

Sept. 8, 1964

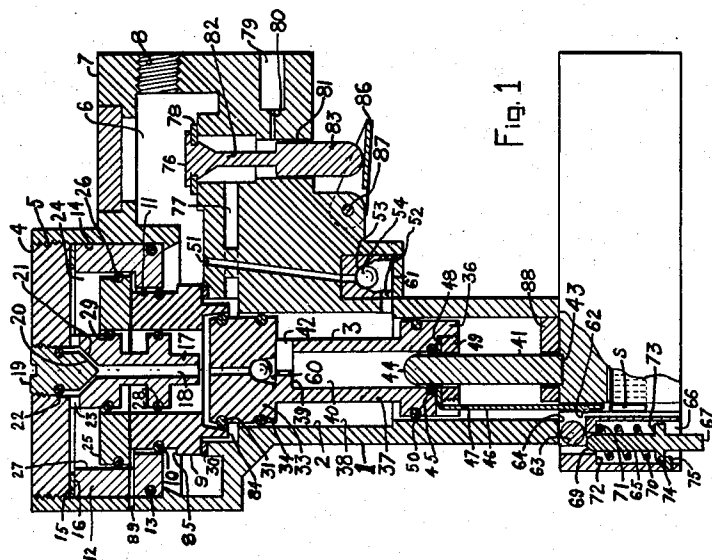
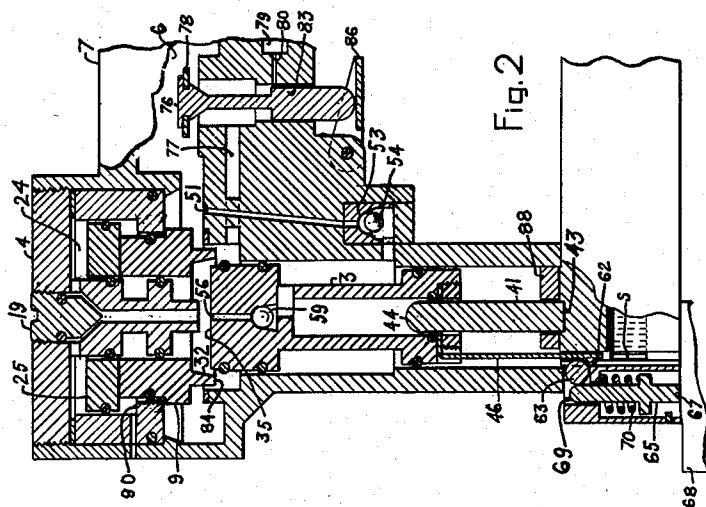
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3,147,670

VALVE AND OTHER APPARATUS

Filed May 10, 1961

2 Sheets-Sheet 1



INVENTOR.

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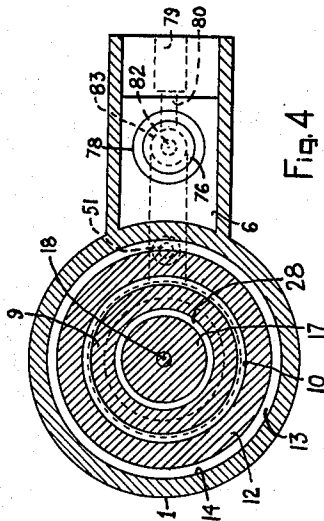


Fig. 4

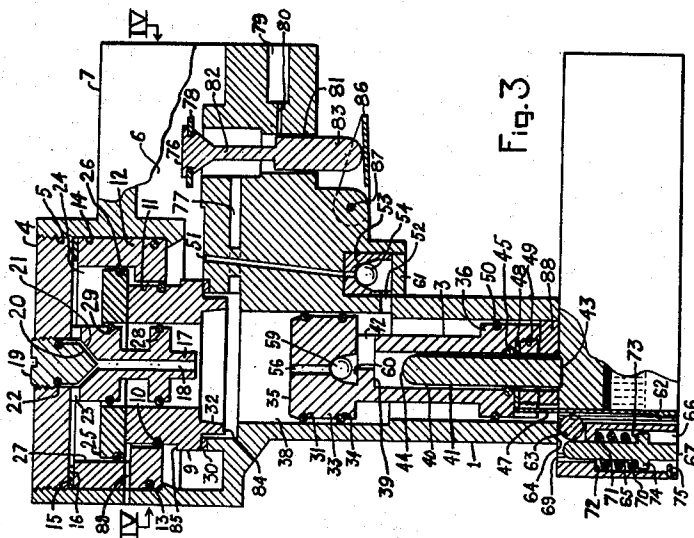


Fig. 3

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VALVE AND OTHER APPARATUS
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This application relates to improvements in a means to accumulate and release compressed air for operation of a staple or nail driving piston, the release of accumulated compressed air being sudden and in volume whereby the force of the released pressure air acts violently against the piston to thereby increase its velocity in working direction.

In Patent No. 3,027,875 of Herman J. Spencer, there is disclosed a pneumatically operated fastener driving device using a cylinder valve that is unseated by induction of pressure air into the cylinder to admit a large volume of pressure air to actuate a fastener driving position. However, this prior device used a spring in connection with the closing of the cylinder valve and by using pressure air instead of the spring, I can regulate the flow of pressure air being used to reseal the cylinder valve to thereby control the force exerted to actuate the fastener driving piston.

The following are objects of my invention:

To provide means for closing a cylinder containing a fastener driving piston to a large volume of pressure air, and pressure air means for manipulation of the means for closing to admit the large volume of pressure air to the cylinder to actuate the piston in fastener driving direction and then apply pressure through an adjustable means to the means for closing to stop the flow of the large volume of pressure air to the cylinder to thereby control the amount of pressure air allowed to enter the cylinder from the large volume of pressure air to thereby regulate the force applied to the fastener driving piston.

To provide means for supplying pressure air to unseat a cylinder valve to admit a large volume of pressure air into a cylinder to actuate a driver piston to drive a fastener and to then apply the pressure air against said cylinder valve to seat it.

A further object is to provide a device of this kind with an independent pocket of pressure air to be used for returning the fastener driving piston to its inoperative position and to provide means in the device for transmitting pressure air to said pocket.

A still further object is to provide an independent pocket of pressure air in the cylinder that is shiftable with the driver piston and used to return the latter after a fastener has been driven.

Another object is to provide valve means for retaining pressure air in the pocket but operable by pressure air from without to admit pressure air into the pocket.

A further object is to provide a driver piston containing a cylinder with an abutment at one end, a stationary piston over which the cylinder reciprocates and means for supplying pressure air to the cylinder between the stationary piston and the abutment to urge the driver piston in reverse working direction.

Another object is to provide means for securing a pierced driver blade to one end of a driver piston by a hollow bolt to thereby provide an opening for a piston.

A further object is to provide a device of the type indicated with a safety device of novel construction that requires pressing the machine against the work before it can be operated.

FIGURE 1 is a side elevation in section showing the parts in position before pressure air is supplied to unseat the cylinder sealing valve with the piston being held upwardly in its sealed engagement with said valve;

FIGURE 2 is a view similar to FIGURE 1 showing the small valve as having been manually unseated to

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thereby admit pressure air into the cylinder to unseat the cylinder sealing valve to move it from sealing engagement with the piston so it can be driven in working direction by pressure air;

FIGURE 3 is a view similar to FIGURES 1 and 2 but showing the piston as having been moved in working direction, the cylinder sealing valve having been seated by pressure air in a manner to be described and shows the manually operated valve as still open;

FIGURE 4 is a plan view through IV-IV of FIGURE 3.

Referring now to FIGURE 1 of the drawings, therein is disclosed a pneumatic tacker or fastener driving device. The fastener driving devices shown has a housing 1 which contains a cylinder 2 open at its upper end to admit pressure air to said cylinder for moving the driver piston 3 therein in working direction, a cover 4 is secured to the housing 1 by threads 5 to close the pressure air storage compartment 6 which extends above the cylinder 2 and rearward into the handle 7 of the housing 1. An air supply opening 8 in housing 1 conducts unimpeded line pressure air to the pressure air storage compartment 6. A movable cylinder valve 9 has a seal 10 in a suitable groove around its body which rubs against the inwardly facing wall 11 of the cylindrical shaped bushing 12 to retain pressure air in the pressure air storage compartment 6 from passing between the cylinder valve 9 and the bushing 12. A seal 13 is in a groove around the outwardly facing side of bushing 12 and it rubs against the cylindrical shaped wall 14 of the inside of the housing 1 to prevent pressure air passing upwardly between the bushing 12 and the housing 1. A seal 15 is around the edge of the underside of the cover 4 and pressed against the upper edge 16 of the bushing 12 to prevent pressure air leakage past the cover 4 or between the bushing 12 and the wall 14 of the housing 1. The cover 4 has a centrally located downwardly extending cylindrical shaped abutment 17 that has a passage 18 extending upwardly through the cover 4. The upper end of passage 18 is enlarged and threaded to accommodate an adjustable valve screw 19 that has its lower end tapered at 20 to fit a valve seat 21 at the enlarged end of passage 18. A seal is around a reduced portion of screw 19 and seal 22 rubs against the walls of the enlarged end of passage 18 to stop leakage of pressure air upwardly past screw 19. Two horizontally disposed ports 23 extend inwardly from outside of the abutment 17 and are open into passage 18 just above valve seat 21 so that air pressure can travel up passage 18 past seat 21 and through ports 23 to the pressure chamber 24 underneath cover 4. The upper part of cylinder valve 9 is a disc shaped piston 25 that has a seal 26 in a suitable groove around its circumference that rubs against the inwardly facing wall 27 of the enlarged upper portion of the bushing 12 to prevent leakage of pressure air between the bushing 12 and the outwardly side of piston 25. The abutment 17 has a seal 28 in a groove around its circumference that rubs against the bore of the cylinder valve 9 and a similar seal 29 in a groove that rubs against the bore of piston 25 to prevent leakage of pressure air between the outside of the abutment 17 and the bores of the cylinder valve 9 and piston 25. In the description so far, it will be apparent that when cylinder valve 9 has been unseated as shown in FIG. 2, pressure air can travel up passage 18 past seat 21 and through ports 23 to the pressure chamber 24 above piston 25 to urge it downwardly against cylinder valve 9 to move it to its seated position shown in FIG. 1. It will also be noted that turning the adjustable valve screw 19 to move it downwardly to seat it against seat 21 could stop or meter the flow of pressure air to the pressure chamber 24 as desired. The force of the pressure air being

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supplied when the cylinder valve 9 is opened can be prolonged or shortened by adjustment of the valve screw 19 and therefore the operator can select any driving power he desires without changing the pressure of air being supplied to the driving device.

A seal 30 between the cylinder valve 9 and the upper open end of cylinder 2 prevents leakage of pressure air from the pressure air storage compartment 6 into the upper end of the cylinder 2 when the cylinder valve 9 is seated. A driver piston 3 has a seal 31 adjacent its upper end in a groove around its circumference adapted to seat itself against the beveled underside 32 of the cylinder valve 9 to seal off the upper end 35 of the driver piston 3 from pressure air injected into the upper end of the cylinder 2 to prevent the pressure air from moving the driver piston 3 prematurely in working direction. A short distance downwardly from seal 31 is another groove in the driver piston 3 containing a second seal 34 which extends outwardly a slight amount from the circumference of the driver piston 3 to prevent leakage of pressure air between the cylinder 2 and driver piston 3. The driver piston 3 shown is spool shaped with its upper end 33 slightly larger in diameter than its lower end 36 and it has a cylindrical shaped stem 37 of much less diameter than its head portions to provide a large pressure air pocket 38 between its heads. The stem 37 of the driver piston is bored upwardly a great distance to a dead end 39 to form a return cylinder 40 to accommodate a piston rod 41. A passage 42 extends horizontally from the dead end 39 of the return cylinder 40 through the wall of the stem 37 of the driver piston 3 to allow pressure air to move into and out of the return cylinder 40 from the pressure air pocket 38 as the driver piston 3 is reciprocated. See FIGS. 1, 2 and 3.

The stationary piston rod 41 has its lower end 43 seated centrally of and at the lower end of cylinder 2 against housing 1. Piston rod 41 extends upwardly into and is closely aligned with the walls of the return cylinder 40 so that the upper end 44 of the piston rod 41 forms an abutment in the return cylinder 40 for pressure air to expand against. See FIGS. 1 and 3. A seal 45 is pressing against the diameter of the piston rod 41 and is seated against a recessed shoulder around the open end of return cylinder 40 to prevent leakage of pressure air from the return cylinder 40 past the piston rod 41. The driver blade 46 has a body portion 47 extending vertically and has a flange 48 extending at right angle that is pierced to freely receive the diameter of the piston rod 41. The flange 48 of the driver blade 46 is seated against the bottom end of piston 3 to hold seal 45 in place. A bolt 49 is hollow to freely receive the piston rod 41 and bolt 49 is secured to the lower end of driver piston 3 by threads to hold the flange 48 of the driver blade 46 tightly against the lower end of the driver piston 3 with the body 47 of driver blade 46 extending downwardly away from the driver piston 3. See FIG. 1. A seal 50 carried in a suitable groove around the circumference of the lower end 36 of the piston 3 rubs the wall of the small bore of the lower end of the cylinder 2 to prevent leakage of pressure air from the pressure air pocket 38 past the lower end 36 of driver piston 3. See FIG. 1.

An optional source for supplying pressure air to the pressure air pocket 38 is shown in the drawings as a small diameter passageway 51 from the pressure air storage compartment 6 ending with an enlarged end 52 that opens into cylinder 2 at a point always between the ends 33 and 36 of the driver piston 3 as it reciprocates. See FIGS. 1 and 3. Passageway 51 has a valve seat 53 connecting its ends and a ball-bearing 54 movable into valve seat 53 to a depth approximately half its diameter by pressure air against its exposed other half by pressure air from the pressure air pocket 38. See FIGS. 1 and 2. Only a small portion of ball-bearing 54 is exposed to pressure air from the small diameter passageway

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way 51 when the ball-bearing is seated and therefore pressure air from the pressure air storage compartment 6 will initially unseat the ball-bearing 54 to fill the pressure air pocket with equal air pressure. With the pressure air pocket 38 full of pressure air and the ball-bearing 54 sitting near its seat 53, as shown in FIG. 2, the device is triggered to move driver piston 3 downward in fastener applying direction as shown in FIG. 3, piston rod 41 displaces the pressure air in return cylinder 40 to thereby force pressure air to return past the ball-bearing to the pressure air storage chamber 6 and this flow of pressure air moves ball-bearing 54 into valve seat 53 as shown in FIG. 3.

With the ball-bearing 54 moved into its valve seat 53, as just described, pressure exerted against half of its exposed area by pressure air from the pressure air pocket 38 will hold the ball-bearing 54 seated against pressure being applied against the small portion of the ball-bearing 54 exposed to higher air pressure in passageway 51 from the pressure air storage compartment 6. As the driver piston 3 is moved upwardly by expansion of pressure air between the end 44 of the piston rod 41 and the dead end 39 of the return cylinder 40 or by expansion of pressure air between shoulder 55 of the cylinder 2 and against the overlying marginal difference in the size of the upper end 33 of the driver piston 3, the area of the pressure air pocket 38 will increase to thereby lower the pressure of air now trapped in pocket 38. However, the drop in the pressure of air in the pressure air pocket 38 as just described is not sufficient to permit unseating of the ball-bearing 54 but loss of pressure air past the seals 34, 50 and 45 would lower the pressure discussed to a point where unseating of the ball-bearing 54 would take place and the pressure air pocket 38 would automatically be recharged in the manner previously described.

In the center of the diameter of the upper end 33 of the piston 3 is a small diameter passage 56 extending downwardly that has a larger end 57 opening into passage 42 of the stem 37 of piston 3 for conveying pressure air above the piston 3 to the pressure air pocket 38 to charge it with pressure air. See FIG. 1. A valve seat 58 similar to valve seat 53 connects the small diameter passage 56 with its larger opening 57 and a ball-bearing 59 similar to ball-bearing 54 is held in seat 58 by pressure air from the pressure air pocket 38 in a manner previously described. The ball-bearing 59, carried by the piston 3, is adapted to be displaced by pressure air in passage 56, in a manner previously described, when pressure air is intermittently injected into the cylinder 2 above the driver piston 3. A shoulder 60 in the driver piston 3 limits movement of ball-bearing 59 away from its valve seat 58 and a plug 61 limits the movement of ball-bearing 54 away from its valve seat 53. See FIG. 1.

The body 47 of the driver blade 46 has a centrally located bump 62 extending forwardly adjacent to its lower end. A roller 63 is movably mounted in a guide 64 for movement horizontally into the path of bump 62 of the driver blade 46 to stop upwardly but not downward movement of the driver piston 3 when the latter is in sealed engagement with the cylinder valve 9 to break this seal to allow pressure air from the pressure air storage compartment 6 to have access to the driver piston 3 to move the latter in fastener driving direction. See FIGS. 1, 2 and 3. A small shaft 65 is mounted for vertical movement in a guide hole 66 located forwardly of the path of the driver blade 46. Shaft 65 has a lower end 67 extending downwardly and out of hole 66 adapted to contact a workpiece 68 to move shaft 65 upwardly in guide hole 66 so that the upper end 69 of shaft 65 contacts roller 63 and moves roller 63 along guide 64 into the path of bump 62 of the driver blade 46 to obstruct upward movement only of the driver blade 46 and thereby driver piston 3. See FIGS. 1 and 2. A slight spring 70 has one end 71 against a shoulder 72 in hole 66 and has

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its other end 73 against an enlarged portion 74 of shaft 65 to retract shaft 65 to its stop 75 when the device is lifted from the workpiece 68 to thereby move upper end 69 of shaft 65 out of contact with roller 63 to permit roller 63 to be moved from its obstructing position in guide 64 by bump 62 of driver blade 46. See FIGS. 1 and 2.

The manually operated valve 76 is identical to the one shown in my Patent No. 3,027,875 mentioned previously. Valve 76 is astride passageway 77 to control the flow of pressure air from the pressure air storage compartment 6 to the cylinder 2. See FIGS. 1 and 2. Valve 76 has a seal 78 which when seated, as shown in FIG. 1, stops the flow of pressure air to passageway 77. An exhaust port 79 has a narrow opening 80 into the cylindrical shaped guide section 81 of passageway 77 located between the seal 78 of the manual valve 76 and the cylinder 2 to exhaust pressure air from it when valve 76 is seated. See FIGS. 1 and 3. The seal end 78 of manual valve 76 is disc shaped and extending a short distance downwardly from its center is a stem 82 of small diameter which has an enlarged end section 83. The enlarged end section 83 of valve 76 fits closely in the guide section 81 of passageway 77 to minimize leakage of pressure air past it and to effectively block off the narrow opening 80 to the exhaust port 79 when valve 76 is unseated as shown in FIG. 2.

The apparatus shown in FIGURES 1, 2, 3 and 4 operates as follows: Assuming that the pressure air pocket 38 has been charged with pressure air as previously described and that the parts are in their starting position shown in FIGURE 1, the cylinder valve 9 is seated on seal 30, the seal 31 of driver piston 3 is seated against the beveled underside 32 of the cylinder valve 9 with the upper end 35 of the driver piston 3 being a slight distance below the abutment 17, seal 78 of the manually operated valve 76 is seated blocking pressure air to passageway 77 and the enlarged end section 83 of manual valve 76 is not blocking the narrow opening 80 to the exhaust port 79 so that normal air pressure prevails in pressure chamber 24, past the adjustable valve 19 down passage 18 in the abutment 17, the upper end of cylinder 2 and therefore underneath the exposed area 84 of the underside of cylinder valve 9 as shown in FIGURE 1 are open to the atmosphere via passageway 77, narrow opening 80 to the exhaust port 79. In FIGURE 1, line pressure air is in the pressure air storage compartment 6 around cylinder valve 9 exerting downward pressure on flange 85 of cylinder valve 9 to hold it seated on seal 30 and pressure air in the pressure air pocket 38 is urging driver piston 3 upward into sealed engagement with cylinder valve 9.

The trigger 86 is pivoted counterclockwise on the housing supported pin 87 against stem 83 of valve 76 to unseat it and move its enlarged stem portion 83 to block off the narrow opening 80 to the exhaust port 79. See FIGURES 1 and 2. With the manual valve 76 now open, as shown in FIGURE 2, the pressure air from the pressure air storage compartment 6 moves through passageway 77 into the upper end of cylinder 2 to exert more upward pressure against the exposed underneath area 84 of cylinder valve 9 than existing downward pressure against cylinder valve 9 to thereby unseat and move it upwardly out of reach of seal 31 of the piston 3 as it stopped by abutment 17 or by the roller 63 as preferred (see FIGURE 2) to thereby permit a volume of pressure air from the pressure air storage compartment 6 to contact the now exposed upper end 35 of driver piston 3 to thereby move it in working direction to the limit of its travel against stop 88 to drive staple S. Bump 62 of driver blade 46 is below roller 63 so that roller 63 does not obstruct downward movement of the driver blade 46. See FIGURES 1, 2 and 3. While the driver piston 3 is moving in working direction, the pressure air in the open end of cylinder 2 travels up passage 18 in abutment 17 and is metered

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past valve screw 19 into pressure chamber 24 and exerts downward pressure against the upper side of the large piston 25 which is in contact with or can be attached as a part of cylinder valve 9 to thereby move the cylinder valve 9 downward to seat it to shut off the large volume of pressure from the pressure air storage compartment 6 to the cylinder 2 containing the driver piston 3. See FIGURE 3. The trigger 86 is released as shown in FIGURE 1 and pressure air on top of the seal 78 end of manual valve 76 moves it downward until its seal 78 covers passageway 77 to thereby stop pressure air from entering it. As the manually operated valve 76 is seated, its enlarged stem portion 83 was moved from blocking the narrow opening 80 to the exhaust port 79 to thereby allow all pressure air from the pressure chamber 24 down through the cylinder 2 above the driver piston to exhaust itself through passageway 77, narrow opening 80 to the exhaust port 79 as the driver piston 3 is moved upwardly in reverse driving direction to its starting position shown in FIGURE 1 by pressure air in the pressure air pocket 38. When the cylinder valve 9 has been unseated, the pressure air is against its entire underside and then seeps to exert downward pressure against the upper side of piston 25 which is larger and moves it and the cylinder valve 6 downward to seat the latter and pressure air on flange 85 of the cylinder valve holds the latter seated as shown in FIGURE 1. A vent hole 89 extends from outside through housing 1 and bushing 12 to a point adapted to prevent an air lock between the underside of piston 25 and ledge 90 of bushing 12.

I claim:

1. In a pneumatic device for driving a fastener, a driver piston reciprocally mounted in said device, pressure air means in said device for moving said driver piston in fastener applying direction, movable means adapted in an unseated position to admit said pressure air to said piston, pressure air means for seating said movable means to stop the flow of said pressure air to said piston and adjustable means for regulating the flow of pressure air being used to seat said movable means.

2. In a pneumatic device for driving a fastener, a driver piston reciprocally mounted in said device, pressure air means in said device for moving said driver piston in fastener applying direction, means urging said driver piston upwardly in reverse fastener applying direction, seated means to block said pressure air from said driver piston and for arresting upwardly movement of said driver piston but operable to admit said pressure air, means for moving said seated means upwardly from its seated position to admit pressure air to said driver piston, a driver blade connected to and movable with said driver piston for driving a fastener, movable obstruction means adapted in one position to engage said driver blade to stop it and the driver piston from moving upwardly, contact means movable relative to the device by contact with a workpiece for engaging and moving said obstruction means to stop upward movement of said driver piston to disengage the latter from said seated means when the latter is moved upwardly to admit pressure air to said driver piston.

3. Claim 2 and further characterized by a spring for moving said contact means relative to said obstruction means to permit movement of the latter from its obstructing position.

4. In a pneumatic device for driving a fastener, a driver piston reciprocally mounted in said device, pressure air means in said device for moving said driver piston in fastener applying direction, movable means seated for blocking said pressure air from said driver piston, means for directing pressure air to unseat said movable means to admit a flow of said pressure air to said driver piston to move it in fastener applying direction, and adjustable means for metering the flow of said pressure air against said movable means for seating said movable means to stop the flow of pressure air to said piston.

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5. In a pneumatic driving device comprising a driver piston and a cylinder in which said driver piston is reciprocally mounted, said driver piston having an upwardly facing end and extending downwardly therefrom it contains a return cylinder in its body portion that is closed at its upper end but open at the lower end of said driver piston to receive therein the upper end of a stationary return piston rod, a stationary return piston rod that has its lower end mounted on the device with its length and upper end in line with said piston return cylinder to permit the latter to enclose and reciprocate relative to said return piston rod, a driver blade that has a length extending from its upper end downwardly away from the lower end of said driver piston and the blade has a flange at its upper end extending at right angle to its length that is pierced to provide a hole to freely receive therein said stationary piston rod, a hollow bolt adapted to be secured as by threads around the open end of said return cylinder to securely hold the flange of said driver blade to said driver piston.

6. In a pneumatic driving device, a driver piston reciprocally mounted in said device that has one area adapted to receive pressure air for urging it in fastener applying direction and it has another area exposed to pressure air for urging it in reverse fastener applying direction, a chamber in said device supplied with line pressure air for supplying pressure air to urge said driver

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piston in fastener applying direction, an air pocket in said device in which said other area of said driver piston reciprocates, a passageway connecting said chamber with said pocket and a one-way valve in said passageway for permitting pressure air to move from said chamber to said pocket to pressurize the latter to apply the pressure air in said pocket against said other area of said driver piston to urge said driver piston in reverse fastener applying direction.

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