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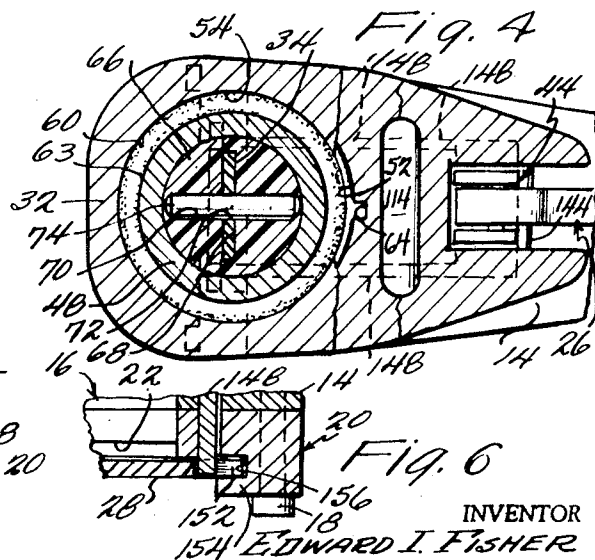
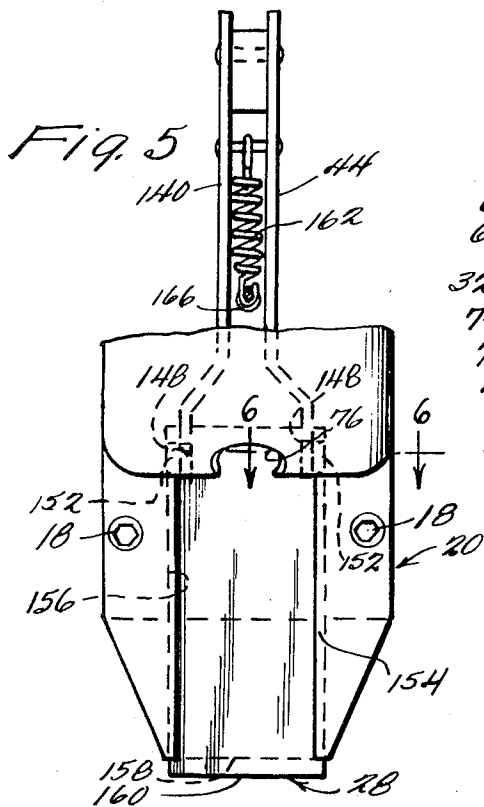
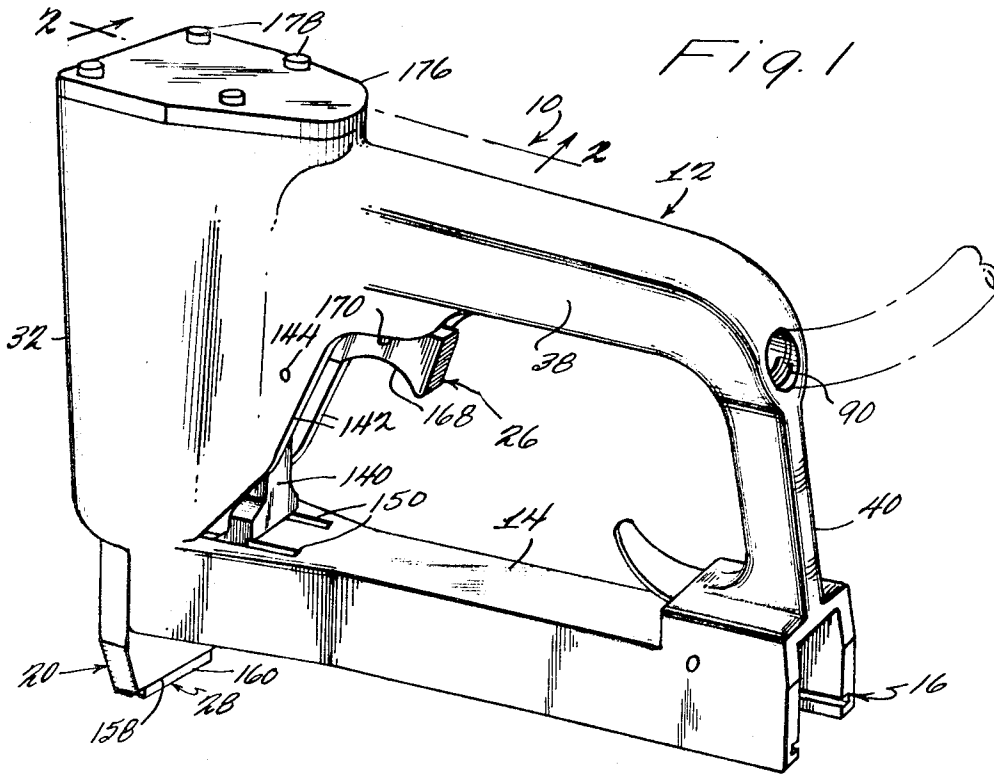
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PNEUMATIC FASTENER DRIVING APPARATUS

Filed June 28, 1966

3 Sheets-Sheet 1



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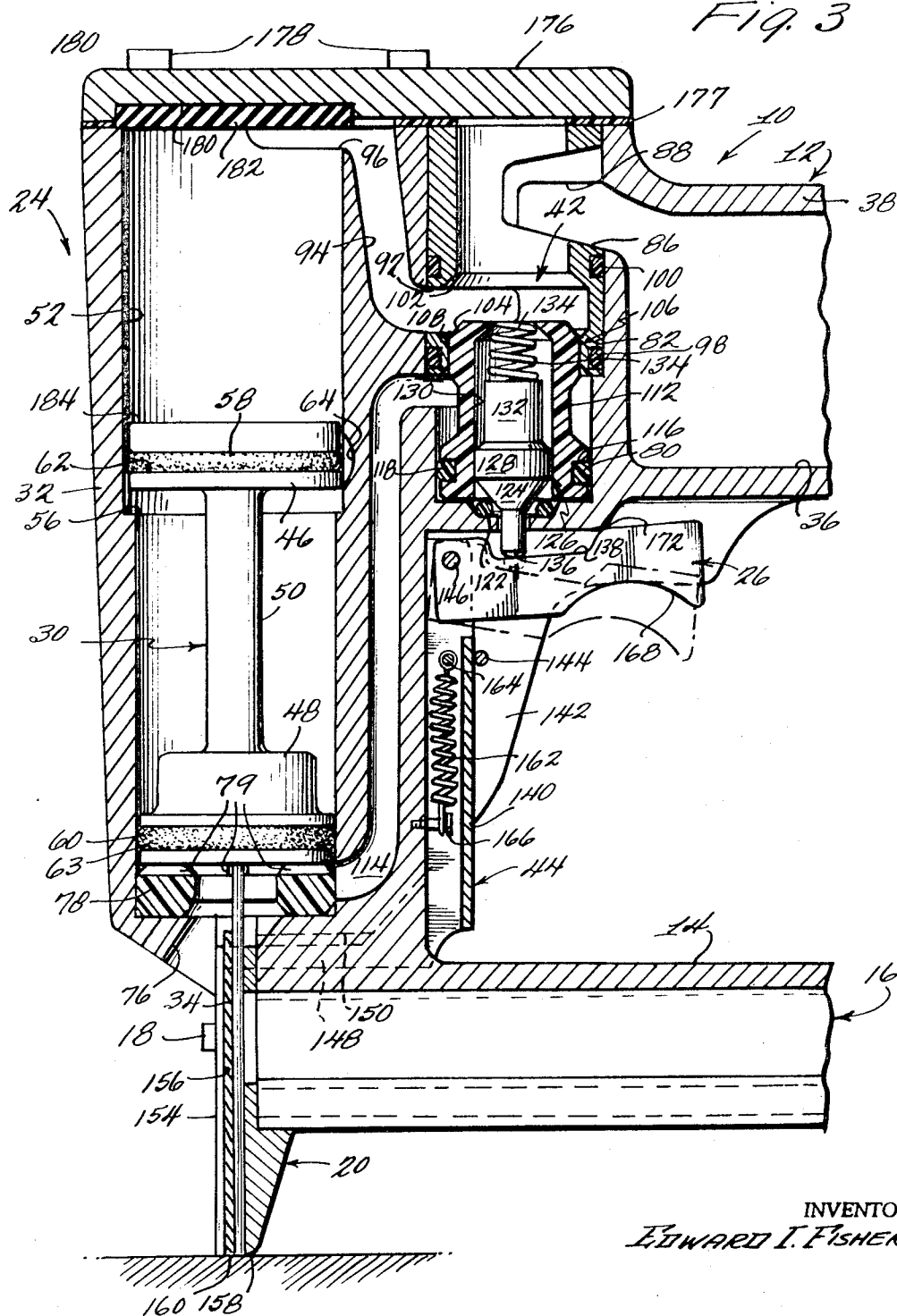
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PNEUMATIC FASTENER DRIVING APPARATUS

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3 Sheets-Sheet 3



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PNEUMATIC FASTENER DRIVING APPARATUS
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6 Claims

ABSTRACT OF THE DISCLOSURE

A pneumatically actuated fastener driving apparatus embodying a housing having a differential cylinder receiving a differential driving piston, the driving piston having a fastener driving element connected therewith for driving staples and the like fed to a drive track from a magazine assembly. The apparatus includes a trigger actuated control valve for communicating a source of air under pressure with the drive piston to move the latter through a drive stroke. The drive piston is provided with a relatively sharp upwardly extending rim which engages a resilient pad when the drive piston is in its uppermost position, the engagement of the rim with the pad serving to delay the initiation of the drive stroke until the air under pressure communicated with the drive piston increases to a value substantially equal to the pressure of the source. The differential cylinder is provided with an opening in the wall which serves to communicate the air under pressure which moves the piston through the drive stroke to the differential chamber when the piston reaches a position adjacent the end of its drive stroke so as to charge the differential chamber with air under pressure operable to effect the return stroke of the piston. During the return stroke, the air above the drive piston is discharged to atmosphere under the control of the trigger actuated valve through the bottom of the differential cylinder so as to prevent a suction action therein. A contact trip element is mounted on the apparatus adjacent the nosepiece for movement from an inoperative position into an operative position in response to the movement of the device against a workpiece. The trigger is pivotally carried by a structure movable with the contact trip element and is arranged so as to actuate the control valve only in response to simultaneous movement of the contact trip assembly into its operative position with a manual actuation of the trigger or when both movements are sequentially performed in either order. The housing is provided with abutments including ribs on opposite sides of the trigger to prevent manual movement of the trigger into a position to actuate the control valve when the contact trip is in its inoperative position.

This invention relates to fastener driving apparatus and more particularly to fastener driving apparatus of the type actuated by air under pressure.

An object of the present invention is the provision of a fastener driving apparatus of the type described which is characterized by simplicity of construction involving a minimum number of operative parts which can be economically fabricated and assembled, rendering the apparatus capable of economic construction while still maintaining efficient operation and low maintenance.

Another object of the present invention is the provision of a fastener driving apparatus of the type described having improved means for initially charging and maintaining the space between the piston heads of a differential piston assembly charged with air under pressure for the purpose of returning the piston assembly after each driving stroke and hence to supply adequate lubrication there-

to by means of a lubricant contained within the air charged therein.

Another object of the present invention is the provision of a fastener driving apparatus of the type described having improved means for preventing the suction of air and hence dirt and other foreign material into the interior working parts of the apparatus through the discharge opening of the cylinder during the return movement of the piston assembly therein.

Still another object of the present invention is the provision of a fastener driving apparatus of the type described having improved means for delaying the initial driving stroke of the piston assembly until such time as the air under pressure available to effect the driving stroke of the piston assembly has built up to a pressure substantially equal to the supply or reservoir pressure so as to insure a rapid and effective driving stroke.

Still another object of the present invention is the provision of a fastener driving apparatus of the type described having an improved valve mechanism therein for effecting the driving and return strokes of the piston assembly.

A still further object of the present invention is the provision of a fastener driving apparatus of the type described having improved interlock means for permitting drag firing and bump firing of the apparatus and single firing of the apparatus only when both the trigger member has been manually depressed and the apparatus has been moved into work engaging relation.

These and other objects of the present invention will become more apparent during the course of the following detailed description and appended claims.

The invention may best be understood with reference to the accompanying drawings wherein an illustrative embodiment is shown.

In the drawings:

FIGURE 1 is a perspective view of a fastener driving apparatus embodying the principles of the present invention;

FIGURE 2 is an enlarged fragmentary sectional view taken along the line 2—2 of FIGURE 1 showing the position of the parts in their normally biased inoperative position;

FIGURE 3 is a view similar to FIGURE 2 showing the parts in their operative fastener driven position;

FIGURE 4 is a fragmentary sectional view taken along the line 4—4 of FIGURE 2;

FIGURE 5 is a fragmentary front elevational view showing the work engaging member of the apparatus; and

FIGURE 6 is a fragmentary sectional view taken along the line 6—6 of FIGURE 5.

Referring now more particularly to FIGURE 1 of the drawings, there is shown therein a fastener driving apparatus, generally indicated at 10, embodying the principles of the present invention. The apparatus includes a housing, generally indicated at 12, including a base portion 14 shaped to receive a fastener magazine assembly, generally indicated at 16. The magazine assembly may be of any suitable construction and is conventional in operation. The details of construction thereof form no part of the present invention.

Fixedly mounted on the housing 12, as by bolts 18 or the like, is a nose piece 20 having a fastener drive track or passage 22 formed therein within which the leading fastener of a fastener stick mounted within the magazine assembly 16 is adapted to be engaged in conventional fashion.

As best shown in FIGURES 2 and 3, the apparatus 10 includes a pneumatically actuated driving system, generally indicated at 24, mounted within the housing 12 to drive the leading fastener contained within the maga-

zine assembly 16 outwardly of the guide track and into a work piece. The driving system 24 is of a type which may either be drag fired or bump fired and to this end includes a manually actuatable trigger member 26 and a work engaging member 28, both of which must be actuated to operate the driving system 24 to drive a fastener into the work piece.

The driving system 24 includes, in general, a piston assembly 30 mounted within an elongated portion 32 of the housing 12 disposed in longitudinal alignment with guide track 22. The piston assembly 30 is mounted within the housing portion 32 for longitudinal reciprocating movement including a driving stroke and a return stroke and has a driver blade member 34 connected for movement therewith which, during the driving stroke of the piston assembly 30, will engage the fastener within the guide track 22 and move the same into the work piece.

The piston assembly 30 is reciprocated by air under pressure from a suitable source (not shown) which is communicated with an inlet pressure reservoir or chamber 36 formed in a hollow handle portion 38 of the housing extending outwardly from the end of the housing portion 32 remote from the nose piece 20. Preferably, the outer end of the handle portion 38 is interconnected with the base portion 14 as by a connecting portion 40, so that with this construction the main housing of the apparatus is formed from a single casting.

Mounted within the housing between the inlet pressure chamber 36 and the piston assembly 30 is a control valve mechanism, generally indicated at 42, which serves to control the communication and discharge of air under pressure to the piston assembly to effect the reciprocatory movement thereof. The valve mechanism 42 is adapted to be actuated by the aforesaid cooperative action of the trigger member 26 and work engaging member 28 through an interlocking structure, generally indicated at 44.

As best shown in FIGURE 2, the piston assembly 30 is of the differential pressure type and includes first and second axially spaced piston heads 46 and 48 rigidly interconnected in spaced relation by a central stem portion 50. The first piston head 46 is of a diameter size greater than the diameter size of the second piston head 48 and is mounted for longitudinal reciprocatory movement within a first cylindrical chamber 52. The second piston head 48 is mounted for longitudinal reciprocatory movement within a second cylindrical chamber 54, the second chamber 54 being formed in the housing 12 as by a bore or the like, with the first chamber 52 constituting a counterbore therein defining an interconnecting annular shoulder 56 therebetween.

The piston heads 46 and 48 are sealed within their respective chambers 52 and 54 by any suitable means, such as annular sealing members 58 and 60 of conventional O-ring construction, mounted within annular grooves 62 and 63 formed in the outer periphery of the piston heads 46 and 48, respectively. It will be understood that in accordance with conventional practice, the annular sealing members 58 and 60 are slidably sealingly engaged with the interior peripheral surface of the chambers 52 and 54, respectively.

An important feature of the present invention resides in the structure for charging the space between the piston heads 46 and 48 with air under pressure during each driving stroke of the piston assembly to effect the return stroke of the piston assembly and to maintain a fresh supply of lubricating oil within this space. In accordance with the principles of the present invention, this function is achieved simply by cutting an arcuate groove 64 in the wall of the first cylindrical chamber 52 at a position adjacent the shoulder 56 so that when the annular sealing member 58 is moved into a position intermediate the ends of the groove 64 the pressure acting on the piston head 46 will be bypassed around the piston head and into the space between the piston heads.

The driver blade member 34 is connected with the sec-

ond piston head 48 for movement therewith by any suitable means. As shown, the second piston head 48 is of generally hollow construction opening in a direction facing toward the nose piece 20 and has an insert 66 of plastic material mounted therein which is provided with an axially extending slot 68 and a transversely extending aperture 70 intersecting the slot 68. The adjacent end of the driver blade member 34 is disposed within the slot 68 and has an aperture 72 formed therein for receiving a securing rod or pin 74 disposed in the transverse aperture 70 within the insert 66.

The portion of the housing 12 between the drive track 22 and the adjacent end of the second chamber 54 is formed with an enlarged opening 76 within which the opposite end portion of the drive blade is mounted and through which the adjacent end of the chamber 54 is communicated with the atmosphere. Disposed within the adjacent end of the chamber 54 is a bumper ring 78 of rubber or other suitable resilient material, the ring being of generally octagonal configuration in cross section, as shown. The bumper ring 78 serves to receive the piston head 48 during the driving stroke of the piston assembly and to cushion the end of this movement. In order to prevent the engagement of the piston head with the bumper from sealing the adjacent periphery of the chamber 54, a plurality of radially extending grooves 79 are formed in the upper surface of the bumper ring.

As best shown in FIGURES 2 and 3, the control valve mechanism 42 is mounted within a bore 80 formed in the housing 12 in parallel relation to the cylindrical chambers 52 and 54. A counterbore 82 is formed within the outer end of the bore 80 and receives therein a sleeve insert 84. The sleeve insert has a lateral inlet opening 86 formed in the outer end portion thereof which communicates with a passage 88 formed in the housing 12 in communication with the pressure reservoir or chamber 36. As shown, the handle portion of the housing 12, defining the opposite end of the chamber 36, is provided with a threaded inlet opening 90 to receive one end of a hose fitting (not shown) which serves to connect the apparatus 12 with a source of air under pressure (not shown).

The insert sleeve 84 is also formed with a lateral outlet opening 92 which faces in a direction opposite from the opening 86 and communicates with one end of an inlet passage 94 formed in the housing, the opposite end of which communicates with a lateral opening 96 communicating with the adjacent end of the first cylindrical chamber 52. As shown, the inner end of the insert 84 is sealed within the counterbore, as by an annular seal 98, disposed on one side of the passage 94 and an annular seal 100 serves to seal the insert 84 within the counterbore between the openings 86 and 92. Formed on the inner periphery of the insert 84 between the openings 86 and 92 is an inwardly facing frusto-conical valve seat 102 which is adapted to be engaged by an exterior frusto-conical surface 104 formed on one end of a spool valve member 106 mounted within the bore 80 and the inner end portion of the insert 84.

Formed on the exterior periphery of the spool valve member 106 adjacent the frusto-conical surface 104 is a cylindrical control portion 108 which is adapted to sealingly engage within a cooperating cylindrical surface 110 formed on the interior inner portion of the insert 84. The exterior periphery of the spool valve member is also formed with an annular groove 112, adjacent the control portion 108, having an axial extent sufficient to provide communication between the opening 92 and the bore 80 when the frusto-conical surface 104 is disposed in engagement with the spool valve member 106. The outer end of the bore 80, adjacent the inner end of the insert 84, has one end of a discharge passage 114 communicating therewith, the opposite end of which communicates with the chamber 54 at a position adjacent the end thereof within which the bumper ring 78 is mounted.

The communication of the discharge passage 114 with

the chamber 54 at the position indicated is an important feature of the present invention since, by this structural arrangement, air under pressure will be discharged into the second cylindrical chamber 54 adjacent the discharge opening 76 therein at a time when the second piston head is moving away from the opening, which movement, in the absence of the introduction of air under pressure from the discharge passage 114, would tend to create a suction of air through the opening 76 tending to draw dirt and other foreign matter into the working parts of the driving system.

The end portion of the spool valve member 106 opposite from the frusto-conical surface 104 is mounted within the bore 80 and has an annular groove 116 formed in the exterior periphery thereof within which an annular seal 118 is mounted. The seal 118 slidably sealingly engages the wall of the bore 80 and defines a pilot pressure chamber within the inner end of the bore 80. The pilot pressure chamber is communicated with the atmosphere by means of a central opening 120. Disposed in surrounding relation to the opening 120 adjacent the inner side thereof is an annular valve seat 122 which, as shown, is in the form of an O-ring of resilient material or the like.

The valve seat 122 is adapted to be engaged by a frusto-conical surface 124 formed on the exterior periphery of a trigger valve member 126. Valve member 126 is provided with a cylindrical control portion 128 on the exterior periphery thereof adjacent the frusto-conical surface 124 for movement within a cylindrical interior peripheral portion 130 of the spool valve member. The relative diameter sizes of the exterior control portion 128, the trigger valve member 126, and the interior cylindrical portion 130 of the spool valve 106 are such as to permit a slight air leakage thereby.

The trigger valve member 126 includes a sleeve-like guide portion 132 disposed within the cylindrical portion 130 of the spool valve member 106 having an exterior diameter size somewhat less than the cylindrical control surface 128. The interior of the sleeve portion 132 receives one end of a compression coil spring 134, the opposite end of which engages within the end of the spool valve member adjacent the inner end of the cylindrical portion 130. The spring 134 thus serves to resiliently bias the valve members 106 and 126 in a direction away from each other so that they are in engagement with the valve seats 102 and 122, respectively, as shown in FIGURE 2.

In order to actuate the valve mechanism 42 to initiate the driving stroke of the piston assembly 30, trigger valve member 126 is provided with a stem portion 136 which extends outwardly of the opening 120 and has its outer end shaped for engagement by an actuating surface 138 formed on the center portion of the trigger member 26.

The interlocking structure 44, which serves to mount the trigger member 26 on the housing 12 in a position to permit the trigger actuating surface 138 to engage the trigger valve stem portion 136, includes an elongated motion transmitting member 140 of generally U-shaped configuration in cross section. The member 140 is mounted for longitudinal reciprocating movement on the exterior of the housing portion 32 at a position adjacent the valve mechanism 42 and between a pair of transversely spaced rib portions 142, forming an integral part of the housing 12. As shown, a pin 144 is mounted between the rib portions 142 and serves to retain the motion transmitting member 140 in sliding engagement with the adjacent surface of the housing portion 32. The end of the member 140 adjacent the trigger 26 has its bight or web portion cut out to receive the adjacent end of the trigger member between the leg portions thereof. The trigger member is pivotally connected to the motion transmitting member 140, as by a pivot pin 146.

The opposite end of the motion transmitting member 140 has a pair of parallel leg portions 148 extending transversely outwardly therefrom in generally perpendic-

ular relation within a pair of side grooves or recesses 150 formed in the adjacent portion of the housing. The free ends of the leg portions 148 are adapted to engage within a pair of side opening notches 152 formed within one end of the work engaging member 28.

As best shown in FIGURES 2, 3 and 5, the drive track 22 is defined by one surface of the work engaging member 28 and by a longitudinally extending recess formed in one surface of the nose piece 20. The work engaging member is mounted for longitudinal reciprocatory movement on the nose piece 20, by any suitable means, and, as shown, the nose piece is provided with a pair of transversely spaced guide portions 154 having opposed longitudinally extending grooves 156 formed therein which slidably receive the opposite edge portions of the member 28.

The work engaging member 28 is thus mounted for longitudinal reciprocatory movement with the motion transmitting member 140 and includes an outer end portion 160 which is adapted to extend outwardly of a work engaging portion 158 of the nose piece 20 when the member 28 is disposed in its normally biased position, as shown in FIGURE 2. This position is determined by engagement of the adjacent end of the member 140 with the base portion 14 of the housing. The contact trip member 28 is normally maintained in such position by suitable spring means such as a tension spring 162 connected between a pin in 164, extending across the leg portions of the member 140 adjacent pin 144 and a pin 166 fixed to the adjacent base portion 14 of the housing 12.

The end portion of the trigger member 26 opposite from the pivot pin 146 is formed with a concavely arcuate finger-engaging surface 168 which faces in a direction opposite from the stem-engaging surface 138. When the trigger member 26 is disposed in its inoperative position, as shown in FIGURE 2, the finger-engaging surface 168 is disposed in spaced relation to generally co-extensive finger-engaging surfaces 170 formed on the rib portions 142 of the housing 12. The trigger member 26 also includes an abutment surface 172 facing in a direction toward the adjacent housing portion 38 and disposed in spaced relation thereto when the trigger member is in its inoperative position a distance generally equal to the spacing between the finger-engaging surfaces 168 and 170. The trigger abutment surface 172 is adapted to engage an abutment surface 174 on the adjacent portion of the housing when the trigger member 26 is manually depressed.

It will be noted that the outer ends of the first cylindrical chamber 52 and the outer end of the sleeve insert 84 are open at the adjacent portion of the housing. A cover member 176 is provided for the purpose of closing this open portion of the housing. As shown, a gasket 177 is mounted between the cover member and adjacent portion of the housing and a series of bolts 178 extend through the cover member and are threadedly engaged with the housing to retain the cover member fixedly thereon.

As best shown in FIGURES 2 and 3, the interior portion of the cover member adjacent the cylindrical chamber 52 is recessed, as indicated at 180, to fixedly receive therein a pad 182 of resilient material. Preferably, the pad is formed of a synthetic rubber having a durometer of from 50 to 60, 55 durometer being preferred. The pad 182 forms a part of a fluid pressure actuated timing means which constitutes an important feature of the present invention, serving to delay the driving stroke of the piston assembly for a time sufficient to permit the build-up of pressure substantially to the pressure of the source so as to effect a rapid initial driving stroke of the piston assembly.

The upper end of the piston head 46 is shaped to cooperate with the pad 182 and forms a cooperating part of the timing means. To this end, the outer periphery of the piston head 46 is formed with a relatively sharp outer

annular edge 184 as, for example, an edge having a radius of the order of 0.005 inch. The annular edge 184 is dimensioned as closed as possible to the dimension of the piston head 46 so as to define a maximum area when in engagement with the pad 182. The outer end surface of the piston head 46 includes an outer annular frusto-conical rim surface 186 which merges at its outer periphery with the edge 184 and at its inner periphery with an annular recess 188 formed in the central portion of the piston head. It will be noted that the recess 188 and rim surface 186 define with the pad 182 and annular edge 184, when the latter are in engagement, a timing chamber into which air under pressure within the lateral opening 96 leaks between the annular edge 184 and the pad 182 to initiate the driving stroke of the piston assembly.

OPERATION

As noted above, the apparatus 10 of the present invention is capable of drag firing and bump firing by virtue of the interlock structure 44. This structure permits single firing of the apparatus only after the work engaging member 28 has been moved from its normally biased position, as shown in FIGURE 2, into its operative or second position, as shown in FIGURE 3, and the trigger member 26 is manually depressed from its normally biased position, as shown in FIGURE 2, to its operative position, as shown in FIGURE 3.

With reference to FIGURE 2, it will be noted that tension spring 162 serves to retain the outer end portion 160 of the work engaging member 28 beyond the adjacent end portion 158 of the nose piece 20. The weight of the trigger member 26 maintains it in a normally biased position, as shown in FIGURE 2. If the operator depresses the trigger member 26 without engaging the member 28 with the work piece, trigger member 26 will merely move into the dotted line position shown in FIGURE 2 wherein abutment surfaces 172 and 174 engage one another without the surface 138 engaging the valve stem portion 136. It will be noted that in the dotted line position, the trigger member is disposed substantially entirely within the rib portions 142 so that further efforts by the operator to depress the trigger member will simply result in digital pressure being applied to the finger engaging surfaces 170.

With reference to FIGURE 3, it will be noted that the engagement of the member 28 with the work piece to effect movement thereof into its operative position, as shown in FIGURE 3, without a manual depression of the trigger member 26 will result in the trigger member assuming the position shown in dotted lines wherein valve stem portion 136 is not engaged. Thus, it is not until both members 26 and 28 are moved into their operative positions, as shown in full lines in FIGURE 3, that the driving system 24 is actuated. The trigger member is thus movable into four positions, namely: a first normally biased position, as shown in full lines in FIGURE 2, wherein the work engaging member 28 is disposed in its inoperative position; a second position wherein the work engaging member 28 has been moved into its operative position but the trigger member has not been manually moved, as shown in dotted lines in FIGURE 3; a third position wherein the trigger member has been manually moved but the work engaging member has not been moved into its operative position, as shown in dotted lines in FIGURE 2; and finally, a fourth operative position wherein the work engaging member has been moved into its operative position and the trigger member manually moved into its operative position, as shown in full lines in FIGURE 3.

It will be noted that movement of the trigger member into any position other than its operative position will not result in the engagement of the actuating surface 138 thereof with the stem portion 136 of the trigger valve member 126, so that the latter will remain in its closed position. It is only when the trigger member 26 is moved into its operative position that the actuating surface 138

will engage and move the stem portion 136 of the trigger valve member into its opened position to initiate the operation of the driving system 24.

The arrangement of the interlock structure 44 is such that the trigger member 26 can be moved into its operative position in three distinct ways. First, by simultaneous movement of the work engaging member 28 into its operative position with a manual movement of the trigger member 26; second, by movement of the work engaging member 28 into its operative position while the trigger member 26 is maintained in its third position; or third, by manually engaged movement of the trigger member 26 while the work engaging member 28 is maintained in its operative position. The capability of effecting movement of the trigger member 26 into its operative position by the last two procedures makes possible bump firing and drag firing, respectively.

Bump firing would be accomplished by continuously manually depressing the trigger member 26 and bumping or lifting the entire apparatus successively into engagement with the work piece so as to cycle the work engaging member 28 by each engagement of the work piece. Drag firing would be accomplished by the operator maintaining a pressure on the handle portion 38 to keep the work engaging member 28 in contact with the work piece and then successively depressing the trigger member 26 while the apparatus is moved along the surface of the work piece.

The valve mechanism 42 is operable to effect a movement of the piston assembly 30 from the fastener receiving position, shown in FIGURE 2, to the fastener driven position, shown in FIGURE 3, in response to the movement of the trigger member 26 into its operative position, as shown in full lines in FIGURE 3 in the following manner. It will be noted that when the valve mechanism 42 is in its inoperative position, as shown in FIGURE 2, the valve members 106 and 126 are disposed in their outer limiting positions wherein the frusto-conical surface 104 of the spool valve member 106 is in engagement with valve seat 102, and the frusto-conical surface 124 of the valve member 126 is in engagement with the valve seat 122. Consequently, air under pressure within the reservoir 36 is prevented from entering the inlet passage 94, but is admitted to the pilot pressure chamber defined by the bore 80 through the interior surface 130 of the spool valve member 106. The pressure within the pilot chamber serves to maintain the spool valve member 106 in its closed position since the surface area thereof communicating with the pilot pressure chamber is greater than the surface area communicating with the reservoir chamber 36. In addition, spring 134 aids in maintaining the spool valve member 106 in its closed position, as well as the trigger valve member 126 in its closed position.

When the trigger member 26 is moved into its operative position, actuating surface 138 will engage the stem portion 136 of the valve member 126 moving the latter inwardly of the spool valve member 106. During this movement, the frusto-conical surface 124 is moved away from the valve seat 122 thus discharging the pilot pressure chamber to atmosphere through the opening 120. As soon as the pilot pressure is relieved to the atmosphere, the pressure within the reservoir chamber 36 acting on the adjacent end of the spool valve member will effect movement of the latter away from the valve seat 102. During this movement, the cylindrical control portion 128 of the trigger valve member 126 engages within the cylindrical interior peripheral portion 130 of the spool valve member 106 preventing substantial passage of air under pressure through the spool valve member. In addition, the control portion 108 of the spool valve member moves into closing relation within the cylindrical surface 110 preventing communication of the air under pressure with the discharge passage 114. Consequently, as the spool valve member 106 moves away from its seat 102, the pressure within the

reservoir 36 will pass into the inlet chamber 94 and the lateral opening 96.

The pressure communicated with the lateral opening 96, however, does not immediately act upon the piston assembly 30 by virtue of the engagement of the annular edge 184 with the pad 182, since there is substantially no surface area upon which the pressure can act to effect movement of the piston assembly. However, as the pressure within the opening 96 builds up, leakage will occur between the annular edge 184 and the pad 182 until sufficient pressure is built up within the timing chamber defined by the recess 188 and rim surface 186 to overcome the differential component resulting from the pressure within the cylinder 52 between the differential piston heads 46 and 48.

Due to the delayed action of the edge to pad engagement, the pressure within the lateral opening 86 has time to build up substantially to the reservoir pressure before any movement of the piston assembly 30 occurs. Thus, since substantially full reservoir pressure is available to the full surface area of the piston head 46 after the initial movement occurs, this initial movement will be very rapid, thus resulting in a rapid movement of the piston assembly 30 from the fastener receiving position, shown in FIGURE 2 to the fastener driven position, shown in FIGURE 3.

During this movement, the driver blade member 34 is moved through the fastener drive passage 22 to engage a fastener disposed therein and move the same outwardly into the work piece with a rapid and forceful action.

During the movement of the piston assembly 30 from its fastener receiving position to its fastener driven position, the air within the second cylinder 54 will be discharged to the atmosphere through opening 76. When the piston assembly reaches a position adjacent the fastener driven position, the annular seal 58 will contact the arcuate groove 64 permitting the air under pressure acting on the first piston head 46 to bypass the piston head and enter the space between the piston heads 46 and 48, thus charging the same with air under pressure.

When the trigger member is moved out of its operative position, the trigger valve member 126, through the action of spring 134 will move into closing engagement with the valve seat 122 thus sealing the pilot pressure chamber from the atmosphere. Air under pressure from the reservoir then leaks by the cylindrical control surface 128 to charge the pilot pressure chamber with air under pressure until it reaches a value sufficient to effect movement of the spool valve member 106 toward its seat 102 in conjunction with the action of spring 134. During this movement, control portion 108 of the spool valve member 106 moves out of closing relation with the cylindrical opening 110 thus communicating the inlet passage 94 with the discharge passage 114 past the annular groove 112. Immediately following the communication of the inlet passage 94 with the discharge passage 114, the frusto-conical surface 104 of the spool valve will engage the valve seat 102 closing off air under pressure in the reservoir 136. As the pressure within the chamber 52 is rapidly decreased, the air under pressure within the space between the piston heads acts to effect a movement of the piston assembly from its fastener driven position to its fastener receiving position.

During this movement the air within the first cylindrical chamber 52 is discharged through the inlet opening 94, past the annular groove 112, through the discharge passage 114, and into the second cylindrical chamber 54 adjacent the opening 76. By discharging, in this fashion, the air under pressure, which is communicated with the piston assembly 30 to effect the driving movement thereof, there is sufficient air under pressure introduced into the second cylindrical chamber 54 to prevent the creation of a negative pressure therein during the movement of the piston assembly 30 into its fastener receiving position. The prevention of a negative pressure within the chamber 54 is important since it prevents suction of dirt and other for-

eign material through the opening 76 and into the interior working parts of the driving system 24. Thus, with the present arrangement there will be no dirt or other material drawn into the mechanism and maintenance problems are reduced to a minimum.

It thus will be seen that the objects of this invention have been fully and effectively accomplished. It will be realized, however, that the foregoing specific embodiment has been shown and described only for the purpose of illustrating the principles of this invention and is subject to extensive change without departure from such principles. Therefore, this invention includes all modifications encompassed within the spirit and scope of the following claims.

What is claimed is:

1. Pneumatically actuated fastener driving apparatus comprising

a housing defining cylindrical chamber means, piston means mounted within said chamber means for axial reciprocating movement,

valve means for controlling the communication of a source of air under pressure with one end of said chamber means to effect movement of said piston means from a fastener receiving position to a fastener driven position and for isolating said one end of said chamber means from the source of air under pressure and permitting the air under pressure communicated therewith to discharge to the atmosphere during movement of said piston means from said fastener driven position to said fastener receiving position,

fastener driving means connected with said piston means for movement therewith to drive a fastener in response to the movement of said piston means from said fastener receiving position to said fastener driven position, and

means for delaying the movement of said piston means out of said fastener receiving position for a period sufficient to permit the air under pressure adjacent said one end of said chamber means to build up substantially to the pressure of the source so that the built up pressure will effect a rapid initial movement of said piston means out of said fastener receiving position, said delaying means comprising

a pad of rubber-like material fixedly carried by said housing adjacent said one end of said chamber means,

a fixed annular portion on said piston means facing in a direction toward said pad having a relatively sharp annular pad engaging edge of a diameter substantially equal to the diameter of said piston means, said fixed portion defining with said pad when said annular edges is in engagement therewith a chamber into which the air under pressure adjacent said one end of said chamber means leaks between said annular edge and said pad to initiate the movement of said piston means out of said fastener receiving position.

2. Apparatus for driving a fastener into a work piece when in work engaging relation thereto comprising

a housing having means defining a fastener drive passage,

fastener driving means carried by said housing for movement between a fastener receiving position and a fastener driven position and operable during movement from said fastener receiving position into said fastener driven position to move through said fastener drive passage to engage a fastener therein and move the same outwardly into a work piece,

a work engaging structural assembly carried by said housing for movement from a normally biased first position into a second position in response to the movement of said apparatus into work engaging relation,

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a trigger member pivotally carried by said work engaging assembly for movement from a normally biased first position into a second position in response to the movement of said work engaging assembly from its first position into its second position, said trigger member having a finger engaging surface digitally engageable to move said trigger member from the first and second positions thereof into third and fourth positions, respectively,

abutment means fixed with respect to said housing and disposed in a position to prevent digitally engaged movement of said trigger member into said fourth position when said work engaging assembly is disposed in its first position, and

means carried by said housing operable to effect movement of said fastener driving means from said fastener receiving position into said fastener driven position in response to the movement of said trigger member into said fourth position only, either (1) by simultaneous movement of said work engaging assembly into its second position with digitally engaged movement of said trigger member into its fourth position, (2) by movement of said work engaging assembly into its second position while said trigger member is digitally maintained in its third position, or (3) by digitally engaged movement of said trigger member into its fourth position while said work engaging assembly is maintained in its second position.

3. Apparatus as defined in claim 2 wherein said work engaging assembly comprises

a plate-like work engaging member mounted for reciprocating movement in a position to define one surface of said fastener drive passage,

a motion transmitting member mounted on said housing for reciprocating movement, said motion transmitting member including

an elongated portion pivotally receiving at one end thereof said trigger member and

a pair of leg portions extending laterally outwardly from the opposite end thereof, the free ends of said leg portions being connected with said work engaging member, and

spring means for resiliently urging said motion transmitting member and said work engaging member into positions corresponding to the normally biased first position of said work engaging assembly.

4. Apparatus as defined in claim 3 wherein said trigger member is pivotally mounted at one of its ends to the one end of the elongated portion of said motion transmitting member.

5. Apparatus as defined in claim 2 wherein said trigger member is pivotally mounted at one of its ends to said work engaging assembly, and said abutment means includes

a surface on said housing for engaging the opposite end portion of said trigger member when said trigger member is moved into said third position and

a pair of fixed rib portions on said housing on opposite sides of said trigger shaped to prevent digital movement of the one end of said trigger member into said fourth position when the latter is disposed in said third position.

6. Pneumatically actuated fastener driving apparatus comprising

a housing having means defining first and second axially aligned cylindrical chambers,

said first chamber being of a size greater than said second chamber and communicating, at one end thereof with one end of said second chamber,

a piston assembly having axially spaced first and second piston heads mounted within said first and second cylindrical chambers, respectively, for axial reciprocating movement,

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first and second annular seal means carried by said first and second piston heads and slidably, sealingly engaging said first and second cylindrical chambers, respectively,

valve means for controlling the communication of a source of air under pressure with the opposite end of said first chamber to effect movement of said piston assembly from a fastener receiving position wherein said first piston head is disposed adjacent the opposite end of said first chamber to a fastener driven position wherein said first piston head is disposed adjacent said one end of said first chamber and for isolating the opposite end of said first chamber from the source of air under pressure and permitting the air under pressure communicated therewith to discharge to the atmosphere during movement of said piston assembly from said fastener driven position to said fastener receiving position,

fastener driving means connected with said piston assembly for movement therewith to drive a fastener in response to the movement of said piston assembly from said fastener receiving position to said fastener driven position,

said housing having groove means formed in said first chamber adjacent said one end thereof in a position such that said first annular seal means is disposed intermediate the ends thereof when said piston assembly is in said fastener driven position to thereby communicate the air under pressure acting to move said piston assembly toward said fastener driven position with the space between said annular seal means and charge the latter with air under pressure so that upon communication of the opposite end of said first chamber with the atmosphere the air under pressure charged into said space will effect movement of said piston assembly from said fastener driven position to said fastener receiving position,

means for delaying the movement of said piston assembly out of said fastener receiving position for a period sufficient to permit the air pressure adjacent the opposite end of said first chamber to build up substantially to the pressure of the source so that the built up pressure will effect a rapid initial movement of said piston assembly out of said fastener receiving position,

said delaying means comprising a pad of rubber-like material fixedly carried by said housing adjacent the opposite end of said first chamber,

a fixed portion on said piston head facing in a direction toward said pad having a relatively sharp annular pad engaging edge of a diameter substantially equal to the diameter of said first piston head,

said fixed portion defining with said pad when said annular edge is in engagement therewith a chamber into which the air under pressure adjacent the one end of said chamber means leaks between said annular edge and said pad to initiate the movement of said piston assembly out of said fastener receiving position.

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