

Filed July 9, 1962

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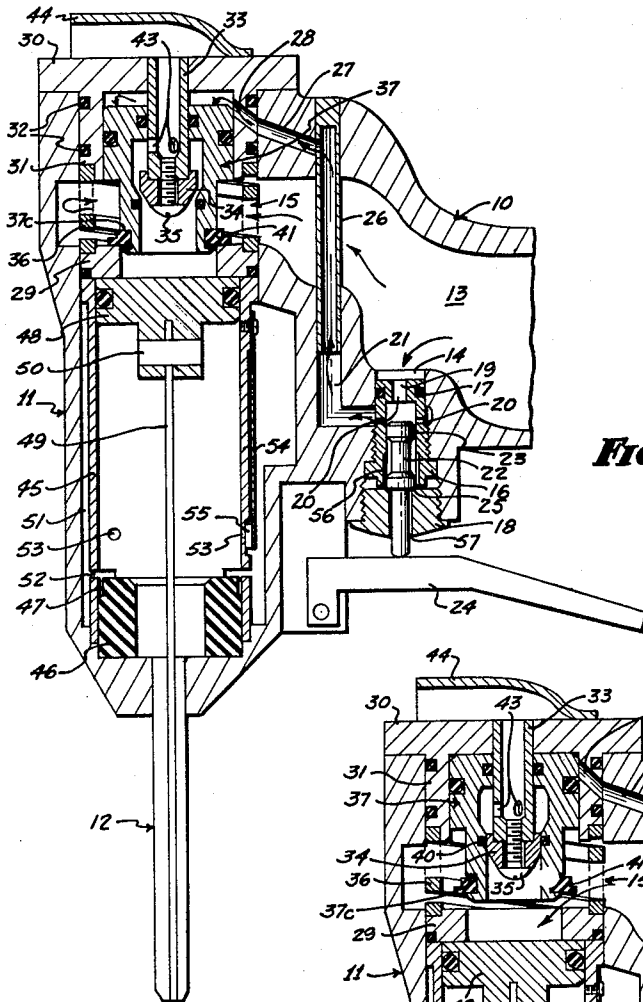


Fig. 1

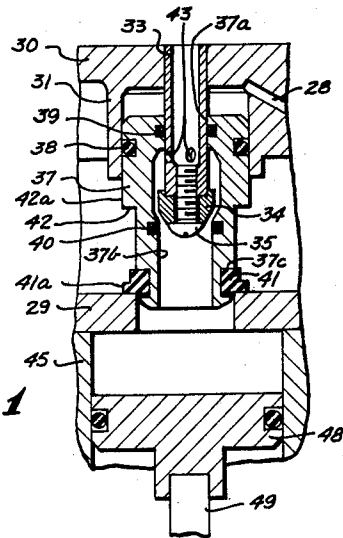


Fig. 6

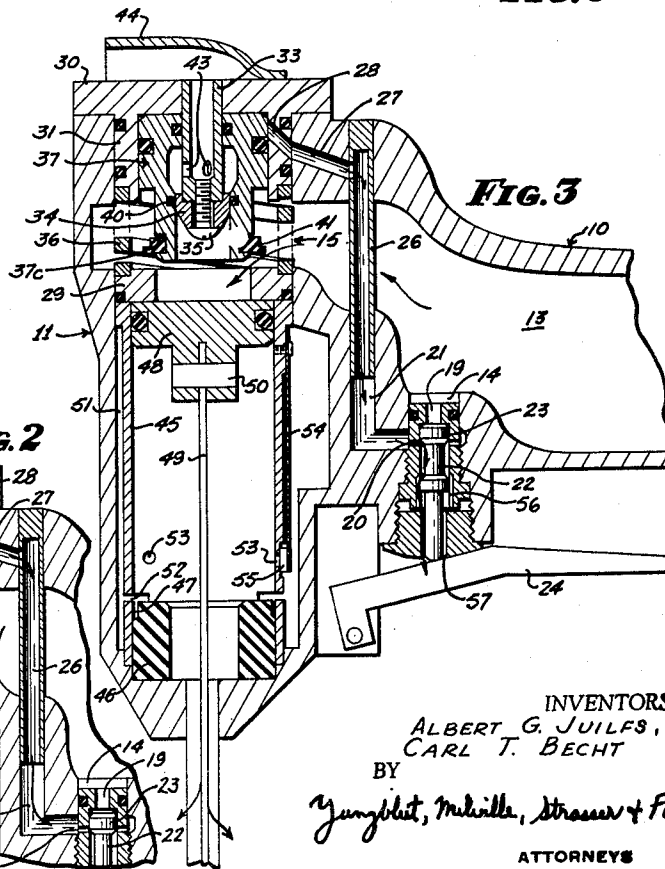


Fig. 3

INVENTORS.

ALBERT G. JUILFS,
CARL T. BECHT

BY

Youngblood, Melville, Strasser & Foster

ATTORNEYS

Feb. 23, 1965

A. G. JUILFS ETAL
SPRINGLESS FIRING VALVE

3,170,487

Filed July 9, 1962

2 Sheets-Sheet 2

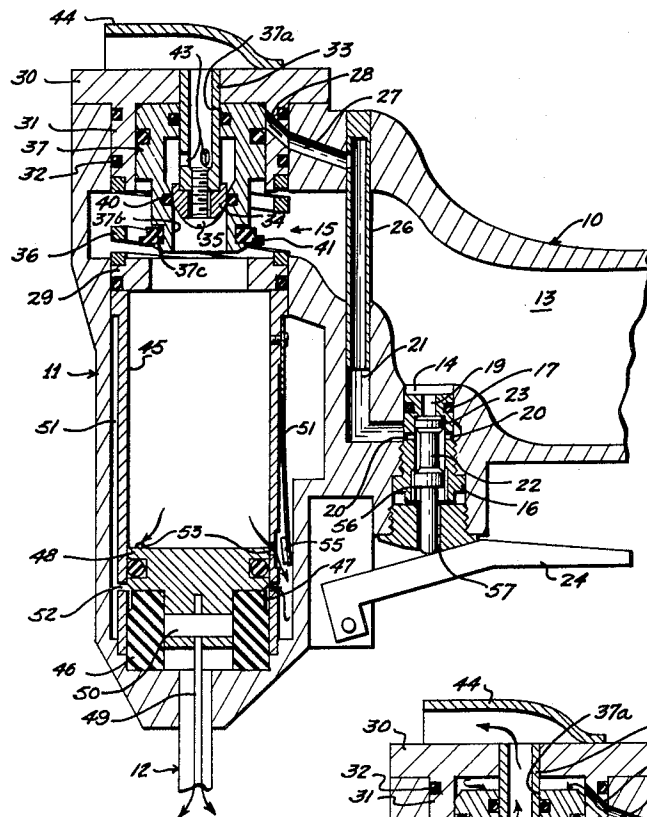
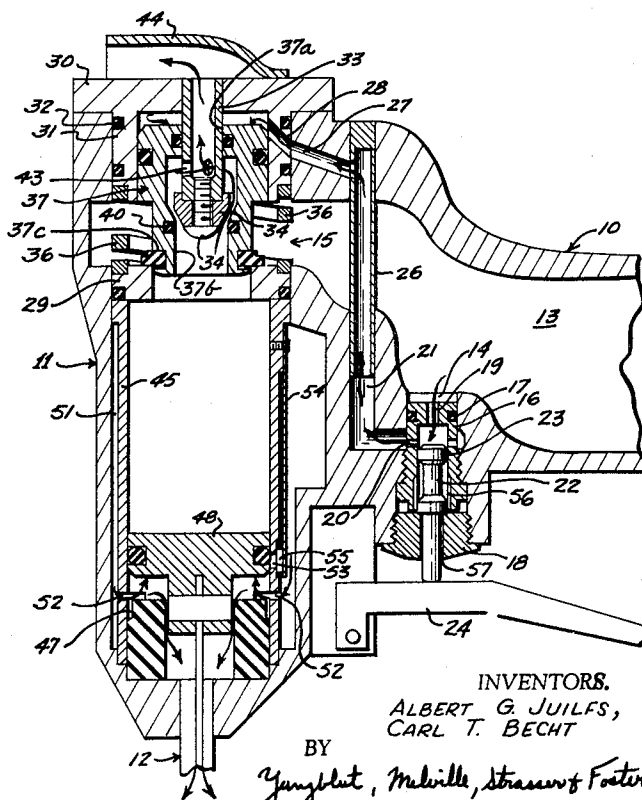


FIG. 4

FIG. 5



INVENTORS.
ALBERT G. JUILFS,
CARL T. BECHT

BY

Youngblut, Melville, Strauss & Foster

ATTORNEYS

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3,170,487

SPRINGLESS FIRING VALVE

Albert G. Juilfs and Carl T. Becht, Cincinnati, Ohio,
assignors to Senco Products, Inc., Cincinnati, Ohio, a
corporation of Ohio

Filed July 9, 1962, Ser. No. 207,175

7 Claims. (Cl. 137—625.6)

This invention relates to a springless pressure valve, and more specifically, to such a valve disposed to control the flow of fluid into a driving or working cylinder.

In its broadest terms, this invention will have utility any time it is necessary or desirable to control the flow of a fluid under pressure. However, and for purposes of illustration only, the invention will largely be described as employed with pneumatic staplers and nailers where it has been found to have great particular utility. In such an application, the valve of this invention serves to control the flow of fluid power into the working or driving cylinder of the device. But it is to be understood, and for that reason emphasized at the outset, that none of these factors is to be considered a limitation on the invention, except as specifically set forth in the claims following this disclosure.

In the case of the conventional valve which is spring biased to its closed position, and which is opened either manually or by the action of fluid pressure, speed of operation will vary over a considerable range depending on the pressure used. In other words, for any given spring, the greater the pressure, the faster the valve will open, and the lower the pressure, the slower the valve will open. This is particularly important in the case of a firing valve, since a quick acting valve will deliver the fluid power to the driving or working cylinder much more rapidly, and thereby obtain more power in the working stroke. Since pressures available in commercial operations will vary considerably and since springs also vary considerably, undesirable variations in the speed of valve operation will occur in these prior devices. Herein lies one of the greatest merits of this invention. Since the valve hereinafter disclosed is actuated solely by pressure and force differentials it will work equally well at all operating pressures.

To aid in fully and completely understanding the operation of the instant valve in its specific applications to a pneumatic stapling device, a brief analysis of the prior art background will be very helpful. These comments will necessarily be somewhat generalized; if desired, a full and complete disclosure of one type of pneumatic stapler may be found in U.S. Patent 2,983,922 issued to A. G. Juilfs on May 16, 1961. Basically, such a device comprises a remote control valve, actuated by simple trigger, which serves to actuate a firing valve. This firing valve in turn controls the flow of pressurized air into the driving or working cylinder. When the remote control valve is actuated by the trigger, thereby opening the firing valve, pressurized air from any conventional source will flow through the gun to the driving cylinder, forcing a piston and the staple driver downwardly, driving the staple or nail into the workpiece. The flow of pressurized air to the top of the piston must then be stopped, so that the piston and driver may return to their initial position. Early devices operating on this principle included springs or similar mechanical devices, serving both to return the driving piston to its original position and to return the firing valve to the closed position. In the interest of

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operating efficiency, it was later found desirable to eliminate as many of these springs as possible. A major step forward occurred with the development of a means for utilizing the pressurized air to return the driving piston to its original position. While this step sounds relatively simple, it will be obvious to one skilled in the art that it increases many fold the difficulties of timing and the complexities of the valve structures required. In other words, as a pressurized fluid is introduced to the driving cylinder above the driving piston, the area in that cylinder below the driving piston must be provided with an exhaust port which will permit the fluid beneath the piston to be expelled as it moves downwardly. To effect a return of the piston, these exhaust ports must be closed, and pressurized fluid must now be introduced to the cylinder beneath the driving piston; and of course, means must be provided to exhaust the pressurized air which is now in the driving cylinder above the piston. The valving and timing problems of such a device are so great that it is characteristic of all prior devices that at some point in their cycle, both intake and an exhaust port will be open at the same time, with the consequent loss of air.

Accordingly, it is a primary object of this invention to provide a springless valve to control the flow of a pressurized fluid into the driving or working cylinder positively and accurately irrespective of the pressure used.

An equally important object of this invention is the provision of a firing valve of such a construction that at no time in its operating cycle are the exhaust and intake ports open together.

A further object of this invention is to provide such a valve adapted for use in a pneumatic stapler which used as minimum amount of air even though the driver actuating piston is both driven and returned by air.

A very important object of this invention is the provision of a springless firing valve for a portable pneumatic stapler such that the efficiency of the stapler will be greatly increased.

Still another object of this invention is to provide a springless firing valve for a portable pneumatic stapler which will result in substantially trouble free operation, and which may be easily replaced in the event that a defect should occur.

These and other objects of the invention will be readily apparent to one skilled in the art after reading this specification and examining the accompanying drawings. For purposes of illustration, the invention is shown as applied to a portable pneumatic stapler, and the same reference numerals have been employed to designate similar parts throughout the several views.

FIGURE 1 is a fragmentary cross-sectional view, showing the original position of the various components.

FIGURE 2 is also a fragmentary cross-sectional view similar to the top portion of FIGURE 1, showing the position of the firing valve just prior to the beginning of the driving stroke.

FIGURE 3 is a fragmentary cross-sectional view similar to FIGURE 1 indicating the position of the firing valve at the initiation of the driving stroke.

FIGURE 4 is a fragmentary cross-sectional view showing the various parts at the end of the driving stroke.

FIGURE 5 is a fragmentary cross-sectional view showing the driving mechanism and firing valve at the beginning of the return stroke.

FIGURE 6 is a fragmentary cross-sectional view showing only the firing valve and the driving mechanism towards the end of the return stroke of the driving mechanism.

As noted in the foregoing preambular comments, the firing valve of this invention is actuated entirely by force and pressure differentials. Since this is a crucial aspect of the invention, amplification of these comments by way of brief description of the operation of the device is appropriate at this point. And once again, it should be pointed out that while the description is made in terms of a pneumatic stapling device, this is exemplary only, and should not be construed as a limitation of the scope of this invention. The contemplated firing valve comprises a valve chamber, one end of which communicates with the working or driving cylinder of the stapler. The other end of the valve chamber is provided with a fixed center post, the lower end of which is of a larger diameter than the upper end. Both an air inlet and an exhaust port must be provided near each end of this chamber. Within this chamber is a movable valve element adapted for reciprocal movement over the fixed center post. This will mean that the upper portion of the valve element must be provided with a bore of the same size as the upper end of the fixed center post, and the lower end of the valve element must be provided with a bore of a larger diameter—a diameter equal to that of the enlarged end of the fixed center post. Sealing means are provided between each portion of the center post and its mating bore in the valve element. This construction results in a surface area differential, so that when the same pressure is applied to both ends of the valve element, it is urged in a direction away from the end having the larger area, which in this case would be downwardly.

The operation of the valve when embodied in a pneumatic stapler is as follows. The stapler will be connected to any conventional source of pressurized air. With the various components in their original position, the air inlets in both ends of the valve chamber are open and in communication with this source of pressurized air, so that under the influence of the area differential, the valve element is urged to the closed position; that is, the port leading from the valve chamber to the driving cylinder of the stapler is closed. Also at this time, the exhaust port in the lower end of the valve cylinder (which also serves to exhaust the driving cylinder) is open to the atmosphere.

Upon actuation of the trigger, the first step is to close the air inlet leading to the upper end of the valve chamber. This is accomplished by means of a remote control valve which will be more fully described hereinafter. Further movement of the trigger results in a further movement of this remote control valve which in turn opens the exhaust port in the upper end of the valve chamber to quickly exhaust the pressure applied to this end of the valve element. When the total force applied to the lower end of this valve element (larger pressure applied to the smaller area) can overcome the total force applied to the upper end of this element (this upper end now being open to exhaust), the valve element will be moved upwardly.

By means of the novel and unique construction of this valve element, the upward movement accomplishes two very important functions, and furthermore carefully controls the timing sequence of these operations.

The first fraction of an inch of upward movement of the valve element closes the exhaust port in the lower end of the valve cylinder. As was noted earlier, this same exhaust port also serves to exhaust the driving cylinder during the return stroke of the piston therein, but that stage of the operation will be considered at a later point.

The remainder of the upward motion of the valve element results in the valve lifting off and thereby opening the passageway leading to the driving cylinder of the stapler. With this passage open, the pressurized air rushes into the cylinder, driving the piston and staple driver downwardly, whereupon the driver will engage a staple,

driving it into the workpiece. Conventional means may be provided for holding a plurality of staples and placing them successively beneath the staple driver.

To complete the operating cycle, the above procedures are exactly reversed. In other words, as the trigger is released, the remote control valve will first close the exhaust port in the upper end of the valve cylinder. Further movement of the remote control valve will open the air inlet in the upper end of the valve chamber, thereby permitting the full force of the pressurized air to act upon the top surface of the valve element. As explained above, since this top surface area is larger than the bottom surface area of the valve element, equal pressure applied to both ends will result in its downward movement.

Once again, the downward movement performs two very important functions, and also serves to control their timing. The valve element will move down until it first closes the port leading from the valve chamber to the driving cylinder. And then, further downward movement of the valve element will open the exhaust port in the lower end of the valve chamber. This will then permit the pressurized air above the piston in the driving cylinder to escape to atmosphere, and the piston and driver may be returned to their original position by any suitable means. In the particular embodiment shown, we have provided an air reservoir around the driving cylinder, and again utilize pressure differentials to effect the return of the driving piston.

It is believed that the foregoing brief description will clearly illustrate the primary objects of this invention. In the first place, there are absolutely no springs in either the remote control valve or the firing valve. Both the firing valve which is the subject of this application, and the driving piston are actuated entirely by force and pressure differentials. The remote control valve is actuated manually and returned by air pressure. Secondly, and very important, is the timing of the device which insures that at no time in the operating cycle of either the firing valve or the remote control valve are both an exhaust port and an intake port open together. For example, in the area of the valve chamber above the valve element, the first movement of the trigger and the remote control valve closes the air inlet; further movement will then open the exhaust port. And in the reverse cycle, the exhaust port will be closed before the air inlet is open again. And in the case of the area of the valve chamber beneath the valve element, the exhaust port will be closed before the port opens to admit the pressurized air into the driving cylinder; and in the reverse cycle, the air inlet will be closed before the exhaust port opens.

It will be obvious to one skilled in the art that this construction results in a very simple and very economical operation.

Turning now to FIGURE 1, the invention will be described in greater detail. A conventional pneumatic stapler includes a housing having a handle portion shown generally at 10, a main body portion similarly shown at 11, and a nose portion shown at 12. It will of course be understood that the stapler will include means for storing and feeding staples into the nose section 12; many satisfactory devices for this purpose are available, and since it forms no part of the instant invention, this storing and feeding means has not been shown in any of the figures.

The motive power for this device is obtained from any suitable source of air under pressure. The ordinary shop air line will deliver air at a pressure of about 85 to 100 pounds per square inch; however, it is noteworthy that this invention will operate equally well over a very wide range of air pressures. The handle portion 10 of the stapler is provided with a hollow chamber 13 communicating with the air supply. The air chamber 13 is provided with two ports, 14 and 15, which communicate with the upper and lower ends of the valve chamber respectively. The port 15 is always open, and defines an extension of the chamber 13. The flow of air through

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the port 14 is controlled by means of the remote control valve which includes a valve body or sleeve 16 which is threaded into the handle portion 10 of the stapler. A rubber O-ring 17, or other suitable sealing means, insures an air-tight fit between the valve sleeve and the stapler housing. At its upper end, the valve sleeve 16 is provided with a port 19 which, through the port 14, is in communication with the supply of pressurized air in the chamber 13. The valve body is also provided with a plurality of ports 20 annularly spaced about the valve sleeve and opening into a passage 21 formed in the stapler housing. Within the valve sleeve 16 is a movable plunger 22 having a sealing means 23 with a relatively flat face which is wider than the ports 20. This plunger 22 is adapted to reciprocate within the valve body 16 under the urging of the manually operated trigger 24 in one direction, and under the urging of air pressure in the opposite direction. A cap 18 threaded into the stapler housing serves to retain the plunger 22 against the air pressure entering through the ports 14 and 19. Initially, the parts will be in the position indicated in FIGURE 1. That is, the plunger 22 is in its lowermost position in which the flange 25 abuts against the plug 13. In this position, it will be noted that the member 23 is below the ports 20 in the valve body. This means that the pressurized air in the chamber 13 flows through the ports 14 and 19 into the sleeve, and then through the ports 20 into the passage 21. The small tube indicated in the drawings at 26 serves to connect the passage 21 with the passage 27 also formed in the stapler housing. The passage 27 in turn communicates with the upper end of the firing valve through the port 28.

Still referring to FIGURE 1, the various parts of the firing valve will now be described. The valve chamber is formed in the upper part of the body portion 11 of a stapler. It terminates at its lower end in a valve seat 29, and the upper end is closed by a cap 30. As is clearly shown in the drawings, the cap 30 is provided with an annular wall 31 which extends down into the stapler housing. The sealing rings 32, or other suitable sealing means, insure an airtight fit. The cap 30 may be secured in position by any suitable means (not shown) in the main body portion 11. Securely fastened in the center of the cap 30 is a cylindrical hollow post 33. The post 33 terminates in an exhaust valve 34, which is securely held in place by means of a bolt such as shown at 35. The spacing member indicated at 36 extends from the lower end of the walls 31 to the valve seat 29, and serves to hold the latter element in place.

The moving valve element has been indicated generally at 37 in FIGURE 1. For the sake of clarity, this particular element can probably best be understood by referring at this time to FIGURE 6. It will be observed that the valve 37 is closely fitted within the cap walls 31, with the resilient O-ring 38, or other suitable sealing means, insuring a satisfactory seal. The valve 37 is provided with a hole 37a in its upper end which is slidably engaged over the center post 33, and sealed by means of the O-ring 39 or other suitable sealing means. Similarly, it should be noted that the lower end of the valve 37 is provided with a hole 37b of slightly larger diameter than the hole 37a in the upper end of the valve. And furthermore, the exhaust valve 34 is adapted to seat itself within this latter hole, the O-ring 40 or other suitable sealing means, furnishing a valve seat. Finally, the lower end of the valve body 37 is provided with an annular rubber insert 41. It will be apparent from examining FIGURES 1 and 6 that the rubber insert 41 closely surrounds the valve body 37, but is movable longitudinally with respect to the valve body a very short distance. The importance of this factor will be explained shortly.

Returning now for a moment to FIGURE 1, it has already been pointed out that the air chamber 13 is pro-

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vided with a port 15; it will now be apparent that this port 15 is in constant communication with the lower portion of the valve chamber and valve element 37. As will now be explained more fully, this pressurized air is acting on only a very small surface area. The various members have been so constructed that, see also FIGURE 6, the diameter of the valve element 37 at the point 42a of the shoulder 42 is very slightly greater than the diameter of the rubber insert 41 at its largest part 41a. Therefore, while part of the air pressure is acting to force the rubber insert 41 downwardly to seal against the valve seat 29, the resultant force (considering at this time only the pressure from port 15 acting on insert 41 and shoulder 42) will be upwardly. But at the same time, it will be understood that the pressurized air traveling through the ports 14, 19 and 20, the passageways 21, 26 and 27, and the port 28 into the valve chamber is bearing upon a considerably larger surface area of the valve element 37. As noted before, therefore, this will result in forcing the valve body 37 downwardly which, of course, will effect a seal between the valve seat 29 and the rubber insert 41. As is clearly apparent from FIGURE 1, the hollow center of the valve element 37 is in communication with the atmosphere by means of the ports 43. As will be explained hereinafter, this serves to exhaust to atmosphere the air from the driving cylinder on the return stroke of its piston; the cowl 44 merely serves to direct this exhaust forwardly.

Fixed within the body portion 11 of the stapler is a sleeve 45, which forms the wall of the driving cylinder. Mounted within the lower walls of this sleeve is a resilient bumper 46 which is relieved around its periphery as indicated at 47, and which serves as a piston stop.

Slidably mounted within the cylinder sleeve 45 is a piston 48 to which is firmly secured a staple driver 49. Preferably the driver 49 is connected to the piston 48 by means of a pin 50.

Surrounding the driving cylinder is an air storage chamber 51 defined by the cylinder sleeve 45 and the main body section 11. The sleeve 45 is provided with one or more ports 52 which, as seen in FIGURE 1, lie immediately above the piston stop 46. These ports are always open. Also located in the sleeve 45, but a short distance above the ports 52, are one or more other ports 53; these ports are normally closed by means of the reed 54 and the valve 55.

The skilled worker in the art will of course understand that the operation of such a device is extremely fast—so fast in fact, that the limiting factor is the speed of the operator and not the capacity of the tool. Notwithstanding these very high speeds of operation, the timing of the device is critical. Therefore the step by step operation of the device will now be described. Again, it must be remembered that while the description of such operation sounds slow, the actual operation is very fast. As explained earlier in the specification, with the parts in the position shown in FIGURE 1, the air may travel as indicated by the arrows. That is, air may pass through the ports 14, 19 and 20, through the passages 21, 26 and 27, through the port 28, into the valve chamber above the valve element 37. At the same time, air can pass through the port 15 into the valve chamber adjacent the lower part of the valve element 37. Again, as explained before, the greater exposed surface area at the upper end of the valve element 37 will result in its downward movement, which in turn effects a seal between the rubber insert 41 and the valve seat 29. When the operator depresses the trigger 24, it will raise the plunger 22 in the remote control valve. As this plunger is raised, the member 23 will first block the ports 20, and effectively seal them from the incoming air. As the trigger is depressed further, member 23 passes beyond the ports 20, so that the air which has been compressed above the valve element 37 may now retrace its steps back through the passages 27, 26 and

21, and go through the ports 20, where it is permitted to escape around the plunger 22 by means of the exhaust grooves 56 and 57 in the sleeve 16 (see also FIGURE 3). The pressure previously applied to the upper end of the valve body 37 is now exhausted to atmosphere. The resultant upward pressure of the air acting on the shoulder 42, which has been previously described as larger in diameter than the member 41, will now move the valve element 37 upwardly.

As shown most clearly in FIGURE 2, the rubber insert 41 will remain in place while the valve body 37 is moved upwardly a short distance. Since the exhaust valve 34 is stationary, the effect of this first upward movement of the valve element 37 is to seal the exhaust ports 43 by bringing the O-ring 40 into contact with the valve 34. Continued upward movement of the valve element 37 will lift the member 41 off the valve seat 29, thereby opening this port and permitting the pressurized air to rush into the driving cylinder. The instant that the rubber insert 41 is lifted from the seal 29, the effective surface area of the lowermost part of the valve body 37, to which the upward force of the pressurized air may be exerted, is greatly increased. This results in an explosive-like upward kick to the valve body 37. In other words, the valve body 37 is not driven upwardly by the continuing force of the pressurized air, but by the "kick" it receives as the effective surface area to which the pressurized air is applied suddenly increases. This permits the full force of the pressurized air entering at 15 to be exerted against the piston 43, driving it downwardly. FIGURE 3 shows the relative positions of the various parts just after the rubber insert 41 has lifted off the seat 29.

As the piston 43 moves downwardly, the air beneath it is forced out through the nose of the stapler alongside the driver 49.

FIGURE 4 shows the parts as they will be positioned when the piston 43 has reached the bottom of the driving stroke and rests against the stop 46. In this position, the ports 53 will be above the top edge of the piston 43, and, under pressure of the air, the valve 55 will be open, permitting the air to flow into the chamber 51. Air will continue to pass through the ports 53 against the resistance of the reed 54 until the pressure in the chamber 51 is substantially equal to the pressure in the driving cylinder itself, whereupon the reed 54 will cause the valve 55 to close.

To complete the operating cycle, the above steps must be substantially reversed. This is accomplished upon release of the trigger 24 by the operator. As the trigger 24 moves downwardly, the plunger 22 will also move downwardly under the urging of the pressurized air flowing through the ports 14 and 19, as shown in FIGURE 5. As it moves downwardly, the member 23 will first block and seal the ports 20, preventing further exhaust of the air from above the valve element 37. Continued downward movement of the trigger 24, the plunger 22 and the member 23 will open the ports 20 to the pressurized supply of air. As indicated by the arrows in FIGURE 5, the pressurized air may once again flow into the valve chamber above the valve element 37. And as explained earlier, the greater effective surface area of the top of the valve element 37, as determined by the relative sizes of the holes 37a and 37b in cooperation with the fixed center post 33 and the exhaust valve 34, produces a resultant downward movement, which will once again effect a seal between the rubber insert 41 and the valve seat 29. At this point, the rubber insert will remain stationary, but the valve element 37 itself continues its downward movement a short distance; this last, short downward stroke of the valve element 37 will then break the seal between the O-ring 40 and the exhaust valve 34. When this occurs, the air in the driving cylinder above the piston 43 will be permitted to freely escape around the valve 34, through

the ports 43 and out of the stapler to atmosphere. Final downward movement of the element 37 terminates when the shoulder 37c of this element engages the top surface of the insert or washer 41.

As was the case with the firing valve, a force differential also causes the return of the driving piston. More specifically, it has already been pointed out that the resilient piston stop 46 is relieved at 47. It will also be noted that the ports 52 are located at just the upper edge of the piston stop. This means that the air which has been compressed into the reservoir 51 may now act upon the underside of the piston 43 in the area exposed by the relieved portions 47 of the piston stop. And once again, when the total force on this small surface area overcomes the downward force exerted on the top of the piston (as the air above the piston exhausts to atmosphere), the piston will lift off its stop 46. Once again, the effective surface area on which the pressurized air may act is then suddenly and greatly increased. The resulting "kick" is sufficient to return the piston 43 and the driver 49 to the original position shown in FIGURE 1. And as soon as the piston 43 is started toward its initial position by this kick, the compressed air from the reservoir 51 will be able to escape through the ports 52 and out the nose of the stapler. This air escape means will prevent the full force of the compressed air from acting on the piston during its return, and soften the movement.

In commercial devices of this character, it is generally desirable to provide some means for holding the driving piston in its uppermost position. This may be accomplished by either a spring detent located in the nose of the stapler, or by a magnet located beneath the valve seat 29, or by other means known in the art. Such means are entirely conventional, and have not been shown in the drawing accompanying this specification.

From the foregoing it is believed that the operation of the invention has been fully and completely described. Broadly considered the invention lies in the provision of a springless valve—one which is actuated solely by fluid pressure and force differentials. This insures high speed, effective operation of the valve irrespective of the fluid pressures used. With specific reference to pneumatic staplers, a very efficient and economical tool is produced. This tool has the further advantage that should a malfunction occur, it may be easily and quickly repaired. For example, should a defect develop in the firing valve, the entire assembly including the cap 30, the post 33, the valve 37, and the insert 41 may be removed in a single unit and then replaced.

Having thus described the invention, what is claimed as new and what is desired to be protected by United States Letters Patent is:

1. In combination, a valve chamber having a head and a seat, a valve element (37) reciprocable in said chamber, a stationary member fixed in said chamber and having a first portion (33) of a given diameter, said valve element having a bore (37a) in one end thereof to receive said first portion, said stationary member having a second portion (34) of a different diameter, and said valve element having another bore (37b) in the other end thereof to receive said second portion, the diameter of said first mentioned bore being different than the diameter of said second mentioned bore, and the effective outside diameter of said valve element being constant throughout, whereby when fluid power of equal pressure is applied to both of said ends of said valve element at a time when said portions occupy their respective bores, said valve element will move under the influence of the fluid power applied at that end of said valve element having the smaller bore therein.

2. The combination of claim 1 in which said stationary member is provided with a passage therethrough to atmosphere, said stationary member also being provided with orifices extending from the outside of said stationary member to said passage, said orifices being located in-

intermediate said second portion and said head, sealing means (40) in said valve element adapted to engage said stationary member when said valve element is moved toward said head, and a sealing member (41) on said valve element, the peripheral edge at least of said sealing member (41) being movable with respect to said valve element, the stationary member (33-34), sealing member (41) and sealing means (40) being arranged so that when said sealing member (41) is on said seat, said sealing means (40) is normally free of said stationary member; initial movement of said valve element towards said head bringing said sealing means (40) into sealing engagement with said stationary member while said sealing member (41) remains on said seat; further movement of said valve element toward said head serving to lift said sealing member (41) off said seat; and whereby when said sealing means (40) is engaged with said stationary member and said sealing member (41) is off said seat, initial movement of said valve element toward said seat will bring said sealing member (41) into contact with said seat while said sealing means (40) remains engaged with said stationary member, further movement of said valve element toward said valve seat serving to bring said sealing means (40) out of engagement with said stationary member while maintaining said sealing member (41) on said seat.

3. A springless valve comprising a valve chamber having a head (30) at one end of said chamber and a valve seat (29) at the other end of said chamber, a valve element (37) reciprocable in said chamber between said head and said seat, and a sealing member (41) on said valve element adapted to seat on said valve seat, a valve post (33) fixed in said chamber, said valve element (37) having a bore (37a) in one end thereof to receive said post (33), a control member (34) fixed on said post (33), said control member (34) being larger than said post (33), and said valve element (37) having another bore (37b) in the other end thereof to receive said control member (34), the diameter of said first mentioned bore (37a) being smaller than the diameter of said second mentioned bore (37b), and the effective outside diameter of said valve element (37) being the same at both ends thereof, whereby when fluid power of equal pressure is applied to both of said ends of said valve element (37) at a time when said post (33) and said control member (34) both occupy their respective bores (37a and 37b), said valve element (37) will move under the influence of the fluid power applied at said one end of said valve element (37).

4. The springless valve of claim 3 in which said sealing member (41) is located on said valve element (37) adjacent said other end thereof, the peripheral edge at least of said sealing member (41) being movable with respect to said valve element (37) a relatively short distance, and means (42) to move said valve element toward said head, whereby when said sealing member (41) is on said valve seat (29) at a time when said control member (34) is free of said bore (37b) and said valve element (37) moves toward said head (30), said sealing member (41) will remain on said valve seat (29) during the initial movement of said valve element (37) until said control member (34) occupies said bore (37b), further movement of said valve element (37) toward said head (30) serving to lift said sealing member (41) off said valve seat (29); and whereby when said valve element (37) is at said head (30) and said control member (34) occupies its bore (37b) while said member (41) is free of said seat (29), application of fluid power of equal pressure to both ends of said valve element (37) will first cause said valve element (37) to move towards said seat (29) and said member (41) to engage said seat (29) while said control member (34) continues to occupy said bore (37b), further movement of said valve element (37)

in the same direction then resulting in said control member (34) leaving said bore (37b).

5. A springless valve for controlling the application of fluid power from a source thereof comprising: a valve chamber, a valve seat (29) at one end of said chamber, and a head (30) at the other end of said chamber; a valve element (37) slidable in said chamber between said seat and said head, said valve element having a sealing member (41) adapted to seat on said valve seat, the effective area of one end of said valve element being greater than the effective area of the other end of said valve element; first port means (28) for introducing fluid power from said source to said one end of said valve element, and second port means (15) for introducing fluid power adjacent said other end of said valve element; exhaust port control means (34) for exhausting air from outside of said valve seat and said sealing member to atmosphere; a tube (33) fixed in said head and extending from atmosphere into said valve chamber, said exhaust port control means (34) being fixed on said tube within said chamber; said one end of said valve element having a bore (37a) to receive said tube, said other end of said valve element having a bore (37b) to receive said exhaust port control means, the effective outside diameter of said valve element being one and the same at each of said ends, said bore (37a) being smaller than said bore (37b); and means (23) to cut off the supply of fluid power through said first port means and to exhaust fluid power from said one end of said valve element to atmosphere while maintaining the application of fluid power through said second port means, whereby said valve element will move toward said first port means; and whereby when said means (23) is actuated to supply fluid power through said first port means (28) while maintaining the application of fluid power of equal pressure through said second port means (15), said valve element (37) will move towards said valve seat (29) by reason of the area differentials caused by the effect of the difference in said bores (37a and 37b).

6. The valve of claim 5 in which said sealing member (41) is located on said valve element in the region of said other end, the peripheral edge at least of said sealing member being movable with respect to said valve element, and including means (40) to seal said exhaust port means (34) when said valve element is moved toward said first port means, said sealing member (41) remaining on said valve seat until said means (40) seals said control means (34) whereby preventing any pressure loss to atmosphere, and whereby continued movement of said valve element will lift said sealing member from said valve seat and immediately expose all of the effective area of said other end of said valve element to the fluid power introduced through said second port means.

7. A springless fluid valve for use with a source of fluid under pressure comprising a valve chamber; a valve seat at one end of said chamber; a valve piston slidably received in said chamber, one end of said valve piston being adapted to seat against said valve seat, said valve piston having a single effective outside diameter and a passage extending therethrough; means cooperating with said passage in said valve piston whereby the other end of said valve piston has a greater effective surface area than said one end of said valve piston; said valve chamber having a first port in communication with said fluid under pressure located adjacent said other end of said valve piston, said valve chamber having a second port in communication with said fluid under pressure located adjacent said one end of said valve piston; valve means for controlling the flow of said fluid under pressure to said first port; and exhaust means associated with said valve chamber adjacent said other end of said valve piston; whereby when said fluid under pressure is applied to both ends of said valve piston the resultant force is

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operative to seat said one end of said valve piston against said valve seat.

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M. CARY NELSON, *Primary Examiner.*

SAMUEL LEVINE, *Examiner.*