Sept. 24, 1968 D. F. CARTER ET AL 3,402,778

PNEUMATIC RIVET GUN

Filed April 18, 1967 2 Sheets-Sheet 1

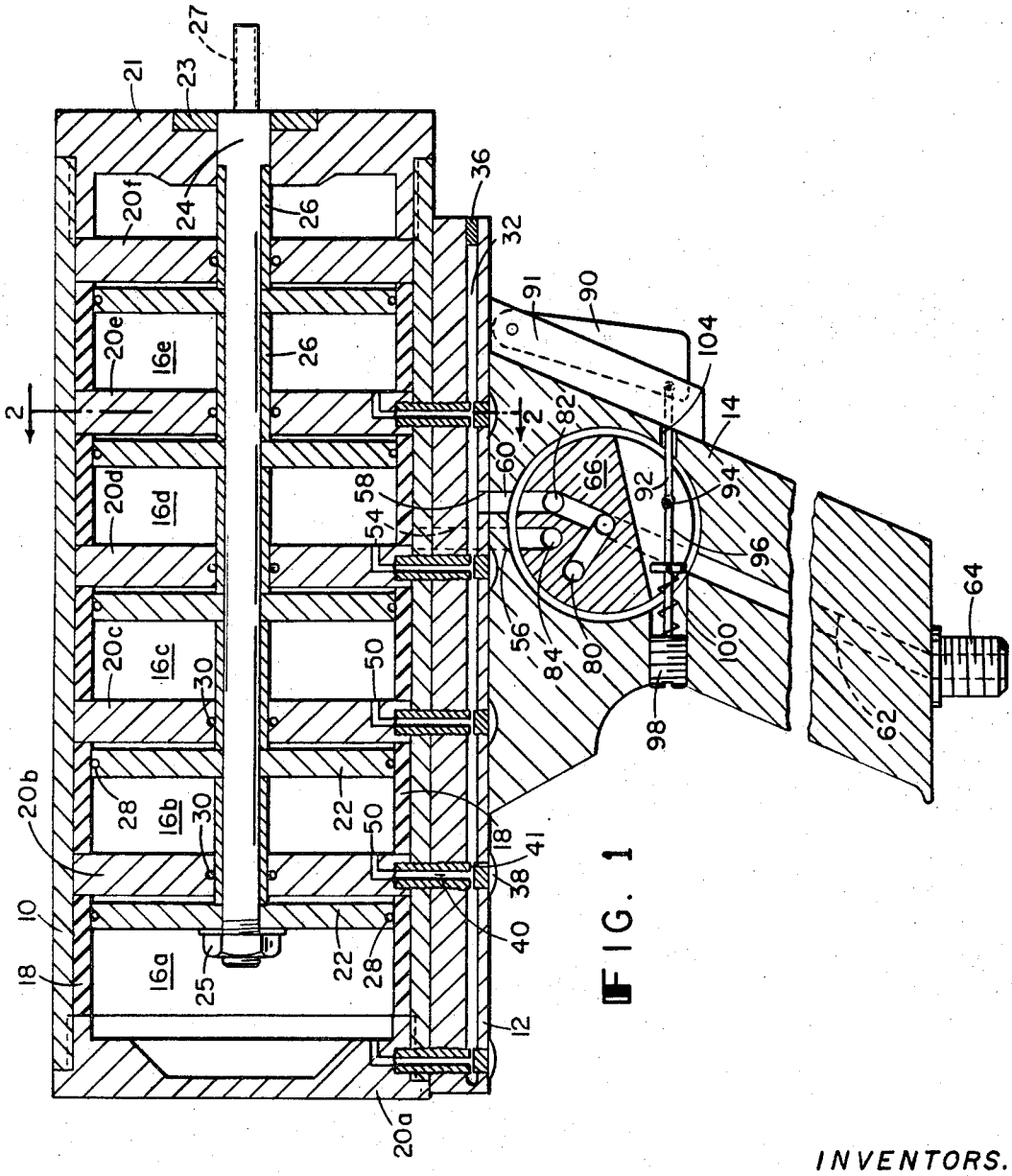


FIG. 1

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FIG. 2

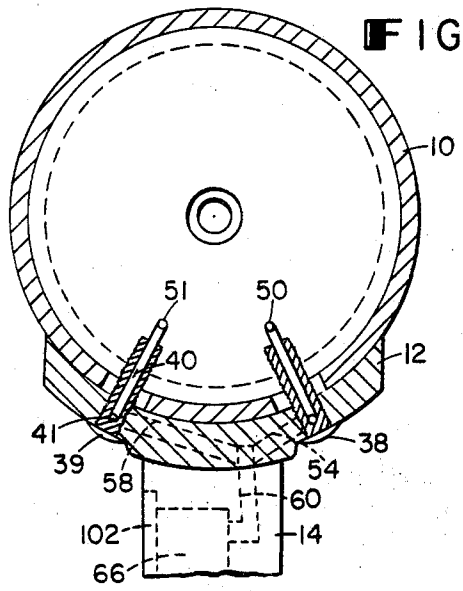


FIG. 4

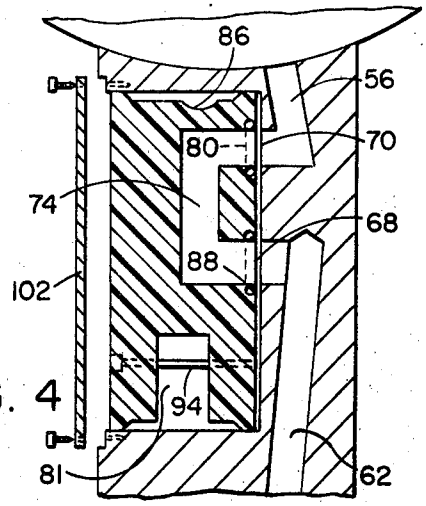


FIG. 3

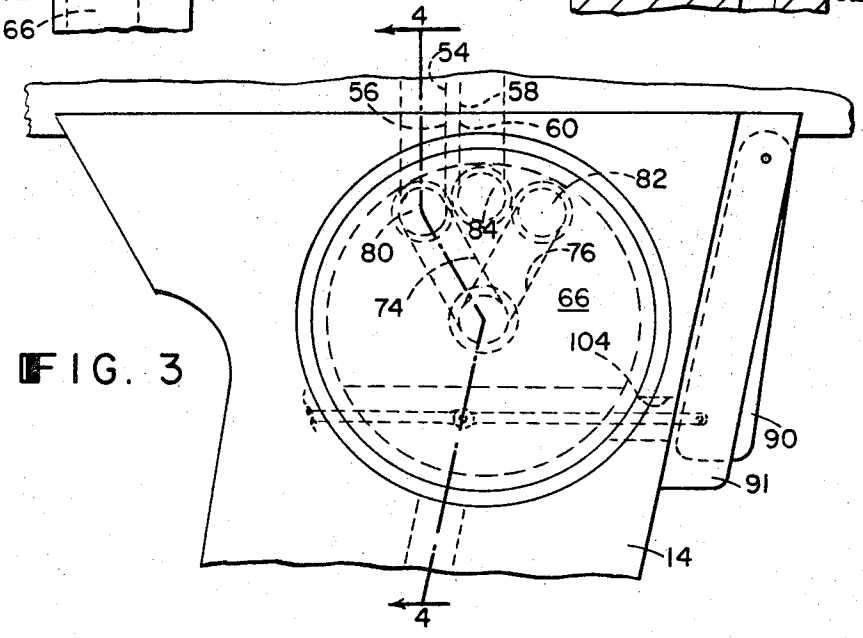
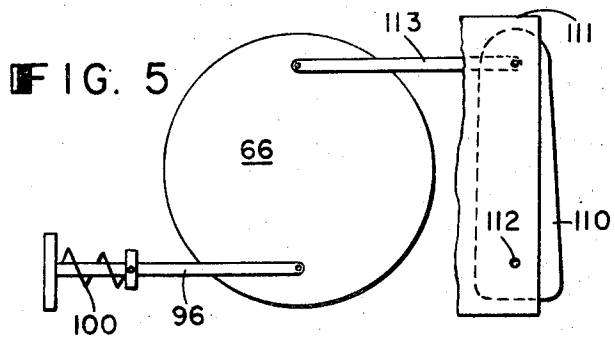


FIG. 5



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PNEUMATIC RIVET GUN

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ABSTRACT OF THE DISCLOSURE

A pneumatic rivet gun which includes a plurality of axially aligned cylinders each having a piston ganged to a common axially movable shaft adapted to be connected to a rivet fastening head. A rotary valve is contained within the handle of the gun and is operative by a manually actuated trigger mechanism to couple an air supply to the powered end of all the cylinders and also to provide an exhaust path for air escaping from the exhaust end of the cylinders. Air is coupled between the rotary valve and the cylinders via first and second manifolds contained within the gun housing, one manifold providing an air passage to one end of respective ones of the cylinders, and the other manifold providing an air passage to the other end of each of the cylinders. The pistons are powered on both the forward stroke and the backstroke, the first manifold functioning during a backstroke via the rotary valve, to supply pressurized air to one side of the cylinders to drive the pistons rearward while the second manifold provides an exhaust path for air escaping from the other side of the cylinders. To accomplish a forward stroke, the functions of the manifolds are reversed by action of the rotary valve, and the second manifold now supplies pressurized air to the other side of the cylinders to drive the piston forward, while the first manifold now provides an exhaust path for air escaping from the one side of the cylinders.

Background of the invention

This invention relates to rivet guns and particularly to pneumatic guns for fastening blind rivets.

A variety of pneumatically operated rivet guns are known in which the stem of a blind rivet is gripped by a suitable jaw mechanism and pulled by means of a powered piston until the stem breaks and the rivet consequently seated. Guns are also known by which blind rivets can be fastened by gripping the rivet stem and pushing against the rivet to break the stem and thereby seat the rivet. Conventional guns of both types are often cumbersome and employ operating valves of relatively complex construction and, in addition, require relatively high pneumatic pressure to produce effective operating force.

Summary of the invention

According to the present invention, an efficient and simple pneumatic rivet gun is provided which achieves high operating power with relatively low air pressure by use of a plurality of axially aligned cylinders and pistons operated via a rotary valve mechanism contained within the handle of the gun. The axially disposed pistons, each associated with a respective cylinder, are ganged to a common axially movable drive shaft which is adapted to be attached to a conventional rivet fastening head. The rotary valve mechanism, which is operated by a suitable manually actuated trigger mechanism, is coupled to a pair of manifolds which respectively provide an air passage to respective opposite ends of each of the cylinders. Each manifold functions to provide, under the control of the rotary valve, a powered air path or an exhaust air path. The pistons are powered on both the forward stroke and the backstroke. When driving the pistons in the forward direction, one manifold transmits powered air and the other exhausting air, while when driving the pistons in the backward direction, the functions of the manifolds are reversed.

The symmetrical pneumatic transmission of powered and exhaust fluid under the judicious control of a simple rotary valve allows forward or backward power strokes to be accomplished with equal ease and either stroke can be initially provided upon actuation of the trigger by suitably linking the trigger mechanism to the rotary valve to produce the proper direction of rotation.

Brief description of the drawings

The invention will be more fully described in the following detailed description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a cross-sectional side elevation view of a rivet gun according to the invention shown with the rotary valve mechanism in the unpowered position;

FIG. 2 is a partly cutaway front view of the gun taken along lines 2—2 of FIG. 1;

FIG. 3 is a cutaway side view of the rotary valve mechanism shown in its powered position;

FIG. 4 is a cutaway sectional view of the rotary valve mechanism as taken along lines 4—4 of FIG. 3; and

FIG. 5 is a schematic representation of an alternate rotary valve linkage useful with the invention.

Detailed description of the invention

Referring to FIG. 1, the illustrated rivet gun comprises a cylindrical casing **10** with an arcuate plate **12** fastened on the bottom portion thereof, with a handle **14** secured to this arcuate plate. Casing **10** contains five cylinders **16***a*–**16***e*, each cylinder formed by a cylindrical shell **18** and a respective pair of plates **20***a*–**20***f*. Plate **20***a* forms one end plate of cylinder **16***a* and also serves as the back cover of the gun, and is fitted to housing **10** in sealing relationship therewith. Within each cylinder is a piston **22** fixedly secured to a drive shaft **24** by means of cylindrical sleeves **26** which slidably pass through appropriate openings in corresponding end plates **20***b*–**20***f* and butt against corresponding pistons. Shaft **24** is secured to the rearwardmost piston by a nut **25**, or other suitable fastener, attached to a threaded portion of the shaft. The forward end of shaft **24** slidably passes through a suitable opening in cover plate **21**, which includes a journal member **23**, and is adapted to be connected to one of the well-known rivet fastening heads, for example, by a threaded end **27**. The pistons are slidably sealed to the interior cylinder walls, for example by sealing rings **28**. Similarly, sealing rings **30** provide slidable seals between sleeves **26** and end plates **20***b*–**20***f*.

The multiple cylinder arrangement using shells **18**, plates **20***a*–**20***f* and sleeves **26** allows facile assembly of the gun, as should be evident. The casing, handle, pistons and cylinders are typically fabricated of aluminum, and the drive shaft, sleeves **26** and journal **23** of stainless steel.

Arcuate plate **12** contains a first manifold **32** and a second manifold **34**, each disposed axially throughout the major part of the length of this plate and circumferentially spaced from each other. Each manifold is formed by a cylindrical or other suitable passage provided in plate **12**, for example by drilling a hole longitudinally into the wall of plate **12** and then sealing the drilled end, for example, with a plug **36**. The first manifold includes and communicates with one side of each cylinder by means of five air screws **38** passing through holes provided in plate **12**, casing **10** and threadably attached to cylinder plates **20***a*–**20***e*. These screws have a passage **40** formed along the axis thereof and a transverse passage **41** communicating with passage **40** and with manifold **32**. Similarly, the second manifold **34** includes and communicates with the other side of each cylinder by means of five

air screws **39** passing through plate **12**, casing **10** and threaded into plates **20***b*–**20***f*. These air screws pass through suitably sealed holes in casing **10** to prevent air leakage. The cylinder plates each have air passages **50** and **51** formed therein, passage **50** communicating with passage **40** of each corresponding screw **38**, and passage **51** communicating with the longitudinal passage of each respective screw **39**. These air screws also serve to secure plate **12** and plates **20***a*–**20***f* to casing **10**. The first manifold **32** is coupled to the rotary valve mechanism by means of a channel **54** formed in plate **12**, this channel terminating at one end in a port aligned with a passage **60** in handle **14**. The second manifold **34** is similarly coupled to the rotary valve mechanism by means of channel **58** formed in plate **12** which aligns with passage **56** within handle **14**. Air from a suitable supply enters the rotary valve mechanism via a passage **62** running within the handle between the valve and a suitable fitting **64** attached to the bottom of handle **14**.

The rotary valve mechanism, shown in greater detail in FIGS. 3 and 4, includes a cylindrical member **66**, which is typically made of plastic, rotatably mounted in a cylindrical chamber provided within handle **14**. The cylindrical chamber has a central port **58** which communicates with the supply passage **62**, and first and second ports, only one port **70** being visible in FIG. 4, formed near the periphery of the cylindrical chamber on a common radius and being one terminating end of respective passages **56** and **60**. The cylindrical rotor **66** has a Y-shaped passage formed therein which includes passages **74** and **76**, the common end being vented on the bottom surface of the rotor via a port which aligns with port **68** located within handle **14** at the bottom of the cylindrical chamber. The outer ends of passages **74** and **76** terminate on the bottom side of the rotor in ports **80** and **82** at a radius in circumferential alignment with the radial ports of the cylindrical chamber. Another valve port **84** is disposed in circumferential alignment with ports **80** and **82** and midway therebetween and communicates between the bottom surface of the rotor and a circumferential groove **86** formed in the cylindrical surface of rotor **66**. The rotor is mounted within the cylindrical chamber to prevent the escape of air by sealing rings **88** or other suitable means.

The rotor is operated by a trigger **90** pivotally fastened at its upper end to a suitable flange **91** affixed to or being a part of the handle of the gun and pivotally linked at its lower end to the rotor, such as by link **92** and pin **94**. A second link **96** is connected between pin **94** and a set screw **98** fastened within a threaded hole provided in handle **14** and cooperates with spring **100** to urge valve rotor **66** to its original position upon release of trigger **90**. A channel **81** is provided in rotor **66** to accommodate the trigger linkage. The valve mechanism and trigger linkage is contained within the handle by a circular cover plate **102** (FIG. 4) which is fitted into a recessed annular region provided in handle **14**. This cover plate can include a suitable bearing on its inside surface to reduce friction between rotor **66** and the cover. A hole **104** is provided in handle **14** as a passage for link **92** and also provides an exhaust port for air being released via groove **86** in alignment therewith, as will be explained hereinafter.

With the trigger and thus the rotary valve in the released position, as illustrated in FIG. 1, port **82** aligns with passage **60** thereby coupling manifold **32** to the air supply, allowing air entering through the supply passage **62** in the handle to flow through passages **76** and **60** into manifold **32** and thence via openings **50** into one side of each cylinder to urge the corresponding pistons to their forward position. Port **84** communicates via passage **56** with manifold **34** to provide an exhaust passage for air which escapes from the unpowered side of each of the cylinders.

When the trigger is pulled, the valve rotates clockwise, as illustrated in FIG. 3 to align port **80** with passage **56** and port **84** with passage **60**. Air from the supply now flows via passages **62**, **74** and **56** into manifold **34** and thence via air screw **39** and ports **51** to the other side of each cylinder to force the pistons to move rearward and thereby operate a rivet pulling head attached to the drive shaft **24**. The now unpowered side of the cylinders is vented to the atmosphere by means of manifold **32** which is coupled through passage **60** to valve port **84** which allows the escaping air to travel through annular groove **86** to exhaust port **104**. Thus it is seen that one manifold and its associated passages provides a path for the energizing fluid while the other manifold and its associated passages provides an exhaust path for the escaping fluid, both powered and exhausting fluid being controlled via the rotary valve mechanism.

The use of the rotary valve mechanism to always provide one powered path and one exhaust path allows the gun to be powered both on the forward and return stroke, and by a simple change in the trigger linkage the valve can be operated to provide, upon actuation of the trigger, either an initial forward stroke or an initial rearward stroke depending upon the particular rivet fastening mechanism with which the gun is employed.

Most rivet fastening heads grip the stem of a blind rivet and pull the stem away from the rivet to break the stem and thereby seat the rivet. For this type of pulling head, it is, of course, required that the gun provide a powered backstroke upon actuation of the trigger, as described hereinabove, but there are also rivet fastening heads wherein a pair of jaws grip the rivet stem and the rivet is pushed away from the stem to seat the rivet. For use with this latter type of fastening head, the gun should provide a powered forward stroke upon actuation of the trigger and the rotary valve should, therefore, operate oppositely to the one described hereinbefore. The unpowered position of the rotor in this case is as shown in FIG. 3 so that the pistons are in their rearmost position. Upon depression of the trigger, the rotor must move counterclockwise to align the valve as in FIG. 1, and in this case a linkage such as that shown in FIG. 5 provides the requisite valve rotation.

Referring to FIG. 5 trigger **110** is pivotally linked to flange **111**, such as by a pin **112**, and is connected to rotor **66** by a linkage **113** pivotally pinned to the rotor and the trigger. It is evident that depression of trigger **110** will cause counterclockwise movement of rotor **66**, and upon release of the trigger, the rotor will return to its initial position by action of spring **100** and link **96**.

An embodiment of the invention which has been constructed and operated with considerable success is about 7 inches long, 3 inches in diameter and has an overall weight of about 4½ pounds. This particular gun is operable with air supplies providing pressure in the range of approximately 40 p.s.i. to 110 p.s.i., which is sufficient to fasten rivets of sizes ranging from 3/32 inch to ¼ inch. The operating air pressure is, of course, a function of the particular materials and dimensions used to construct the gun and the sealing means employed, and the gun can therefore be designed to suit particular operating requirements.

While there has been described what is now thought to be a preferred embodiment of the invention, various modifications and alternative implementations will occur to those versed in the art without departing from the true scope of the invention. The invention is not, therefore, to be limited to what has been particularly shown and described except as indicated in the appended claims.

What is claimed is:

1. A pneumatic rivet gun comprising:

a housing having a plurality of cylinders axially disposed therein;

a like plurality of pistons ganged to a common shaft axially disposed within said cylinders, one end of

said shaft adapted to being connected to a rivet fastening head;

a pistol grip handle attached to the lower portion of said housing and containing a rotary valve assembly operatively disposed therein and a fluid supply passage communicating between said valve assembly and a fluid supply port;

a first and second manifold each axially disposed within the lower portion of said housing and circumferentially separated from the other, said first manifold including a plurality of first fluid passages each respectively coupled to one end of each of said cylinders and said second manifold including a plurality of second fluid passages each respectively coupled to the opposite end of each of said cylinders, said first and second manifolds also having respective third and fourth fluid passages coupled to said rotary valve assembly;

said rotary valve assembly being operative in a first position to direct fluid from said supply port to said first manifold and thence to one side of each of said cylinders to urge the corresponding pistons to a first axial position, and operative in a second position to direct fluid from said supply port to said second manifold and thence to the other side of each of said cylinders to urge the pistons to a second axial position opposite from said first position.

2. The invention according to claim **1** wherein said fluid supply passage and said third and fourth fluid passages terminate in a cylindrical chamber provided in said handle, and said rotary valve assembly includes a cylindrical rotor mounted within said chamber and having fluid passages therein in alignment with said supply passage and said third and fourth passages.

3. The invention according to claim **1** wherein said rotary valve assembly comprises:

a cylindrical rotor rotatably mounted within a cylindrical chamber provided in said handle and operable by means of a manually actuated trigger mechanism associated with said handle;

said rotor having a Y-shaped passage formed therein, the common end of which terminates at the center of one cylindrical end of the rotor and in alignment with said fluid supply passage, and the bifurcated ends of which terminate near the periphery of the one cylindrical end and radially disposed to align with said third or fourth fluid passages;

an annular groove formed in the cylindrical wall of said rotor and in fluid coupling relationship with an exhaust port in said handle;

and an exhaust passage formed in said rotor having one end terminating at the one cylindrical end midway between and in circumferential alignment with the bifurcated ends of said Y-shaped passage, and its other end communicating with the annular groove.

4. The invention according to claim **1** wherein said housing includes a cylindrical casing containing said cylinders and an arcuate plate attached to the lower portion of said casing, said arcuate plate containing said manifolds.

5. The invention according to claim **4** wherein each of said cylinders includes a cylindrical shell coaxially disposed within said casing.

6. The invention according to claim **2** wherein one of the outer ends of said Y-shaped passage is in fluid coupling relation with one of said third and fourth fluid passages, while one end of said exhaust passage is in fluid coupling relation with the other of said third and fourth fluid passages.

7. The invention according to claim **2** wherein one of said plurality of first fluid passages and one of said plurality of second fluid passages are contained in a cylindrical end plate axially separating adjacent cylinders, said first fluid passage communicating with one end of said plate and said second fluid passage communicating with the other end of said plate.

References Cited

UNITED STATES PATENTS

280,971	7/1883	Stevens	91—411
1,612,779	12/1926	Mercer	92—175 X
2,703,557	3/1955	Polki	173—169 X
2,813,514	11/1957	Von Seggern	173—169 X
2,911,951	11/1959	Swanson	173—169 X

FOREIGN PATENTS

1,473	7/1854	Great Britain.
105,833	10/1942	Sweden.

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