

### [54] FASTENER DRIVING APPARATUS

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[51] Int. Cl. .... B23p 11/00, B23p 19/04, B25d 9/16

[58] Field of Search .... 29/243.56, 252; 227/127, 130

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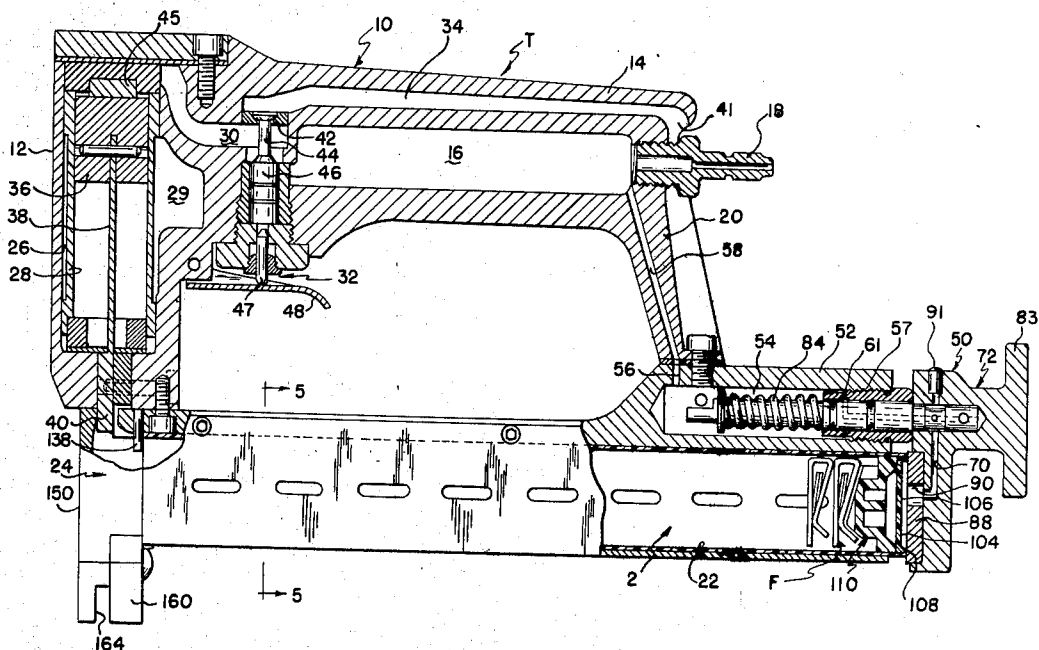
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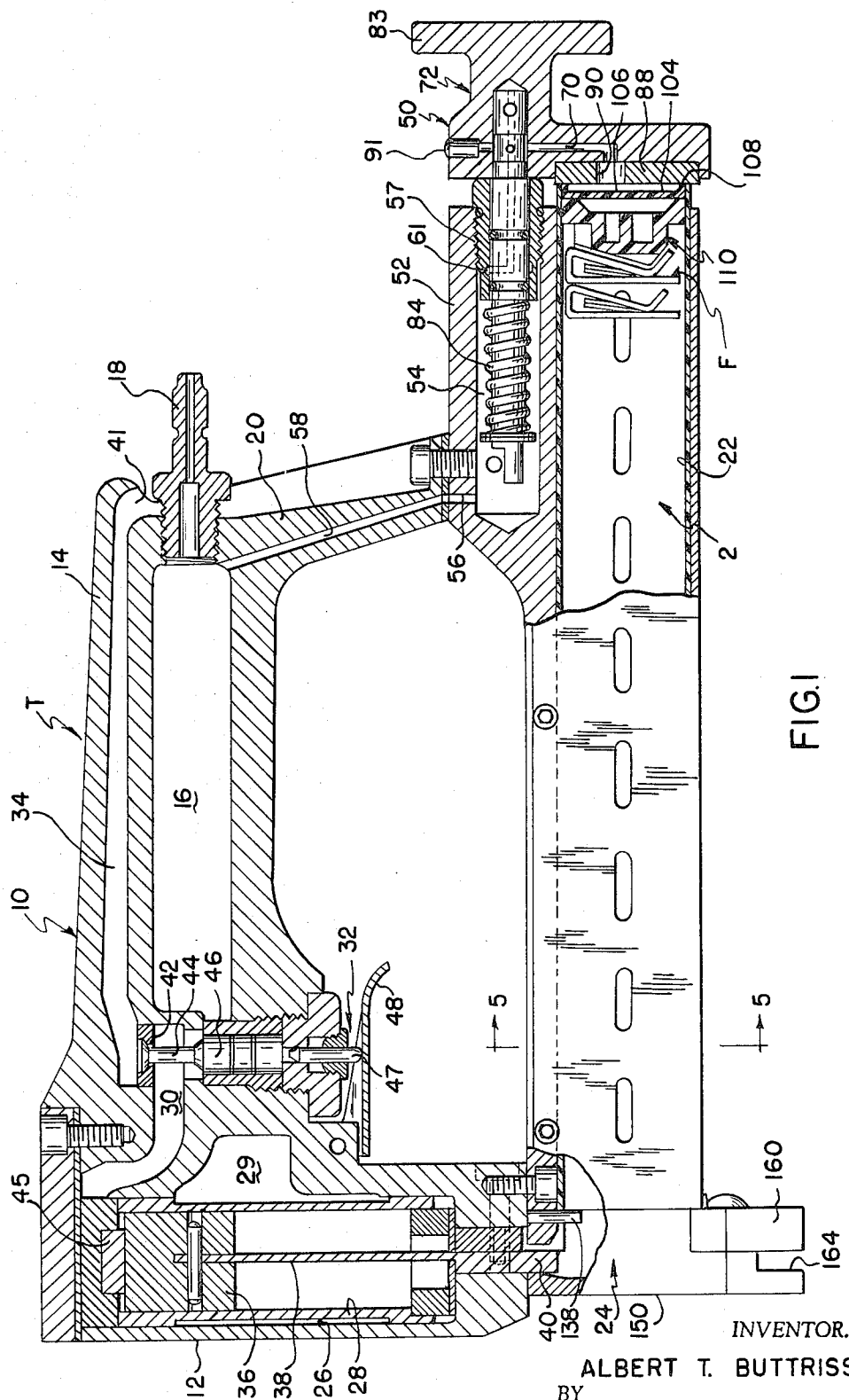
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### ABSTRACT

A fastener driving apparatus including an improved construction for a fluid operated fastener driving tool adapted to receive a detachable and replaceable magazine for automatically and sequentially feeding a plurality of fasteners in an aligned side-by-side relation into a predetermined uniform spaced and secured position on a work piece.

5 Claims, 10 Drawing Figures





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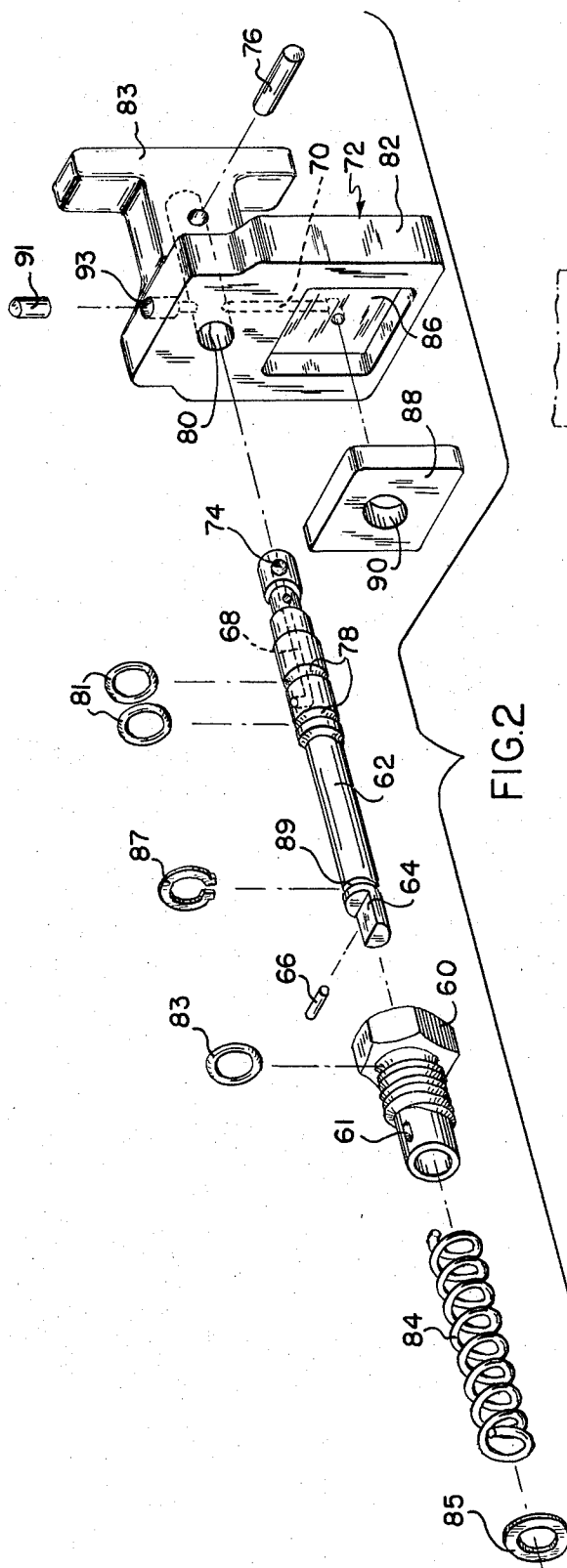


FIG. 2

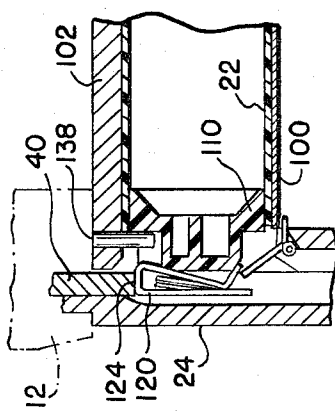


FIG. 4

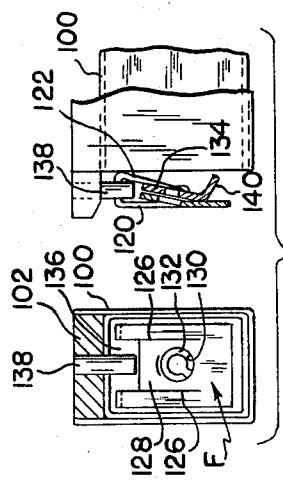


FIG. 3

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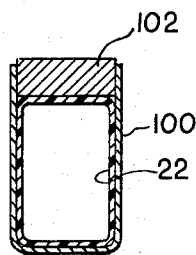


FIG. 5

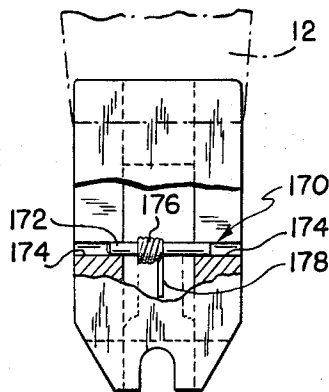


FIG. 6

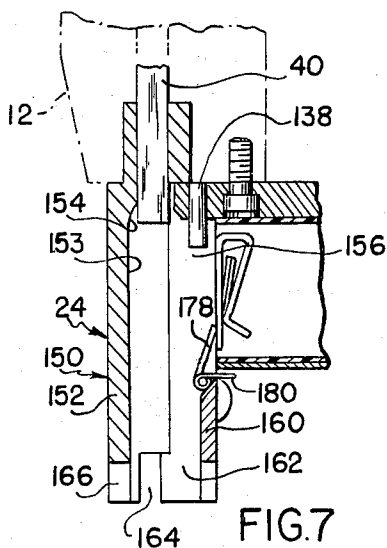


FIG. 7

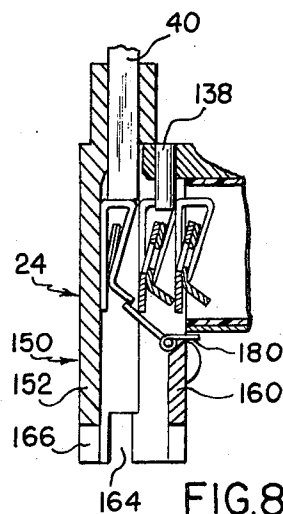


FIG. 8

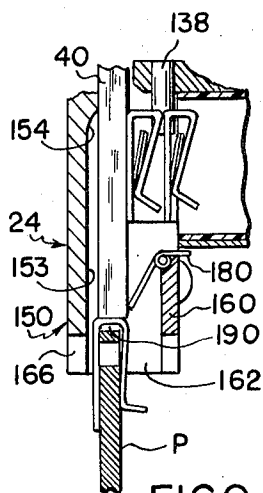


FIG. 9

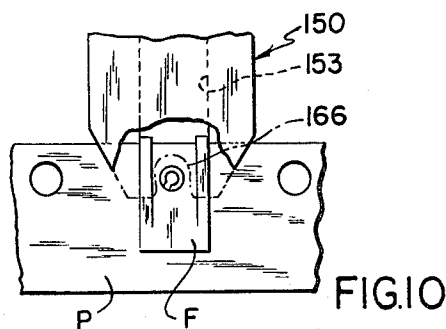


FIG. 10

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## FASTENER DRIVING APPARATUS

## BACKGROUND OF THE INVENTION

This invention relates in general to a fastener driving apparatus for installing fasteners, and more particularly relates to an improved construction and method for a fastener driving apparatus for automatically and sequentially feeding and installing fasteners, such as of the U-shaped construction, from a pre-filled magazine, into uniform secured relation on panels, flanges, or the like for use in high speed application in the automotive, appliance, electronic and other mass-producing industries. This application relates to the co-pending application to Albert T. Buttriss, Ser. No. 9,834, filed Mar. 9, 1970.

Heretofore, it has been known to provide various electromagnetic or pneumatically operated tools for driving staples, nails, tacks and the like into a work piece. Such prior devices, however, have generally required specially designed tool bodies and/or dies, headed fasteners or "strips" of headed fasteners which are not only expensive to produce, but which do not readily lend themselves to high speed automatic application and/or equipment and hence, such devices do not fully realize the advantages of high speed and ease of application to which the driving apparatus are capable. This is particularly the situation with respect to applications wherein the tools perform a feeding operation in which a series of fasteners are to be driven onto a work piece at spaced intervals and without damage to the surface and/or edges of the work piece, particularly when employing fasteners of a U-shaped construction and/or are to be applied in relatively inaccessible locations. Further, in such prior arrangements, it is often difficult to replace a depleted supply of fasteners so as to reduce loose parts handling and wasted parts with a minimum of time and effort. In addition, the driving apparatus should be capable of being readily portable, which is simple to use and operate and which can be employed for applying fasteners of different sizes and/or shapes, and which can be operated to precisely install the fasteners without damage to the work piece in a minimum time.

## SUMMARY OF THE INVENTION

A fastener driving apparatus for high speed, automatic application of fasteners, such as of the U-shaped construction, to a work piece including, in combination, a fluid operated driving tool adapted to receive a interchangeable, pre-filled disposable magazine. The tool is preferably of a pneumatically operated construction which includes a body and an interchangeable magazine assembly for carrying a plurality of U-shaped fasteners mounted in side-by-side relation for individual and sequential delivery to a work piece upon actuation of the tool. The fasteners are fed through the magazine in separate or individual form without attachment to one another for sequential and precise alignment with the work piece. The tool is constructed and arranged to provide quick and easy interchangeability of the magazine assembly, which prevents inadvertent ejection of the fasteners from the tool in the inoperative position thereof, and which acts to cushion the shock transmitted to the fasteners via the magazine assembly upon actuation of the tool.

As will be apparent from the foregoing, the following description and accompanying drawings, it will be seen that the present invention provides a new and novel construction of a fastener driving apparatus which is of a high speed, simple, yet inexpensive construction, and which is easy to operate and maintain for feeding fasteners in individual sequential relation from a pre-filled disposable magazine. The tool is readily portable and is constructed and arranged to readily receive the magazine assembly for holding and feeding the fasteners in bulk from the tool upon controlled actuation of the trigger mechanism. The tool of the present invention quickly and efficiently applies fasteners, such as of the U-shaped construction, onto panels or flanges many times faster than by hand and eliminates small parts handling, eliminates parts loss, and saves on fastener inventory. The tool has stan-

dard couplings for quick-disconnect type attachment to a fluid supply source and the magazine assembly provides a reservoir to accommodate a wide panel range of U-shaped fasteners for quick delivery. The tool of the invention is designed to install the bright portion of the fastener without contact with the work piece so as to be safe to use on porcelain, pre-painted, plastic, decorative, light-gauge panels or the like. In addition, the tool is of a lightweight construction which can be used in any position without loss of efficiency, and provides maximum flexibility on production lines. Further objects and advantages of the invention will be apparent as the following description proceeds with reference to the accompanying drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevation view, partly in section, and partially broken away illustrating the fastener driving apparatus of the present invention;

FIG. 2 is a generally perspective, assembly view of the closure or foot mechanism removed from the apparatus of FIG. 1;

FIG. 3 is a vertical section side elevation, respectively, illustrating the position of a respective one of the fasteners with respect to the dowel pin in the magazine mechanism;

FIG. 4 is a fragmentary, vertical section view illustrating one position of the finger mechanism of the invention upon forward movement of one of the respective fasteners to a forward position;

FIG. 5 is a vertical section view taken along the plane of line 5-5 of FIG. 1;

FIG. 6 is a fragmentary, front elevational view, on a reduced scale and partly in section, showing the nose and finger assembly of the present invention;

FIG. 7 is a fragmentary, side elevational view, on a reduced scale and partially in section illustrating another position of the finger mechanism in another forward position of a respective one of the fasteners prior to actuation of the tool;

FIG. 8 is a fragmentary, elevation view, on a reduced scale and partly in section, illustrating another position of the finger mechanism in another forward position of a respective one of the fasteners upon actuation of the tool;

FIG. 9 is a fragmentary, elevation view on a reduced scale and partly in section illustrating the final installed position of a respective one of the fasteners with a work piece upon reciprocal movement of the plunger mechanism in accordance with the invention; and

FIG. 10 is a fragmentary, top plan view looking generally from the left-hand side of FIG. 9.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring again to the drawings and particularly to FIG. 1 thereof, there is illustrated the fastener driving apparatus or tool, designated generally at T, mounting a magazine assembly 2 which contains a plurality of fasteners F for automatically and sequentially driving the fasteners into secured relation with a work piece P, as illustrated in FIGS. 9 and 10. In FIG. 1, the driving tool is illustrated in its normal or static position with the plunger mechanism disposed in its uppermost position prior to driving a fastener F onto a work piece, as will be described hereinafter.

As best illustrated in FIG. 1, the tool T includes a generally C-shaped body 10 having a forward and generally vertically extending head portion 12 and a rearwardly extending handle portion 14 which provides a reservoir or chamber 16 to which a pressurized fluid, such as compressed air, may be supplied from a suitable source (not shown) by means of a quick-disconnect coupling, as at 18. The rear end of the handle 14 is provided with an integrally formed, downwardly extending leg 20 which serves as a means for supporting the rear end of the magazine assembly 2. The fasteners are fed from an interchangeable and disposable cartridge 22 into a ram guide formed in a nose assembly 24 which may be detachably connected to the head 12 of the tool.

As shown, the head 12 of the tool includes a cavity 26 in which is mounted a sleeve forming a cylinder 28. An air return chamber 29 is defined in the cavity by the sleeve 28 and the lower end of the sleeve 28 is in communication with the chamber 29 and an open upper end thereof is in continuous communication with a port or passageway 30 formed in the body 10. A trigger actuated control valve assembly 32 normally connects the passageway 30 to the atmosphere through a passageway 34 formed in the hollow handle portion 14 and is operable to a position in which it connects the passageway 30 to the fluid chamber 16. The fluid admitted to the passageway 30 enters the open end of the cylinder 28 and drives a power piston 36 which is slidably mounted within the cylinder 28 and which is secured to the upper end of a fastener driving blade or plunger 38 outwardly so that the lower end 40 of the plunger engages and drives a fastener F supplied one at a time to a ram guide in the nose assembly 24 via the magazine assembly 2, as aforesaid. Upon downward movement of the piston 36, the air is disposed within the cylinder 28 below the piston 36 is driven through a plurality of ports (not shown) in the lower wall of the cylinder 28 into the return air chamber 29. When the compressed air disposed above the piston 36 is exhausted to the atmosphere under the control of the control valve assembly 32, air pressure from the return air chamber 29 is effective to act on the lower surface of the piston 36 to return the piston from its displaced position adjacent the lower end of the cylinder 28 to a normal position adjacent the open upper end thereof, as shown in FIG. 1.

The connection of the open upper end of the cylinder 28 to either the atmosphere via port 41 or the fluid chamber 16 is controlled by a manually actuated control valve assembly 32 which generally includes an exhaust valve seat opening 42 disposed in communication with the passageway 34. This seat may be closed by a valve stem 44 extending from a slide valve 46. A pilot valve 47 coacts with the valve 46 to permit a minimum application of force to the trigger mechanism. When the tool is actuated, a trigger 48 is pivoted in a counter-clockwise direction to engage the slide valve 46 so as to close the exhaust opening 42 such that the passageway 30 and the open end of the cylinder 28 are placed in communication with the fluid in chamber 16 so that the piston 36 and plunger 38, 40 are driven downwardly to engage and drive the fasteners delivered from the magazine assembly 2. The piston 36 is pneumatically restored to its normal position against a resilient bumper 45 following the release of the trigger 48 and after a respective one of the fasteners has been driven by the blade 40. When the trigger 48 is released, the passageway 30 is connected to atmosphere through the exhaust passageway 34 and outlet port 41.

Now in accordance with the invention, a foot or closure assembly 50 is provided for coacting fluid seating and transmitting engagement with the rearward end of the magazine assembly 2. As best seen in FIGS. 1 and 2, the assembly 50 includes a rearwardly extending housing 52 detachably connected to the leg 20 of the body 14. The housing 52 has a cylindrical bore 54 which is open at one end and which is provided adjacent its other end with a slot 56 which communicates with a passageway 58 provided in the leg 20 which passageway, in turn, communicates with the fluid chamber 16. The bore 54 threadably receives, as at 57, a hollow bushing 60 which, in turn, receives therethrough an elongated shaft 62 which extends into the bore. The shaft 62 is provided at one end with a flat 64 adapted to engage a dowel pin 66 which extends transversely through the bore 54 to prevent the rotational movement of the shaft in the inoperative position thereof. A generally L-shaped passageway 68 may be provided adjacent one end of the shaft 62 adapted to communicate with another generally L-shaped passageway 70 provided in a closure member 72. The terminal end of the shaft 62 may be provided with a transverse bore 74 adapted to receive a dowel pin 76 for connecting the shaft to the closure member. The shaft 62 may be provided with a pair of grooves 78 and corresponding O-rings 81 to provide a fluid sealing engagement interiorly

of the bushing 60. Similarly, another O-ring 83 may be provided around the bushing 60 to provide a fluid seal adjacent the open end of the bore 54 in the installed position of the bushing 60. In the form shown, a resilient compression spring 84 is disposed around the shaft 62 as to bear at one end against the bushing 60 and at the other end against a collar 85 held in position by a C-ring 87 received in an annular groove 89 in the shaft 62. By this arrangement, the shaft may be manually reciprocated within the bore 54 against the resilient bias of the spring 84 so as to normally be held against rotation via the pin 66 and flat 64. On rearward movement of the shaft 62 the flat 64 disengages the pin 66 to permit rotational movement of the shaft 62 about its rotational axis within the bore 54.

As shown, the shaft 62 is adapted to be disposed within a bore 80 provided in the closure member 72 and fixedly attached thereto via pin 76. The closure member 72 includes a generally flat base 82 which has a generally T-shaped handle 83 made integral with and extending outwardly therefrom. The other side of the base 82 is provided with a recess 86 which is preferably of a polygonal construction and which communicates with the passageway 70 which, in turn, communicates with the bore 80. The recess 86 has a depth sufficient to receive a resilient pad 88 dimensioned to it snugly within the recess 86. The pad 88 is preferably made of a polymeric or elastomeric material which may be fixedly attached within the recess 86 by means of a suitable adhesive material. The pad 88 is provided with a central opening 90 which is adapted to be concentrically disposed with respect to the outlet end of the passageway 70. By this arrangement, fluid pressure introduced through passageway 58, bore 54, passageway 68 and 70 is transmitted outwardly from the closure member 72 via opening 90 in the resilient pad 88 in a selective rotated position of the handle 83. In this connection, it will be noted that the bushing 60 is provided with an opening or aperture 61 adapted for communication with the passageway 68 in the shaft 62. Moreover, as the handle 83 is pulled outwardly the forwardmost one of the O-rings 81 is drawn across the opening 61 in the bushing so as to cut off the supply of fluid pressure from the chamber 16. The base member 82 may be provided with a suitable plug 91 which communicates via a bore 92 which, in turn, communicates with the transverse bore 80.

The magazine assembly 2 is fully described in the applicant's aforementioned co-pending application, Ser. No. 9,834. As shown, the assembly generally comprises an inverted U-shaped casing 100 (FIG. 5) adapted to be detachably connected to a transverse housing structure 102 which, in turn, may be detachably connected to the body 10 of the tool T. The casing 100 is adapted to be received at one end within the ram guide of the nose 24 and at its other end operably connected to the resiliently actuated base 82 of the closure mechanism 50.

As shown, the casing 100 is adapted to receive a disposable cartridge member 22 pre-filled with a plurality of fasteners F disposed in side-by-side stacked relation therein. The cartridge 22 is preferably of a polygonal construction, in cross section, and includes at one end a closure member 104 in the form of a flat disc or base which may be adjoined to the confronting interior surface of the cartridge by any suitable means, such as by cementing, heat sealing, molding or the like. Preferably, the member 104 is provided with an aperture, as at 106 to enable fluid under pressure to be transmitted therethrough. The aperture 106 is disposed inwardly of a flange 108 which defines a recess-like opening which provides a pocket-like construction for coacting sealing engagement with the resilient pad 88 of the closure mechanism 50. In addition, the cartridge 22 is provided with a plunger member 110 disposed interiorly thereof for driving the fasteners F generally axially through the body of the cartridge in a direction from the rearward end toward the forward end for ultimate discharge therefrom into the ram guide structure of the tool. The construction and operation of the plunger member 110 is fully described in the aforementioned co-pending application, Ser. No. 9,834.

As best seen in FIGS. 3 and 4, the fasteners F which may be employed with the cartridge are preferably made from a strip of sheet metal having a generally U-shaped configuration defined by a linearly extending leg 120 and an inclined leg 122 which extend downwardly from an interconnecting bight portion 124. The leg 120 is provided with a pair of longitudinal slits 126 which together define a spring arm 128 which extends angularly inwardly toward the opposite leg 122. The arm 128 is provided with a central opening 130 which is preferably concentrically disposed relative to an apertured helix 132 provided in a similarly formed spring arm 134 in the leg 122. Preferably, the arms 128 and 134 extend generally parallel with respect to one another generally between the legs 120 and 122, but terminate short of the bight portion 124. Accordingly, by this arrangement, an opening or slotted area 136 is provided in the bight portion 124 between the legs 120 and 122 adapted to receive therethrough a dowel pin 138 which extends downwardly from the supporting structure 102. The leg 122 is preferably provided with an integral outwardly extending flange 140 which facilitates snap acting coaxing engagement of the fastener with respect to the marginal edge of the work piece P, as shown in FIG. 9. Accordingly, the upper marginal surfaces of the bight portion 124 provide an abutment means adapted to receive the lower blade end 40 of the reciprocal drive element 38 for driving a respective one of the fasteners outwardly from the ram guide structure of the nose assembly 24. Further details with respect to the construction and operation of the fasteners may be had by reference to R. A. Hartman et al. U.S. Pat. No. 2,672,905.

Now in accordance with the invention, the nose assembly 24 is adapted to be detachably connected to the head 12 of the tool to receive and guide fasteners outwardly which are received from the magazine assembly 2. As best seen in FIGS. 7-9, the nose assembly 24 includes an outer nose piece 150 which may be detachably connected by bolts or the like to the head 12. The nose piece includes an elongated channel-like ram guide 152 which may be tapered at one end, as at 154, adapted to reciprocally receive therethrough the lower blade member 40 of the drive element 38. The ram guide 152 is dimensioned to slidably receive therein the transverse width of the respective fasteners F so as to guide the same in a rectilinear path outwardly in a direction away from the head 12 upon actuation of the blade 40. The nose piece 150 is of a generally hollow construction and has an opening, as at 156, on the side opposite the ram guide 152 which is dimensioned to slidably receive therein the corresponding adjacent end of the casing 100 of the magazine assembly 2 so that fasteners discharged from the cartridge member 22 are disposed within the nose piece adjacent and in engagement with the guide ram 152, as seen in FIGS. 7 and 8.

The nose piece 150 is preferably provided with a lower jaw member 160 which may be detachably connected thereto by suitable bolts or the like. The jaw member 160 is provided with a channel 162 which communicates with the ram guide 152 in the nose piece 150 so as to provide a generally polygonal shaped passageway for receiving and discharging fasteners therethrough. The nose piece 150 is provided with transverse cut-out slots 164 which together with the jaw member 160 provide a jaw-like slot construction to receive therein the thickness of the work piece P, as seen in FIGS. 9 and 10. The slot 164 is dimensioned so as to slidably accommodate therein the thickness of the work piece together with the thickness of the legs 120 and 122 of the respective fasteners. Accordingly, the ram guide 152 together with the construction of the nose piece 150 and the lower jaw member 160 act to provide a guide structure to maintain rectilinear movement of the fastener upon discharge therethrough and into secured engagement with the work piece. Preferably, the nose piece 150 is provided adjacent its lower end with a generally U-shaped slot 166 which provides an access area to permit visual observation of the thread engaging portion of the fasteners in the installed position thereof.

In the invention, the nose assembly 24 is provided with a resilient keeper or retainer mechanism 170 for controlling movement of the fasteners from the magazine assembly 2 to the nose assembly 24. As best seen in FIGS. 6-9, the mechanism 170 includes a dowel pin 172 supported by transverse slots 174 provided in the lower jaw member 160. A resilient guide spring member 176 is disposed around the dowel pin which has a first upstanding finger 178 which in the normal inoperative position of the tool extends generally vertically or at a slightly inclined angle upwardly in a direction away from the dowel pin 172. The spring is provided with a second resilient finger 180 which may be foreshortened relative to the finger 178 and which extends outwardly and generally parallel with respect to the casing 100 so as to be resiliently held in engagement therewith to prevent rotation of the spring relative to the dowel pin 172. In operation, the resilient finger 178 is progressively rotated in biased relation in a counter-clockwise direction relative to the dowel pin 172 upon engagement with a respective one of the fasteners so that the finger is rotated in excess of 90° upon engagement with the blade member 40 of the drive element 38 for driving a respective fastener through the guide ram 152 onto the work piece. By this arrangement, the resilient spring 176 acts to hold a column of fasteners in proper alignment within the magazine assembly 2 in the event no fluid pressure is present during loading without regard to the gravity position of the tool; holds the fasteners in aligned position in the fluid operating position of the tool or when pressure is removed therefrom; and provides precise rectilinear movement of the fastener as it is driven forward to secured relation with the work piece.

In a typical operation of the fastener driving apparatus of the invention, the tool is preferably held in a vertical position with the nose assembly 24 up and the handle 83 pulled downwardly against the biasing force of the compression spring 84 and then rotated about one-quarter turn to the right or left which acts to cut-off the supply of fluid pressure from chamber 16 to the foot pad 88 through respective passageways 58, 56, 54, 68, and 70. A cartridge member 22 which has been pre-filled with fasteners stacked in side-by-side relation therein may then be inserted into the casing 100 of the magazine assembly 2 and the handle 83 rotated back to its original position so that the compression spring 84 acts to draw the base 82 of the closure mechanism 72 axially forward until the resilient foot pad 88 is brought into engagement with the adjacent end of the casing 100 to provide an effective fluid seal therewith. Preferably, the fluid seal is such to allow slight leakage to eliminate the possibility of overpressurizing the magazine assembly thereby obviating the need for any auxiliary regulatory equipment. Moreover, fluid pressure is now free to enter the interior of the cartridge 22 through the aperture 90 in the foot pad 88 for forcing the resilient plunger member 110 forwardly and outwardly so as to move axially through the cartridge and into fluid sealing engagement with the confronting interior walls of the cartridge to effect an additional air seal for effectively forcing the fasteners progressively toward the ram guide 152. Prior to movement of the fasteners through the cartridge 22, the resilient finger 178 of the spring 176 is in the generally vertically oriented position as shown in FIG. 7. As the foot pad structure is fluidized the fasteners progressively move forwardly into the ram guide past the dowel pin 138 so that the fasteners consecutively move in a step-down relation into the ram guide which rotates the spring finger resiliently in a counter-clockwise direction upon engagement of the bight portion 124 of the fastener by the blade member 40 of the drive element 38, as best seen in FIG. 8. The resilient finger 178 acts to retain the fastener in the upper part of the ram guide 152 so that as the fastener is driven outwardly through the guide via blade 40, the finger forces the fastener against the interior wall 153 of the guide thereby to guide the fastener into proper engagement with the panel. By this arrangement, the fastener is maintained in an accurate linear position to prevent any damage to the assembly tool which may result, for instance, from a misaligned fastener striking

the panel edge. In the invention, the travel of the drive element 38 and blade 40 is effectively controlled so that the area adjacent the U-bend of the fastener will not contact the panel edge. Moreover, a space 190 (FIG. 9) is provided between the bight portion 124 of the fastener and the confronting edge of the work piece to prevent any damage to the surface thereof. The guide pin or dowel 138 effectively prevents fasteners entering the ram guide in a reversed position while the slot 164 provides an effective engagement with the work piece to steady the tool during normal operation thereof. When the magazine assembly 2 is empty, it may simply be disposed of and another cartridge reloaded into the magazine assembly for another series of operations.

I claim:

1. An apparatus for driving fasteners comprising:
  - a body having a reciprocally movable drive means for driving successive fasteners supplied from a magazine assembly,
  - a magazine assembly including a support structure mounted on said body adapted to receive an elongated, interchangeable cartridge means holding a plurality of fasteners in side-by-side relation adapted to be fed therefrom and into successive driving engagement with said drive means, and
  - a nose assembly mounted on said body having a guide structure means for receiving fasteners delivered from said cartridge means, said nose assembly including retainer means disposed interiorly thereof for successively controlling the movement of fasteners into said guide structure means from said cartridge means, said retainer means including a resiliently mounted element adapted to be yieldably pivoted in one direction upon engagement by a respective one of said fasteners upon its movement into said guide structure means and a stop means disposed interiorly adjacent the juncture of said cartridge means and said nose assembly in the path of movement of said fasteners to prevent the same from entering said guide structure means in an inverted position thereof,
  - said drive means including a drive member having an integral blade portion disposed for reciprocal movement

through said guide means structure for pushing engagement with the confronting surfaces of said fasteners for feeding said fasteners outwardly through said guide means structure and yieldably past said retainer means into secured engagement with a work piece.

2. A pressurized fluid operated apparatus for driving fasteners received from an interchangeable cartridge having an integral fluid operated fastener feeding plunger therein, said apparatus comprising:

- a body having a reciprocally movable drive means for driving successive fasteners received from said cartridge, said body having a chamber for connection to a source of pressurized fluid, said chamber selectively connected to said drive means for driving said fasteners, and

- a cartridge receiving assembly for mounting said cartridge to said body, said assembly including a closure member movable into and out of fluid sealing relation with said cartridge, said assembly having a fluid passageway for supplying fluid from said chamber to said cartridge for actuation of said plunger only when said closure member is in fluid sealing relation, with said cartridge.

3. The apparatus of claim 2 wherein said cartridge receiving assembly additionally comprises:

- means for biasing said closure member into fluid sealing relation with said cartridge; and
- valve means for closing said passageway when said closure member is moved out of said relation.

4. The apparatus of claim 3 wherein said closure member includes a resilient pad having a fluid transmitting aperture therethrough, said pad sealingly engaging one end of said cartridge when said closure member is in sealing relation with said cartridge.

5. An apparatus in accordance with claim 3 including:

- a nose assembly mounted on said body having a guide structure means for receiving fasteners delivered from said cartridge means and a retainer means disposed interiorly thereof for successively controlling the movement of fasteners into said guide structure means from said cartridge means.

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