured to the lower end of the head portion 16. The nosepiece 36 includes an integral, radially extending wall or flange 38 at the upper end which closes the lower end of the cylindrical bore 18 in the head portion 16, and the flange or wall is formed with a plurality of radially spaced holes 38*a* therein for venting the lower end of the bore 18 to the atmosphere, thereby maintaining atmospheric pressure on the underside of the lower piston head 20.

The upper end of the head portion 16 of the tool body is larger in internal diameter than the outer diameter of the cylinder insert 30, thereby forming an annular space or chamber 40 below the upper end of the cylinder insert. The chamber 40 is in open communication with the forward end of the hollow or handle portion 14 of the tool and is continuously supplied with compressed air therefrom. The upper end of the head is closed by a removable cap member 42 having an integrally formed, centrally disposed, upwardly extending projection 44 thereon.

In order to selectively open and close communication between the interior bore of the upper end of the cylinder insert 30 and the annular chamber or space 40, a slidable poppet valve member 46 is mounted for sliding movement in the large diameter, upper end portion of the head 16 for movement between the upper end of the cylinder insert and the lower surface of the cap member 42. The poppet valve 46 includes a circular, piston-type valve disc portion 48 with a resilient gasket 50 on the underside thereof adapted to seal the upper end of the cylinder insert 30 when the valve is closed (FIGS. 1 and 3), and includes a hollow stem 52 projecting upwardly from the disc portion and slidable within a cylindrical bore 44*a* formed in the upper projection 44 on the cap member 42. The bore 44*a* is normally vented to the atmosphere through a laterally extending exhaust port 44*b* when the poppet valve 46 is closed, and when the valve is opened (FIG. 2) the stem 52 moves upwardly in the bore and closes the port, thereby sealing the upper end of the tool from the atmosphere.

The large diameter, upper end portion of the head 16 of the tool body forms an annular valve chamber 54 in which the flange or disc portion 48 of the poppet valve is slidable between an upper or open position adjacent the lower surface of the cap member 42 and a closed position, spaced downwardly thereof, closing off the upper end of the cylinder insert 30. When the valve chamber is supplied with pressurized fluid from the handle 14, the fluid pressure acting on the upper surface of the valve disc portion 48 causes the poppet valve 46 to move downwardly to the closed position against the upper end of the cylinder insert 30.

In order to fire the tool and thereby cause the piston assembly 22 and driver 32 to move rapidly downward on a power stroke, the fluid in the poppet valve chamber 54 is exhausted to the atmosphere by means to be described hereinafter and, when this occurs, air pressure within the annular chamber 40 beneath the outer peripheral portion of the valve disc portion 48 acts upwardly on the valve, forcing it upwardly to the open position. The upper end of the cylinder insert 30 is thus opened and in direct communication with the pressurized fluid in the annular space 40, and this fluid rapidly flows into the upper end of the cylinder insert above the piston head 24, causing the piston assembly 22 to be driven rapidly downwardly on a power stroke. When a power stroke is thus initiated by evacuation of the poppet valve chamber 54 above the valve disc portion 48, the stem portion 52 seals off the lateral vent port 44*a* in the cap projection 44 so that pressurized fluid in the upper end of the tool cannot escape to the atmosphere, and thus maximum fluid pressure is available for driving the piston assembly 22 rapidly downward on a power stroke.

In order to cushion or dampen the shock of the piston assembly 22 and driver 32 at the end of the power stroke, a resilient, annular cushion member 56 is mounted on the upper surface of the flange or wall portion 38 of the nosepiece 6. The resilient cushion 56 includes a plurality of vent holes 56*a* in alignment with the ports 38*a* in the flange 38 to continuously vent the lower end of the bore 18 beneath the lower piston head to the atmosphere.

After a power stroke of the piston assembly 22 and driver 32 has been completed, the poppet valve chamber 54 is again pressurized and the poppet valve 46 returns downwardly to the closed position, sealing off the upper end of the cylinder insert 30. When this occurs, the valve stem 52 moves downwardly and opens the exhaust port 44*b* in the cap projection 44 and the fluid in the upper end portion of the cylinder insert 30 above the upper piston head 24 is vented to the atmosphere through the hollow bore in the stem portion 52 and the exhaust port 44*b*.

The annular piston chamber 28 around the stem 26 between the upper and lower piston heads, is continuously supplied with pressurized fluid from the handle reservoir portion 14 through the port 58 formed in the wall portion of the head 16 immediately below the cylinder insert 30 and, because the upper piston head 24 is slightly larger in diameter than the lower piston head 20, the pressurized fluid in the piston chamber 28 acts on the piston assembly 22 with a net resultant upward force which causes the piston assembly to move upward on a return stroke. When the piston assembly 22 is returned to the upper end of the cylinder, the upper surface of the piston head 24 engages the lower surface of the gasket 50 on the poppet valve flange 48, limiting further upward travel of the piston assembly, and the tool is now ready for another cycle of operation as described.

In accordance with the present invention, the tool 10 is adapted to drive relatively large roundhead nails or fasteners 60 which are supplied from a continuous flexible carrier strip 62 and fed into the drive track 34 beneath the lower end of the driver 32 when the piston assembly 22 is in its upper or rest position. A carrier strip of the type disclosed in U.S. Pat. application Ser. No. 637,510, filed May 10, 1967, now U.S. Pat. No. 3,438,487, issued Apr. 15, 1969 is suitable for holding the nails.

The drive track 34 is provided with a lateral, rearwardly facing feed opening 34*a* (FIG. 3) to accommodate the nails 60 and the carrier strip 62 which are fed forwardly into the drive track from a rearwardly extending magazine 64, and a forwardly facing exit opening 34*b* is provided on the forward wall of the drive track opposite the feed opening 34*a* to accommodate the carrier strip moving out of the drive track after each nail has been driven. The magazine 64 includes a pair of spaced apart, parallel sidewalls 66 and 68 for guiding the nails toward the drive track, and longitudinal grooves are formed on the facing inside surfaces thereof as at 66*a* for supporting the round heads of the nails. Top and bottom walls 67 and 69 are provided for completing the magazine enclosure, and the nails on the carrier strip are thus held and guided by the magazine during forward movement into the drive track.

In accordance with the present invention, the driving tool 10 includes a fastener feeding assembly 70 which is adapted to feed the nails 60, one at a time, from the magazine 64 into the drive track 34 in synchronism with the operation of the driver 32. The feeding assembly 70 is operatively interconnected with a manual trigger valve assembly 72 which controls the firing of the tool and a safety valve assembly 74 associated

therewith for preventing a firing stroke of the tool unless the lower end of the nosepiece **36** is positioned against a workpiece.

The magazine feeding assembly **70** includes a piston member **76** which is disposed for sliding movement within a cylinder or bore **78** formed in the tool body **12** and extending axially parallel with the longitudinal axis of the magazine **64**. The bore **78** is closed at its forward end and is open to the atmosphere at the rearward end, and the feeder piston member **76** includes an elongated stem **80** coaxial with the bore having an enlarged handle portion or knob **82** at the outer end to facilitate manual movement of the piston. The piston **76** is movable between a rearward position, as shown in FIG. **2**, a forward position, as shown in FIG. **1** and a full forward or shutoff position as shown in FIG. **3**, in synchronism with the operating cycle of the piston assembly **22** and driver **32**. The outer end portion of the stem **80** externally of the bore **78** is connected to a downwardly and forwardly extending reciprocal feeder member **84** having a pivot pin **86** adjacent the forward end thereof and laterally offset from the longitudinal axis of the magazine **64**. A nail engaging pawl or finger **88** is pivotally mounted on the pin **86** and is biased inwardly towards the central, longitudinal axis of the magazine **64** between the opposite sidewalls **66** and **68** by means of a spring **90**, mounted on the pin **86**, as best shown in FIGS. **1***a*, **2***a*, and **3***a*. The forward end or tip of the pawl or finger **88** is movable inwardly into the interior of the magazine **64** between the sidewalls and directly into the drive track **34** through a slot or opening **66***b* formed in the sidewall **66** and an adjacent opening **34***c* formed in the drive track adjacent the rearward lateral feed opening **34***a* thereof. The forward end of the finger is adapted to directly engage the shanks of the nails **60**, as shown in FIG. **2***a*, and advance the nails forwardly into a centered position in the drive track (FIG. **1***a*) upon forward movement of a feeding stroke of the feeder member **84** from the position of FIG. **2** to the position of FIG. **1**. The spring **90** urges the finger **88** in a counterclockwise direction about the pin **86** so that the forward end or tip of the finger is biased against the inside surface of the opposite sidewall **68** of the magazine and this insures that a fastener or nail **60** is positively engaged by the forward end surface of the finger upon movement in a forward direction. As the finger **88** is moved rearwardly of the drive track on a rearward or return stroke of the member **84**, engagement between the nail **60** in the magazine next adjacent the drive track cams the finger outwardly or in a clockwise direction, until the tip of the finger moves to the rear of the nail, and at this time the spring **90** is then free to urge the finger inwardly toward the opposite sidewall **68** so that on the next forward or feed stroke of the finger **88** the nail is positively engaged by the finger and is fed into a centered position in the drive track for driving, as shown in FIG. **1***a*. In the forward position (FIG. **1**), the pawl finger **88** projects directly into the drive track beneath the head of the nail, and further forward travel is limited by the nail itself.

In order to prevent rearward movement of the nails **60** and carrier strip **62**, when the pawl or finger **88** is moved on a rearward or return stroke, the sidewall **68** is provided with a slot **68***a* therein for accommodating a spring latching member **92** which projects into the guideway and resiliently engages longitudinally spaced slots or openings in the web portion of the carrier strip at a position spaced rearwardly of the drive track. The spring member **92** normally prevents rearward movement of the nails in the magazine unless sufficient force is used to overcome the spring latch **92** when it is desired to rearwardly retract the nails from the magazine. On each forward or feed stroke of the feed member **84**, the nail **60**, engaged by the forward tip of the finger **88**, is fed into centered position in the drive track ready to be driven. Before the driver **32** is activated on a downward power stroke, the feed finger **88** is retracted rearwardly until the forward tip is clear of the drive track and, after completion of the power stroke and during or after return of the driver to the rest position, another feed stroke of the feed member **84** is initiated, carrying the next nail into a centered position in the drive track. This cycle is repeated until all of the nails contained in the magazine **64** have been driven. After the last remaining nail has been driven, the feed finger **88** is no longer restrained by the nail in the drive track and moves to a full forward position shown in FIG. **3**. When the feeder member **84** is in full forward position, a power stroke cannot be initiated, as will be described hereinafter, until a new supply of nails **60** has been loaded into the magazine and the leading nail has been advanced into position for driving centered in the drive track, as shown in FIG. **1**. By grasping the knob **82**, manual rearward retraction of feed member **84** clears the finger **88** from the drive track and permits the insertion of a new supply of nails into the magazine and, after insertion of the nails, the knob **82** is released and the spring **98** moves the member **84** forwardly carrying the first or leading nail in the strip into the drive track.

The feeder piston **76** is formed with a pair of axially spaced piston heads **94** and **96** mounted on or integrally formed with the small diameter, elongated stem **80** and is biased forwardly in the bore or cylinder **78** by means of a spring **98** having a forward end bearing on the rearward face of the piston portion **96**. The outer end of the spring is seated against an inwardly extending, annular flange **78***a* adjacent the open rearward end of the bore **78**.

As previously described, the poppet valve **46** initiates a driving stroke of the piston assembly **22** and driver **32** and the poppet valve is moved from the closed to the open position by exhausting of air pressure from the valve chamber **54** above the valve disc or flange **48**. In order to provide a path for exhausting this valve fluid to the atmosphere, the cap member **42** is formed with a passage **42***a* therein which is in communication at its outer end with a vertical, drilled passage **100** formed in the upper end portion of the head of the tool body. The lower end of the passage **100** is connected to a tubular conduit **102** extending transversely across the hollow handle portion **14** and connected at its lower end to a short, vertical passage **104** formed in the tool body **12** beneath the handle. The passage **104** is connected with a rearwardly extending passage **106** which is in communication at its rearward end with a trigger valve chamber **108** of the trigger valve assembly **72**. Intermediate the ends of the passage **106** of the tool body is provided a vertical bore or passage **110** of the safety valve assembly **74**, and mounted in the passage for vertical sliding movement therein is a safety valve member **112** having a lower end extended downwardly from the lower open end of the bore **110**. The trigger valve chamber **108** is in communication with the source of compressed air in the tool handle **14** through a small passage or port **114** in communication with the upper end thereof, and a ball valve **116** is loosely mounted in the chamber for movement between the upper and lower ends of the chamber. O-ring type valve seats **118** and **120** are mounted in the valve chamber **108** at the upper and lower ends, respectively, for cooperating seating engagement with the ball valve **116** in either its upper or lower position. The lower end of the trigger valve chamber **108** is in communication with a downwardly extending, drilled passage **122** open to the atmosphere at its lower end and a manual operator **124** is slidably disposed within the passage to activate the ball **116** and to prevent the escape of fluid from the valve chamber to the atmosphere through the lower end of the passage. The operator **124** includes a reduced diameter, upper pin portion **126** adapted to directly engage the ball **116** and move it off the lower O-ring **120**, thereby opening communication between the passage **106** and the passage **122** through the valve chamber **108**. When the valve operator **124** is moved from the position of FIG. **1** to the position of FIG. **2**, the ball **116** is moved upwardly to seat against the upper O-ring **118**, thereby closing off the supply of pressurized fluid in the hollow handle **14** from the valve chamber **108** through the upper port or passage **114**. At the same time, communication is established between the passages **106** and **122** through the valve chamber **108**. The valve operator **124** is moved from the lower to the

upper position described by a manual actuation of trigger **128**, which is pivotally mounted at its rearward end on a downwardly projecting lug **130** formed on the underside of the handle **14** of the tool body. The forward end of the trigger **128** is connected to the lower end portion of the operator **124** below the body of the tool, and when the trigger is released air pressure from the passage **114** moves the ball valve **116** to seat on the lower O-ring **120**.

The passage **122** below the valve chamber **108** is in communication with the feeder piston bore **78** by a passage **132** having its lower end in communication with the bore intermediate its ends. When the feeder piston **76** is in the position shown in FIG. **1** and the forward tip of the feed finger **88** is projecting into the drive track **34**, the piston head **96** blocks the lower end of the passage **132** so that fluid cannot flow from the passage **122** into the feeder piston bore **78**. However, when the feeder piston **76** is moved rearwardly to the position shown in FIG. **2**, the lower end of the passage **132** is uncovered and fluid in the passage can flow into the bore **78** between the piston heads **94** and **96** of the piston member. An exhaust port **134** is provided in the lower wall of the feeder piston bore **78** at a position offset longitudinally of the lower end of the passage **132**, and when the feeder piston **76** is moved to the rearward position, as shown in FIG. **2**, the passage **132** and port **134** are in communication through the bore between the piston heads **94** and **96**.

Digressing momentarily to the safety valve feature of the tool, the safety valve member **112** is slidable vertically in the bore **110** between a lower or safe position (FIG. **1**) and an upper or fire position, as shown in FIG. **2**. In order to actuate the safety valve in response to the movement of the tool into a firing position with the lower end of the nosepiece **36** pressed against a workpiece, a slidable foot or collar **136** is mounted for sliding movement on the lower end portion of the nosepiece around the lower end of the drive track **34**. When the lower end of the nosepiece is out of engagement with a workpiece, as shown in FIGS. **1** and **3**, the collar **136** is biased downwardly and extends below the lower end of the drive track **34**, as shown in FIG. **1**, and the biasing force is transmitted through a bracket member **138** connected between the collar and the lower end of the safety valve member **112**. The safety valve member is formed with an annular ring or shoulder **140** adjacent its lower end, and a spring **142** engaging the ring urges the valve member and collar downwardly. The upper end of the spring **142** is seated against a shoulder formed by an enlarged, annular recess **144** in the tool body around the lower end of the safety valve passage **110**. When the tool is ready for firing and the lower end of the nosepiece is pressed against a workpiece, as shown in FIG. **2**, the collar **136** is moved upwardly on the lower end portion of the nosepiece, and the safety valve stem **112** is moved upwardly against the force of the spring **142** to the fire position of FIG. **2**. The safety valve member **112** includes an upper end portion **112***a* having a sloping upper end face and an intermediate piston portion **112***b* spaced downwardly of the upper end portion and integrally connected thereto by a reduced diameter stem **112***c*. The valve member also includes a lower end or terminal portion **112***d* spaced downwardly of the intermediate and integrally connected thereto by a reduced diameter stem **112***e*. When the safety valve is in the lower or safe position, as shown in FIG. **1**, the sloped upper surface of the upper end portion **112***a* permits communication directly between the reservoir **14** and the left-hand segment of the passage **106** extending between the valve bore **110** and the passage **104**, and pressurized fluid is supplied to the valve chamber **54** above the valve flange **48**, causing the poppet valve member **46** to close. Accordingly, when the safety valve stem **112** is in the safe position, firing of the tool cannot be initiated by movement of the trigger **128** because the upper end portion **112***a* of the safety valve member blocks the passage **106** intermediate its ends and thus prevents the fluid in the chamber **54** from being exhausted to the atmosphere. When the valve member **112** is moved to the upper or fire position, the upper end portion **112***a* is moved upwardly above the passage **106** and communication between opposite end portions of this passage is established through the safety valve bore **110** around the narrow stem portion **112***c*. When the trigger **128** is squeezed, unseating the ball valve **116** from its lower seat **120** in the valve chamber **108**, communication is established between the poppet valve chamber **54** and the lower end of the passage **132** which terminates in the feeder piston bore **78**. However, the tool still cannot be fired in this condition until the feeder piston **76** is moved rearwardly to the position of FIG. **2**, thereby withdrawing the pawl or finger **88** from the drive track so that the driver **32** on its downward power stroke will not engage the finger, thereby damaging the tool.

In accordance with the present invention, positive means are provided for insuring that the finger **88** is retracted from the drive track before a downward power stroke of the driver **32** can commence. In order to move the feeder piston assembly **76** on a rearward stroke, thereby withdrawing the tip of the finger **88** from the drive track and enabling the tool to be fired, a passage **146** is provided in communication at its upper end with the passage **58** and in communication at its lower end with the safety valve bore **110** at a point spaced below the passage **106**. When the safety valve member **112** is in the lower safe position, as shown in FIG. **1**, the intermediate body portion **112***b* blocks off the lower end of the passage **146**, and when the valve member is then moved to the upper or fire position, the intermediate portion **112***b* moves upwardly above the lower end of the passage **146** and permits a flow of compressed air into the safety valve bore **110** around the stem portion **112***e*. This compressed fluid flows around the stem portion **112***e* and into the forward end of the feeder piston bore **78** through a feeder passage **148**, having its upper end in communication with the safety valve bore **110** at a point beneath the lower end of the passage **146**, and the lower end of the passage **148** is in axial communication with the forward or closed end of the feeder piston bore **78**. As the valve stem **112** is moved upwardly from the safe to the fire position, compressed fluid from the reservoir **14** flows into the forward end of the feeder piston chamber **78** via the passages **58** and **146**, around the stem portion **112***e* of the safety valve **112**, through the passage **148** communicating between the safety valve bore **110** and into the forward end of the feeder piston bore **78**. This fluid drives the feeder piston **76** rearwardly to the position of FIG. **2** against the biasing spring **98** and, as described, retracts the finger **88** clear of the drive track **34**. As this occurs, the piston head **96** uncovers the exhaust port **134** and the lower end of the passage **132** which communicates with the bore, thereby establishing an exhaust path between the passage and the atmosphere between the piston heads **94** and **96**. When the trigger **128** is now squeezed, a power stroke is initiated by the exhausting of pressurized fluid from the valve chamber **54** through passages **42***a*, **100**, conduit **102**, passages **104**, **110** and **106**, valve chamber **108**, passages **122** and **132**, feeder piston bore **78** between the piston heads **94** and **96**, and finally the exhaust port **134**. After the firing stroke has been completed and the lower piston head **20** strikes the cushion member **56** at the lower end of the cylinder bore **18**, when either the safety valve **112** or the trigger **128** is released, compressed air is again supplied to the upper poppet valve chamber **54**, causing the poppet valve **46** to close, sealing the upper end of the cylinder insert **30**. When this occurs, the piston member **22** commences an upward return stroke, as previously described.

After a power stroke, when the safety valve **112** is moved from the fire position to the safe position, the intermediate portion **112***b* moves downwardly, closing the lower end of the passage **146**, and the lower end portion **122***d* uncovers the upper end of an exhaust passage **150** which has a lower end in communication with the atmosphere. The compressed fluid in the forward end of the feeder piston bore **78** is then free to escape to the atmosphere through the passage **148**, around the stem portion **112***e* in the valve bore **110**, and out the exhaust passage **150**. When this occurs, the biasing spring **98** at the

rearward end of the feeder piston bore **78** moves the piston assembly **76** forwardly on a feeding stroke, thereby advancing another nail **60** into a centered position in the drive track ready to be driven. The cycle of operation is then repeated as described, until all of the nails in the magazine have been driven.

As previously mentioned, forward movement of the feeder piston **76** is restricted by engagement of the forward tip of the pawl or finger **88** with the shank of the nail centered in the drive track **34**. However, if a nail is not present in the drive track, the feeder piston **76** is free to move farther forward to the full forward position, as shown in FIG. **3**, until the piston is stopped by engagement of a resilient O-ring **152** on the forward end of the piston against the frustoconical surface of an annular recess **154**. The annular recess **154** is formed at the lower end of the passage **148** at the forward end of the feeder piston bore **78** and is mounted on a short projection ahead of the piston head **94** for seating in the recess **154** to close communication between the forward end of the bore **78** and the passage **148**. If the safety valve member **112** is now moved from the safe to the fire position, thereby supplying pressurized fluid to the passage **148**, none of this fluid can reach the forward end of the feeder piston bore **78** to move the feeder piston **76** rearwardly and, hence, the exhaust port **134** mains covered by the piston head **96** and the tool cannot be fired, regardless of the position of safety valve member **112** or movement of the trigger **128** because the recess **154** has a reduced diameter which is not great enough to permit air pressure force on the piston to overcome the spring **98**. Thus, after the last nail has been driven the tool cannot be fired, and this feature prevents damage to the tool and advises the operator to reload if he is not already aware that the nail supply has been exhausted.

From the foregoing, it will be seen that the tool **10** of the present invention automatically prevents firing of the tool when there are no more nails in the magazine **64**. In addition, the tool includes means for positively feeding the nails into the drive track in synchronism with the movements of the driver and the nails are guided into the drive track by the forward tip of the finger **88**. The tool cannot be fired until the feed pawl **88** is positively retracted from the drive track regardless of the position of the safety valve or trigger.

After the last nail in the tool has been fired and the feeder piston **76** is in the inoperative or full forward position, as shown in FIG. **3**, the feeder piston is retracted rearwardly by manually grasping the knob **82** and moving it rearwardly until the forward finger **88** is clear of the guideway between the magazine sidewalls **66** and **68**. A new strip of nails is then inserted into the magazine and advanced forwardly until the leading nail on the carrier strip is centered in the drive track for driving. The knob **82** is then released and the spring **98** moves the feeder piston **76** forwardly to the position of FIG. **1** and the tool is again ready for operation by movement of the safety valve **112** from the safe to the fire position and manual squeezing of the trigger **128**. It is also possible to operate the tool on continuously repeating cycles by maintaining the trigger in a depressed position and moving the lower end of the nosepiece into and out of contact with the workpiece to thereby initiate power strokes of the driver.

In accordance with the present invention, in FIGS. **4** through **6** is illustrated another embodiment of the fastener driving tool referred to generally by the reference numeral **200**, and differing generally from the previous embodiment of FIGS. **1** through **3***a* in that it is not necessary to recycle the safety valve in order to initiate each cycle of operation of the tool including a power and return stroke of the driver **32**. Components of the tool **200**, which are identical to or substantially similar to the components of the tool **10** of the previously described embodiment are given identical reference numerals and will not be described in detail hereinafter except to the extent necessary in order to relate to the features of the second illustrated embodiment of the invention.

In the tool **200**, the tubular conduit **102** leading to the poppet valve chamber **54** above the flange portion **48** of the poppet valve assembly **46** is connected to a valve chamber **202** having a spherical ball valve member **204** mounted therein for movement between an upper and lower position. The tubular conduit **102** is connected into a sidewall portion of the valve chamber **202** through a short drilled passageway **206**, and the upper end of the valve chamber is in communication with the reservoir **14** in the tool handle via a short passage or port **208**. An O-ring **210** is provided around the port opening **208** so that when the ball valve member **204** is forced upwardly to the position of FIG. **5**, the passage **208** is closed and communication between the valve chamber **202** and the pressurized fluid in the handle portion **14** is cut off. The lower end of the valve chamber **202** is in communication with a drilled passage **212** and an O-ring **214** is provided at the lower end of the chamber **202** so that when the ball valve member **204** is in a downward position, as shown in FIGS. **4** and **6**, air pressure from the handle reservoir **14** forces the valve member **204** tightly against the O-ring **214** closing off communication between the valve chamber **202** and the upper end of the passage **212**. Immediately below the valve chamber **202**, the passage **212** is in communication with an exhaust passage **216** opening to the atmosphere so that when the valve member **204** is seated against the upper O-ring **210**, the conduit **102** leading to the poppet valve chamber can exhaust to the atmosphere through the valve chamber **202**, passage **206**, upper end of the bore **212** and passage **216** to initiate a firing stroke of the tool. The lower end of the passage **212** is in communication with a larger diameter cylinder or bore **218** formed in the body of the tool. Within the coaxially aligned passage **212** and cylinder **218** is mounted for sliding movement a movable piston member **220** including an elongated piston rod **222** having an upper portion slidable in the passage **212**. At the upper end of the piston rod **222** is provided a short, ball valve actuator or projection **224** of reduced diameter and adapted to move upwardly to unseat the ball valve member **204** from the O-ring **214** and force it upwardly to seat against the upper O-ring **210** and seal off the port **208**.

The piston member **220** includes an upper piston **226** spaced below the projection **224** and slidable in the large diameter bore or cylinder **218** from an intermediate position shown in FIG. **4** to an upper position shown in FIG. **5**, where it bears against an annular surface at the upper end of the cylinder **218**. When the piston member **220** is in the upper position, the actuator projection **224** engages the ball valve **204**, lifting it off the lower O-ring **214** and moving it upwardly to seat against the upper O-ring **210**, thus permitting the pressurized fluid in the poppet valve chamber **54** to exhaust into the atmosphere and thereby initiate a power stroke of the piston assembly **22** and driver **32** to drive a fastener **60** downwardly in the drive track **34**. The piston member **220** also includes a smaller diameter lower piston **228** spaced below the piston **226** and slidable within a tubular sleeve **230** inserted into the lower portion of the cylinder **218** adjacent the exhaust end. When the piston member **220** is in the intermediate or upper position, the lower piston **228** seals off the lower end of the cylinder **218** by tightly sealed engagement around the internal surface or bore of the insert **230** and normally prevents the exhaust of fluid in the cylinder **218** contained between the upper and lower piston members **226** and **228**, respectively.

The lower end of the piston rod **222** is pivotally connected to a triangularly-shaped magazine actuating member **232** by means of a cross-pin **234** which is slidably disposed in a slot **232***a* at the rearward, upper corner of the actuator. The forward, upper corner of the magazine actuator is mounted for pivotal movement relative to the magazine **64** on a mounting pin **236**, extending laterally transversely of the longitudinal axis of the magazine. The lower corner of the triangularly-shaped magazine actuator is pivotally interconnected with the magazine feeder member **84** by a pin **238** which projects through an elongated slot **240***a* formed in a magazine cocking

member 240 which is also pivotally mounted on the pin 236. The cocking member 240 includes a knob or handle 241 at the lower end manually movable by a tool operator to cock the magazine member and retract the feed pawl or finger 88 from the drive track after the last nail has been driven and a new supply or strip of nails 60 is being inserted into the magazine. When the piston member 220 is in the intermediate position shown in FIG. 4, the forward end or tip 88 of the feeding finger or pawl is in contact with the leading fastener 60 in the magazine which is in centered position in the drive track 34 ready to be driven by a power stroke of the driver 32. When a power stroke is initiated by movement of the piston 220 from the position of FIG. 4 to the upper position of FIG. 5, the feeder pawl or finger 88 is retracted rearwardly out of the drive track, as in the prior embodiment, so that no interference between the driver 32 and the feed pawl can occur.

Similar to the tool 10 of the previous embodiment, the tool 200 includes a safety valve mechanism which is operatively interconnected with presser foot 136 and connecting bracket 138 forming a touch trip mechanism for the tool. The upper end of the bracket 138 is connected to the lower end of a safety valve rod 242 which is slidable in an elongated bore 244, having its upper end in communication with the interior of the handle reservoir 14 and a lower end open to the atmosphere. The safety valve rod 242 is biased downward by the compression spring 142 which is seated in an enlargement 244*a* at the lower end of the safety valve bore 244, and the lower end of the spring 142 bears downwardly against an annular collar 140 provided on the lower end portion of the valve rod. The presser foot 136 is thus biased downwardly to the safe position below the lower end of the drive track 34 by the spring 142. When the tool is to be fired and the lower end of the drive track 34 is pressed against the workpiece, the presser foot 136 is moved upwardly to the fire position and the valve rod 242 is moved upwardly from the safe position of FIGS. 4 and 6 to the fire position of FIG. 5. The safety valve rod includes a sloped upper end surface 242*a* and an annular recess 242*b* in the body of the rod spaced downwardly from the upper end surface. The safety valve passage 244 is in communication with the upper end surface of the cylinder 218 above the piston 226 by a cross passage 246.

When the safety valve rod 242 is in the lower or safe position, shown in FIG. 4, the sloped upper end surface 242*a* permits fluid to flow from the reservoir 14 into the upper end of the bore 244 and through the passage 246 into the upper end of the cylinder 218 above the piston portion 226, moving the piston 220 downwardly from the position of FIG. 5 to the position of FIG. 4. Movement of the piston 220 in the above manner, causes a new fastener 60 to be fed into the drive track 34 and further downward movement of the piston member 220 is limited because of engagement of the forward end of the feed pawl or finger 88 with the shank of the fastener when it is centered in the drive track 34. When the safety valve member 242 is in the downward or safe position, pressurized air from the handle reservoir 14 is continuously supplied to the upper end of the cylinder 218 above the piston member 226 and prevents upward movement of the piston member 220 from the position of FIG. 4 to that of FIG. 5 and, accordingly, the valve member 204 is seated on the lower O-ring 214 and a drive stroke of the piston assembly 22 and driver 32 cannot be initiated. When the tool 200 is moved into working position and the presser foot 136 is depressed upwardly by engagement against a workpiece, the safety valve rod 242 is moved upwardly to the fire position, and the annular recess 242*b* is aligned with the passage 246 and a short intermediate passageway 248 which extends into the sidewall of a trigger valve chamber 108 similar to the trigger valve chamber in the preceding embodiment.

Within the trigger valve chamber 108 is mounted a ball valve member 116 and the upper end of the valve chamber is connected to the interior of the handle reservoir 14 through a port 114 which is surrounded by an upper O-ring 118 having an upper valve seat. The lower end of the trigger valve chamber 108 is in communication with the atmosphere through a downwardly extending port or passage 122 and a lower O-ring seat 120 is provided in the valve chamber to seal off the passage 122 when the ball valve is seated thereon, as in FIGS. 4 and 6. The ball valve 116 is mounted for movement within the chamber 108 between a lower position seated against the lower O-ring 120 and closing off the passage 122, and is movable upwardly to a seated position against the O-ring 118 sealing off the port 114 by means of an actuator pin 126, having a diameter smaller than the passage 122 and pivotally connected to the forward end of a trigger 128. On upward depression of the trigger 128, the stem 126 forces the ball valve member 116 upwardly, closing off the port 114 to the reservoir 14 and the short transverse passage 248 then permits air in the upper end portion of the cylinder 218 above the piston 226 to exhaust to the atmosphere through the passage 246, recess 242*b* on the safety valve rod 242, passage 248, valve chambers 108, and passage 122 around the stem 126. When this occurs, the piston member 220 moves upwardly because of the pressurized fluid in the cylinder 218 between the pistons 226 and 228, and this movement retracts the magazine feeder pawl 88 from the drive track 34 and unseats the ball valve 204 from the lower O-ring seat 214, thereby permitting a drive stroke of the piston assembly 22 and driver 32 to be initiated as the fluid from the poppet valve 54 exhausts to the atmosphere through the passage 216. It is thus seen that a power or driving stroke cannot be commenced until the forward end of the magazine feed pawl or finger 88 has been positively retracted from the drive track 34 to be clear of the driver 32. After a power stroke has been completed and either the safety valve 242 is released to return to the downward or safe position or the trigger 128 is released allowing the trigger valve 116 to reseat on the lower O-ring 120, pressurized fluid is again introduced into the upper end of the cylinder 218 above the piston 226 via the safety valve passage 244 and passage 246 or via the port 114, valve chamber 108, passage 248, annular recess 242*b* and passage 246. When this occurs, the piston 220 moves downwardly to the position of FIG. 4, and thereby advances another fastener or nail 60 into a centered position in the drive track ready to be driven. As previously stated, engagement between the forward end of the pawl or finger 88 and the shank of the leading nail 60 in the drive track prevents further downward movement of the piston member 220 beyond the intermediate position of FIG. 4. The tool can again be fired if the safety valve rod 242 is still in the upper or fire position and the trigger 128 is in the upper or fire position unseating the trigger valve ball 116, as previously described. Successive operative cycles may be initiated by continuously maintaining either the trigger 128 or the safety valve rod 242 in the upper or fire position and cycling the other one of the two between the fire and safe positions.

When the last nail or fastener 60 in the magazine 64 has been driven, the forward end of the feed pawl or finger 88 is moved by the piston member 220 to a full forward position, as shown in FIG. 6 wherein the forward end of the pawl bears against the forward wall of the drive track 34. This occurs because the fluid pressure in the upper end of the cylinder 218 bearing downwardly on the piston 226, forces the piston rod assembly 220 downwardly from the position of FIG. 5 to the position of FIG. 6, wherein the lower piston 228 is moved below a tapered lower bore portion of the sleeve insert 230 and exhausts the fluid from the cylinder 218 between the pistons 226 and 228. When the pressure between the piston portions 226 and 228 is relieved and exhausted to the atmosphere, there is no upward force acting on the piston member 220 to unseat the valve 204 from its lower seat 214, and subsequent depression of the trigger 128 and safety valve member 242 is ineffective to initiate a firing stroke of the tool. The tool 200 cannot be fired after the last nail 60 has been driven, and this feature prevents an inadvertent power stroke of the driver when there are no fasteners present in the tool magazine and eliminates damage to the tool, resulting from initiating a power stroke when the tool is empty.

In order to reload the tool, a new supply of fasteners **60** is inserted into the magazine **64** and is advanced forwardly until the leading nail **60** is adjacent the entrance to the drive track. The knob **241** on the cocking lever **240** is manually retracted rearwardly, causing the lever to pivot counterclockwise. This movement forces the piston rod member **220** upwardly, and the lower piston **228** again is sealed in the insert sleeve **230**. When the piston **228** is moved into sealing engagement with the sleeve insert **230**, the upper piston **226** is spaced above the sleeve insert and compressed fluid from the handle reservoir **14** flows into the cylinder **218** between the pistons **226** and **228** through a passage **250**. With pressurized fluid present in the cylinder **218** between the pistons **226** and **228**, a power stroke can again be initiated by exhausting the fluid from the upper end of the cylinder **218** above the piston **226**, as previously described.

In order to prevent an inadvertent firing stroke of the piston assembly **22** and driver **32** when the tool is cocked by manual movement of the cocking lever **240**, as described, a stop lug **252** is provided on an adjacent sidewall of the magazine for limiting the pivotal movement of the lever during a cocking operation so that the piston member **220** does not move upwardly beyond the intermediate position of FIG. **4** to the firing position of FIG. **5**. After the tool is loaded with a new supply of fasteners and is cocked as described, firing strokes can again be initiated by depression of the safety valve rod **242** and trigger **128**, as previously described.

From the foregoing, it will be seen that an embodiment of the invention illustrated in FIGS. **4** through **6** provides positive means for retracting the feeder pawl **88** from the drive track **34** before a power stroke of the driver **32** can be initiated. Furthermore, the tool **200** can again be recycled for successive firing strokes while holding the nosepiece in constant contact against the workpiece and cycling the trigger **122**. Or in the alternative, the trigger **128** can be maintained in a depressed condition and the tool can be cycled by moving the presser foot **136** against and away from the workpiece. The tool **200** also includes a last nail feature which prevents firing of the tool after the last nail magazine has been exhausted and, once exhausted, the new fasteners can be loaded into the magazine and the tool is manually cocked with the cocking lever **240**, putting it in a ready condition for commencement of subsequent firing operations.

In the tool **10**, illustrated in FIGS. **1—3**, it is necessary to cycle the safety valve stem **112** in order to feed each new nail into the drive track. In the tool **200** of FIGS. **4—6**, it is not necessary to cycle the safety valve **242** to feed the nails into the drive track. It has been found in some instances that tool operators using tools of the latter type have taped or otherwise permanently secured the valve rod **242** in the fire position, thus enabling the tool to be manipulated and fired somewhat easier and at a slightly higher rate than possible otherwise. This, of course, eliminates the safety feature afforded by the valve **242** and results in a dangerous situation in that the tool can be fired in any position by squeezing the trigger regardless of whether or not the lower end of the nosepiece is pressed against a workpiece. In the tool **10**, however, the safety valve feature cannot be disabled by taping or otherwise securing the valve stem **112** in the fire position because it is necessary to cycle the safety valve to feed each new nail into the drive track. The tool **10** cannot remain operative if the safety valve is taped or restrained in the fire position and, as a result, the tool is operative only in the safe manner as intended. When restraining of the safety valve is not a serious problem, the tool **200** offers the advantage of not requiring the cycling of the safety valve each time a nail is to be driven.

Although the present invention has been described with reference to two illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this invention.

We claim:

1. A fastener driving tool comprising a drive track for guiding fasteners as they are driven, a pneumatically powered driver in said drive track movable on a power stroke to drive fasteners and a return stroke, pusher means for feeding fasteners into said drive track and movable between a forward position extending into said drive track and a rearward position rearwardly retracted therefrom, and fluid control means including a piston slidable in a cylinder, said piston interconnected with said pusher means for moving the same and providing valving action for preventing the initiation of a power stroke of said driver until said pusher means is retracted from said drive track.

2. The driving tool of claim **1** wherein said control means includes first motor means for moving said driver on a power and return stroke and second motor means for moving said pusher means, and passage means operably interconnecting said first and second motor means whereby said second motor means normally closes said passage means preventing a power stroke of said driver until said pusher means is clear of said drive track.

3. The driving tool of claim **2** including safety valve means responsive to the position of said drive track relative to a workpiece movable between a safe and a fire position and operable upon movement from said safe to said fire position to retract said pusher means from said drive track, said safety valve means operable to activate said second motor means to feed a fastener into said drive track with said pusher means when returned from said fire position to said safe position.

4. The driving tool of claim **2** wherein said control means comprises a manual trigger valve operable to open and close said passage means between said first and second motor means.

5. The driving tool of claim **3** wherein said second motor means includes valve means operable to open communication between one end of said passage means and the atmosphere when said safety valve means is moved from the safe to the fire position.

6. The driving tool of claim **5** wherein said valve means on said second motor means is operable to close communication between said one end of said passage means and the atmosphere when said safety valve means is returned from the fire to the safe position.

7. A fastener driving tool comprising a drive track, a driver slidable in said drive track, pneumatic motor means operable to move said driver on a power and return stroke in said drive track, pusher means operable to move into and out of said drive track to position fasteners therein to be driven, control valve means for activating said motor means to initiate a power stroke of said driver, means for retracting said pusher including a piston slidably mounted in a cylinder and a valve, said piston operable to actuate said valve for preventing a power stroke of said driver until said pusher means is retracted from said drive track.

8. The driving tool of claim **7** wherein said control valve means includes exhaust passage means in communication between said motor means and the atmosphere for initiating a power stroke, said retracting means normally closing said passage means and operable to open said passage means after retraction of said pusher means from said drive track.

9. The driving tool of claim **8** wherein said retracting means is operable to advance said pusher means into said drive track after said motor means has initiated a return stroke of said driver.

10. A fastener driving tool comprising a drive track for receiving fasteners, a driver slidable in said drive track and movable on a power stroke to drive fasteners and a return stroke in an opposite direction, pusher means movable on a feed stroke from a retracted position clear of said drive track forwardly to a forward position extending into said drive track and movable rearwardly on a return stroke in the opposite direction to said retracted position, first valve means for initiating a power stroke of said driver and second valve means associated therewith preventing the initiation of a power

stroke until said pusher means moves on a return stroke to said retracted position.

11. The driving tool of claim 10 wherein said second valve means comprises piston means slidable in a bore, and said first valve means includes passage means intersecting said bore and blocked by said piston means when said pusher means is in said forward position.

12. The driving tool of claim 11 wherein said piston means moves to open communication between said passage means and said bore when said pusher means is moved to said retracted position.

13. The tool of claim 12 including safety valve means movable between a safe and a fire position, and means controlled by said safety valve means to supply pressurized fluid to move said piston means to retract said pusher means when said safety valve means is moved from said safe to said fire position.

14. The driving tool of claim 10 wherein said first valve means includes passage means and a pair of valve members in series communication in said passage means, each valve member movable between a first and second position and operable to initiate a power stroke of said driver only when both valve members are moved to said second position.

15. The driving tool of claim 10 wherein said second valve means includes a piston member interconnected with said pusher means and a second valve member, said first valve means including a valve member operable between a first and second position to move said piston member to retract and advance respectively said pusher means.

16. The driving tool of claim 15 wherein said piston member is operable to open and close said second valve member upon retraction and advancement of said pusher means, said second valve member opening to initiate a power stroke of said driver and said one valve member operable to initiate a return stroke thereof.

17. The driving tool of claim 16 wherein said piston member is movable to a third position in response to the absence of fasteners in said tool to close said second valve member and prevent the initiation of a power stroke of said driver.

18. The driving tool of claim 17 wherein said first valve means includes a first valve passage between said piston member and a pair of valves in series movable between open and closed positions to connect and disconnect an end of said first valve passage to the atmosphere.

19. A fastener driving tool comprising a drive track and a driver slidably disposed therein, motor means for reciprocating said driver to drive successive fasteners positioned in said drive track, safety valve means movable on an operating cycle between a safe and a fire position and operably connected with said motor means to prevent initiation of a drive stroke of said driver until said safety valve means has been cycled between said safe and fire positions, said safety valve means including a workpiece engaging structure movably mounted adjacent the lower end of said drive track for movement between a safe position projecting below said lower end of said drive track and a fire position spaced upwardly thereof, and reciprocating feeder means for advancing successive fasteners into said drive track and means operatively interconnecting said feeder means and said safety valve means for initiating a feeding stroke of said feeder means in response to cycling of said safety valve means between said safe and fire positions.

20. The fastener driving tool of claim 1 wherein said cylinder is formed with a port therein for cooperation with said piston to provide said valving action upon movement of said piston to open and close said port.

21. The fastener driving tool of claim 1 wherein said piston includes a pair of piston portions having different diameters, at least one of said piston portions serving as a component for said valving action.

22. The fastener driving tool of claim 20 wherein said piston includes an axial stem of reduced diameter between said piston portions forming a piston chamber movable into and out of communication with said port.

23. The fastener driving tool of claim 7 wherein said valve includes a port formed in said cylinder and opened and closed by said piston.

24. The fastener driving tool of claim 23 wherein said piston includes portions of different diameters, at least one portion functioning as a component of said valve for controlling the operation of said motor means for initiating a power stroke of said driver.