

Nov. 28, 1961

H. G. ALLEN ET AL
FASTENER DRIVING MACHINE

3,010,430

Filed May 19, 1959

3 Sheets-Sheet 1

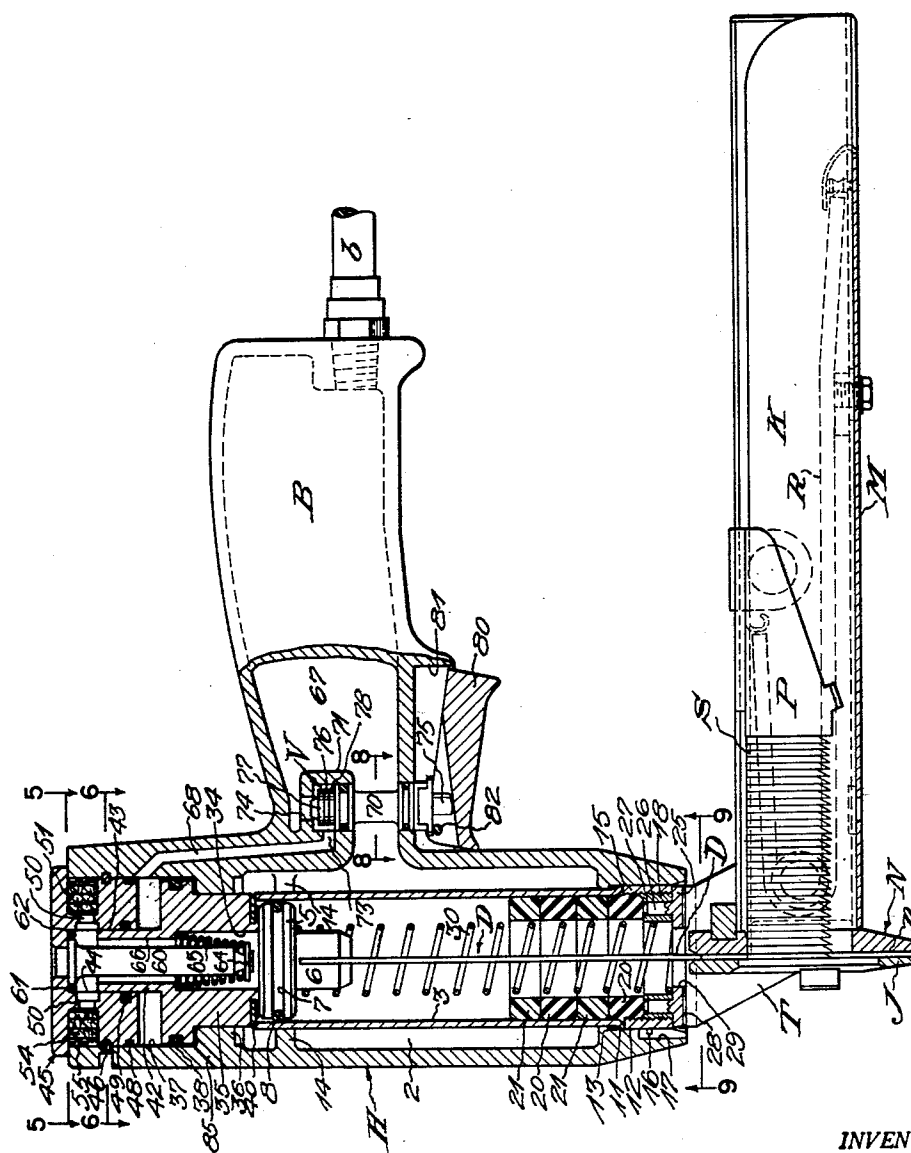


FIG. 1

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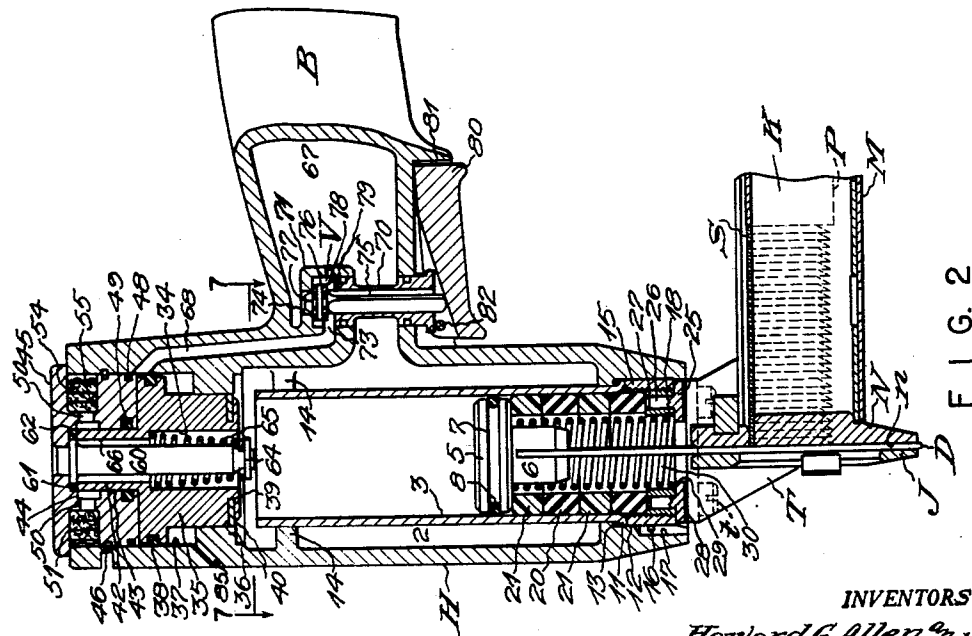
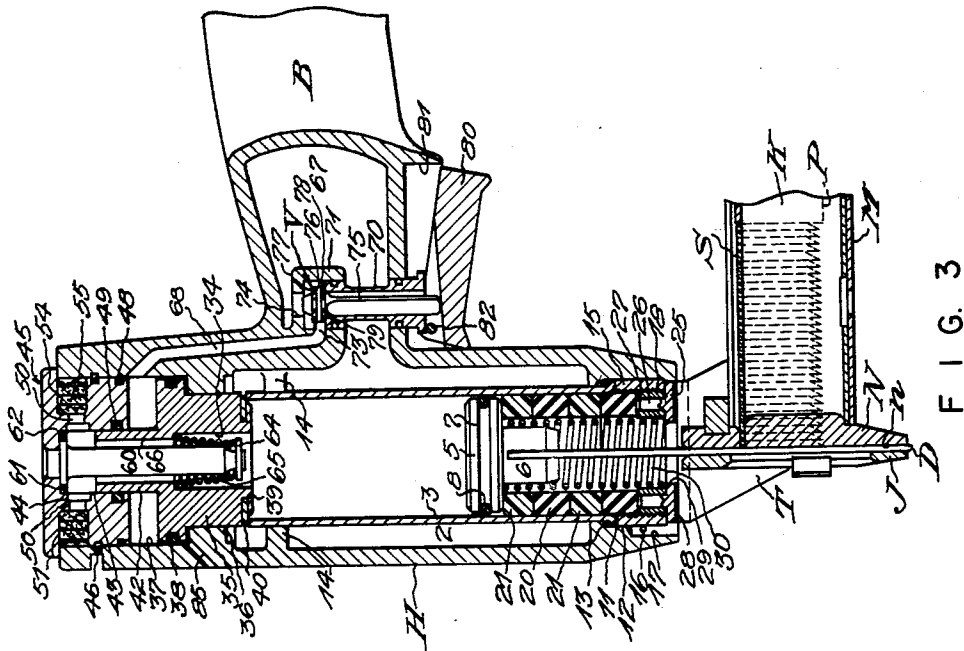
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3 Sheets-Sheet 2



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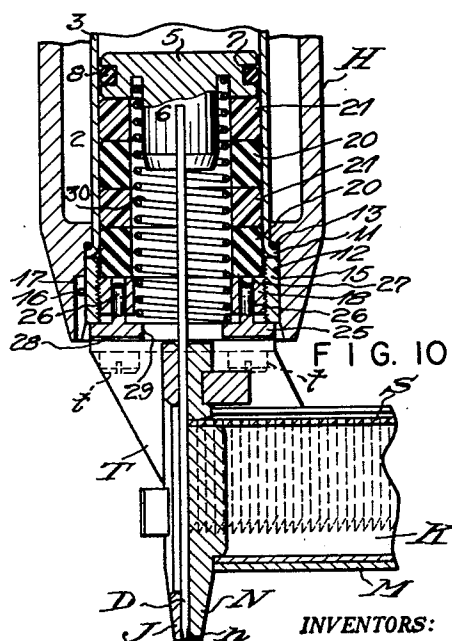
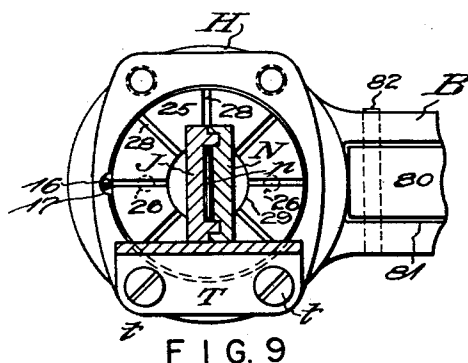
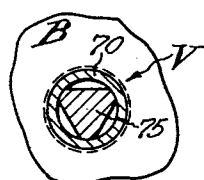
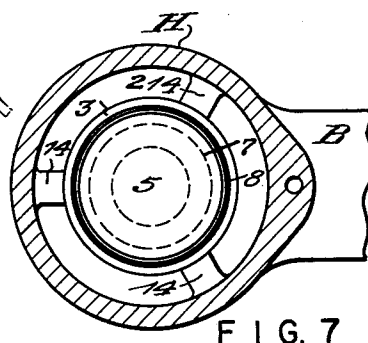
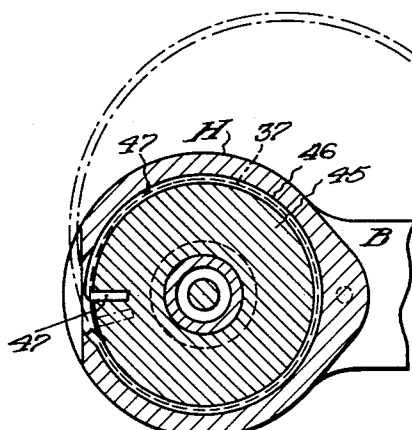
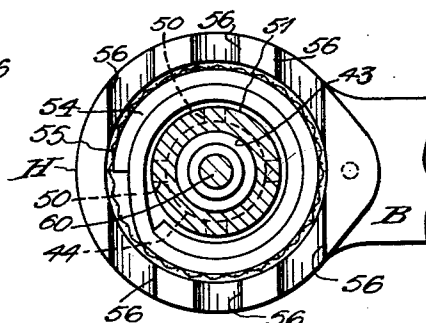
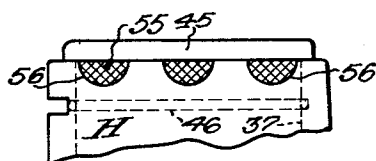
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3,010,430

FASTENER DRIVING MACHINE

Filed May 19, 1959

3 Sheets-Sheet 3



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3,010,430

FASTENER DRIVING MACHINE

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Filed May 19, 1959, Ser. No. 814,179
5 Claims. (Cl. 121-13)

This invention relates to piston-driven machines or appliances and more particularly to a portable fluid-pressure operated implement for fastening together various objects and articles by driving staples to attach parts of automobile bodies, fastening the covers to boxes and cases, tacking or nailing sheathing to the walls of buildings, and for fastening together numerous other articles and objects.

One object of the invention is to provide a lightweight compact implement adapted to be held conveniently in one hand and operated to apply fasteners, such as U-shaped wire staples or the like, to the parts to be attached.

Another object is to provide an implement of the type indicated for rapidly driving staples having relatively long legs to completely embed them in the material of the parts to be attached.

Another object is to provide a machine of the type indicated embodying a piston reciprocated by fluid-pressure, either pneumatic or hydraulic, for actuating the driving means under maximum power throughout a complete stroke.

Another object is to provide a constant supply of high pressure fluid with its full force applied to the piston by means of a semi-automatic diaphragm type valve for admitting the full pressure of the fluid to the cylinder in which the piston operates.

Another object is to provide in a device of the type indicated a main reservoir of large capacity for compressed air or other fluid to be delivered to the cylinder and a smaller chamber separated therefrom by a valve member with manually-operable means for controlling the pressure admitted to the cylinder from the larger reservoir.

Further objects and advantages of the present invention are set forth in the following specification or will be obvious to those skilled in the art; it being understood that the present disclosure is by way of example only to illustrate a preferred embodiment of the invention as shown by the accompanying drawings. In the drawings:

FIG. 1 is a side elevational view of the complete implement taken in a plane intersecting the vertical axis of the machine and showing the driver piston as raised in inoperative relationship;

FIG. 2 is a similar sectional view of the fore part of the machine showing the piston depressed to its lowermost position under fluid-pressure and the driver-blade at the end of its descent after driving a fastener;

FIG. 3 is a similar sectional view showing the valve member closed against the upper open end of the cylinder and the exhaust passage open for venting the pressure from the cylinder to permit the piston to be returned to inoperative position after driving a fastener;

FIG. 4 is a detailed view of a portion of the exhaust passages at the upper end of the head containing the cylinder in which the piston reciprocates;

FIG. 5 is a plan view of the same in transverse sectional view on line 5-5 of FIG. 1 showing the exhaust vents in the top of the head;

FIG. 6 is a transverse sectional view on line 6-6 of FIG. 1;

FIG. 7 is a similar transverse sectional view on line 7-7 of FIG. 2;

FIG. 8 is a transverse sectional view of the manually-operable poppet valve taken on line 8-8 of FIG. 1;

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FIG. 9 is a bottom plan view showing the lower end of the head of the implement partly sectional on line 9-9 of FIG. 1; and

FIG. 10 is a transverse sectional view of the lower portion of the head of the machine similar to FIG. 3 and showing the means for adjusting the abutment or bumper at the bottom of the cylinder to regulate the extent of the downward stroke of the piston and thereby the length of stroke of the driver for driving a fastener into the work.

In general, the present improved fastener applying implement is similar to that disclosed in a co-pending application for United States Letters Patent Serial No. 695,412 filed November 8, 1957. As herein illustrated, the machine is of conventional construction comprising a head H containing the operating elements and surmounting the forward end of a magazine M of usual form for containing U-shaped fasteners such as wire staples S. The magazine M is connected at the front to a nosepiece N formed with a vertical throat or guideway *n* in which the staple-driver D is adapted to reciprocate. The nosepiece N forms part of a bifurcated bracket T, the sides of which are flanged outwardly at the top to abut the bottom of the head H, being fastened thereto by screws *t* as shown in FIGS. 9, 10 and more particularly described herein-after. As shown in FIG. 9, a door or closure plate J has a dovetailed connection with the front of the nosepiece N and may be removably held thereagainst by any suitable means; this part of the structure not being directly related to the present invention. The staples S are supported in straddled relation across a core or longitudinally-extending member K and are fed forwardly therealong by a pusher P advanced under the force of a spring R as usually arranged.

A hollow handle B projects rearwardly from the side of the head H with a hose *b* connected to its end for supplying the interior chamber of the handle with pressure fluid such as compressed air from a suitable source.

The head H is of generally cylindrical shape, being constructed as a casting or otherwise and bored or cored out to provide a relatively large pressure chamber or reservoir 2 on its interior. Mounted axially of the pressure chamber 2 within the head H is a cylinder 3, preferably constructed of tubing or the like with relatively thin walls. A piston 5 has a downwardly-projecting stem 6 slotted to receive the upper end of the driver-blade D of usual construction which is suitably fastened therein. The piston 5 is scored with a peripheral groove 7 in which is a gasket 8 for sealing it in slidable engagement with the inner wall of the cylinder 3. The cylindrical wall is flanged outwardly at the bottom in a projecting rim 11 secured in the enlarged bore 12 at the lower end of the head H in engagement with a shoulder 13 at the upper end of the bore. The cylinder 3 is held concentrically of the chamber 2 in the head H by three spaced lugs 14 projecting inwardly to engage therewith. Inserted in the bore 12 is an annular member or sleeve 15 formed with screw-threads on its interior. A hardened metal ball 16 welded or otherwise secured to the periphery of the sleeve 15 (FIGS. 9, 10) engages in a vertical groove 17 in the lower bore 12 of the head H to key the sleeve to prevent it from turning. An annular nut 18 is threaded to screw into the lower end of the sleeve 15, thus forming a seat for a series of washers 20 and 21 disposed thereabove to provide a resilient bumper for taking the thrust of the piston at the end of its descent.

The washers 20 may be constructed of neoprene, rubber or similar resilient material while the alternate washers 21 may be constructed of suitable plastic material such as polyethylene. In this way a yieldable abutment is formed with the intervening plastic washers protecting the softer resilient ones. A relatively flat disk-like member or plate 25 carrying a pair of upwardly

projecting pins 26 (FIGS. 9, 10), welded or otherwise suitably secured thereto, forms a support at its rim for holding the sleeve 15 in the bore 12. The pins 26 engage in holes 27 in the annular nut 18 and the bottom face of the plate is formed with radial grooves 28 (FIG. 9) adapted for engagement by the end of the blade of a screwdriver or other tool to rotate the plate and thereby turn the nut 18 for raising or lowering the bumper washers 20 and 21. In this way, the extent of stroke of the piston 5 can be adjusted to regulate the length of stroke of the driver-blade D for different types of work. For example, in driving staples into hard material such as metal, it requires that the stroke of the driver-blade be extended slightly as shown in FIG. 3 with its lower end projecting beyond the bottom of the nose N to allow for the rebound; while with material of a softer nature and less resistance to penetration the end of the blade should not project beyond the nose (FIG. 1) to thereby cause it to embed the head of the staple and tear or rupture the material.

It is noted that the plate 25 is formed with a central opening 29 for escape of atmospheric pressure there-through during the descent of the piston 5. A helical spring 30 having one end seated on the member 25 in the bottom of the bore 12 extends upwardly with its upper end surrounding the stem 6 of the piston 5 to adapt it for raising the piston after each stroke.

Reciprocally mounted above the cylinder 3 (FIGS. 2, 3) is a valve closure or member 35 of diaphragm type which is adapted to seat against the open upper end of the cylinder to close it against the ingress of air-pressure. The valve member 35 is of cylindrical formation mounted to slide in an annular bearing 36 formed within the main chamber 2 of the head H. The upper portion of the valve member 35 is shouldered to provide a projecting portion of increased diameter slidable in a larger bore 37 extending through the top of the head H. A gasket 38 held in a peripheral groove in the enlarged upper portion of the valve member 35 engages the bore 37 to seal the joint therebetween. Let into a narrow slot 39 in the lower end of the valve member 35 is a flat annular washer 40 of resilient material projecting outwardly beyond the bottom of said member for engagement with the upper end of the cylinder 3 to effect a tight closure for the opening therein. The valve member 35 is formed with an axial bore 34 and has a tubular stem 42 projecting thereabove for sliding in the bore 43 of the cap or cover 45 fastened to the top of the head H.

The cap 45 has its main portion held in the upper end of the bore 37 in the head H and is scored with a groove for receiving an expansible spring ring 46 (FIG. 6) engaging a groove in the interior of the bore to secure the cap in place. The spring ring 46 has one end 47 bent inwardly for insertion in a radial hole in the side of the cap 45. An annular gasket 48 seated in a groove below the spring ring 46 engages against the interior of the bore 37 to seal the joint for preventing leakage of pressure at this point. Still another smaller gasket ring 49 seated in a groove in the axial bore 43 of the cap 45 bears against the periphery of the stem 42 of the valve to form a seal therebetween. The upper portion of the cap 45 is flanged radially outward to overlie the end of the bore 37 at the top of the head H.

The bore 43 in the cap 45 is counterbored to form an annular recess 44 with holes 50 leading therefrom into a larger circumferential annular recess 51 (FIG. 5). Surrounding the outer ends of the holes 50 in the cap 45 is a felt strip 54 (FIG. 5) helically coiled around the recess 51. Enclosing the felt strip 54 is a narrow strip of screen-cloth 55 sprung into the recess 51 and serving with the felt as a filter for preventing leakage of oil while permitting air from the bore 43 to pass through the vents 50 and exhaust into the atmosphere through concaved grooves 56 in the top of the head H (FIGS. 4, 5).

The grooves 56 provide relatively wide passages for communication between the annular recess 51 in the cap 45 and the atmosphere, thereby providing for venting the air from the cylinder 3 through the stem 42 of the valve member 35 when it is seated against the top of the cylinder 3 as shown in FIG. 3. A spindle 60 fastened in the top of the cap 45 projects downwardly through the axial bore 34 in the valve 35. An annular gasket 61 is held in a groove 62 surrounding the flanged upper end of the spindle. A washer 64 riveted to the lower reduced end of the spindle 60 abuts the end of a helical spring 65 to mount it on the spindle with its upper end engaging the shouldered end of the bore in the main portion of the valve member 35. The spring 65 operates to initially unseat the valve member 35 from the opening in the top of the cylinder 3 for admitting full pressure thereunder to raise it to the full extent as shown in FIG. 2 and later explained.

As before indicated, the hollow handle B serves as an auxiliary chamber or supplemental reservoir for pressure fluid which is in direct communication with the interior 2 of the head H constituting the main reservoir. Consequently, constant pressure is maintained in the main reservoir 2 at all times. The auxiliary pressure chamber 67 communicates with the bore 37 in the upper end of the head H by means of a duct 68 to apply pressure for normally maintaining the valve closure or member 35 seated against the upper open end of the cylinder 3. Actuation of the implement is controlled by manual operation of a poppet valve V at the forward end of the handle B.

The poppet valve V (FIGS. 2, 3) comprises a stem 75 mounted in a tubular bearing 70 inserted through an opening in the lower wall of the handle B and supported thereabove in a bore at the bottom of a casing 71 depending from the upper wall of the handle. The interior of the casing 71 provides a restricted chamber communicating with the duct 68 through a port 73. A port 74 at the top of the casing 71 communicates with the auxiliary pressure chamber 67 in the interior of the handle B. The poppet stem 75 is flatted on three sides (FIG. 8) to provide passageways down through the interior of the tubular bearing 70 to allow escape of the air-pressure into the atmosphere. The stem 75 is tapered at its upper end to adapt it to enter the port 74 at the top of the casing 71 and formed thereon is a disk 76 faced on opposite sides by annular gaskets or washers 77, 78. The gasket 77 is adapted to engage with the inner face surrounding the opening or port 74 (FIG. 2) to close it; and alternately the gasket 78 is adapted to engage the upper end of the opening in the tubular bearing 70 (FIG. 3) to prevent escape of the air therethrough.

A trigger 80 is pivotally mounted between the sides of a slot or opening 81 on the under side of the handle B by means of a pin 82 passing through the sides of said opening. Normally, the poppet stem 75 is forced downwardly as shown in FIG. 3 by the pressure in the auxiliary air-chamber 67 to seat its gasket 78 against the upper end of the bearing 70, thus closing the exhaust port. Simultaneously, the port 73 to the duct 68 is opened for admitting air into the bore 57 above the valve member 35 to maintain it seated against the upper end of the cylinder 3. By raising the trigger 80 as shown in FIG. 2 the poppet stem 75 may be slid upwardly to close the port 74 against pressure from the auxiliary chamber 67 and allow pressure to be released from above the valve member 35 to escape down through the duct 68, port 73 and thence out through the bore in the bearing 70 for exhausting into the atmosphere. The method of operating the poppet valve V is explained more in detail in connection with the actuation of the complete implement.

To prepare the implement for operation the magazine M is loaded with staples S to adapt the pusher P to

feed them forwardly and advance the foremost one into the guideway or throat *n*; it being noted that the magazine *M* may be loaded either through the rear, or from the front by removing the door *J* held against the nose-piece *N*. The machine is charged with pressure fluid such as compressed air supplied from a suitable source through the hose connection *b* at the end of the handle *B*. The auxiliary chamber *67* is open around the poppet valve bearing *70* to cause the air to enter without restriction into the larger main chamber *2* surrounding the cylinder *3* so as to maintain the pressure therein constant at all times.

After the implement has been conditioned for operation as above explained the handle *B* is grasped in the operator's hand with the forefinger looped under the trigger *80* for operating the poppet valve *V*. At this point the poppet stem *75* is maintained depressed by the pressure from the auxiliary chamber *67* with the air entering through the port *74* and acting against the head of the stem (FIG. 3). The port *73* is also held open at this time so that the air flows through the duct *68* into the upper chamber *37* in the head *H* above the valve member *35* to hold the latter seated against the open end of the cylinder *3* for closing it to ingress of the air. It should here be explained that a small duct *85* opens through the side of the head *H* below the shouldered portion of the valve member *35* to vent the air from the bore *37* so as to prevent resistance to the downward movement of the valve member under the pressure thereabove. At this juncture the piston *5* is held raised against the under side of the valve member *35* by the spring *30* (FIG. 1).

The operator may now apply the implement to the work by placing its nose *N* thereagainst, whereafter he starts the operation of driving a fastener by lifting the trigger *80* with his finger. Upon raising the trigger *80* (FIG. 2) the poppet stem *75* is slid upwardly to close the port *74* at the top of the casing *71* and open the port *79* (FIG. 2) at the upper end of the bore in the tubular bearing *70*.

At this operation the air in the bore *37* of the head above the valve member *35* (FIGS. 1 and 2) is released to flow down through the duct *68*, port *73* and exhaust out through the bore in the tubular bearing *70*. As the pressure above the valve member *35* is thus released the spring *65* will act to initially lift said valve member so that full pressure from the reservoir *2* will flow under its rim and force it rapidly upward to the position shown in FIG. 2 for completely opening the top of the cylinder *3*. As the valve member *35* is slid upwardly the end of its stem *42* engages the gasket *61* to close and seal the vent openings *50*. As the top of the cylinder *3* is opened full pressure is applied to the piston *5* to drive it downwardly at high velocity, thereby sliding the driver-blade *D* down in the throat *n* to apply maximum force for inserting a staple into the work. As the piston *5* descends atmospheric pressure escapes from the cylinder *3* through the opening *29* at the bottom of the head *H*. At the end of its descent the piston *5* impinges against the upper washer *21* to cause the resilient washers *20* to cushion the shock; it having been explained that the series of washers is adjusted vertically within the cylinder *3* to regulate the length of stroke of the driver-blade *D* in accordance with difference types of material into which the staples are to be driven.

At the completion of driving each staple the trigger *80* is released to return the parts of the device to their initial relationship as shown in FIG. 1. Upon releasing the trigger *80* the poppet stem *75* is released to be forced downwardly by pressure from the auxiliary chamber *67*. This action opens the port *74* at the top of the casing *71* and also the port *73* to cause the air to flow through the duct *68* and enter the bore *37* in the top of the head *H* so that the valve member *35* is immediately carried down

against the top of the cylinder *3* to close the opening therein. As the piston *5* is now raised in the cylinder *3* the pressure thereabove exhausts through the axial opening in the valve member *35* and the interior of its tubular stem *42* to escape through the radial bores or vents *50*. From the vents *50* the air exhausts to the atmosphere through the grooves *56* as it flows through the filter *54*, *55*. Due to the relief of pressure from the top of the chamber *2* the piston *5* is permitted to slide upwardly rapidly under the force of the helical spring *30* to engage the valve member *35*, held down against the upper end of the cylinder *3*. The parts are thus returned to initial relationship to prepare the machine for subsequent operation in the manner as above explained.

It will be observed from the foregoing specification and by reference to the accompanying drawings that the present invention provides an especially simple and practical form of construction of the device adapted for economical cost of manufacture. At the same time the device is positive and prompt in action for driving fasteners one after another under manual control by the operator to insure rapid application of the fasteners to the work. That is to say, the piston may be operated at high speed with maximum driving force applied to the fasteners so that especially large staples may be set in the work even when the material such as metal imposes considerable resistance to their penetration therein. The appliance is provided with a relatively long magazine for containing a large supply of staples or similar fasteners so that the device may be operated continuously over long periods of time.

While the invention is herein disclosed as embodied in a preferred form of construction and applied to a certain type of machine, it is to be understood that variations may be made in the form and structure of the parts of its mechanism and in the type of machine with which it is used without departing from its scope as expressed in the appendant claims. Therefore, without limitation as to the exact form of construction herein disclosed, we claim:

1. In a staple-applying machine comprising a head constructed as a casting cored out on the interior to provide a chamber therein providing a reservoir for pressure fluid, a cylinder extending vertically within said chamber with its lower end seated in a relatively short bore at the bottom thereof and its upper end spaced from the side walls of the head, said cylinder open across its top to admit fluid pressure from said reservoir, a valve member for engaging the rim of the opening at the top of said cylinder to close said opening therein, means to admit pressure above said valve member for normally seating it across the opening in said cylinder, a spring held under tension for initially lifting said valve member, means to admit full pressure under the bottom of said valve member for raising it to open the top of the cylinder, a piston slidable in said cylinder under the force of pressure admitted thereto, and a driver connected to said piston for reciprocation thereby.

2. In a fastener-applying machine comprising a head of substantially cylindrical formation cored out on the interior to provide a fluid pressure chamber, a sheet-metal cylinder having its lower end seated in a relatively short bore in the bottom of said head, lugs extending from the side walls of said head and engaging with the upper sides of the cylinder to support it vertically in said head, said cylinder completely open across its top, a piston slidable in said cylinder, a staple driver connected to said piston for reciprocation thereby, a diaphragm valve member slidable in said head to seat across the open top of said cylinder, a spring normally held under tension for initiating the lifting of said valve member to cause pressure to enter under its rim for raising said member to admit full pressure from said chamber under said valve member to completely open the top of said cylinder, and manually-controlled means for admitting pressure under said valve

member to raise it for the ingress of pressure into the cylinder to drive said piston.

3. In a fastener-applying machine comprising a head with a chamber therein forming a reservoir for pressure fluid, a cylinder in said chamber having an opening across its top, a piston reciprocable in said cylinder, a valve member slidable above said cylinder to seat against the rim of said opening, said valve member formed with an integral tubular stem projecting thereabove and an opening leading through said valve member to the interior of said stem, a cap closing the upper end of the chamber in said head and having an axial opening therein, vents leading radially outward from the opening in said cap to exhaust pressure into the atmosphere, a spindle projecting downwardly from the opening in said cap, and a spring carried by said spindle and engageable with said valve member to initially lift it above the opening in said cylinder to admit full pressure thereunder.

4. In a fastener-applying machine comprising a head with a chamber therein forming a reservoir for pressure fluid, a cylinder in said chamber having an opening across its top, a piston reciprocable in said cylinder, a valve member slidable in said chamber above the opening in said cylinder to adapt it to seat across the rim of said opening, said valve member formed with an opening through its center and an integral tubular stem projecting thereabove, a spring for initially lifting said valve member to cause pressure to enter under its edge and lift it and admit full pressure thereunder to raise it away from the opening in the top of the cylinder and admit pressure thereinto for driving said piston, a cap closing the upper end of the chamber in said head with a recess therein for receiving the end of the tubular stem on said valve member, and vents leading radially outward from said recess in said cap to discharge into the atmosphere, said vents being closed by the stem on said valve member when said member is raised away from the opening in said cylinder and opened thereby when said valve member is seated against the opening in the cylinder.

5. In a staple-applying machine, a casing having a head with a longitudinally extending chamber therein providing a reservoir for fluid under pressure, a sheet-metal cylinder in said head extending longitudinally of said chamber, said cylinder having an opening across the top thereof for ingress of pressure fluid from said reservoir, a piston slidable in said cylinder by said pressure fluid, a driver connected to said piston for reciprocation thereby, a valve member slidable in said head to seat across the opening in said cylinder for closing it, means for admitting pressure to said chamber above said valve member to normally maintain it seated against the opening in the cylinder to prevent ingress of pressure thereinto, said valve member having a central opening therethrough, a cap closing the upper end of said chamber in said head and formed with an axial recess with vents leading therefrom to the atmosphere, said valve member having a hollow stem integral therewith and of such length as to adapt it to slide across and close the vents in said cap when said valve member is raised away from the opening in the top of the cylinder and to open said vents when said valve member is carried downwardly to seat across the opening in the cylinder, a spring in the opening in the valve member, means for supporting said spring under compression to cause it to engage said valve member to initially lift it away from the opening in the top of the cylinder, means for normally applying pressure on the top of said valve member to maintain it seated across the opening in the cylinder, and manually-operable valve means to admit full pressure under said valve member when it is initially lifted by said spring.

References Cited in the file of this patent

UNITED STATES PATENTS

338,771	Page et al.	Mar. 30, 1886
2,121,891	Stetson	June 28, 1938
2,233,395	Blanchard	Mar. 4, 1941
2,677,933	Hopkinson	May 11, 1954
2,682,658	Hoefflich	July 6, 1954
2,872,901	Goldring	Feb. 10, 1959