United States Patent [19]

Richardson

[11] **3,898,833**

[45] **Aug. 12, 1975**

[54] **AIR-HYDRAULIC RIVET GUN**

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[73] Assignee: **Textron Inc.**, Providence, R.I.

[22] Filed: **Apr. 15, 1974**

[21] Appl. No.: **460,729**

[52] **U.S. Cl.** **72/391**

[51] **Int. Cl.** **B21j 15/22**

[58] **Field of Search** 72/391, 453

[56] **References Cited**

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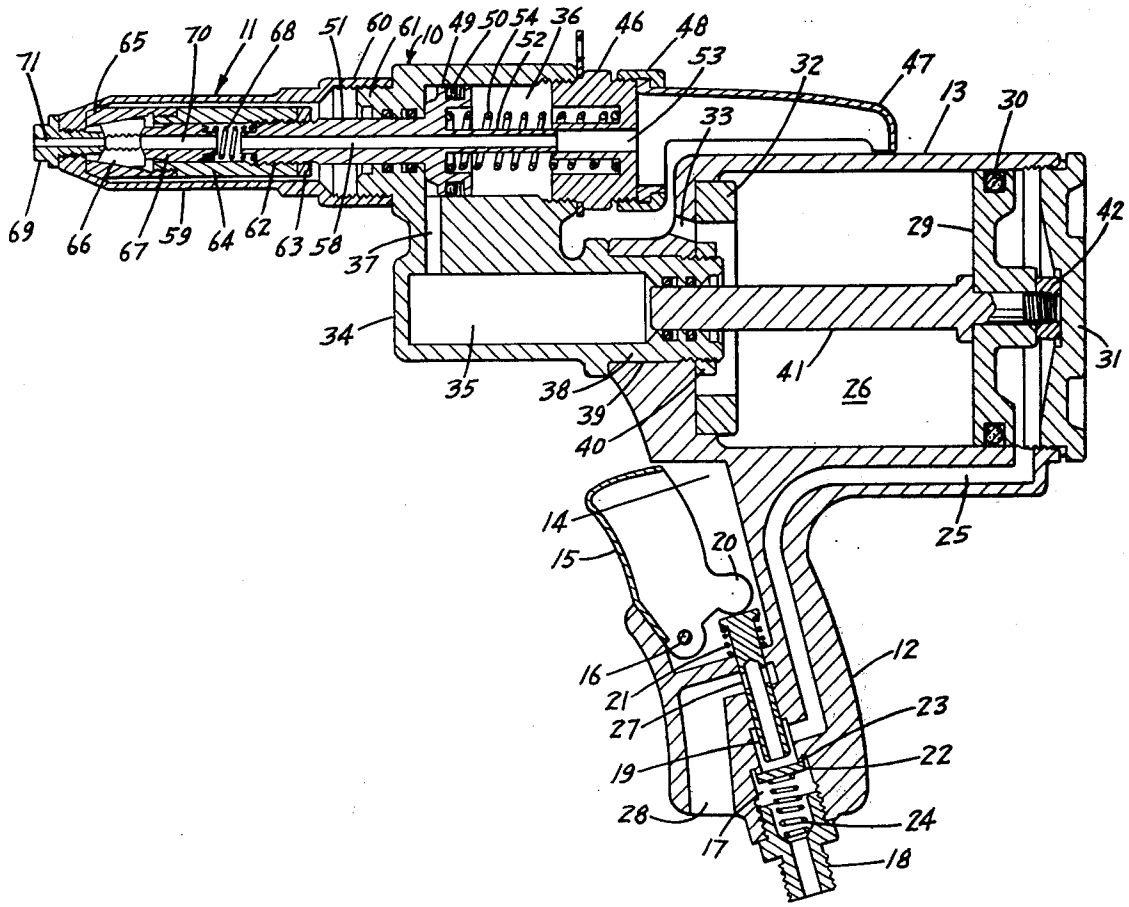
Primary Examiner—C. W. Lanham

Assistant Examiner—Gene P. Crosby

[57] **ABSTRACT**

A rivet gun of the type for setting blind tubular rivets mounted on a mandrel by tensioning the mandrel to the point of rupture. The rivet gun is characterized by an air actuated hydraulically driven mechanism to grip and retract the mandrel and to eject the mandrel when separated from the rivet. The power unit may be fitted with interchangeable rivet setting heads for either in-line "straight-on" riveting or a 90° angle head to permit use of the gun in otherwise inaccessible places.

5 Claims, 8 Drawing Figures



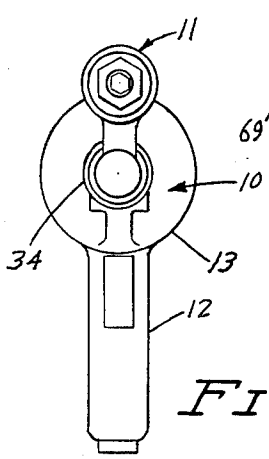


FIG. 2

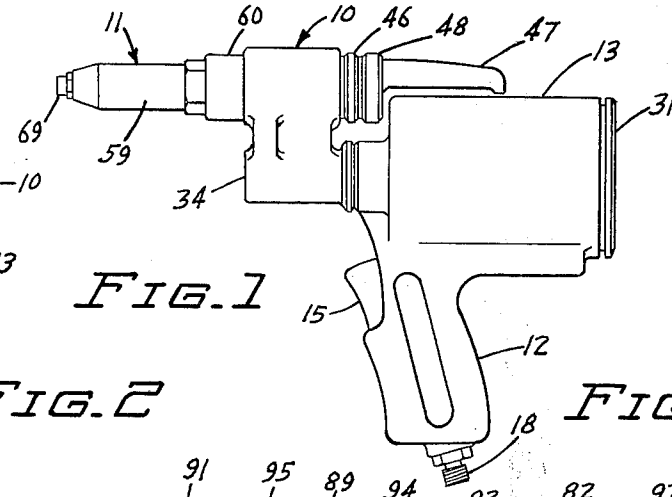


FIG. 1

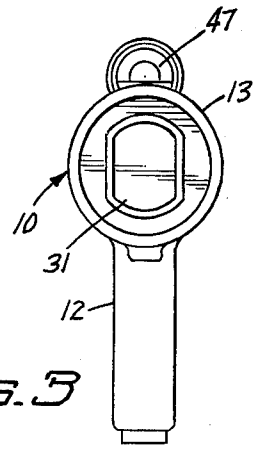


FIG. 3

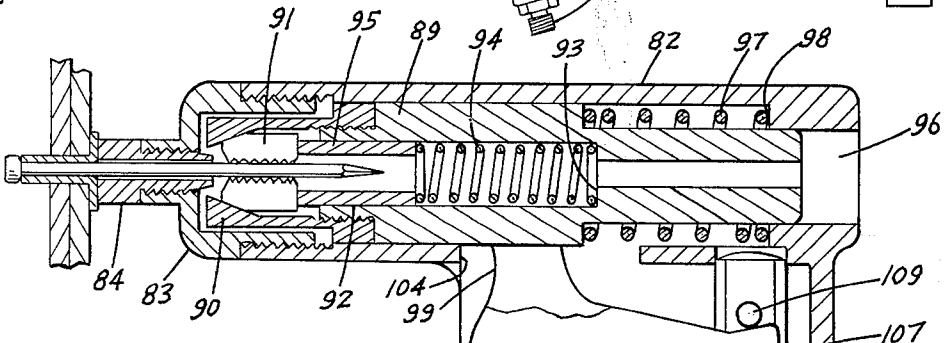


FIG. 8

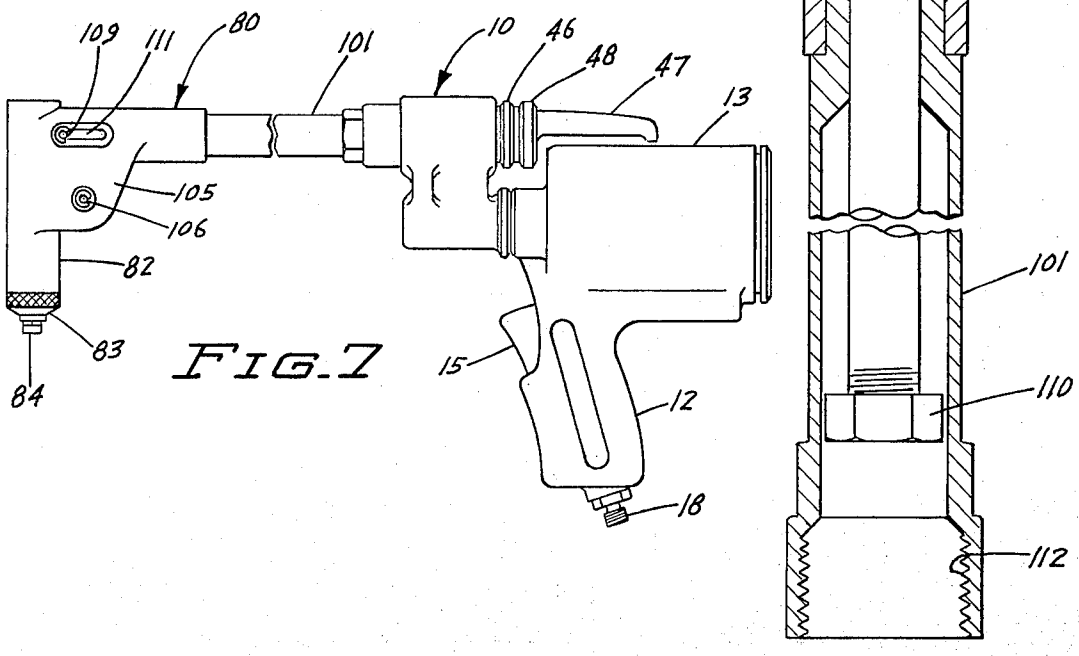


FIG. 7

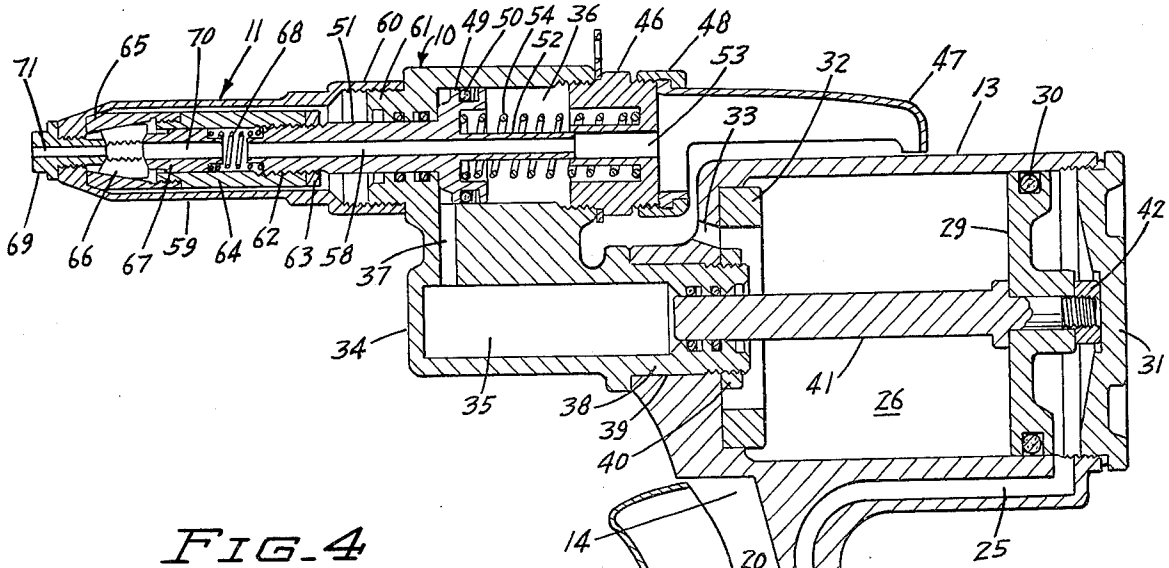


FIG-4

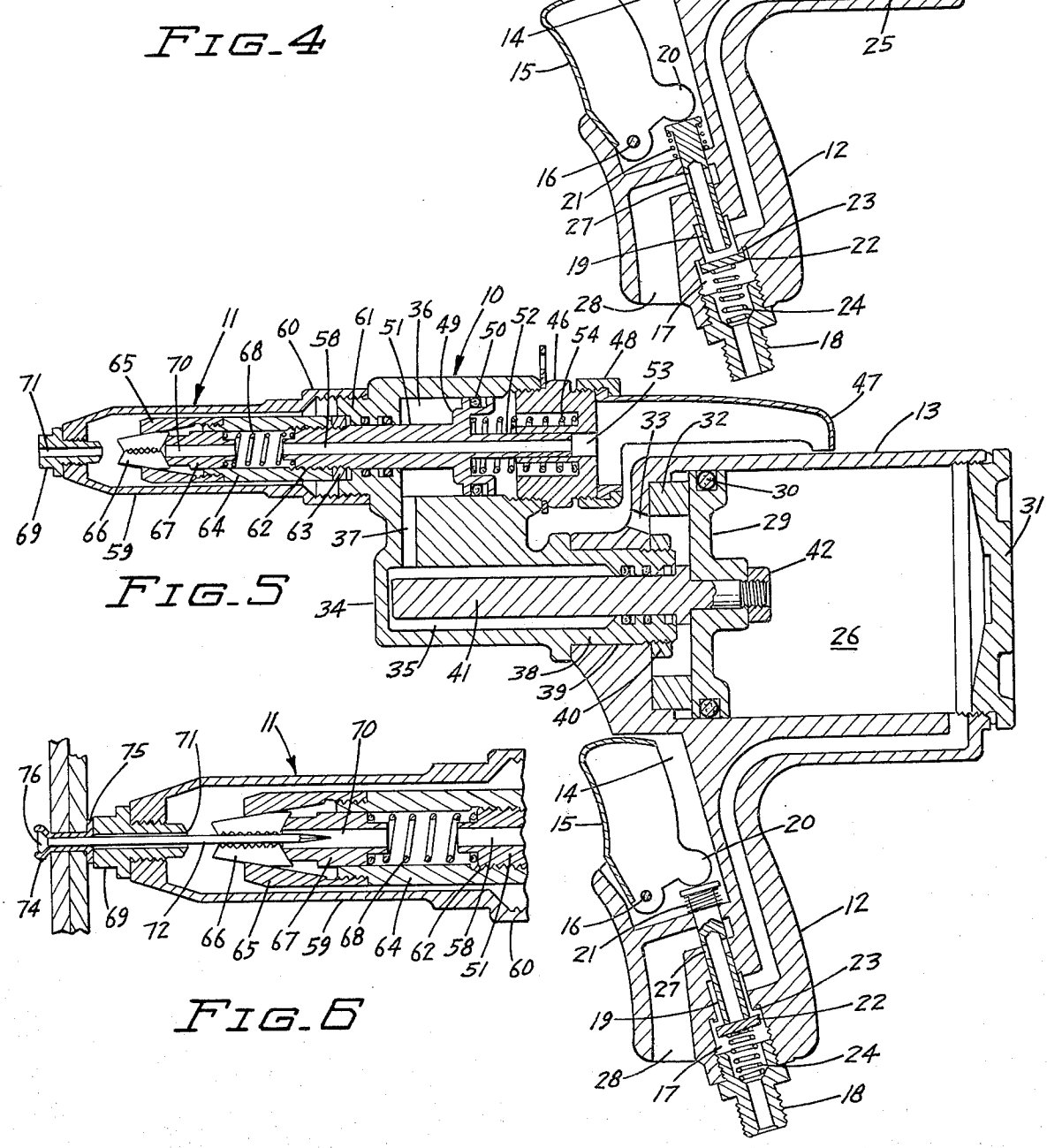


FIG-5

FIG-6

AIR-HYDRAULIC RIVET GUN

This invention relates to a gun for setting "blind" rivets of the type in which the rivet is both inserted into the work and secured therein from the same side, without access by the operator to both sides of the work. The rivet is set by deformation of the tubular stem of the rivet on the remote side of the work by virtue of expansion of the stem by pulling the head of the mandrel on which the rivet is mounted into the stem and then rupturing the mandrel to free it from the rivet.

Rivets for this purpose and guns for setting such rivets are well known. Both manually operable and power operated guns are available. Heavy duty work and repetitious work over a long period of time, such as on an assembly line, tend to be fatiguing to the operator. The present invention is directed to a power operated rivet setting gun of improved design characterized by an air actuated hydraulically driven mechanism for grasping and retracting rivet mandrels.

The invention is illustrated in the accompanying drawings in which:

FIG. 1 is a side elevation of one form of rivet gun according to the present invention;

FIG. 2 is a front elevation thereof;

FIG. 3 is a rear elevation thereof;

FIG. 4 is a vertical longitudinal section on an enlarged scale showing the operating parts in "at-rest" position;

FIG. 5 is a similar sectional view showing the parts under air and hydraulic pressure just prior to separation of the mandrel from the rivet head;

FIG. 6 is a fragmentary sectional view on an enlarged scale showing the gun in engagement with a rivet mandrel just prior to separation;

FIG. 7 is a side elevation of another form of rivet gun according to the present invention having a right angle head; and

FIG. 8 is a fragmentary longitudinal section showing details of construction of that angle head.

Referring now to the drawings, and particularly to FIGS. 1 through 6, the rivet gun comprises a power unit, indicated generally at **10**, and one form of interchangeable rivet setting head for "in-line" work, indicated generally at **11**. The power unit includes a body having a pistol grip handle portion **12** and an integral air cylinder housing **13**. Handle **12** is provided with a recess **14** for receiving a palm grip trigger **15** pivotally held on pin **16**. Handle **12** is also provided with a longitudinal passage or channel **17** extending from the free end of the handle into trigger recess **14**.

A fitting **18** is inserted into the free end of passage **17** for the purpose of connecting the rivet gun to a source of compressed air or other gas under pressure. A hollow tubular plunger pin **19** is inserted into passage **17** from the trigger recess. A cam **20** on trigger **15** bears against the head of plunger pin **19** which is spring biased by a light coil spring **21** to be normally urged upward into the trigger recess urging the trigger into its at-rest position. A valve disc **22** lies in passage **17** between the inner ends of plunger pin **19** and air fitting **18**, normally urged into sealing engagement with annular valve seat **23** by coil spring **24**.

When trigger **15** is squeezed, cam **20** bearing against the end of plunger pin **19** compresses spring **21** and causes valve disc **22** to be unseated, compressing spring **24**. This permits air to enter through passage **17** into air passage **25** to chamber **26** within air cylinder housing **13**. When trigger **15** is released, spring **21** retracts plunger pin **19** and returns the trigger to its at-rest position. At the same time, spring **24** reseats valve disc **22** on seat **23** to shut off the supply of air to the rivet gun. Air bleeding from chamber **26**, as explained in detail hereinafter, is forced out through passage **25** into passage **27** and the open end of pin **19** and out through bleeder holes **27** and passage **28** to the atmosphere.

An air ram or piston **29** is disposed in chamber **26** for reciprocal movement therein. The outer perimeter of piston **29** is provided with an annular groove into which is fit a resilient O-ring **30** for sealing engagement with the inside cylinder wall. The air cylinder chamber is closed by means of a cap **31** inserted therein. An annular seal ring **32** is seated in the opposite end of chamber **26** from which a bleed hole **33** permits escape of air from chamber **26** on the operating stroke of piston **29**.

An hydraulic cylinder housing **34** is connected to the air cylinder housing. Housing **34** encloses a pair of spaced apart chambers **35** and **36** interconnected by passage **37** and adapted to contain hydraulic fluid. Hydraulic fluid chamber **35** is in axial alignment with air chamber **26**. One end **38** of housing **34** extends through a central passage **39** in air cylinder housing **13** and is rigidly fixed therein by means of a lock nut **40**.

An hydraulic ram **41** is rigidly secured to air piston **29** in axial alignment therewith, as by means of nut **42**. Ram **41** extends into hydraulic chamber **35** through a restricted passage having a pair of annular grooves therein fitted with resilient seal rings to prevent loss of hydraulic fluid. Upon admission of air into chamber **26** behind air piston **29**, the piston and ram **41** are moved forwardly. As ram **41** advances into chamber **35**, it pushes the noncompressible hydraulic fluid therein through passage **37** into chamber **36** which overlies chamber **35**.

Chamber **36** is closed at one end by means of a back cap **46** to which a deflector **47** is attached by means of a threaded ring or collar **48**. An hydraulic piston **49** is disposed in chamber **36** for reciprocal movement therein. The peripheral edge of piston **49** is provided with a groove in which is seated a resilient seal ring **50** held in place by an expansion washer. Piston **49** is provided with a forwardly extending stem **51** and a rearwardly extending stem **52**.

The free end of stem **52** fits into a central passage **53** in back cap **46** for reciprocal movement therein. Piston **49** is spring biased by means of a heavy coil spring **54** normally urging the piston to an at-rest forward position adjacent passage **37**. Stem **51** extends through a passage in the forward wall of housing **34** sealed against leakage of hydraulic fluid, as by means of a pair of resilient O-rings set in annular grooves in the passage. A central passage **58** extends through piston **49** and its stems **51** and **52** for ejection of spent mandrels.

A tubular nose housing **59** having an internally threaded base **60** is secured to the externally threaded boss **61** on the forward wall of hydraulic housing **34**. The free forward end **62** of hydraulic piston stem **51** is externally threaded and has an adjusting nut **63** and tubular pulling head **64** secured thereon. The forward end of pulling head **64** is externally threaded to receive annular jaw case **65** whose inner tapering walls engage a plurality of mandrel gripping jaws **66**. A jaw pusher **67** is disposed within pulling head **64** and jaw case **65** biased by coil spring **68** to maintain force on jaws **66**

constantly urging the jaws toward the forward end of the jaw case **65** into engagement with the inner walls thereof.

As seen in FIG. **4**, when the parts are in at-rest position with spring **54** holding hydraulic piston **49** in the forward end of chamber **36**, jaw case **65** bears against the inside forward end of the nose housing. The inner or rearward end of nose piece **69** bears against jaws **66** spreading them apart and pushing them inwardly into jaw case **65** pushing jaw pusher **67** rearwardly and compressing spring **68**. Jaw pusher **67** has a central passage **70** and nose piece **69** has a central passage **71**, both in alignment with passage **58** to receive and eject a mandrel.

As seen in FIG. **6**, passage **71** in the nose piece serves as a central bore in which to receive the mandrel **72** of a conventional blind rivet. Such a rivet has a hollow tubular shank or body **74** which extends through the work piece to be riveted (here shown as composed of two plates to be riveted together) and an annular flanged head **75**, which may be flat or domed or counter-sunk, and engages the operator'side of the work. The mandrel **72** is inserted through the rivet in the reverse direction, that is, toward the operator's side with the head **76** of the mandrel at the opposite end from the head **75** of the rivet. As seen in FIG. **4**, when the jaws are spread apart when the mechanism is in at-rest position, the mandrel is easily inserted.

When the rivet gun is connected to a source of air or other gas under pressure and trigger **15** is depressed to move air piston **29** forward, as described above, ram **41** advancing in hydraulic chamber **35** forces the hydraulic fluid therein through passage **37** into chamber **36**. As the hydraulic fluid fills chamber **36**, it moves hydraulic piston **49** rearwardly compressing spring **54**. As piston **49** moves rearwardly, it pulls stem **51** and along with it pulling head **64** and jaw case **65**. As the jaw case **65** is drawn backwardly from nose piece **69**, force on spring **68** is withdrawn causing it to expand, moving jaw pusher **67** forwardly and causing the jaws to close. This force in combination with the rearward force exerted by the inside tapered surfaces of the jaw case **65** against the jaws **66** forces the jaws into tight gripping engagement with mandrel **72**. As the rearwardly directed pulling force continues, the head **76** of mandrel **72** is forced into and expands the outer end of tubular body **74** of the rivet tightening it in place in the work piece and severing the mandrel from the head. The mandrel then may pass rearwardly through passages **70, 58** and **53**. Deflector **47** protects the operator from injury in the event the mandrel is forcefully ejected.

When pressure on the trigger is released, piston **49** is returned to its at-rest position by force exerted by spring **54**, returning the pulling head and jaw case to their at-rest positions ready to receive another mandrel. Hydraulic fluid is forced from chamber **36** through passage **37** into hydraulic chamber **35**. Ram **41** and air piston **29** are returned to their at-rest positions. Air from air piston chamber **26** is bled to the atmosphere as already described.

Referring now to FIGS. **7** and **8**, there is shown a rivet gun with an alternative riveting head **80** for setting rivets in inaccessible places by exerting force at an angle of 90° relative to the direction of force exerted by the power unit. As is explained in further detail hereinafter, angle head **80** is interchangeable with the on-line rivet head **11** previously described, using the same power unit and operating in generally the same manner with the exceptions noted below.

In U.S. Pat. No. 3,760,627, issued Sept. 25, 1973, of which the present applicant is co-patentee, there is disclosed an angle head rivet gun, the basic structure and operation of which, except for the power source, are generally the same as described herein. The disclosure of that patent is incorporated herein by reference.

The angle rivet setting head **80** comprises a hollow tubular body **82** internally threaded at one end to receive a nose piece **83** having a restricted bore which is likewise internally threaded to receive a bushing **84**. Bushing **84** has a central bore in which to receive the mandrel of a conventional blind rivet. A pulling head **89** reciprocates within the hollow body **82**. The forward end of pulling head **89** is externally threaded and adapted to receive chuck or jaw case **90** whose bore is tapered to receive a pair of tapered jaws **91** which function to engage the shank of a mandrel. Pulling head **89** has a central bore **92** extending axially through its length. Bore **92** is of reduced diameter at its rearward end providing a shoulder against which one end of a coil spring **94** bears. A tubular sleeve **95** within bore **92** functions as a jaw actuating member, one end of sleeve **95** bearing against jaws **91** and the opposite end bearing against spring **94** to maintain the jaws in constant gripping engagement with the mandrel.

The rearward end of pulling head **89** is of reduced diameter and reciprocates in passage **96** in the rearward end of housing **22** opposite from the nose piece. A heavy coil spring **97** surrounds the reduced diameter end of pulling head **89**, one end of spring **97** bearing against a shoulder formed on the pulling head and the other end bearing against an internal shoulder **98** within the body. As illustrated in the aforesaid patent, the opposite sides of the pulling head are flattened to provide a pair of recesses, each having a rearward shoulder against which a cam **99** of a cam arm lever **100** bears.

Angle head **80** includes an elongated tubular housing **101**, the upper end of which is fixed in a tubular sleeve **102** disposed at right angles to the longitudinal axis of housing **82** and having an opening **103** therein. Tubular housing **82** is provided with an opening **104** about midway between its ends. A pair of parallel spaced apart gusset plates **105** generally enclose the space between openings **103** and **104**. A pair of parallel spaced apart crank arm levers **100** are pivotally supported between the gusset plates on a pin **106**. Cam arm **99** extends through opening **104**. Cam arm **107** extends through opening **103** embracing the sides of pulling shaft **108** and engaging pin **109** extending transversely through the pulling shaft. The opposite end of pulling shaft **108** is threaded and provided with a coupling nut or threaded sleeve **110** by which the pulling shaft is connected to the threaded end of stem **51** of hydraulic piston **49**.

In order to hold the pulling shaft against rotation within tubular body **101** to permit this connection to be made, pin **109** is of sufficient length that its ends extend into slots **111** formed in sleeve **102**. For safety reasons, the ends of pin **109** may be received in a pair of internal longitudinal grooves formed in the sleeve, or a protective cover may be snapped over the slot area. Tubular body **101** is internally threaded at **112** to permit attachment of the angle head to the power unit by screwing onto threaded boss **61**. Sleeve **102** is freely rotatable on

tubular body **101** permitting the angle head to be rotated through 360°.

The operation of the power unit is identical for use of the angle head as for use of the in-line head. The difference is that the pulling force exerted by piston **49** is transmitted to pulling shaft **108.** Pin **109** bearing against cam arm **107** causes crank arm **100** to rotate on its pivot. This translates the pulling force through 90°, causing cam arm **99** to exert pulling force on pulling head **89.** Thereafter the operation is the same as already described in connection with the in-line head. Although the angle rivet setting head is described and illustrated as being disposed at a right angle relative to the axis of the pulling force exerted by the power unit, the head may be disposed at an angle other than 90° with only minor modification of the levers **100** and their supporting structure.

It is apparent that many modifications and variations of this invention as hereinbefore set forth may be made without departing from the spirit and scope thereof. The specific embodiments described are given by way of example only and the invention is limited only by the terms of the appended claims.

The embodiments of the invention in which an exclusive property or privelege is claimed are defined as follows:

1. A rivet gun for setting blind rivets, said gun comprising:

A. a setting head for engaging and pulling the mandrel of a blind rivet,

B. a body including force exerting means for applying pulling force to said setting head, the direction of said force being generally longitudinal of said body,

C. said force exerting means comprising

1. a first hydraulic pressure chamber within said body having a piston reciprocable therein generally longitudinally of the body,
2. stem means movable with said piston in the same direction,
3. means connecting said stem means to the setting head to operate the same,
4. a second hydraulic pressure chamber disposed within said body in parallel closely spaced apart relation to the first chamber, said chambers being connected through an intercommunicating passage within said body,
5. a piston reciprocable in said second chamber,
6. a third pneumatic pressure chamber within said body in axial alignment with said second chamber,
7. a piston reciprocable in said third chamber and connected to the piston in said second chamber for simultaneous movement thereof,
8. means adapted to connect said third chamber to a source of gas under pressure, and
9. means to regulate flow of gas to said third chamber,

D. a pistol grip handle on said body adjacent to said third chamber.

2. A rivet gun according to claim **1** further characterized in that said setting head is replaceable and interchangeable with other setting heads and includes a tubular housing detachably secured to said body and a reciprocable pulling head within said housing detachably secured to said piston stem,

A. said pistion stem extending from said body through a coaxial passage in an externally threaded boss on the exterior of the body,

B. said setting head housing being internally threaded for attachment thereto,

C. said piston stem being externally threaded at one end, and

D. said pulling head being internally threaded for attachment thereto.

3. A rivet gun according to claim **1** further characterized in that said setting head is secured to said body with the longitudial axis of said setting head disposed at an angle relative to the longitudinal axis of said body and the direction of force applied by said force exerting means.

4. A rivet gun according to claim **3** further characterized in that said setting head is replaceable and interchangeable with other setting heads and includes:

A. an elongated tubular housing internally threaded at one end, the longitudinal axis of said tubular housing being in alignment with said body and the direction of force applied by said force exerting means and attached to said body through an externally threaded boss on the exterior of said body surrounding a passage coaxial with said piston stem,

B. a tubular setting head housing secured to the opposite end of said elongated tubular housing, the longitudinal axis of said setting head being disposed at an angle relative to the longitudinal axis of said elongated tubular housing,

C. a pulling shaft disposed within said elongated longitudinal housing and detachably secured at one end to said piston stem; and

B. pivotal crank arm lever means interconnecting said pulling head and said pulling shaft for transmission of force from said pulling shaft to reciprocate said pulling head.

5. A rivet gun for setting blind rivets, said gun comprising:

A. a setting head for engaging and pulling the mandrel of a blind rivet,

B. a body including force exerting means for applying pulling force to said setting head, the direction of said force being generally longitudinal of said body and setting head, said force exerting means comprising

1. a first hydraulic pressure chamber within said body having a piston reciprocable therein generally longitudinally of the body,
2. externally threaded stem means movable with said piston in the same direction and extending from said body through a coaxial passage in an externally threaded boss on the exterior of the body,
3. a second hydraulic pressure chamber disposed within said body in parallel closely spaced apart relation to the first chamber, said chambers being connected through an intercommunicating passage within said body,
4. a piston reciprocable in said second chamber,
5 a third pneumatic pressure chamber within said body in axial alignment with said second chamber, and
6. a piston reciprocable in said third chamber and connected to the piston in said second chamber for simultaneous movement thereof,

C. an internally threaded tubular setting head housing detachably secured to the externally threaded boss on said body,

D. a reciprocable internally threaded pulling head within said housing detachably secured to said piston stem,

E. a longitudinal axial passage extending through said setting head, the piston in said first chamber, the stem thereof and said body for passage of used rivet mandrels therethrough,

F. a pistol grip handle on said body adjacent said third chamber,

G. passage means in said handle for passage of gas under pressure to the third chamber and bleeding of gas from said chamber to the atmosphere, and

H. trigger actuated valve means in said handle for alternately controlling flow of gas through said passage means.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,898,833
DATED : August 12, 1975
INVENTOR(S) : Russell F. Richardson

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 8, "27" should be --17--.

Column 3, line 22, "operator'side" should be --operator's side--.

Column 5, line 25, "privelege" should be --privilege--.

Signed and Sealed this

twenty-eight Day of *October 1975*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks