June 1, 1971 H. W. MURDOCH ET AL 3,581,373

RIVETING DEVICE

Filed Dec. 20, 1968 3 Sheets-Sheet 1

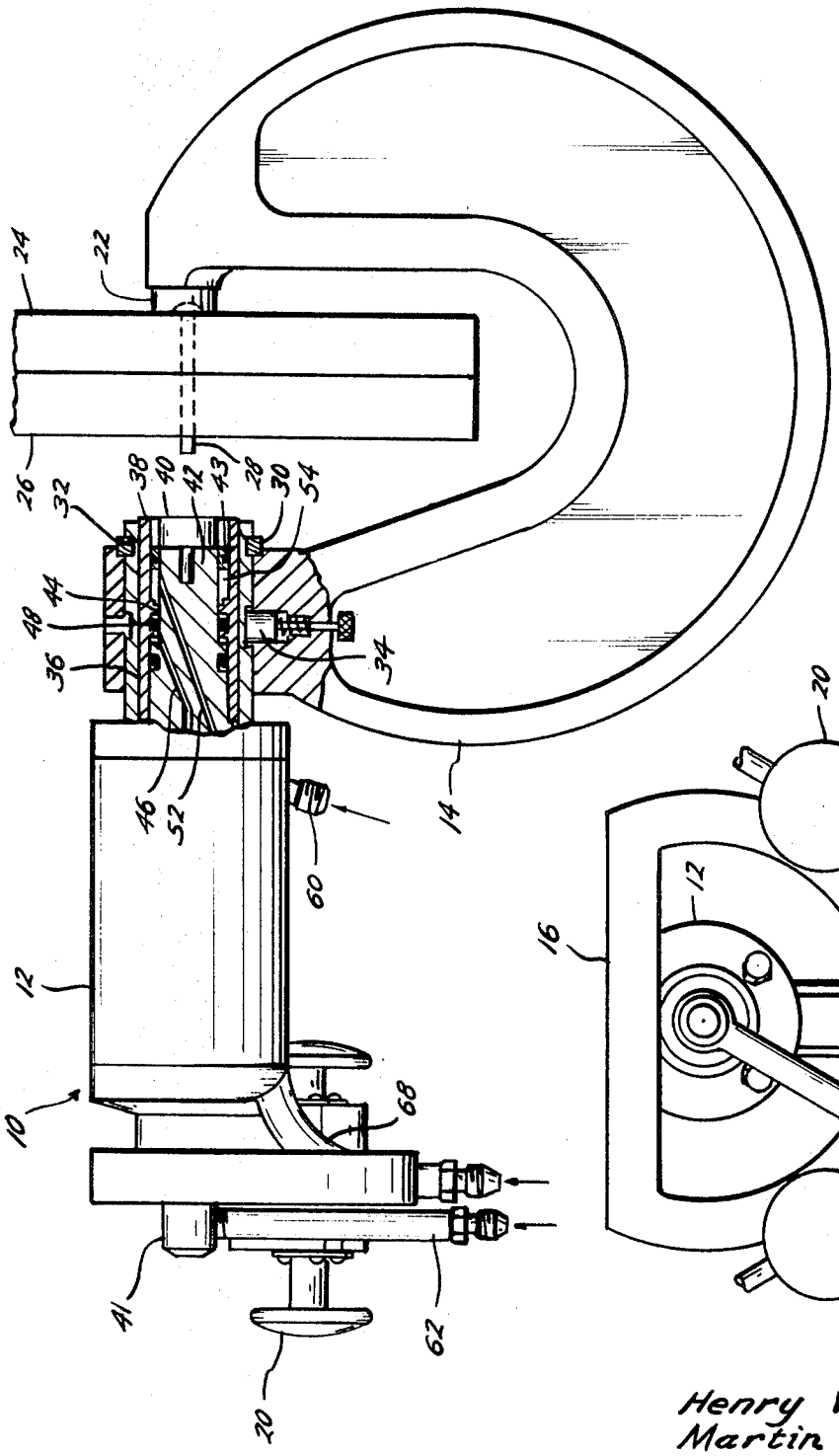



Fig. 2




Fig. 1

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RIVETING DEVICE

Filed Dec. 20, 1968 3 Sheets-Sheet 2

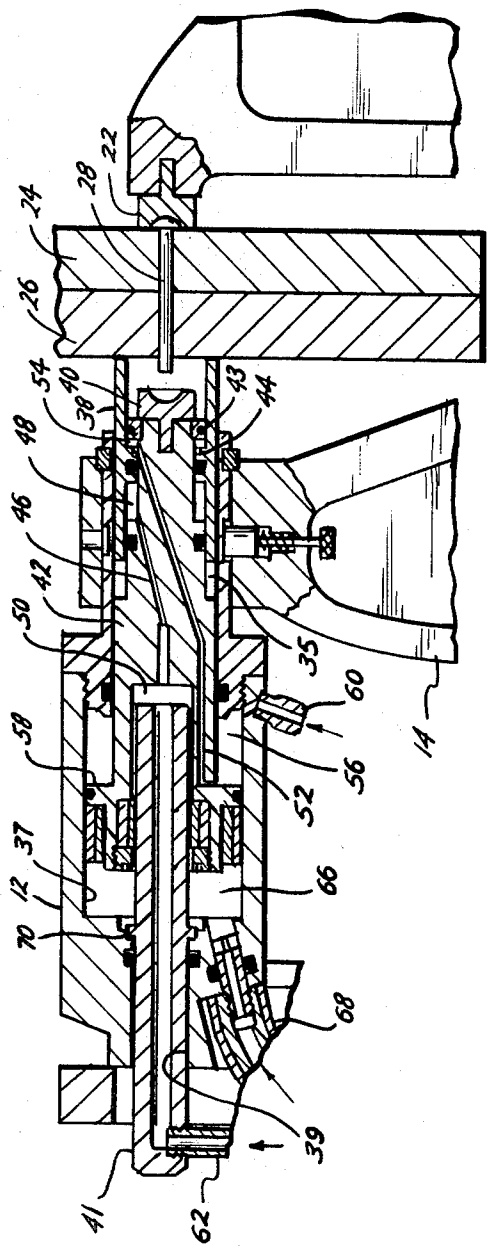



Fig. 3

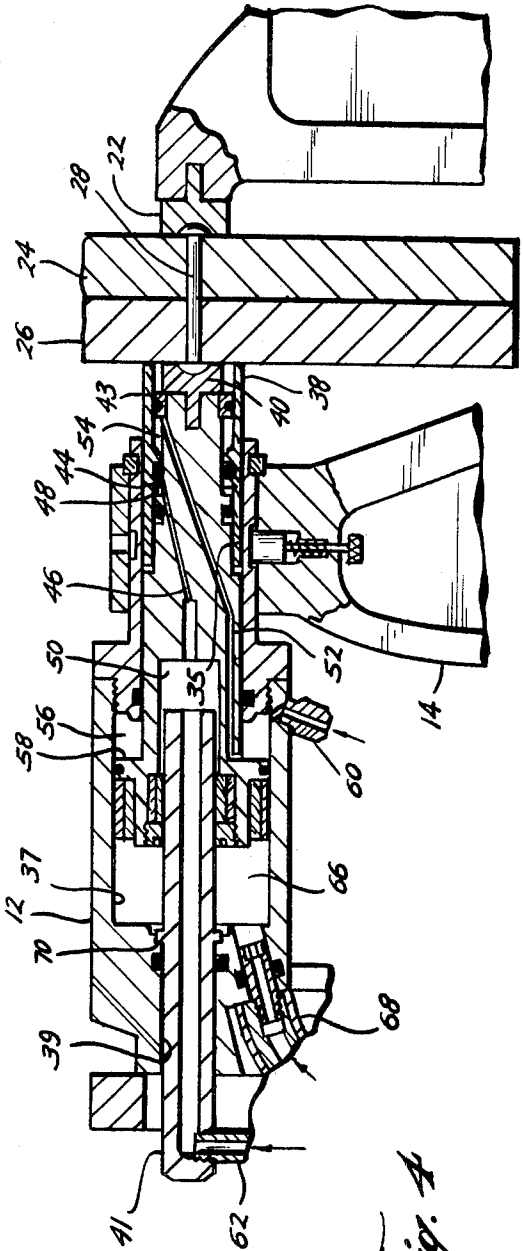



Fig. 4

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RIVETING DEVICE

Filed Dec. 20, 1968 3 Sheets-Sheet 3

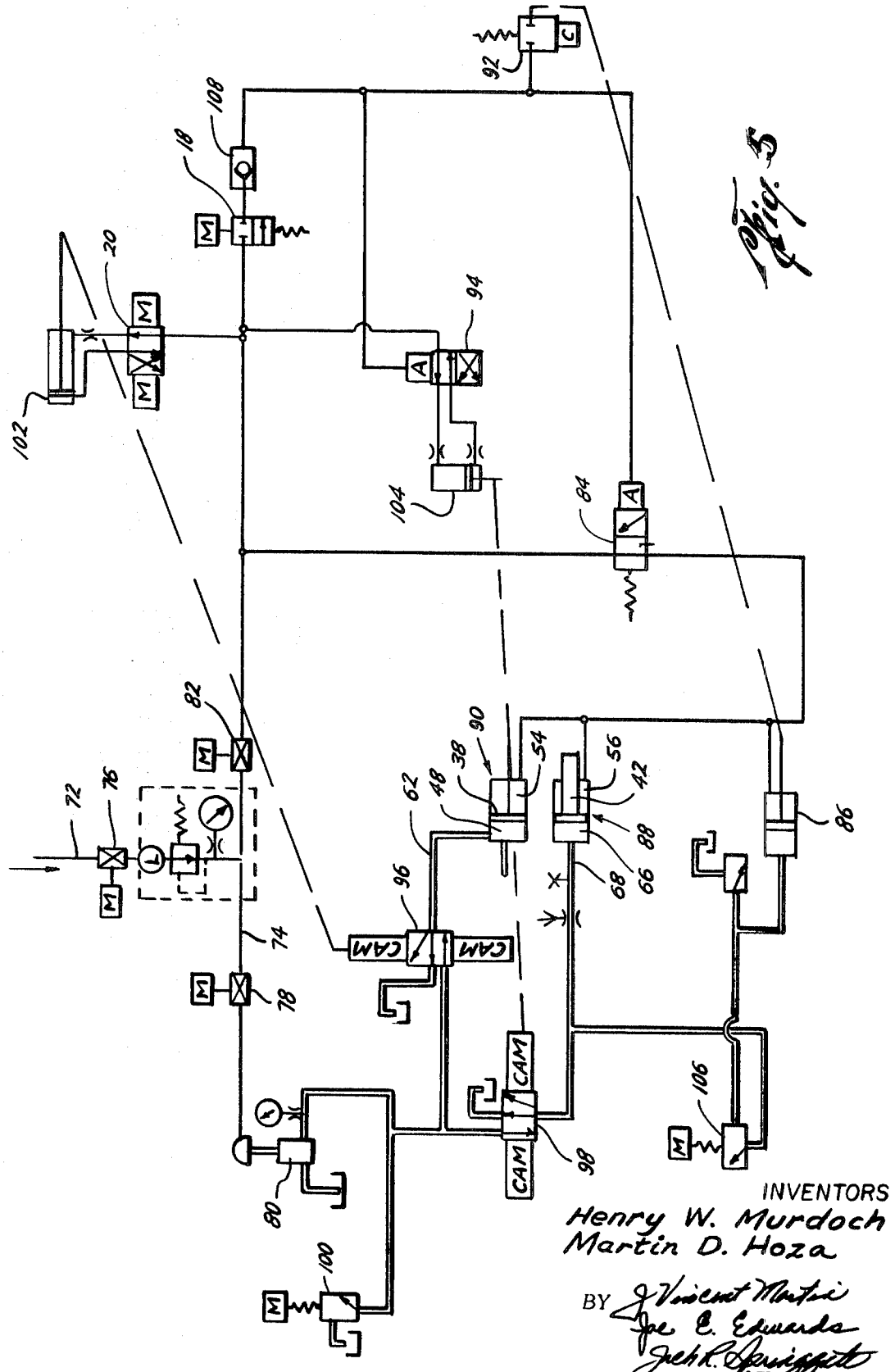



Fig. 5

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# RIVETING DEVICE

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U.S. Cl. 29—243.54 16 Claims

## ABSTRACT OF THE DISCLOSURE

A riveting device including a yoke to extend around work pieces to be riveted, a pressure actuated clamp and a pressure actuated rivet former, the pressure actuated clamp and rivet former being secured to one side of said yoke and actuating against the other side of said yoke.

## SUMMARY

The present invention relates to an improved riveting device.

An object of the present invention is to provide an improved riveting device which forms or sets rivets by squeezing rather than by impacting.

Another object is to provide an improved riveting device having separate and substantially independently operated pressure responsive clamping and rivet forming and setting means.

A further object is to provide an improved riveting device operable by one person to clamp work pieces to be riveted and to rivet the work pieces together.

A still further object is to provide an improved riveting device in which the highest force to be exerted on the rivet may be preselected.

## BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and advantages of the present invention are hereinafter set forth and explained with reference to the drawings wherein:

FIG. 1 is an end view of the improved riveting device of the present invention.

FIG. 2 is an elevation view of the riveting device partly in section showing both the clamping and rivet forming means withdrawn.

FIG. 3 is a partial sectional view of the riveting device showing the clamping of work pieces.

FIG. 4 is a partial sectional view of the riveting device showing the forming of the rivet.

FIG. 5 is a schematic diagram of the pneumatic-hydraulic control system for the riveting device.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

The riveting device **10** as shown in the drawings includes body **12** with the yoke **14** secured to one end thereof. The handle **16** is secured to the opposite end of the body **12** and supports the manual control valves **18** and **20**. The yoke **14** is generally C-shaped and has one end secured to the body **12** and the opposite end has the setting die **22** directly opposite from the yoke end of body **12**. Thus, the work pieces **24** and **26** which are to be secured together by the rivet **28** are positioned between the ends of yoke **14** with the head of rivet **28** in the setting die **22** and the distal or unformed end of rivet **28** extending through the work pieces **24** and **26** toward the body **12**.

Yoke **14** defines a bore through which the smaller end of body **12** extends. Snap ring **30** which engages in the groove **32** around body **12** and the spring loaded plunger **34** in yoke **14** which engages in groove **36** around body **12** retain yoke **14** on body **12**. With this means of securing yoke **14** to body **12**, the body **12** is free to rotate within yoke **14**. This allows the yoke **14** to be positioned for the convenience of the work pieces **24** and **26** and body **12** to be positioned for the convenience of the operator.



The riveting device **10** also includes a clamping means, a rivet forming means and actuating means for said clamping and forming means. The body **12** is hollow having the bore **35** at the yoke end, the enlarged bore **37** and the reduced bore **39** through which tube **41** extends. Within the bores **35** and **37** are positioned suitable pressure chambers for providing the clamping and rivet forming forces as hereinafter explained.

The clamping means includes the sleeve **38** which is slidable within the reduced bore **35** of body **12**. As can be seen by comparing FIGS. 2 and 3, sleeve **38** moves from its retracted position (FIG. 2) to its clamping position (FIG. 3). Sleeve **38** engages work piece **26** to clamp the work pieces **24** and **26** against setting die **22**. Because sleeve **38** is tubular it engages the work pieces around rivet **28** and therefore holds the work pieces against the setting die and allows the forming die **40** to be moved through sleeve **38** to engage and form the projecting end of rivet **28**. Forming die **40** is secured to the outer end of piston **42** which is slidably mounted in body **12** and adapted to slide through sleeve **38** to the rivet forming and setting position of die **40** as shown in FIG. 4.

Sleeve **38** moves responsive to the pressure differential across the internal rib **44** on sleeve **38**. Passage **46** communicates through piston **42** between pressure chamber **48** on one side of rib **44** and the central chamber **50** defined by piston **42**. Passage **52** communicates through piston **42** between pressure chamber **54** on the opposite side of rib **44** and the annular chamber **56** defined between the flange **58** on the end of piston opposite forming die **40** and the enlarged bore in body **12**. The pressure differential across rib **44** therefore is controlled by the fluid pressure supplied through fitting **60** to annular chamber **56** and by the fluid pressure supplied through line **62** and tube **41** to central chamber **50**. When the pressure in chamber **48** exceeds the pressure in chamber **54**, sleeve **38** moves toward clamping position. When the pressure in chamber **54** exceeds the pressure in chamber **48**, sleeve **38** moves toward retracted position.

The movement of piston **42** is responsive to the forces on piston **42** resulting from the fluid pressures in central chamber **50**, annular chamber **56** and annular chamber **66** on the opposite side of flange **58** from chamber **56**. Fluid pressure is delivered to chamber **66** through line **68** under suitable controls as hereinafter described. Piston **42** is provided with suitable packing and seals to seal against the interior of both bores **35** and **37** in body **12**, the interior of sleeve **38** and the exterior of tube **41**. As shown tube **41** extends through body **12**, is suitably sealed in bore **39** and is held against movement outwardly by the shoulder **70**.

Since it is desired that actuation of sleeve **38** and piston **42** be substantially independent of the other, a fluid such as air is supplied under pressure to chamber **56** and hydraulic fluid under higher pressure than the air pressure is supplied to chambers **50** and **66**. The effective pressure area of the piston **42** exposed to pressure in chamber **48** is greater than the effective pressure area of the piston **42** exposed to pressure in chamber **50**. Since both of these chambers are exposed to the same pressure the slight effective area difference results in a force urging piston **42** to the left as viewed in the drawings. This differential assures that the piston **42** does not engage the rivet **28** during the clamping cycle even if the air pressure in chambers **54** and **56** is lost completely. The hydraulic fluid is supplied through line **68** under pressure control which is preselected to relieve the pressure in chamber **66** once such preselected pressure has been

reached as hereinafter explained. This allows the maximum force exerted on rivet **28** to be preselected.

The pneumatic-hydraulic control system illustrated in FIG. 5 is a suitable control system for controlling the actuation of the rivet device **10**. The system is supplied with compressed air from a suitable source (not shown) through line **72** to manifold **74** under control of valve **76** and with suitable lubrication and pressure regulation as shown. Valve **78** controls the flow of air from manifold **74** to the hydraulic pump **80** in the hydraulic portion of the system. The valve **82** controls the flow of air from the manifold **74** to the pneumatic portion of the system. Air is supplied through normally open valve **84** to one end each of the cylinders **86**, **88** and **90**. Cylinder **88** represents the squeeze or piston portion of riveting device **10** while cylinder **90** represents the clamping or sleeve portion of riveting device **10**. Cylinder **86** is utilized to control bleed valve **92** as hereinafter explained. Air pressure is conducted to the valves **18**, **20** and **94**.

The pump **80** delivers hydraulic fluid to valves **96** and **98** under control of pressure relief valve **100**. Valve **96**, controls the flow of hydraulic fluid to cylinder **90** and is controlled by cylinder **102** responsive to operation of valve **20**. Valve **98** controls the flow of hydraulic fluid to cylinder **88** and is controlled by cylinder **104** responsive to operation of valve **94**. Hydraulic fluid between valve **98** and cylinder **88** is conducted through relief valve **106** to cylinder **86** as hereinafter described.

In operation, the riveting device **10** is provided with air under pressure through valve **84** in chambers **54** and **56** which pressure is sufficient to assure that both piston **42** and sleeve **38** are retracted. The work pieces **24** and **26** with the rivet **28** extending therethrough are then positioned in the yoke **14** with the head of the rivet **28** in the setting die **22**.

To clamp work pieces **24** and **26** in such position, the operator actuates the valve **20** which moves cylinder **102** to actuate valve **96** to deliver hydraulic fluid through line **62** to chambers **48** and **50** causing sleeve **38** to engage and clamp the work pieces against setting die **22**. If the operator is not satisfied with the clamped position he may reverse valve **20** to relieve chambers **48** and **50** whereby the air pressure in chamber **54** causes sleeve **38** to retract. It should be noted that while sleeve **38** moves substantially independent of piston **42**, when the rib **44** on sleeve **38** engages the ring **43** on piston **42**, both sleeve **38** and piston **42** move toward the work pieces **24** and **26** until they are clamped in position.

With the work pieces properly clamped, valve **18** is actuated to direct hydraulic fluid through line **68** into chamber **66** whereby piston **42** is actuated. The opening of valve **18** delivers air pressure through the check valve **108** to the valves **84**, **94** and **92**. Pneumatic pressure in this system is trapped by check valve **108**. Valve **84** is actuated by this pressure to relieve the air pressure from chambers **54** and **56**. This pressure actuates valve **94**, moving cylinder **104** to open valve **98** delivering hydraulic fluid through line **68** to chamber **66** and also to relief valve **106** which is preset to open at a preselected maximum desired pressure. The hydraulic pressure in chamber **66** moves piston **42** toward the work pieces.

As piston **42** moves, the excess of the hydraulic fluid displaced from chamber **48** to chamber **50** is returned through line **62** and valve **96** and is returned to the reservoir. As the die **40** engages the end of rivet **28** the force exerted on piston **42** is sufficient to form and set rivet **28**. This type of riveting which results from the increase in pressure provides a preferred rivet joint as compared to the multiple impact type of riveting. When the riveting is completed, the pressure in chamber **66** reaches the preselected release point and is released through valve **106** to cylinder **86** and to the hydraulic reservoir. Actuation of cylinder **86** opens valve **92** to relieve pressure in the system supplying air pressure to valves **84** and **94**. Then



valves **84** and **94** return to their original position causing valve **98** to close.

In this position the riveting has been completed and air pressure is supplied through valve **84** to chambers **54** and **56** to return piston **42** to its retracted position. The clamping sleeve **38** is retracted by reversing valve **20** which reverses cylinder **102** moving valve **98** to a position connecting line **62** to the hydraulic reservoir. This completes the riveting cycle and the device may be moved into the next riveting position.

From the foregoing it can be seen that the improved riveting device of the present invention is easily operated having only two hand controls with a preselected adjustment setting the maximum riveting force applied. The riveting device has substantially separate clamping and rivet setting and forming means so that the clamping means can be set and released if desired without actuating the rivet setting means.

What is claimed is:

**1.** A riveting device comprising

a body,

a pressure responsive sleeve slidably mounted in said body,

a pressure responsive piston slidably mounted in said body independent of said sleeve,

a rivet forming die connected to said piston,

means connected to said body to support received work pieces to be riveted having a rivet extending through the work pieces,

means for supplying pressure fluid to said sleeve to move said sleeve independent of said piston into clamping engagement with the work pieces, and

means for supplying pressure fluid to said piston to move said piston independent of said sleeve and apply said rivet forming die thereon into engagement against said rivet with force sufficient to form and set said rivet in the work pieces thereat.

**2.** A riveting device according to claim **1** including means for relieving the pressure fluid supplied to said piston when the pressure reaches a preselected pressure.

**3.** A riveting device according to claim **1** wherein said piston is slidable within said sleeve whereby when said sleeve clamps said work pieces said piston engages the projecting end of the rivet within said sleeve and sets said rivet in said work pieces.

**4.** A riveting device according to claim **1** including means for supplying air pressure to said sleeve and said piston to urge said sleeve and said piston toward their retracted positions.

**5.** A riveting device according to claim **4** including means for relieving air pressure on said sleeve and said piston when pressure fluid is delivered to said piston.

**6.** A riveting device, comprising

a body,

a yoke, having one end secured to said body and the other end spaced from said one end,

a pressure responsive sleeve slidably mounted with respect to said body to move toward and away from the end of said yoke away from said body so that members to be joined may be clamped between said yoke end and said sleeve,

a rivet forming die,

a pressure responsive member reciprocally mounted in said body independent of said sleeve,

said rivet forming die being secured to said pressure responsive member,

means for supplying fluid pressure to said pressure responsive sleeve to move said sleeve independent of said pressure responsive member, and

means for supplying fluid pressure to said pressure responsive member to move said member independent of said sleeve for forming a rivet between said opposite end of said yoke and said rivet forming die.

**7.** A riveting device according to claim **6** wherein said yoke is pivotally mounted around said body.

8. A riveting device according to claim 6 including
a first control valve mounted on said body and adapted to control the fluid pressure supplied to said sleeve, and
a second control valve mounted on said body and adapted to control the fluid pressure supplied to said pressure responsive member.

9. A riveting device comprising
a body having a first bore and a larger second bore,
a sleeve slidably mounted in said first bore of said body,
a piston slidably mounted in said second bore of said body and extending within said sleeve slidably independent thereof,
said sleeve and said piston when extended adapted to be partially outside said body,
support means for supporting received work pieces to be riveted,
means for supplying a pressure fluid to said sleeve to actuate said sleeve independent of said piston to extended position clamping work pieces against said support means with the projecting end of a rivet extending through the work pieces being within said sleeve, and
means for supplying a pressure fluid to said piston to actuate said piston independent of said sleeve into riveting position within said sleeve and engaging the projecting end of the rivet to form and set the rivet in the work pieces.

10. A riveting device according to claim 9 wherein
said sleeve and said piston define a first and a second pressure chamber,
fluid pressure in said first chamber moving said sleeve to extended clamping position and said piston to retracted position,
said piston and said body define a third and a fourth pressure chamber,
fluid pressure in said third chamber moving said piston to extended rivet forming and setting position.

11. A riveting device according to claim 10 including means for supplying air pressure to said second and fourth chamber to urge said sleeve and said piston toward their retracted positions.

12. A riveting device according to claim 11 including means for relieving air pressure from said second and fourth chambers when pressure fluid is supplied to said third chamber.

13. A riveting device according to claim 12 including means for relieving pressure fluid from said third chamber when the pressure therein reaches a preselected maximum pressure.



14. A riveting device according to claim 13 including means associated with said pressure fluid relieving means to shut off said air relieving means when pressure in said third chamber is relieved whereby the air pressure is supplied to said second and fourth chambers to retract said piston.

15. A riveting device according to claim 14 wherein
said sleeve moves substantially independently of said piston, and
the air pressure in said second chamber urging said sleeve toward a retracted position whereby when fluid pressure is relieved from said first chamber said sleeve retracts from clamping position responsive to air pressure.

16. A riveting device, comprising
a body,
a yoke, having one end pivotally mounted around said body and the other end spaced from said one end,
a pressure responsive sleeve slidably mounted with respect to said body to move toward and away from the end of said yoke away from said body so that members to be joined may be clamped between said yoke end and said sleeve,
a rivet forming die,
a pressure responsive member reciprocally mounted in said body,
said rivet forming die being secured to said pressure responsive member,
means for supplying fluid pressure to said pressure responsive sleeve, and
means for supplying fluid pressure to said pressure responsive member for forming a rivet between said opposite end of said yoke and said rivet forming die.


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