Jan. 28, 1958 R. A. JACOBUS 2,821,170

STAPLER

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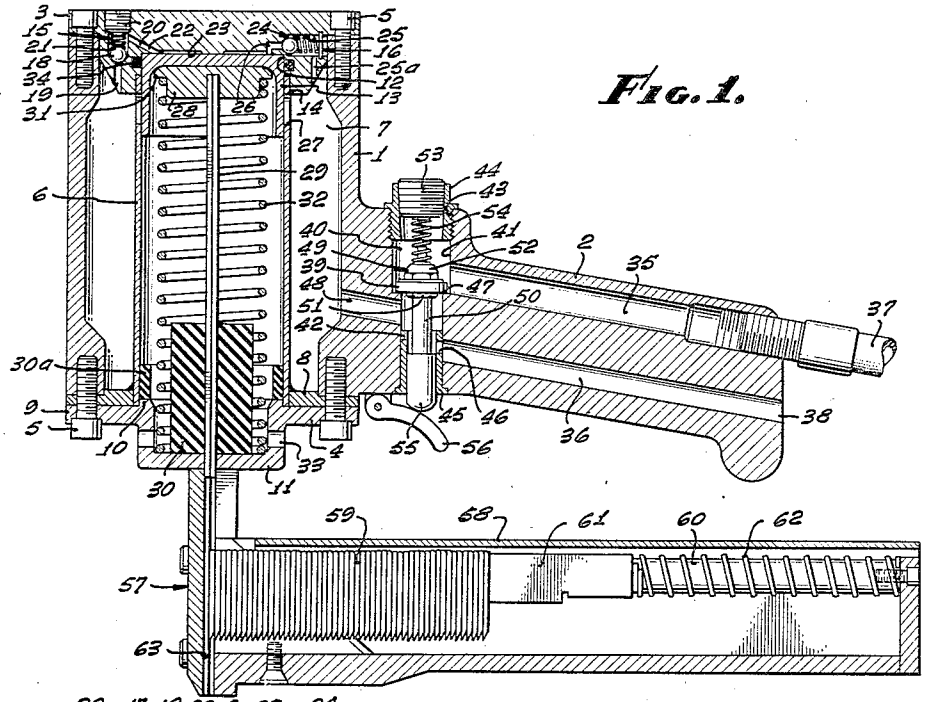


FIG. 1.

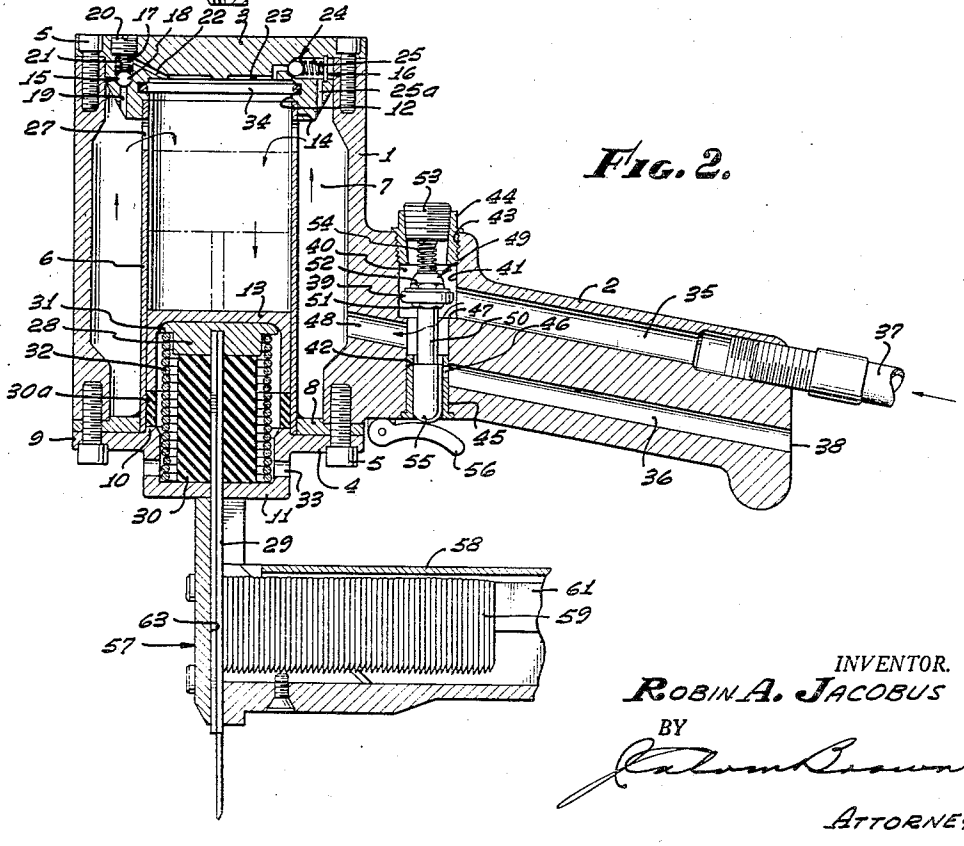


FIG. 2.

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FIG. 3.

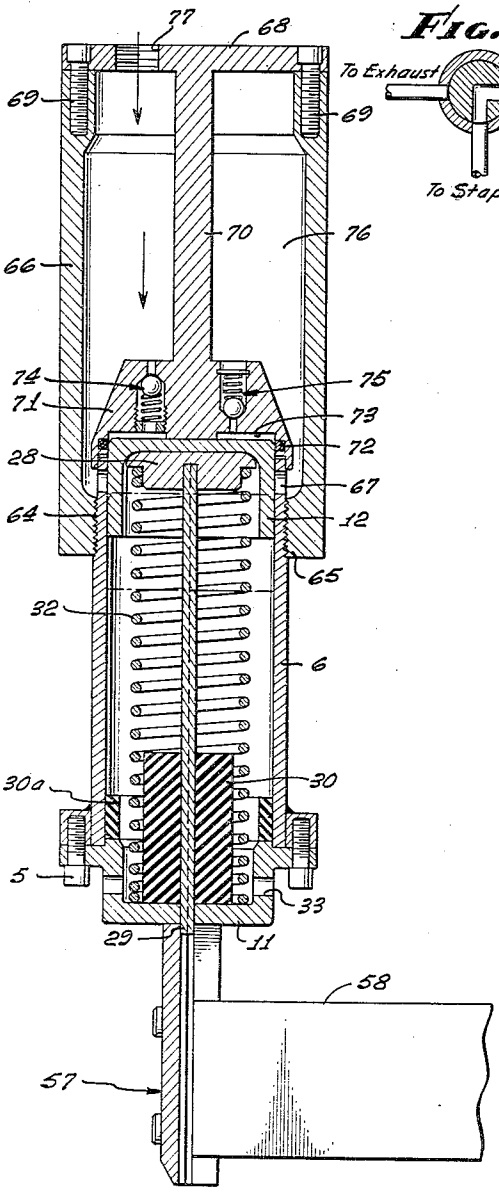
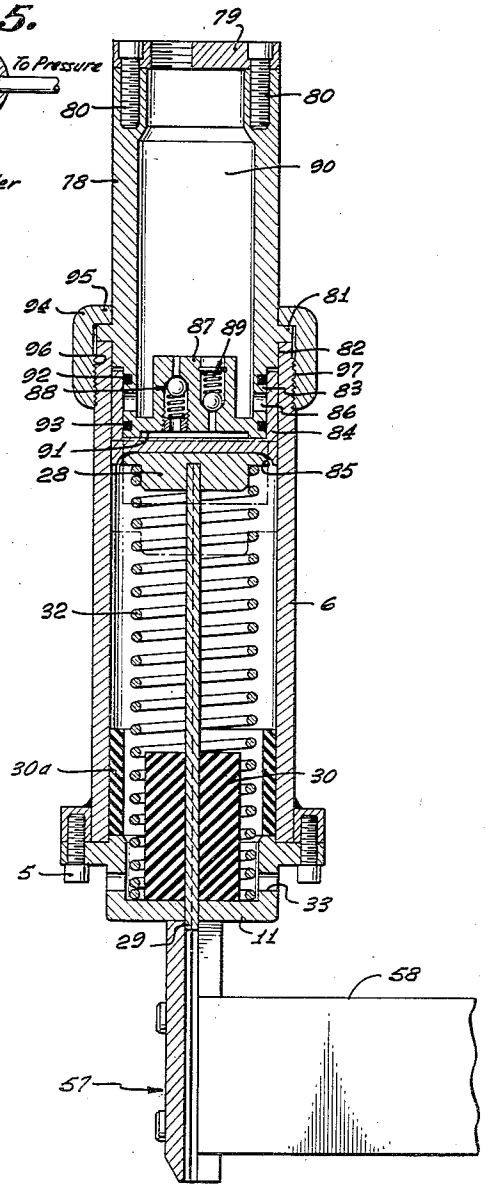



FIG. 5.




FIG. 4.




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# STAPLER

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Application May 2, 1955, Serial No. 505,084

5 Claims. (Cl. 121—21)

The present invention relates broadly to staplers, and more specifically to a driving or impact tool.

The present invention has for an object the provision of a pneumatically operated impact tool which, in one of its embodiments, is used for the driving of staples which are automatically fed to the tool, and which device incorporates an efficient controlled velocity drive.

A further object is the provision of an impact tool so constructed and arranged as to build up a high pressure therein, which is suddenly released to move a driver at high velocity.

The inventor is aware that various pneumatic staplers are now on the market, but so far as the inventor is aware, there is no stapler construction wherein a driver for the staples is adjustably held until a selected pressure has been built up sufficient to suddenly release the driver, and to accomplish this result by simple construction, which is foolproof in operation and inexpensive in cost of manufacture.

A further object is the provision of a driving or impact tool of small size, which may be either manually manipulated or held by suitable means to an object, wherein the air pressure necessary to move a staple driver may be manually controlled, with the result that varying air pressures may be compensated for in the operation of the tool, and which device is of few parts and easily maintained in condition of service.

With the above mentioned and other objects in view, the invention consists in the novel and useful provision, formation, construction, association, and relative arrangement of parts, members and features, all as shown in certain embodiments in the accompanying drawings, described generally, and more particularly pointed out in the claims.

In the drawings:

Figure 1 is a vertical sectional view of one form of impact tool or stapler,

Figure 2 is a view similar to that of Figure 1, certain parts being in changed relationship from that of Figure 1,

Figure 3 is a vertical sectional view of a modified form of the invention shown in Figures 1 and 2,

Figure 4 is a vertical sectional view of a further modified form of the invention from that shown in Figures 1 to 3, inclusive, and,

Figure 5 is a valve which may be used for the forms of invention shown in Figures 3 and 4.

Referring now with particularity to the drawings, and specifically to Figures 1 and 2, I provide a casing 1 provided with an extended handle 2, the casing carrying a head 3 and a base member 4. Both the head and base member are detachably secured to the casing 1 in any appropriate manner, such as by providing screws 5 passed through aligned bores in the head and casing as well as the base member and the said casing.

Within the casing is a cylinder 6, the arrangement being such that there is an annular space 7, which I term the accumulator chamber, between the periphery of the cylinder and the inner wall of said casing. The lower end



of the cylinder is brazed or otherwise secured to a disc 8, and said disc rests upon the flange 9 of the base 4. The disc 8 is provided with bores which match with the bores in the flange 9 through which the screws 5 are passed. The base 4 is provided with an upper annular flange 10, and the lower end of the cylinder 6 is interposed between the inner curved surface of the disc 8 and said flange 10, as shown. The base 4 is provided with a depending cup portion 11.

The head 3 is circularly recessed or bored at 12 so as to receive, in part, a sleeve type piston 13, and the said cylinder is seated in said head in the manner shown at 14, which is to say that the said head is counter-bored for this purpose. The head 3 is provided with an inlet control valve 15 and with an unloading valve 16. The inlet control valve includes a spring-pressed ball 17 and 18, respectively, the ball adapted to seat and thereby close port 19, leading to space 7, the closing, however, being under control of screw 20 which bears against the spring 17 for regulating pressure of the spring against the ball 18. The spring and the said ball of the inlet control valve are confined within an enlarged bore 21 communicating with port 19, and the enlarged bore 21, in turn, communicates with port 22. Port 22 communicates with an annular recess 23 in the base wall bounding the bore 12. The unloading valve 16 likewise includes a ball and spring combination, here designated generally as 24, which spring-loaded ball is confined in an enlarged bore 25 of the said head, the ball being seated or opened so as to close or open communication between the space 25 and a port 26 which leads to the annular recess 23. The bore 25 is in communication with the space 7 through port $25^a$. The cylinder 6 is provided at its upper end, that is, that portion which is adjacent its connection with the head 3, with a series of transverse ports 27, and the skirt of the sleeve piston is of a length sufficient to close these ports when the piston is received within the bore 12 of the head. Within the confines of the cylinder 6 is a staple driver assembly comprising a disc 28 which fits within the sleeve piston 13 and bears against the inner surface of the crown portion of said piston. The disc is formed to receive and carry a staple driver 29, in the form of an elongated bar. The staple driver is passed through a bumper or shock absorbing member 30 of cylindrical form, which is supported within the cup 11, the said bumper being slotted for this purpose, as is likewise the said cup. An annular bumper $30^a$ is supported by base 4 within the cylinder 6 for absorbing piston shock. The disc is flanged at 31, and interposed between the disc and bearing against the flange 31, and the base of the cup 11 and surrounding the bumper 30 and the staple driver 29, is a coil spring 32. This coil spring normally urges the driver and piston to the position illustrated in Figure 1. To relieve air pressure within the cylinder, the said cup is provided with relief ports 33. To assure a pressure-tight engagement between the piston skirt and the head, I provide one or more O-rings 34.

The handle 2 is of such size as to allow the operator to easily manipulate the device, and said handle is provided with two elongated bores 35 and 36. Bore 35 is adapted to communicate with a compressed air line 37, while bore 36 is open to the atmosphere at 38. The admission of air under pressure to the space 7 or the exhaust of pressure air from space 7 is controlled by a valve 39. Valve 39 is confined within a chamber 40. Thus, the handle is provided with bores 41 and 42, bore 41 having the greater diameter and provides chamber 40. The wall bounding bore 41 is internally threaded, at 43, to receive an externally threaded sleeve 44. Bore 42 is provided with a liner 45, having a port 46 which permits communication between the exhaust bore 36 and the interior of the bore 42. The construction is such as to provide a valve

seat at 47. Communicating with the bore 42 and below the seat 47 is a port 48, which port is in communication with space 7. The valve 39 is of the disc type, being carried on a threaded extension 49 of stem 50 between a shoulder 51 and a nut 52. A plug 53 is threaded into sleeve 44 and a coil spring 54 surrounds extension 49 and is interposed between the nut 52 and the plug 53. The stem 50 is enlarged at 55, this enlarged portion fitting closely within the liner 45 so as to close port 46 when the valve is lifted from its seat, and compressed air is admitted to port 48 into space 7. To facilitate ease in moving the valve stem, I have provided a swing trigger 56, which is pinned to the handle 2. No particular type of trigger or its mounting is detailed.

A nose, designated generally as 57, depends from the cup 11, which nose detachably carries a magazine 58 adapted to hold staples, such as illustrated at 59. The arrangement is such that a single staple may be projected from the nose each time the staple driver moves from the position shown in Figure 1 to that of Figure 2. No particular type of staple magazine is contemplated. However, as shown, the staples 59 straddle a track 60, and the said staples are forced by a staple follower 61 by means of coil spring 62 toward the trackway 63 in said nose for the staple driver 29.

The operation, uses and advantages of the invention shown in Figures 1 and 2, are as follows:

Assuming the parts of the device in the position shown in Figure 1, the chamber 40 which is in communication through bore 35 with a source of air under pressure will admit said pressure air to the accumulator chamber 7 when the trigger 56 is actuated to raise the valve 39. A large volume of pressure air will be confined in chamber 7. The moment the trigger is released, the valve will close under pressure of spring 54. When the valve is raised, the enlargement 55 on the valve stem 50 closes the port 46 to prevent any exhaust of the pressure air through bore 36 to the atmosphere. The air under pressure in space 7 must, to escape, pass through port 19. This port is closed by the ball valve 17, 18. However, if the pressure of the air is high enough, the ball will be raised against the pressure of the spring 17 and said air will then pass into the port 22 and reach the annular recess 23, imposing a pressure on the top of the piston. The air cannot escape into the cylinder 6 for the reason that the piston skirt closes the ports 27. The pressure air will not escape to the atmosphere for the reason that the port 26 will only re-conduct the pressure air back into the space 7 if the ball valve is open. The pressure built up on the head of the piston will gradually move the piston downwardly to compress spring 32 and move the staple driver 29. When the piston head reaches the ports 27, the pressure within the space 7 has built up to such an extent that there is a sudden release thereof through the ports 27 to actuate the piston downwardly under great force, in the manner illustrated in Figure 2. The piston is allowed to return, under action of the spring 32, when the valve 39 is closed, as all air under pressure will be exhausted through port 48 and bore 36 to the atmosphere. The cycle of operations is repeated each time the trigger 56 is actuated. It is obvious, of course, that the return of the piston from the position of Figure 2 to Figure 1 is facilitated by the ball valve 24 and the ports 27.

The air pressure necessary to raise the spring seated ball 18 is controlled by compression of the spring 17 through the screw 20. This adjustability makes it possible to select any desired driving force for the piston 13. This is true for the reason that the setting of this valve will result in the piston passing ports 27 to receive the full force of the accumulated pressure in chamber 7 when the air has reached a desired pressure. By way of example, the valve might be set so that the piston action would take place when the air in the chamber 7 has reached a pressure of, say 25 p. s. i., even though the line pressure might be in the normal range of 100 to 125 p. s. i. Likewise, the setting of this valve might be changed so that the piston action would start when the pressure in chamber 7 reached 50 p. s. i., or some other poundage. Thus, the force of the drive would be altered in proportion to the pressure in chamber 7, and it is this principle of selective driving force which is secured by the selective admission of air to the annular recess 23, which is an important feature of my invention. The unloading valve 24 is of importance, as it allows air included between the piston and the head 3 to be ported, to the end that the piston will reach its full upward position quickly so as to operate normally on the next cycle when the tool might be operated at a rapid rate.

The form of the invention shown in Figure 3 utilizes the principles of that form shown in Figure 2. In the form shown in Figure 3, I provide a cylinder together with a piston movable therein, a base member, a staple driver, and a staple magazine. However, the cylinder is not surrounded by a housing or casing. As the parts just mentioned are identical with the form of the invention shown in Figures 1 and 2, such parts will be given the same numbers. The cylinder 6 of Figure 3 is externally threaded at 64 for engagement with the internally threaded annular flange 65 of a cylindrical housing or casing 66. As shown, this housing or casing is extended beyond the upper end of cylinder 6. Ports 67, which are comparable to the ports 27, open within the said housing or casing 66. The housing or casing 66 is provided with a top plate 68 which is secured to the top of the casing by any suitable means, such as by the screws 69. Depending centrally of the top plate is a post 70, which post carries a head 71 for the cylinder 6. Head 71 is constructed and arranged to fit over the upper end of cylinder 6 without obstructing ports 67 and is so recessed or bored as to accommodate the piston 13 at the upper limit of its stroke. A seal in the form of an O-ring is provided at 72, and the head is formed with an annular recess 73 quite similar to the recess 23. Head 71 is provided with two spring-pressed ball valves 74 and 75; valve 74 is adjustable and designated the inlet control valve, while valve 75 is the unloading valve. Each valve 74 and 75 communicates with chamber 76 and pressure air in chamber 76 will unseat valve 74 to allow air under pressure to enter the annular recess 73 and impose air pressure on the head of the piston to move the same. The top plate 68 is provided with a threaded bore 77 for connection with a hose and a three-way valve which leads to a source of air under pressure, see Figure 5.

The form of the device shown in Figure 4 utilizes, as before, the cylinder 6 and its associated members, and in place of surrounding said cylinder with a housing or casing in the form of a jacket, as in Figures 1 and 2, a cylindrical housing or casing 78 extends from the upper end of said cylinder. Whereas the housing or casing 66 of Figure 3 has a greater diameter than cylinder 6, the housing or casing 78 of Figure 4 is of lesser diameter than the said cylinder. Cylinder 78 is normally capped by a top plate 79 held to the end of said casing or housing by screws 80 while inward from the lower end of the housing 78, I have provided an external flange 81. This external flange rests upon the upper end of cylinder 6, with a portion of the lower end of said housing received within the confines of the cylinder, as shown at 82, the said housing being externally reduced in diameter at 83 to provide an annular space between the cylinder and said reduced diameter portion for receiving the piston sleeve 84.

In this construction, it will be observed that the piston has been reversed as to position from that shown in Figures 1 to 3, inclusive, with the external surface of the head of said piston cupped at 85 to receive member 28. The reduced diameter portion 83 of the housing 78

is provided with ports 86, of which there may be any selected number. The construction is such that a head 87 is received within the piston. This head may be integral with the rest of the housing or casing, and the head is enlarged to confine two spring-pressed ball valves, one of which, 88, is the adjustable inlet valve, while 89 is the unloading valve, both valves communicating with chamber 90 within the housing or casing, and with a circular recess 91 adjacent the head of the piston when the piston is in the position shown in Figure 4. It will be noted that the ports 86 communicate with the space 90, and that O-rings are provided at 92 and 93. To secure the parts in working relationship, I have provided an annular clamp-type nut 94, which is flanged at 95 and internally threaded at 96 for engagement with threads 97 at the upper end of the cylinder. The flange 95 engages flange 81 and in this manner, the parts are held together.

The operation of that form of the invention shown in Figure 3 is identical with the operation of the form shown in Figures 1 and 2. However, in place of utilizing the handle of Figures 1 and 2, it is intended that the cylinder 6 of Figure 3 should be clamped to some object to hold the same, and operation of the piston is under the control of a three-way valve to apply pressure air within the chamber 76 or to release pressure from the said chamber. The valve 74 will open when pressure air is admitted within the chamber to a certain degree, depending upon adjustment of the spring of this valve, to in turn apply pressure to the head of the piston, and after the piston has moved a given distance, the skirting of said piston uncovers the ports 67 and the pressure air then moves the piston downwardly very suddenly and with great force, in the same manner as has been previously described for Figures 1 and 2. Upon return of the piston under actuation of spring 32, and after the piston skirt has passed the ports 67, any entrapped air between the piston and the head 71 will be ported into chamber 76 through valve 75.

The operation of that form of the invention shown in Figure 4 is substantially identical with that of Figure 3, the plate 79 being in connection with a hose and three-way valve leading to a source of air under pressure, which pressure air is admitted through valve 88 within and against the head of the piston to move the same until the skirting thereof uncovers the ports 86, whereupon the piston will be suddenly moved downwardly under great force within the cylinder. Piston return will port the air through ports 86 until closed by sleeve 84, and thereafter through valve 89 into chamber 90.

Regardless of the form of the invention, as shown in Figures 1, 2, 3 and 4, the provision of the accumulator chamber is important to the operation of the present invention. In every instance, as air pressure builds up in the accumulator chamber, resultant upon admitting air under pressure therein, it is essential that the pressure drop within the cylinder 6 during movement of the piston should be at a minimum and, hence, the accumulator chamber, which is a reserve chamber for air under pressure, should be substantially larger than the cylinder. As is generally known, air pressure loss varies roughly as the square of velocity and, hence, as the square of the volume of air flowing through a pipe. Thus, if the gauge pressure in p. s. i. is 100 and the bore 48 has a diameter of a quarter of an inch, the discharge in cubic feet of free air per minute at atmospheric pressure and 70° F. is 104. This air under pressure flows into the accumulator chamber 7 and from the accumulator chamber through the bore 19.

If we assume that the diameter of the bore 19 is 1/16 of an inch, then the discharge in cubic feet per minute at 100 pounds p. s. i. is 6.49. Assuming that the bore 22 is substantially the same size as bore 19, it is immediately realized that the piston will be moved very slowly downwardly until the ports, such as 27 in Figures 1 and 2, are opened during piston movement. During this time, the pressure within the accumulator chamber has built up. Roughly, the diameter of the cylinder 6 is one inch, and at a gauge pressure of 100 p. s. i., the discharge in cubic feet of free air per minute is 1,661. Assuming the internal diameter of the housing or casing 1 is roughly 2 inches, less the 1 inch for the cylinder, the discharge from the chamber 7 is slightly greater than the discharge from the cylinder. Preferably, in order to prevent a pressure drop, the cubic inch capacity of the accumulator chamber should be greater than that of the capacity of the cylinder. As a matter of fact, in the showing of the drawing, this will be the actual result, and it will be observed that the piston, together with the bumper, restricts the capacity of the cylinder, and the capacity of the accumulator chamber is substantially twice that of the cylinder. Hence, it is important, in the design of a tool of this character, that the accumulator chamber should be sufficiently large to provide instantaneous equalization of air pressure between the cylinder and the said accumulator chamber.



I claim:

1. A pneumatic stapler, including a cylinder, a cylinder head and a skirted piston within said cylinder, an accumulator chamber member coaxial with the said cylinder and enclosing the cylinder head, a pair of adjustable valves in the cylinder head and communicating between the accumulator chamber member and the top of the piston, one of said valves opening to pass air under pressure from the accumulator chamber member to the cylinder for exerting air pressure on the piston head and the other of said valves opening to release air pressure between the piston and cylinder head.

2. The device as set forth in claim 1, the said accumulator chamber member being secured to said cylinder adjacent the cylinder head.

3. A pneumatic stapler, including a cylinder, a piston within said cylinder and a staple driver to be moved by said piston, a cylinder head for the cylinder, and means normally holding said piston adjacent the said head, an air accumulator chamber member and a manually operable valve for controlling the flow of pressure air to said accumulator chamber member, there being an air port between the accumulator chamber member and said cylinder adjacent the head thereof normally closed when the piston is adjacent the said cylinder head, an adjustable spring loaded ball valve in said cylinder head and controlling pressure air communication between the accumulator chamber member and the cylinder head, whereby air from said accumulator chamber will first move through said ball valve and contact said piston to cause relatively slow movement of the piston downwardly in the said cylinder the said air accumulator chamber member having a cubic capacity relative to the capacity of the cylinder sufficient to provide instantaneous equalization of air pressure between the cylinder and accumulator chamber member when the port is uncovered to effect instantaneous movement of the piston within the cylinder.

4. A pneumatic stapler including a cylinder having a head, a piston for movement therein, an air accumulator chamber having a cubic capacity equal to the cubic capacity of the said cylinder, an adjustable valve for controlling communication between the said air accumulator chamber member and the said cylinder above the piston, the said piston provided with a skirting and the said cylinder provided with a series of enlarged ports communicating between the air accumulator chamber member and said cylinder and normally closed by the piston skirting when the piston is adjacent the head of the cylinder, said air accumulator chamber member adapted to be connected to a valved source of air under pressure, the said adjustable valve initially controlling the pressure of the air against the head of the piston to move the same gradually down-

wardly, there being instantaneous downward movement of the piston within the cylinder when the enlarged ports are exposed to the head of said piston to provide instantaneous equalization of air pressure between the cylinder and said accumulator chamber member.

5. A pneumatic stapler including a cylinder having a head, a piston for movement therein, an air accumulator chamber having a cubic capacity equal to the cubic capacity of the said cylinder, an adjustable valve for controlling communication between the said air accumulator chamber member and the said cylinder above the piston, the said piston provided with a skirting and the said cylinder provided with a series of enlarged ports communicating between the air accumulator chamber member and said cylinder and normally closed by the piston skirting when the piston is adjacent the head of the cylinder, said air accumulator chamber member adapted to be connected to a



valved source of air under pressure, the said adjustable valve initially controlling the pressure of the air against the head of the piston to move the same gradually downwardly, there being instantaneous downward movement of the piston within the cylinder when the enlarged ports are exposed to the head of said piston to prove instantaneous equalization of air pressure between the cylinder and said accumulator chamber member, and means for valving the air from the cylinder during return movement of the piston within the cylinder toward the head of the cylinder.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 1,825,632 | Korvin et al. | Sept. 29, 1931 |
| 2,585,940 | Juilfs | Feb. 19, 1952 |