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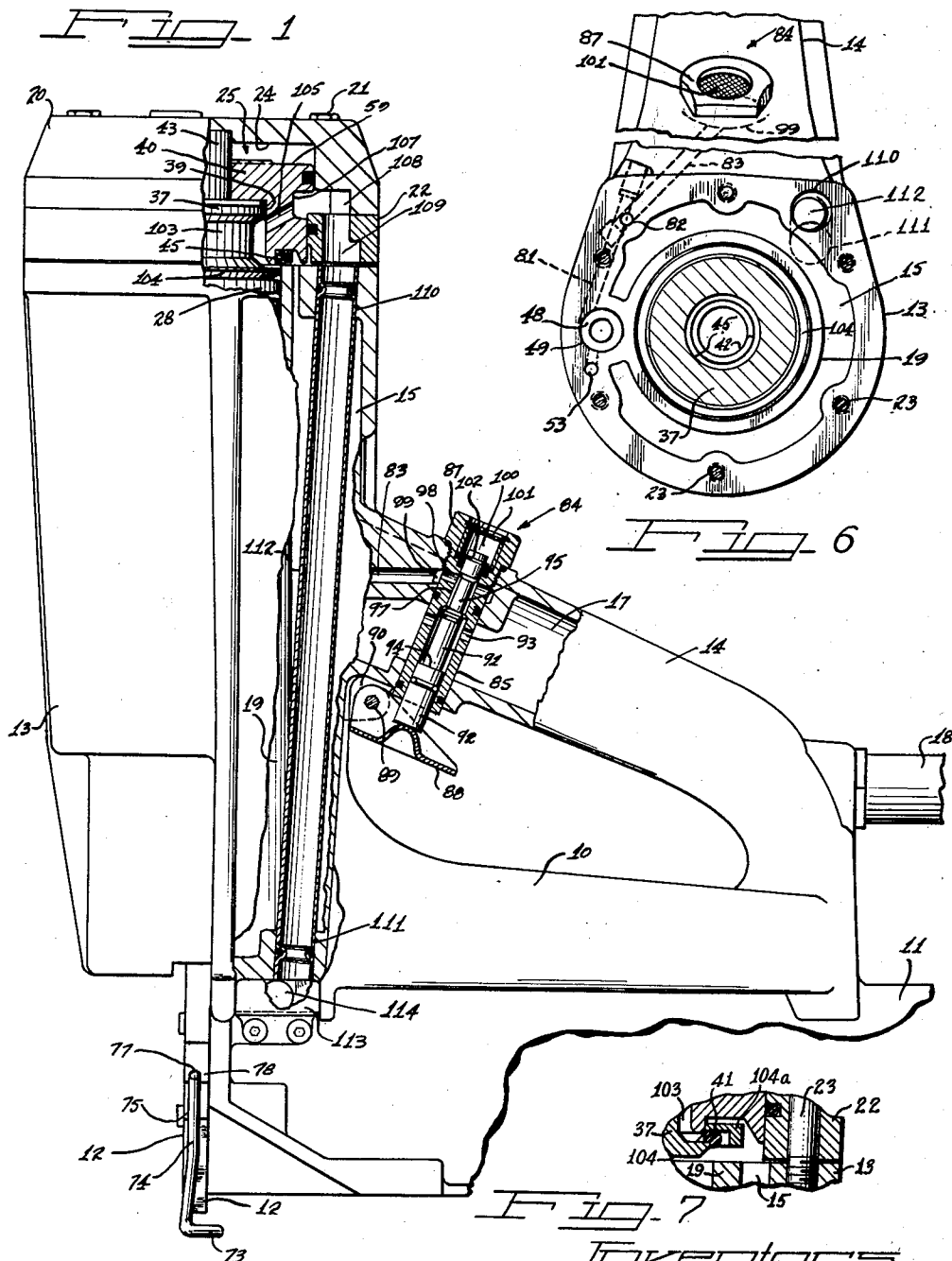
W. R. BECKMAN ETAL

3,112,489

PNEUMATICALLY OPERATED DRIVING MACHINE FOR FASTENERS

Filed Sept. 2, 1960

2 Sheets-Sheet 1



WITNESSES
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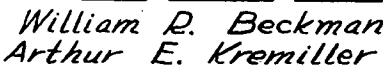
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2 Sheets-Sheet 2



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PNEUMATICALLY OPERATED DRIVING MACHINE FOR FASTENERS

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8 Claims. (Cl. 1-105)

This invention relates to improvements in machines for driving fasteners such as staples, pins, nails and the like and more particularly concerns such machines which are pneumatically operated by means of compressed air or the like.

Among the problems to which the present invention is addressed is that of preventing accidental firing of a pneumatically operated fastener driving machine so as to avoid possible injury to the operator of the machine or a bystander. In pneumatic machines of this kind wherein virtually explosive acceleration of the driver is effected, the fastener is ejected from the machine by the driver at a high rate of acceleration. Hence, should the machine, sometimes referred to as an air gun, be free fired, that is, with the driving nose not contiguous to a work piece into which a fastener is to be driven, the fastener as propelled from the machine becomes a virtual missile.

It is therefore an important object of the present invention to provide new and improved safety means for pneumatic fastener driving machines which will preclude free firing of the machine while the safety device is operational.

Another object of the invention is to provide a safety device for pneumatic fastener driving machines which efficiently controls pneumatic operation of the machine.

Still another object of the invention is to provide a safety device for pneumatic fastener driving machines capable of serving as a trigger for the machine.

Yet another object of the invention is to provide a pneumatic fastener driving machine including coordinated manual and work pressure responsive operating triggers.

Also among the problems to which the present invention is directed is that of providing improved means for utilizing exhaust pneumatic fluid not only for assisting in return of the driving piston of the pneumatic motor of the machine after a driving stroke but also to exclude entry of foreign matter into the under or driver side of the driving piston in that portion of the cylinder of the pneumatic motor which is desirably open to atmosphere for free passage of the driver to the driving nose structure of the machine.

It is therefore a further object of the invention to provide new and improved means for conducting spent pneumatic fluid from the head end portion of the driver piston cylinder during a return stroke of the piston to the underside of the piston in the base portion of the cylinder.

A still further object of the invention is to simplify and improve the construction of pneumatic fastener driving machines generally.

Other objects, features and advantages of the present invention will be readily apparent from the following detailed description of a preferred embodiment thereof taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a fragmentary side elevational view of a pneumatic fastener driving machine embodying features of the invention, with parts broken away and in section to reveal details of structure;

FIGURE 2 is a fragmentary opposite side elevational view of the machine;

FIGURE 3 is a vertical sectional detail view taken substantially on the line III-III of FIGURE 2;

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FIGURE 4 is a fragmental sectional elevational detail view taken substantially on the line IV-IV of FIGURE 3;

FIGURE 5 is a fragmentary sectional detail view taken substantially on the line V-V of FIGURE 2;

FIGURE 6 is a fragmental sectional elevational detail view taken substantially on the line VI-VI of FIGURE 3; and

FIGURE 7 is an enlarged fragmentary sectional detail view taken in the same plane as FIG. 3 but showing the control valve raised from the cylinder closing relation during driving stroke operation of the machine.

In the illustrative embodiment, a manual pneumatically actuated fastener driving machine of the type adapted to drive staple, nail or pin types of fasteners includes a housing 10 which may be constructed as a casting made of aluminum or other lightweight material. On the lower portion of the housing is a horizontal magazine section 11 within which the fasteners in adhered "stick" form are adapted to be supported and pushed by any suitable advancing or feeding mechanism (not shown) toward a forward end driving nose structure 12 secured thereto under an upwardly projecting driving head 13. On the upper portion of the housing body 10 rearwardly of and attached to the driving head 13 is a manipulating handle 14.

Within the driving head section 13 of the casing or housing of the machine is a substantial volume fluid reservoir space 15 with which an auxiliary reservoir space 17 within the handle 14 communicates. Pneumatic pressure fluid such as compressed air is adapted to be delivered into the handle reservoir space 17 from a suitable source (not shown) through a conduit 18 attached to a delivery inlet at the rear end of the handle 14. Compressed air under pressures up to 100 p.s.i. may be employed.

Within the reservoir 15 is a pneumatic motor including an upright cylinder 19 having its upper end in this instance substantially flush with the upper end of the head portion 13 of the housing from which the reservoir space 15 opens upwardly as best seen in FIGS. 3 and 6. Closing the upper end of the head 13 is an inverted generally cup-shaped closure cap 20 secured as by means of screws 21 onto a spacer ring 22 which, in turn, is secured as by means of screws 23 onto the upper end of the head 13.

Defined within the cap 20 and the spacer ring 22 is a cylinder chamber 24 providing generally an upward extension of the reservoir space 15 of the driving head above and of larger diameter than the cylinder 19. Within this cylinder chamber 24 is a vertically reciprocally movable control valve piston assembly 25 for controlling operation of a driving piston 27 reciprocally within the cylinder 19. In this instance the piston 27 is of generally spool shape with a small diameter body or shank carrying on its upper end a piston head 28 and on its lower end a second piston head 29. Below the lower piston head 29 a concentric connector boss 30 connects to the piston a fastener driving blade member 31, the lower driving end of which extends down into the driving nose structure 12 for driving fasteners supplied from the magazine section 11 into a fastener driveway 32 in the nose structure within which the driving blade 31 is reciprocable as actuated by the piston 27. A lower blind end of the cylinder 19 has a rubber bumper 33 mounted therein to cushion and stop the piston 27 upon engagement of the lower head 29 with the bumper, and a clearance opening 34 in such blind end accommodates the driver member 31 therethrough.

Normally the piston 27 is maintained in the raised position ready for firing and the driver member 31 correspondingly poised in position for driving a fastener, by pneumatic pressure entering through one or more unobstructed openings 35 through the wall of the cylinder

19 and affording communication between the reservoir 15 and the chamber within the cylinder 19 defined between the piston heads 23 and 29. By having the diameter of the cylinder below the ports or openings 35 of smaller diameter than the portion of the cylinder above such openings and the cylinder heads 28 and 29 of corresponding differential diameter, pressure fluid acting on the underside of the larger diameter upper piston head 23 acts differentially with respect to the pressure fluid acting on the upper side of the lower smaller diameter piston head 29 and thus acts normally to return and maintain the piston 27 in its retracted, upper ready position when the reservoir 15 is charged with pneumatic pressure fluid.

A stop for upward limit of movement of the piston 27 is provided by the control valve piston assembly 25 which includes a stop portion 37 which normally projects into the upper extremity of the cylinder 19 and herein comprises a circular plug insert secured as by means of screws 38 into a downwardly opening complementary centered recess 39 within a valve piston member 40 of a diameter to be reciprocally vertically guided within the cylinder chamber 24 of the cap 20. A resilient sealing ring gasket 41 carried within the lower face of the control valve piston 40 engages sealingly with the upper end seat surface provided on the cylinder 19 about the opening thereto and thus in the non-operating condition of the machine seals the mouth of the cylinder from the reservoir 15 (FIGS. 1 and 3).

A biasing force downwardly on the piston valve assembly 25 to drive it into closing relation to the top of the cylinder 19 is imposed primarily by the pressure of pneumatic fluid and supplementally by means of a central biasing spring 42 seated at its upper end within a downwardly opening spring retainer thimble 43 depending from the inner side of the crown portion of the closure cap 20 into a vertical central clearance bore 44 in the valve piston member 40 and into an upwardly opening blind end bore spring socket recess 45 in the stop insert member 37 against which the lower end of the spring thrusts downwardly. In its compressed condition the spring 42 may exert as much as thirty pounds thrust pressure.

Pneumatic pressure derived from the reservoir 15 acts upon the top of the valve piston member 40 within the valve piston cylinder chamber 24. Delivery of pressure fluid from the reservoir 15 is normally by way of an upwardly opening bore 47 of a bushing member 48 fitted into a vertical upwardly opening bore 49 in the casing of the head portion 13 alongside the cylinder 19 (FIGS. 2, 3 and 6) and with the bore 47 exposed to the reservoir 15 under the margin of the piston valve member 40 radially outwardly adjacent to the sealing ring 41 and partially underlying the spacer ring 22 which is formed with a clearance cut out 50 for greater freedom of access of the pressure fluid from the reservoir into the bore 47. From the bore 47 the pressure fluid passes by way of a circumferential series of lateral ports 51 into a peripheral groove 52 in the bushing 48. Thence the pressure fluid passes by way of a diagonally upward passage duct 53 (FIGS. 2 and 6) leading from the bore 49 and opening through the upper face of the head portion 13 into communication with an upwardly extending passage bore 54 in the spacer ring 22 (FIGS. 2, 4 and 5) in registered communication with the lower end of an upwardly extending duct passage bore 55 in the relatively thick side wall of the cap member 20 leading into a horizontal passage bore 57 (FIGS. 2 and 5) in the crown portion of the cap member and communicating with a downwardly opening pressure fluid port 58 discharging into the top of the piston valve chamber 24 over the piston valve member 40. As best seen in FIG. 5, the port 58 is located above a marginal recess 59 of substantial width on the crown of the valve piston member 40 so as to remain unobstructed when the valve piston member 40 is in its uppermost position with the relatively small upwardly

offset area of the crown thereof inside the recess 59 engaging as a stop against the roof defining the chamber 24.

Since the area on top of the valve piston assembly 25 exposed to pneumatic pressure fluid is greater than the marginal area of the underside of the valve piston exposed to the force of the pressure fluid at the top of the reservoir 15, firm downward seating and driving piston cylinder sealing thrust is imposed by the pneumatic pressure fluid upon the piston valve. Furthermore, opening of the upper end of the cylinder 19 to expose the top of the piston head 23 to the thrust of pneumatic pressure fluid from the cylinder 15 is adapted to be readily effected by bleeding off pressure fluid from the chamber space above the valve piston 25 so that the fluid pressure from within the reservoir 15 acting upon the underside margin of the piston valve will, in effect, blow the piston valve upwardly to unseat it from the top of the cylinder 19.

According to the present invention, operating control of the machine is adapted to be effected by either a digital trigger mechanism or a work actuated trigger mechanism or a sequential combination of digital and work actuated triggers functioning in a coordinated relation to control delivery of pneumatic fluid to the pneumatic motor through a suitable passageway system. Through this arrangement, the work actuated trigger mechanism serves as a safety device when functioning in coordination with the digital trigger. To this end, a generally spool type plunger disabling valve 60 is reciprocally mounted in the bore 47 of the bushing 48 (FIGS. 3 and 4). This valve is of the usual type having control heads slidably engaging within the bore 47 and an intermediate reduced diameter portion adapted for fluid flow thereby.

Normally the upper control head end of the valve member 60 is disposed to lie below the fluid flow port 51 located in the upper portion of the bushing so that pneumatic pressure fluid can flow freely from the reservoir 15 through the previously described system of passages into the control piston valve chamber 24, as shown in FIG. 3. Positive biasing means maintain this normal position and herein comprise a coiled compression spring 61 disposed about a depending shank or stem portion 62 on the spool valve, the upper end of the spring thrusting against the lower end of the bushing 48 and the lower end of the spring thrusting against an upwardly facing shoulder 63 on the valve stem.

In the present instance, the stem 62 projects downwardly within a vertical clearance chamber 64 in the head portion 13 of the machine housing, with an upwardly facing stop shoulder 65 at the lower end of the clearance chamber 64 opposing a downwardly facing shoulder 67 on the valve stem 62 to afford a positive limit upon protraction of the valve unit by the spring 61. Below the stop shoulder 65 a vertical bearing bore has the lower end portion of the valve stem extending guidedly therethrough to project externally into a clearance below the lower end of the bearing as shown.

Suitably connected to the lower exposed end of the valve stem 61 is a work engageable actuating trigger member 69 which is conveniently in the form of a stirrup-like spring wire member having an upwardly projecting arm 70 suitably detachably connected as by means of a pin and socket arrangement with the exposed lower end of the valve stem 62.

From the connecting arm 70 the trigger stirrup extends downwardly past the lower end of the head portion 13 of the housing and along the adjacent side of the fastener driveway nose assembly 12 of the machine, with a vertical guide portion 71 of the trigger stirrup guidedly engaged within a vertical laterally opening groove 72 in the side of the nose assembly 12. Below this, the stirrup trigger member has a presser foot formation 73 bent into a generally horizontal U-shape and dimensioned to clear the tip portion of the nose assembly therethrough. On the opposite side of the nose assembly from the guide groove 72, the stirrup trigger member has an upstand-

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ing guide arm 74 parallel to the guide portion 71, guidedly engaged in a guide groove 75 in that side of the nose assembly and provided with an inwardly turned terminal stop lug 77 projecting into a clearance notch 78 in the associated side of the nose assembly 12 and providing at the bottom thereof a stop shoulder normally engaged by the lug 77. The construction and arrangement is such that the stirrup trigger member 69 can be readily detached or assembled by springing the arm selectively resiliently laterally to clear the same relative to the groove 75 and to clear the stop terminal lug 77 relative to the clearance and shoulder notch 78. When the arm 74 and the terminal 77 are thus clear, the trigger stirrup member can be removed or replaced by disengaging or engaging the connector arm 70 with respect to the lower attachment end portion of the valve stem 62. In the attached, assembled relationship the terminal stop lug 77 of the trigger member limits the downward projection of the member and more particularly the foot portion 73, with spring bias of the valve spring 61 acting on the trigger member 69 through the valve stem 62 by virtue of the relationship wherein the trigger member arm 70 is so related to the stop terminal 77 as to maintain a slightly retracted relationship of the valve stem 62 as visualized by the spacing of the stop shoulder 67 on the valve stem above the stop shoulder 65 in FIG. 3. Before assembly of the trigger member 69, of course, the stop shoulders 65 and 67 by their interengagement limit the downward movement of the valve stem.

In the assembled relationship shown, upward movement of the trigger member 69 relative to the nose assembly 12 and the head section 13 of the machine, as by pressing the foot 73 on the trigger member against a work surface, causes the trigger member to shift the valve stem 62 upwardly correspondingly and thereby the valve member 60 is similarly shifted in the bushing bore 47. By the particular shape of the foot portion 73 of the trigger member with respect to the tip of the nose assembly 12, and predetermined downward projection of the foot portion 73 relative to the tip of the nose assembly in the normal or non-operating relationship, depression of the nose until the tip thereof engages or closely approaches the work surface against which the foot 73 thrusts will attain to the relative disposition of the trigger member 69 and thus of the valve 60 as shown in full lines in FIG. 4. In such position, the upper head end of the valve 60 is shifted to block the bushing ports 51 from the pressure fluid entry opening at the top of the bushing bore 47 while at the same time establishing a passage-way past the reduced diameter portion of the valve 60 from the ports 51 to ports 79 communicating with a peripheral groove 80 in the lower portion of the bushing 48 with which communicates a passage 81 (FIGS. 2, 4 and 6) in the wall of the head portion 13 of the housing. This passage 81 communicates with a downwardly extending passage duct 82 leading into a lateral passage 83 (FIGS. 1, 2 and 6) extending from a control valve assembly 84 mounted in the handle 14 adjacent to juncture thereof with the head portion 13. Here, a second or alternative communication with fluid pressure from the reservoir of the machine is effected, in this instance the auxiliary reservoir 17 in the handle 14. Thus, up to this point even with the trigger member 69 actuated the control valve piston 25 is held against opening the driving piston cylinder 19 by pressure fluid from the reservoir into the control valve cylinder chamber 24.

In a convenient form, the valve assembly 84 comprises a valve body bushing 85 having a head 87 extending above the handle 14 and with the remainder of the body extending through the handle 14 and exposed on the underside of the handle over a digitally operable trigger member 88 pivotally mounted by means of a pin 89 between a pair of ears 90 (FIGS. 1 and 2) at juncture of the underside of the handle 14 with the head section 13.

Reciprocally mounted in the valve bushing 85 is a

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plunger valve member 91 having a lower butt end portion 92 projecting from the lower end of the valve body bushing 85 and engaged by the trigger 88. Normally the valve 91 is driven downwardly into trigger release position by the force of pneumatic pressure fluid entering the bushing 85 through ports 93 and impressing upon an upwardly facing annular pressure surface 94 on the valve member about a reduced diameter portion thereof. At the same time, in this trigger-released position, pressure fluid entering through the ports 93 passes a still further reduced diameter portion 95 extending up through a bore portion 97 of the bushing 85 of complementary diameter to the main body portion of the valve member 91 and from which lead radial ports 98 communicating with an annular groove 99 in the housing about the bushing 85 and with which the passage duct 83 communicates.

Upon digitally pressing the trigger 88, the valve plunger 91 is correspondingly raised and shifted in the bore of the valve bushing 85 to close off the lower end of the reduced diameter bore portion 97 and at the same time open such bore portion 97 to a bleed-off chamber 100 in the head 87 by movement of the upper end of the valve stem 91 into such bleed-off chamber until the reduced diameter portion 95 of the valve member extends above the bottom of the bleed-off chamber. As a result, fluid pressure is bled off through the valve assembly 84 to atmosphere through the system of passages leading to the control valve 60, and assuming the control valve 60 in the foot trigger shifted upper position thereof as in FIGURE 4, the pressure above the control piston valve assembly 25 in the chamber 24 is bled off, unbalancing the control valve 25 and causing it to pop into open position by force of the pressure fluid from the reservoir 15 on the underside of the control valve member. Across the outer end portion of the bleed-off or exhaust chamber 100 is a protective screen 101.

When the trigger 88 is released, the valve 91 snaps back to closed position with respect to the bleed-outlet of the valve assembly 84 and the open relation of the communication of pressure fluid from the reservoir through the valve assembly 84 and the communicating passage-ways to the valve 60. This snapping return of the valve 91 is effected without the use of any springs, but by action of the pressure fluid from the reservoir acting on the pressure surface 94 which is differentially larger than any surface of the valve member 91 against which pressure fluid acts upwardly beyond the pressure surface 94. In the fully returned position of the valve 91, a stop delimits return movement to the desirable predetermined extent, herein comprising a split ring 102 carried about the upper head end extremity portion of the valve member and engaging an opposing stop surface in the bottom of the bleed or exhaust chamber 100.

After pressure differential has been restored in the control piston chamber 24 to act in conjunction with the biasing spring 42 to snap the control valve assembly 25 back into sealing engagement against the mouth rim of the cylinder 19, the piston 27 which has been driven in a driving stroke upon opening of the valve assembly 25 is driven by pneumatic fluid entering through the air return openings 35 in the wall of the cylinder in a return stroke to the starting position as shown in FIG. 3. In doing so, of course, pneumatic fluid trapped above the piston head 28 under the control piston valve assembly 25 must be exhausted. This is accomplished in a manner which utilizes the exhaust air to advantage in the drive piston cylinder under the piston head 29.

Referring to FIGURES 1, 3 and 7, it will be observed that the control piston valve insert member 37 which serves as a stop for the upward limit of travel of the piston 27 and the control valve piston member 40 are constructed and arranged to provide an exhaust air path through the control piston valve assembly 25. To this end, the member 37 is provided with a peripheral annular groove 103 de-

fined on the lower end of the member by an annular radially extending flange 104 disposed in underlying spaced relation to the adjacent underside of the control piston member 40 and projecting to a diameter which, while it is less than the inner diameter of the cylinder 19, is larger than the inside diameter of the sealing ring 41 and provides a sealing shoulder ledge engageable by the sealing ring 41 to seal the gap between the flange 104 and the underside of the piston member 40 when the control piston valve assembly 25 is moved upwardly into the driving piston cylinder opening relation. For this purpose, of course, the sealing ring 41, which may be of O-ring construction is dimensioned to be relatively loosely mounted with respect to the control valve piston member 40 to have a limited range of axial movement enabling it to effect a positive sealing engagement upon the rim of the cylinder 19 in the cylinder closing relation of the piston valve assembly 25, and spaced above the ledge seat flange 104 to permit exhaust air to move past and over the flange and into the groove 103, but in the opening movement of the control piston valve assembly 25, as shown in FIG. 7 to be engaged by the flange 104, lifted off of the cylinder rim and enter into sealing engagement across the gap between the flange 104 and the overlying undersurface of the piston valve member 40. In order to weight the sealing ring 41 to move positively downwardly when the control piston valve assembly 25 is raised, and to retain the sealing ring 41 against undesirable radially outward displacement, an angularly cross-sectioned metal ring member 104a is associated therewith, with a horizontal flange lying on top of the sealing ring member and a depending flange encompassing the radially outer side of the sealing ring member.

Communicating with the groove 103 is a circumferentially spaced series of exhaust ports 105 in the control valve piston 40 leading to a peripheral annular groove 107 in the valve piston which opens toward a recess 108 in the adjacent portion of the wall of the closure cap 20.

Registering with the recess 108 is a vertical port 109 through the spacer ring 22 (FIG. 1) leading to a registering upwardly opening bore 110 in the upper end portion of the head section 113 of the machine housing casing (FIGS. 1 and 6). Since to provide maximum reservoir space within the head section 13 with minimum outside dimensions, the head section 13 is cored out to as thin a wall section as practicable, the bore 110 opens down into the reservoir space 15. Providing a sealed exhaust passageway through the reservoir 15 from the bore 110 to an aligned bore 111 in the bottom of the reservoir chamber is a rigid tube 112. At its lower end, the tube 112 discharges through the lower port 111 into a detachably removable deflector 113 (FIGS. 1 and 3) which diverts the exhaust air into a discharge port bore 114 opening inwardly and upwardly into the clearance opening 34 in the base of the drive piston cylinder chamber.

Therefore, during return stroke of the piston 27, the air trapped above the piston head 28 is driven by the returning piston through the just-described exhaust air system relatively freely due to the cross-sectional area afforded for this purpose throughout the exhaust system, but nevertheless under sufficient pressure to blow from the discharge port 114 and the opening 34 in sufficient volume to preclude drawing in of atmospheric air through the opening 34 and even affording a slight boost to the returning piston due to the larger volume of the upper portion of the cylinder from which the air is being exhausted relative to the volume of the lower portion of the cylinder under the piston into which the exhaust air is discharged. Drawing in of dust into the lower portion of the cylinder is thereby avoided, to keep the cylinder clean and free from dirt abrasion damage to the cylinder walls or the sealing rings about the piston heads. In addition, the small amount of lubricating air customarily supplied to pneumatic tool operating compressed air is carried by the exhaust air into the cylinder chamber

under the piston 27 for lubrication, complementary to the lubrication afforded through the pressure fluid air above the piston and to the intermediate air return chamber area between the piston heads from the reservoir. During driving strokes of the piston 27 air under the piston head 29 can exhaust freely through the lower opening 34.

In use of the machine, pneumatic fluid such as compressed air delivered from a compressed air source under suitable pressure head such, for example, as 100 p.s.i. fills the reservoir spaces 15, 17 and, assuming both the work-engageable trigger 69 and the manually operable trigger 88 are in their free conditions as shown in FIGURES 1 and 3, the machine is prepared to be fired for driving a fastener supplied from the magazine 11 into driving position within the driveway 32 in the nose assembly 12. Should the person handling the machine actuate the digitally operable trigger 88 before the nose 12 is in proper position for driving a fastener into a workpiece, the valve 60 acts as a safety device preventing firing, by blocking the bleed-off passageway system. Upon placement of the nose 12 in fastener driving and setting position with respect to the work, engagement of the trigger foot 73 with the work effects actuation of the work engaging trigger 69, thus operating the valve 60 to establish communication with the bleedoff passageway system to the valve 95 which if it has been operated by the trigger 88 for bleed-off establishes a firing condition wherein the poppet control piston valve assembly 25 opens the cylinder 19 so that the full force of pressure fluid in the reservoir 15 dumps upon the piston head 28 and drives the driving piston 27 with instantaneous full speed acceleration. Then, either by releasing the digital trigger 88 or by releasing the work engageable trigger 69 shut-off of the bleed passageway and resumption of pressure fluid closing of the control piston valve assembly 25 is effected whereby the driving piston 27 returns to load position.

If the digitally operable trigger 88 is continuously depressed, lifting of the machine away from the work enables the spring biased protraction of the work engaging trigger 69 and the valve 60 which restores the control valve piston air pressure closing bias. Then, if desired, driving operation of the machine can be immediately again effected by engaging the trigger foot 73 against another place on the work to be fastened and pushing on the machine to engage the nose 12 against the work or allowing gravity to overcome the force of the biasing spring 61. This enables rapid fastening by what may be termed "bumping" operation of the machine wherein the operator, while holding the digital trigger 88 depressed maneuvers the machine to carry the driving nose 12 into driving relation with the work at successive points into which a fastener is to be driven, the machine firing each time the trigger member 69 is thus depressed.

However, should it be desired to operate the machine entirely through the medium of the digitally operable trigger 88, so that each firing of the machine comprises cyclically actuating and releasing the trigger 88 and thus cyclically operating the valve 91 between bleed-off and pressure air delivery positions with respect to the passageway system leading to the control piston valve chamber 24, that can be done by inactivating the valve 60. For this purpose, interlock means are provided, herein comprising a spring latch member 115 (FIGS. 2, 3 and 4) which is secured as by means of a pin or screw 117 to an ear flange 118 on the lower portion of the head section 13 of the machine in parallel adjacent relation to the bore 68 from which the lower end of the valve stem 62 projects. Mounting of the spring latch 115 is on the opposite side of the flange 118 from the work engageable trigger member 69 and with an angular arm 119 of the latch member extending through a guide hole 120 in the flange aligned with the projecting valve stem 62 and on the terminus of the arm 119 is a turned terminal 121

which bears against the valve stem under thrust afforded by resilient tensioning of the latch member 115. Within the normal vertical operating range of the depending portion of the valve stem 62 the terminal 121 remains in such inactive thrusting sliding engagement.

When it is desired to inactivate the valve 60, the valve stem 62 is pushed upwardly above its normal operating range, as indicated in dash outline in FIG. 4 until the latching terminal 121 snaps into position under the tip of the valve stem and holds the valve stem against dropping under the bias of the spring 61. Such inactivating raising of the valve stem may be effected by pushing up on the work-engaging trigger 69 beyond its normal valve actuating range. Then, if desired, the trigger member 69 may be disengaged from the nose assembly 12 and the arm 70 of the trigger member disengaged from the valve stem for complete removal of the trigger member. While the valve 60 is thus held inactive by the spring latch member 115, manual firing of the machine through the trigger 88 is adapted to be freely effected. Reactivation of the valve 60 is easily effected by springing the latch member 115 to release the retaining terminal 121 from the holding relation to the lower tip of the valve stem 62.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

We claim as our invention:

1. In a pneumatically operated fastener driving machine, including a fastener directing nose structure and a pneumatic motor having a driver actuated thereby for driving fasteners from said nose structure, means for supplying pneumatic fluid to drive said motor, means for controlling delivery of pneumatic fluid to said motor including a pneumatic fluid passageway system provided with a digitally controllable valve, a disabling valve in said passageway system including a safety trigger associated with said nose structure and disposed to be operated by engagement with a workpiece in advance of engagement of the workpiece by the nose structure so that said disabling valve will be operated to clear said passageway system for control by said digitally operable valve to effect operation of said pneumatic fluid delivery controlling means, and interlock means for holding said disabling valve in a non-operating position wherein said passageway system is cleared for control at will by said digitally operable valve.

2. In a pneumatic fastener driving machine including a head portion having therein a pneumatic fluid reservoir and a cylinder with an open end exposed to said reservoir, a piston reciprocally operable in said cylinder and having a fastener driver projectable from said head portion for driving a fastener into a workpiece, a fluid passage for introducing pneumatic fluid to said cylinder for normally returning said piston toward said open end, said head portion having a control piston valve cylinder chamber aligned with but spaced from said cylinder end and with a reciprocable control valve piston operable therein for closing said cylinder end and opening said cylinder end, a pneumatic fluid passageway system communicating with said control valve piston chamber and connected to a source of pneumatic fluid for controlling operations of said control valve piston, two separate control valves in said passageway system either of which is adapted for controlling delivery of pneumatic operating fluid through said passageway system to said chamber but both of which are dependent upon the other to effect such control of the passageway system, said control valve piston having a passage therethrough for exhaust of the pneumatic fluid from said cylinder upon return of the piston therein towards said end and means bypassing said passageway system and extending through said reservoir and discharging the exhaust fluid into said cylinder at the opposite end thereof and under the piston in the cylinder.

3. In a pneumatic fastener driving machine including a handle and a fastener driving head provided therein

with a reservoir and a cylinder having one end exposed to said reservoir with a piston reciprocable in said cylinder but normally disposed adjacent to said one end and responsive to pressure fluid in said reservoir to be driven from said one end in a fastener driving stroke, means normally operable to close said cylinder one end, means controlling the opening and closing of said cylinder end by said closing means and including a pneumatic fluid passageway system having two points of communication with pressure fluid in said reservoir, one of said points of communication being adjacent to said handle and the other of said points of communication being adjacent to said cylinder, a digitally operable control valve for controlling said one point of communication, a control valve having a work contacting and operable trigger device for controlling said other point of communication, and means for inactivating said last mentioned control valve to limit access of pressure fluid to said passageway system from said one point of communication, said last mentioned means comprising a shoulder on said trigger device and a latch mechanism selectively and releasably engageable with said shoulder to hold the trigger device in the inactive condition thereof.

4. In a pneumatic fastener driving machine including a head having a pneumatic fluid reservoir therein and a cylinder having an end exposed to said reservoir and a piston in the cylinder operable by pressure fluid entering the cylinder to travel in a driving stroke away from said end but returnable after a driving stroke to discharge spent fluid through said end, a control valve operable by pressure fluid to close said cylinder end, a pneumatic pressure fluid passageway system in said head for controlling said control valve, a plunger valve chamber in said head alongside said cylinder and intersecting said passageway system and having communication with said reservoir adjacent to said cylinder end, a plunger valve in said valve chamber and having means projecting from said valve chamber for actuating the same, said control valve having an exhaust passage therethrough for exhausting said spent fluid, and an exhaust passageway communicating with said exhaust passage extending from adjacent to said cylinder end and extending through said reservoir and having means to deliver the exhausted spent fluid to the end of the piston opposite to that exposed to said cylinder end.

5. In a pneumatic driving machine including a head structure defining a pressure fluid reservoir and a cylinder having an end opening into said reservoir with a reciprocable piston in said cylinder normally disposed adjacent to said cylinder end, a control valve operable between open and closed positions but normally closing said cylinder end against ingress of pressure fluid from said reservoir into the cylinder through said end of the cylinder to drive the piston in a driving stroke, said control valve having a portion thereof projecting into the cylinder as a stop for said piston and providing an annular sealing seat spaced from the internal wall of the cylinder and from an overlying portion of the valve and defining therewith a gap communicating with a spent pressure fluid exhaust passage through the valve, a sealing ring movably mounted between said ledge and said valve and operable to seal said cylinder opening against ingress of pressure fluid from the cylinder in the closed position of the valve and movable into sealing relation with said ledge seat to seal said gap and prevent escape of pressure fluid in the open position of the valve.

6. In a pneumatically operated driving machine, a housing providing a driving head having therein a reservoir and a cylinder both opening upwardly, a closure cap closing the open end of the reservoir and defining a chamber for communication between said reservoir and the open end of the cylinder, a piston reciprocable in the cylinder, a control valve structure reciprocable in said chamber between cylinder opening and cylinder closing positions relative to said cylinder end, said control valve

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structure having an exhaust passageway therethrough for exhausting spent pneumatic fluid from above said piston on return of the piston toward said valve structure on a return stroke after the valve structure has closed said cylinder end, a communicating passageway through said closure cap and said reservoir including a tube extending in sealed off relation through the reservoir and discharging through the bottom of the reservoir, and a passageway in the head structure under the reservoir and under the cylinder discharging into the lower end of the cylinder and including a removable deflector connecting said last mentioned passageway and the discharge end of the tube.

7. In a pneumatic driving machine including a head structure having a cylinder therein with a piston reciprocable in the cylinder and having a driver operable from one end of the cylinder,
- a reservoir defined in the head,
 - the opposite end of the cylinder being disposed for exposure to the reservoir,
 - said reservoir being adapted to receive a supply of pressure fluid under substantially constant pressure,
 - a closure structure on the head structure closing the reservoir and providing a chamber aligned with said opposite end of the cylinder,
 - a control valve member mounted in said chamber and partially exposed to pneumatic fluid in the reservoir acting to drive the valve member in cylinder opening direction away from the cylinder,
 - and means for effecting closing of said valve member relative to the cylinder including:
 - a valve bore in said head head alongside said cylinder and opening at its opposite ends in the same directions as the cylinder,
 - the end of said bore which opens in the direction of said opposite end of the cylinder being continuously in communication with said reservoir,
 - a passageway leading from said bore through said closure structure to the opposite side of said valve member from its cylinder closing side to conduct the pneumatic fluid from the bore to bias said valve member into cylinder closing position,
 - a plunger valve member in said bore normally biased to maintain open communication between the bore and said passageway,
 - said plunger valve member having a stem projecting from the end of said bore which opens in the same direction as said one end of the cylinder,
 - and said stem having a trigger device engageable with a work piece toward which said driver is to be driven by said piston for moving said plunger valve member in opposition to its bias to close said passageway from communication with the reservoir,
 - said head having a bleed-off passageway leading

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from said bore and normally closed off from said first mentioned passageway in the biased position of the valve plunger member, but opened to communication with said first mentioned passageway in the trigger device moved position of the plunger valve member for thereby unbalancing said control valve member to open the cylinder to the reservoir and effect driving of said piston.

8. In a pneumatic fastener driving machine including a handle and a head with the handle and the head providing pneumatic fluid reservoir,
- a cylinder in the head having an end exposed to the reservoir,
 - means closing said cylinder end,
 - means for controlling such closing of the cylinder end by said closing means including a fluid passageway system,
 - a valve structure carried by the handle and including a bushing extending through the handle with the opposite ends of the bushing opening respectively above and below the handle,
 - the bushing having a port intermediate its ends communicating with the reservoir,
 - a reciprocable valve plunger in said bushing having a portion thereof normally exposed to pneumatic fluid pressure from the reservoir through the port to drive the valve plunger normally into a position toward one of said ends of the bushing,
 - the opposite end of said bushing affording a bleed-off to atmosphere,
 - the valve plunger having a portion for closing the bleed-off,
 - a second port in said bushing communicating with said passageway system for effecting communication between said ports to direct fluid pressure from the reservoir into said passageway system or to effect communication between said passageway system and said bleed-off,
 - and means adjacent to said one end of the bushing and operable for actuating said valve plunger to shift it in said bushing from said normal position to alter the relationship of the valve plunger to said ports and to said bleed-off for operation of said controlling means.

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