Aug. 8, 1961 H. J. STARR 2,995,114

STAPLER VALVE

Filed Jan. 29, 1959 2 Sheets-Sheet 1

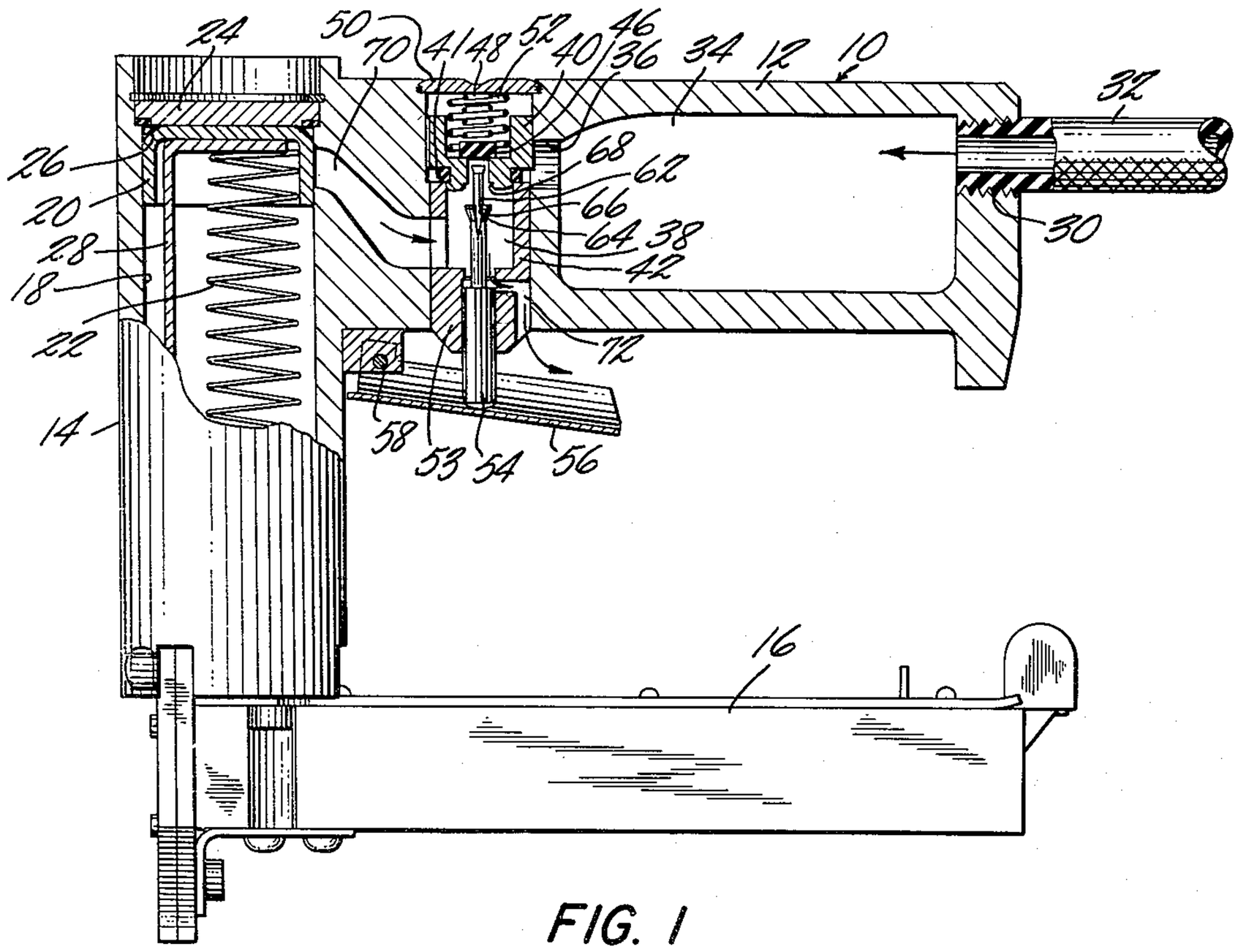

FIG. 1

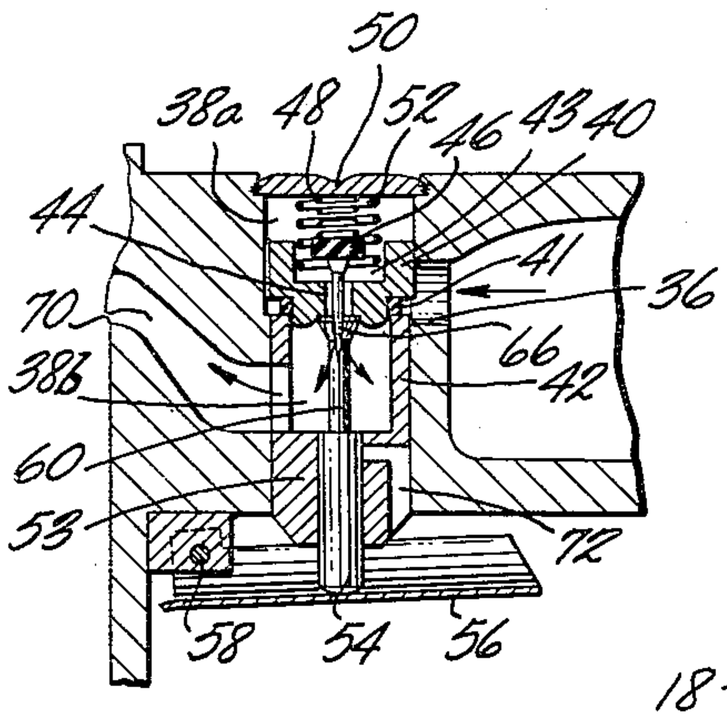

FIG. 2

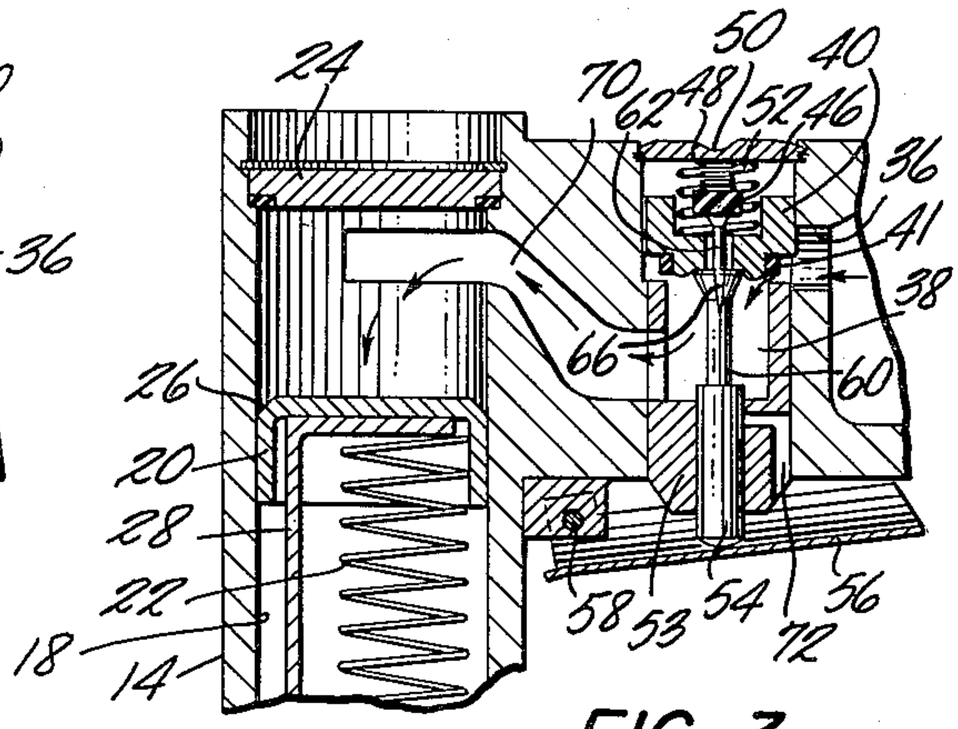

FIG. 3

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STAPLER VALVE

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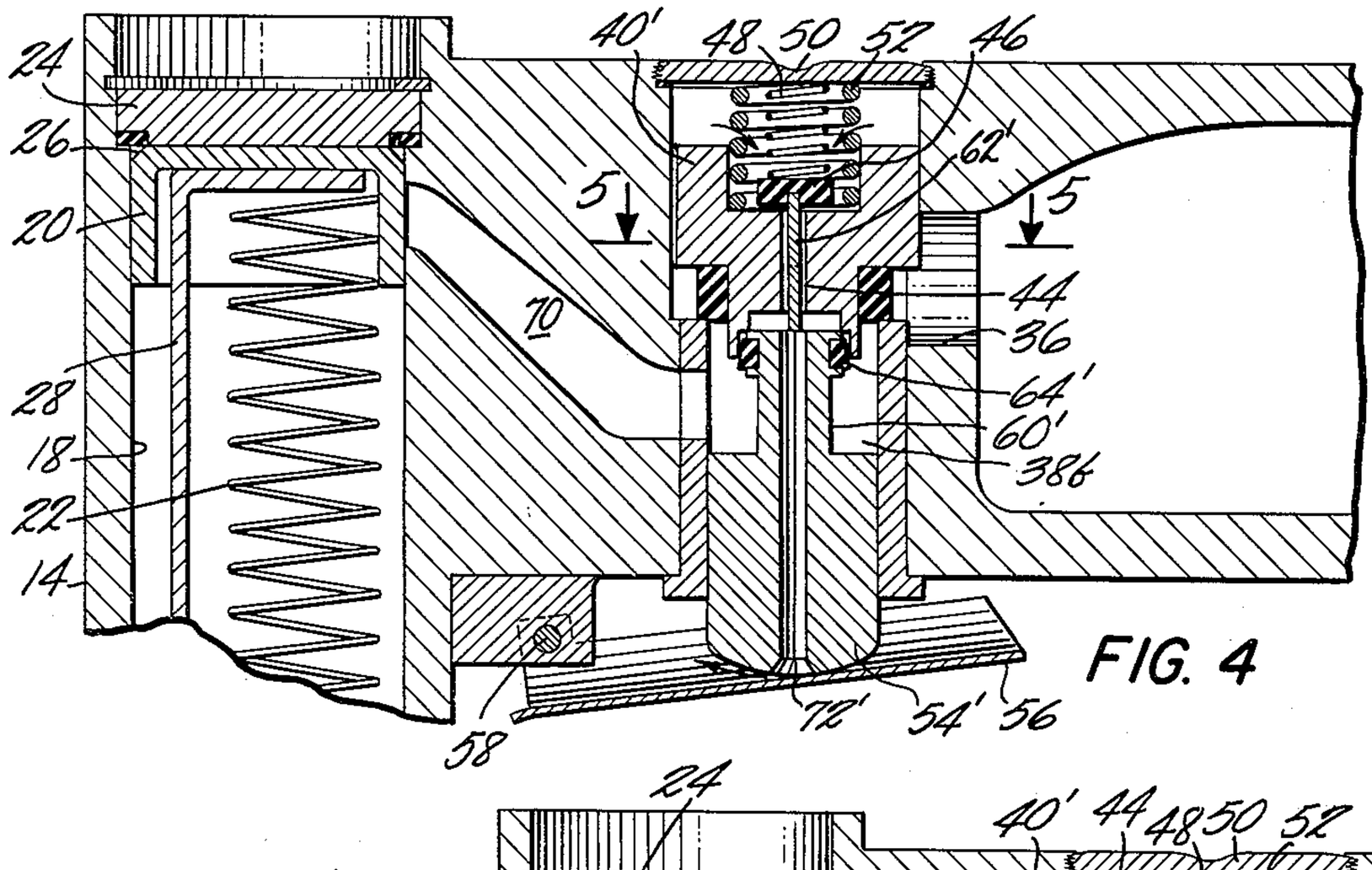

FIG. 4

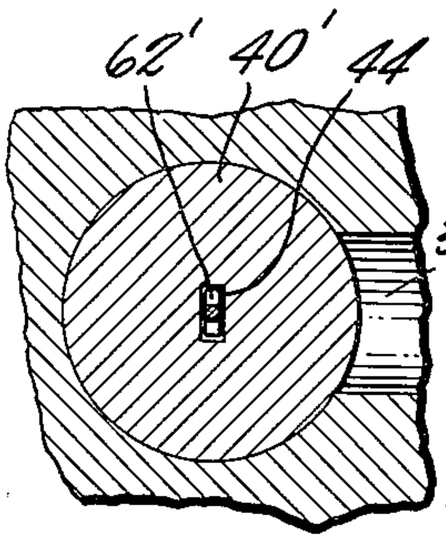

FIG. 5

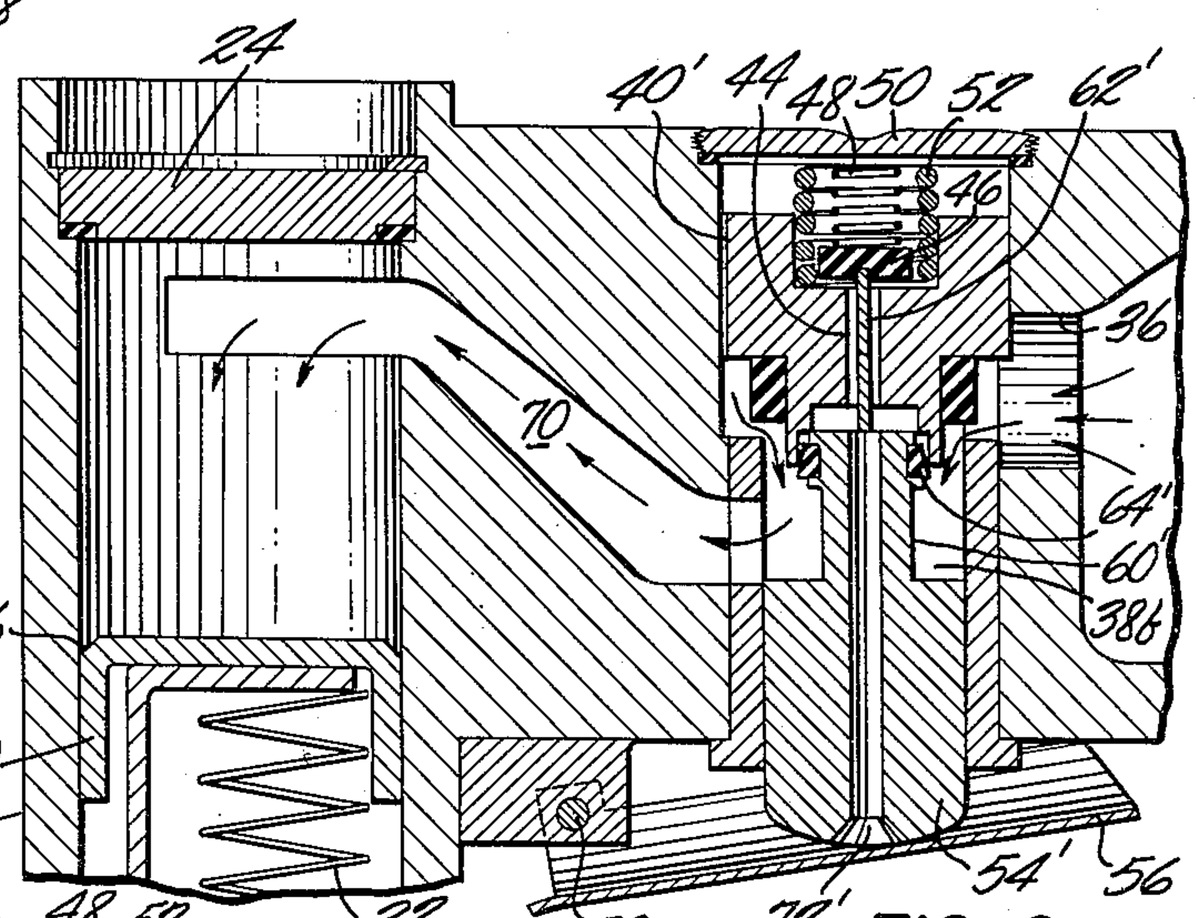

FIG. 6

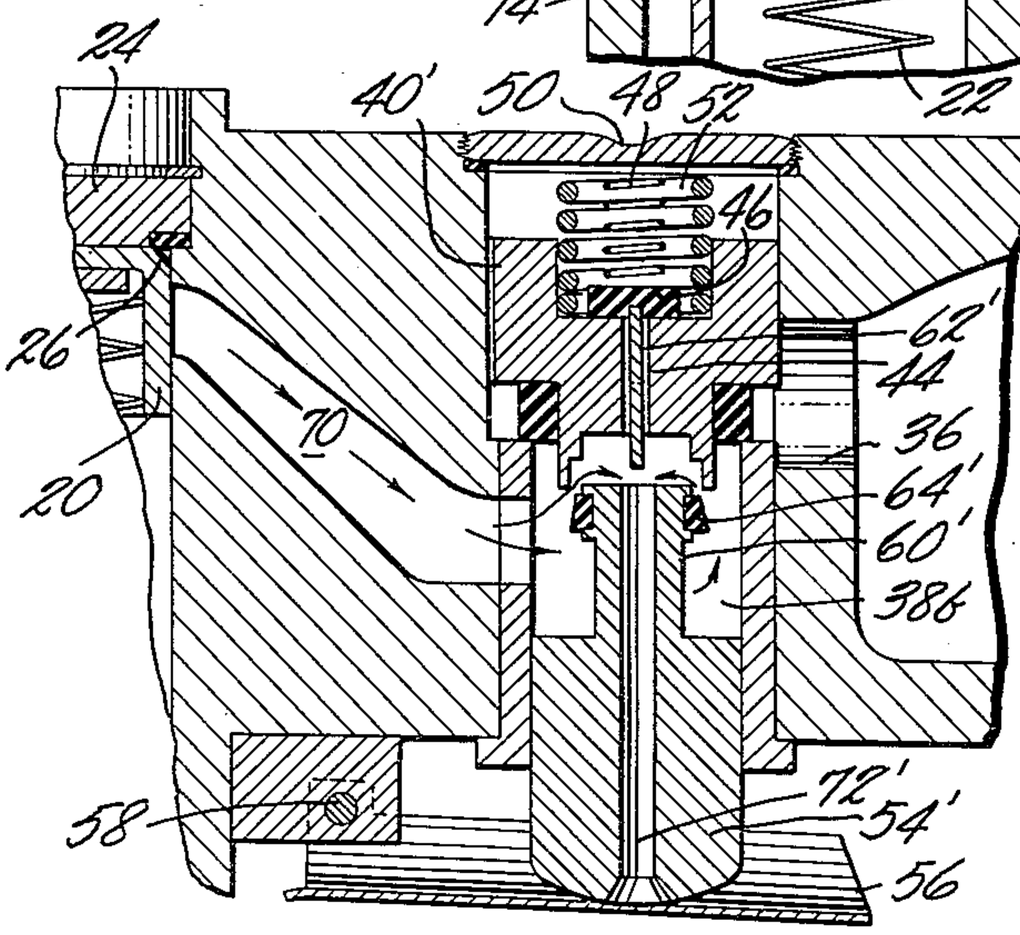

FIG. 7

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2,995,114
Patented Aug. 8, 1961

2,995,114

STAPLER VALVE

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Filed Jan. 29, 1959, Ser. No. 789,872
5 Claims. (Cl. 121—21)

This invention relates to new and useful improvements in air valves and more particularly pertains to a control valve for an air powered stapler.

It is an important object of the present invention to provide in an air powered stapler an air valve having a fast opening action whereby a flow clearance of substantial size is instantaneously provided when the valve is opened.

Another object of the present invention is to provide an improved valve control system for a pneumatic stapler having a trigger mechanism to control the air supply therethrough for driving a staple driver and to exhaust the air upon completion of the staple driving stroke.

Yet another object of the invention is to provide an air powered stapler having a valve action that can be operated with a very light trigger squeeze even though the air supply is under a high pressure.

Still another object of the invention is to provide an improved air powered stapler having few parts, that is easy to make, and requires little if any maintenance.

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

FIG. 1 is an elevational view partly in section of an air driven stapler unit embodying the principles of the present invention;

FIG. 2 is a fragment of the view illustrated in FIG. 1, showing details of the air stapler valve during the initial stage of opening;

FIG. 3 is a fragment of the view illustrated in FIG. 1, showing the air stapler valve in its fully opened position;

FIG. 4 is a sectional elevational view showing a modified form of the valve assembly of the invention during the initial stage of opening;

FIG. 5 is a sectional view taken along line 5—5 in FIG. 4;

FIG. 6 is a view similar to FIG. 4, but showing the valve assembly in its fully opened position; and

FIG. 7 is a view similar to FIG. 4, but illustrating the manner of exhausting air from the air stapler upon completion of the stapler driving stroke.

Illustrated in FIG. 1 is a stapler unit **10** embodying the principles of the present invention and comprising an assembly of a hand grip portion or handle unit **12** rigidly secured to one end of a body portion or stapler housing generally indicated at **14** and a stapler magazine **16** attached to the other end thereof. The body portion **14** comprises a cylinder **18** provided with a cup-shaped piston **20** which is slidably disposed therein and normally held in its uppermost position by a piston return coil spring **22** positioned between the piston and the lower end of the cylinder.

The upper end of the cylinder **18** is slidably closed by a lock spring and plug **24** normally disposed in abutment with the upper face of the piston **20**, there being a chamfered surface **26** on the piston to break the seal between the piston and the plug after air has been admitted into the cylinder. Secured to the piston **20** is a staple driver **28** which drives staples from magazine **16** into the work to be stapled in known manner. Inasmuch as the present invention does not reside in the specific features of the stapler driver **28** or in the manner in which the staple driving action is accomplished, such will not be shown or described herein. However, in this respect,

reference may be made to my copending application, Serial No. 682,812, filed September 9, 1957, or my concurrently filed application, Serial No. 789,871, filed January 29, 1959.

The handle **12** is provided with a bore **30** which is internally threaded to receive a complementary threaded pipe or supply line **32** which is connected to a suitable source of compressed air. Contained within the handle **12** is a pressure chamber **34** communicating at one end with the compressed air line **32** and the other end with a passageway **36** leading into a valve chamber **38** constituted of upper and lower valve chamber sections **38***a* and **38***b*, respectively.

A valve head **40** adapted to slidably reciprocate in the manner of a piston in the upper valve chamber section **38***a* is normally maintained in closed relation with respect to the passageway **36** by means of an oil resistant O-ring fluid seal **41** such as neoprene, that abuts a sleeve or wall **42** in the lower valve chamber section **38***b*. A recess or cavity **43** is formed in the upper part of the valve head **40** and provided with a valve opening **44** communicating with the lower section **38***b* of the valve chamber. A valve element **46** preferably made of neoprene of smaller diameter than said valve head **40** is movable in the valve chamber and seats over valve opening **44** to control the flow of air therethrough. A small diameter compression coil spring **48** may be provided in the cavity **43** to bear at one end against the valve element **46** and at the other end against a closure cap **50** in handle **12** to urge the valve element into seated position over the openings **44**. The cavity **43** similarly may accommodate a large diameter valve head coil spring **52** which is compressed at one end against the valve head **40** and at its other end against the closure cap **50**, thereby urging the valve head **40** against the wall **42**, into sealing relation therewith. It will be recognized by those skilled in the art that other suitable spring arrangements may be employed to fulfill the functions of springs **48** and **52**.

Slidable within a sleeve **53** in the lower valve chamber section **38***a* is an elongated operating button **54** which can be operated by a button head or trigger as desired, a hollowed, semi-cylindrical trigger **56** pivoted about a pin **58** being shown and illustrated herein. Downward pivotal movement of the trigger **56** is limited by body portion **14**, as indicated in FIG. 1 thereby preventing operating button **54** from falling out of sleeve **53**. A stepped shank or neck portion **60** on the button **54** extends into an enlargement of the sleeve forming the sleeve wall **42** and defining lower valve chamber section **38***b*. Integrally united with the neck portion **60** and in stepped relation thereto is an elongated stem **62** which is adapted to be loosely receivable through the valve opening **44** in valve head **40**. Provision is made at the juncture of the neck portion **60** and the stem **62** for a conical flange **64** having either one or more radial slots **66** or other suitable means for allowing air to pass by. The flange **64** is adapted to seat against a shoulder **68** in the lower face of the valve head **40**.

Also provided in the forward end of the handle **12** is a cylinder inlet port or passageway **70** which communicates with the cylinder **18** and the lower valve chamber section **38***b*. An exhaust port passage **72** cut in the sleeve **53** communicates at one end with the lower valve chamber section **38***b* when the operating button **54** is in its lower or retracted position. The opposite end of exhaust passage **72** terminates at the handle surface and exhausts into the air. The stem **62** is of such length as to provide during upward movement of the button **54** a predetermined clearance between the free end of the stem and the valve element **46** to thereby allow the valve element **46** to be lifted so that air from upper chamber **38***a* escapes into valve chamber **38***b* before the flange **64** contacts the valve head

40. During this period, the exhaust port 72 is being closed as seen most clearly in FIGS. 1 and 2.

In operation, compressed air from the pressure chamber 34 bleeds past the valve head 40 into the upper valve chamber section 38*a* and rapidly builds up the pressure to act downwardly upon the upper surface of valve head 40 to press the O-ring seal 41 against the sleeve wall 42. At the same time, the air from chamber 34 will act upwardly against the annular surface of the valve head 40 exposed to the chamber air pressure to produce an opposite but smaller force thereon. Referring to FIG. 2, as the trigger 56 is initially squeezed, the free end of the stem 62 is raised through the valve opening 44 into contact with the valve element 46, and the operating button 54 moves toward the upper end of the sleeve 53, thereby blocking the exhaust port 72. Continued depression of the button 54 causes the stem 62 to raise the valve element 46 against the resistance spring 58 and air pressure in upper chamber 38*a* into the open position. Thereafter, as explained above, the conical flange 64 on the stepped neck portion 60 seats against the lower face of the head valve 40. As soon as the valve element 46 is opened, air under pressure in upper valve chamber section 38*a* passes through the clearance space in valve opening 44 and radial slots 66 into the lower valve chamber section 38*b*, thereby lowering the pressure on the upper side of the valve head 40. The air then enters the inlet port 70 and the annular space behind the piston 20 defined by the chamfered surface 26, and break the seal between the top face of the piston 20 and the plug 24.

Coincident with the opening of the valve element 46, and the consequent reduction in air pressure in the upper valve chamber 38*a*, the relatively larger air pressure from pressure chamber 34 acts upwardly against the annular surface of the valve head 40 and raises the valve head to its open position, as shown in FIG. 3. A plentiful supply of air is then available to pass directly from the passageway 36 through the lower valve chamber 38*a* and into cylinder inlet port 70 to drive the piston with maximum force. The force of the air pressure lifting the valve head 40 makes the trigger squeeze very light, which is highly desirable.

Upon release of the trigger 56, the compression spring 48 seats the valve element 46, the compression spring 52 aided by the bleeding of air into valve chamber 38*a* returns the valve head 40 to its starting position thereby closing passageway 36, and the button 54 uncovers the exhaust port 72 thereby venting the lower valve chamber 38*b*.

Coincident with the uncovering of the exhaust port 72, the piston spring 22 returns the piston 20 to its starting position, venting the air from the stapler cylinder 18.

In the modification shown in FIGS. 4, 5, 6 and 7, a T-shaped stem 62′ is carried by the valve element 46, and the stepped neck portion 60′ is provided with a sealing gasket 64′ instead of a conical flange 64. In addition, the button 54′ has a hollow bore or exhaust port 72′.

As the trigger 56 is initially squeezed, the sealing gasket 64′ seats against the lower face of the valve head 40′, blocking the exhaust port 72′ from chamber 38*b* and raising the stem 62′ and the valve element 46 carried thereby in the manner shown in FIG. 4. Air under pressure in the upper valve chamber 38*a* is thereby released through exhaust port 72′, enabling the valve head 40′ to be opened as shown in FIG. 6 in substantially the same manner as described in connection with FIG. 3.

Upon release of the trigger 56, the valve element 46 and the valve head 40′ both close as described hereinabove, and air is vented from the stapler through exhaust port 72′.

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

What is claimed is:

1. An air valve comprising a valve chamber, a valve head normally slidably movable in said valve chamber from an open position to a closure position against an abutment therein, an air inlet port leading into said valve chamber on one side of said abutment for introducing compressed air into said valve chamber, an air passage leading away from said valve chamber on the other side of said abutment whereby when said valve head is in open position, compressed air flows from said port through said valve chamber and said passage, said valve head having a clearance fit in said valve chamber sufficient for compressed air from said port to bleed behind said valve head and urge said valve head into closure position, thereby interrupting the flow of compressed air through said valve chamber and said passage, an annular surface portion on said valve head exposed to the compressed air in said port and tending to retract said valve head from closure position, and means for reducing the pressure of the compressed air behind said valve head relative to said chamber, thereby enabling the compressed air in said port acting upon said annular surface portion to retract said valve into open position, said air valve being provided with means for exhausting the air in said valve chamber and automatically returning said valve head to closure position, said means for reducing the pressure of the compressed air behind said valve having provision for automatically suspending the exhaustion of air from said valve chamber during the flow of compressed air therethrough.

2. An air valve comprising a valve chamber, a valve head normally slidably movably in said valve chamber from an open position to a closure position against an abutment therein, an air inlet port leading into said valve chamber on one side of said abutment for introducing compressed air into said valve chamber, an air passage leading away from said valve chamber on the other side of said abutment whereby when said valve head is in open position, compressed air flows from said port through said valve chamber and said passage, said valve head having a clearance fit in said valve chamber sufficient for compressed air from said port to bleed behind said valve head and urge said valve head into closure position, spring means cooperating with said air behind said valve head to further urge said valve head into closure position thereby interrupting the flow of compressed air through said valve chamber and said passage, an annular surface portion on said valve chamber exposed to the compressed air in said port and tending to retract said valve head from closure position, an opening through said valve head affording communication from behind said valve head to said valve chamber and said passage, a valve element urged by said spring means into seating position on said opening, an exhaust port in said valve chamber, and an elongated movable button for raising said valve head away from said opening, against the action of said spring means and the air pressure behind said valve head, and automatically closing said exhaust port from said valve chamber, whereby the pressure of the compressed air behind said valve head is reduced relative to said valve chamber, said valve head is opened, and compressed air flows from said port through said valve chamber and said passage.

3. An air valve according to claim 2, said exhaust port being a longitudinal bore through said button.

4. An air valve according to claim 2, said exhaust port being disposed adjacent said button and adapted to be controlled by the movement of said button therepast.

5. A stapling machine comprising an air cylinder, a piston reciprocably movable therein and driven by compressed air, and an air valve controlling the flow of compressed air to said piston, said air valve comprising a valve chamber, a valve head normally slidably movable in said valve chamber from an open position to a closure position, an abutment in said valve chamber disposed against said valve head, an air inlet port leading into said valve chamber on one side of said abutment for introducing compressed air into said valve chamber, an air pas-

sage leading away from said valve chamber on the other side of said abutment whereby when said valve head is in open position, compressed air flows from said port through said valve chamber and said passage, to drive said piston in said cylinder, said valve head having a clearance fit in said valve chamber sufficient for compressed air from said port to bleed therepast and urge said valve head to a closure position into engagement with said abutment, thereby interrupting the flow of compressed air through said valve chamber and said passage, an annular surface portion on said valve head in communication with the compressed air in said port and tending to move said valve head away from said abutment, and reciprocable means cooperable with said valve head in one direction for reducing the pressure of the compressed air behind said valve head thereby to retract said valve into open position, and operable in the opposite direction to

increase the pressure behind said valve head and simultaneously enabling the air from said air cylinder to exhaust during the return stroke of said piston.

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