

June 7, 1966

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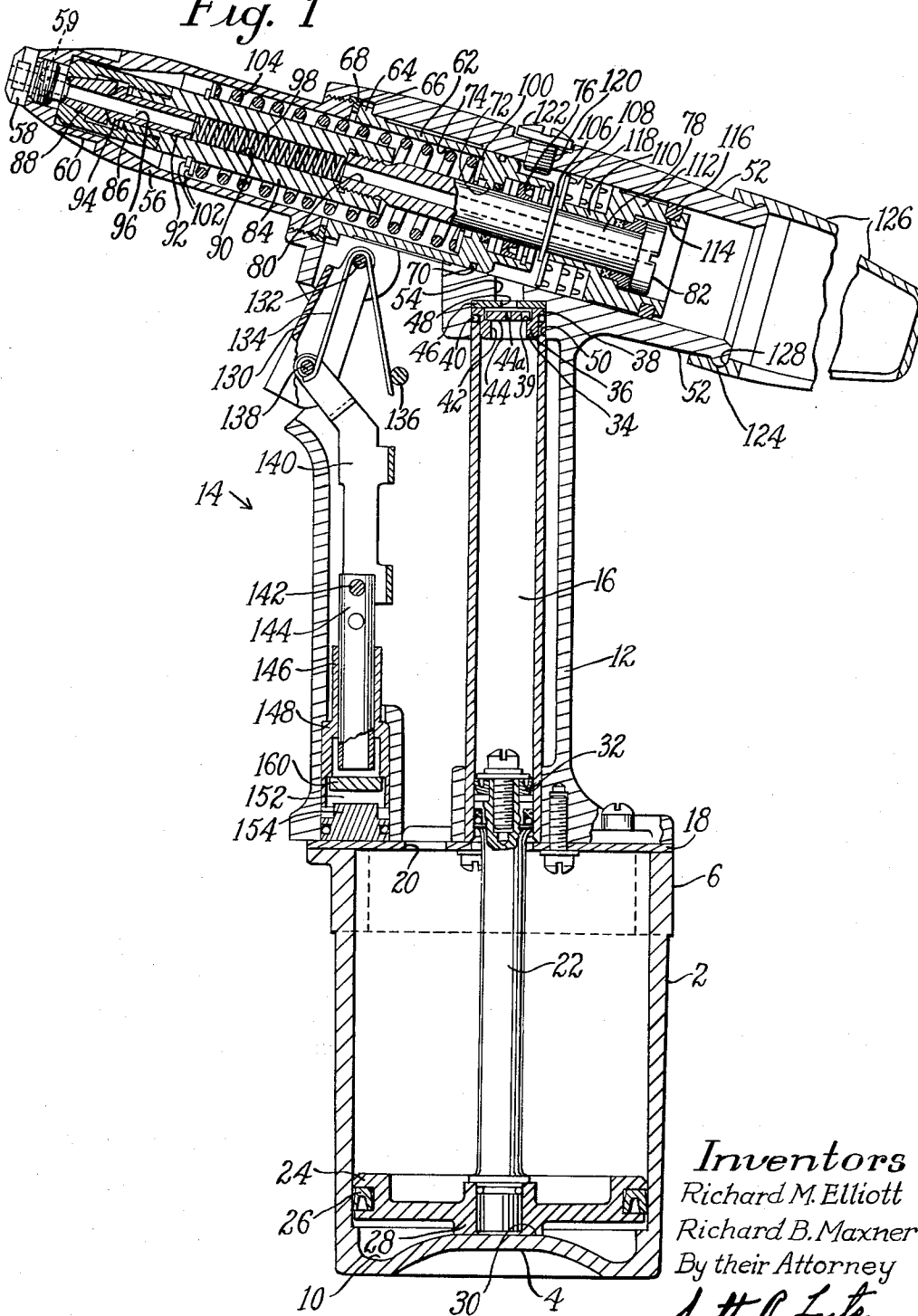
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HYDRAULIC POP RIVETERS

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Fig. 1



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June 7, 1966

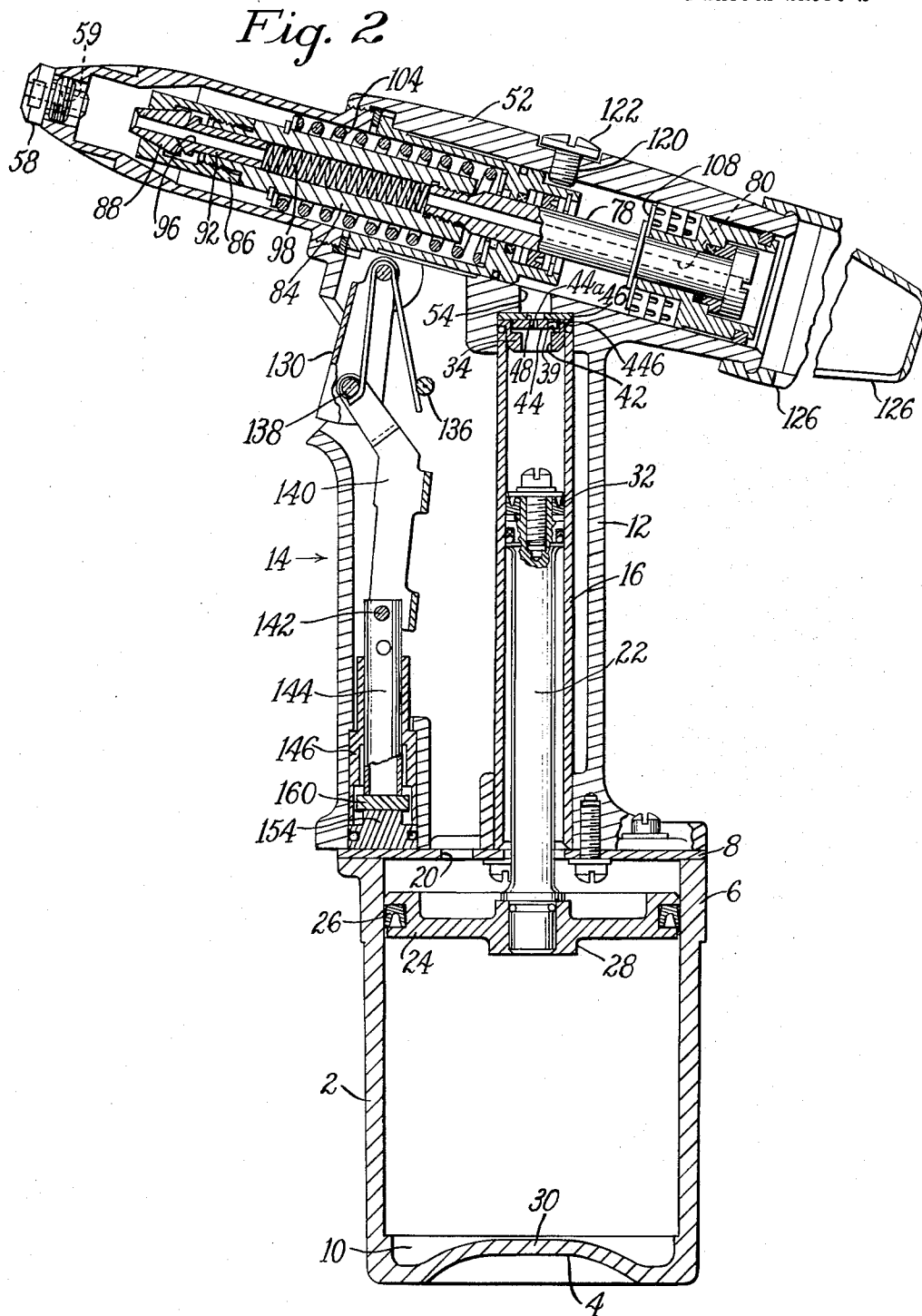
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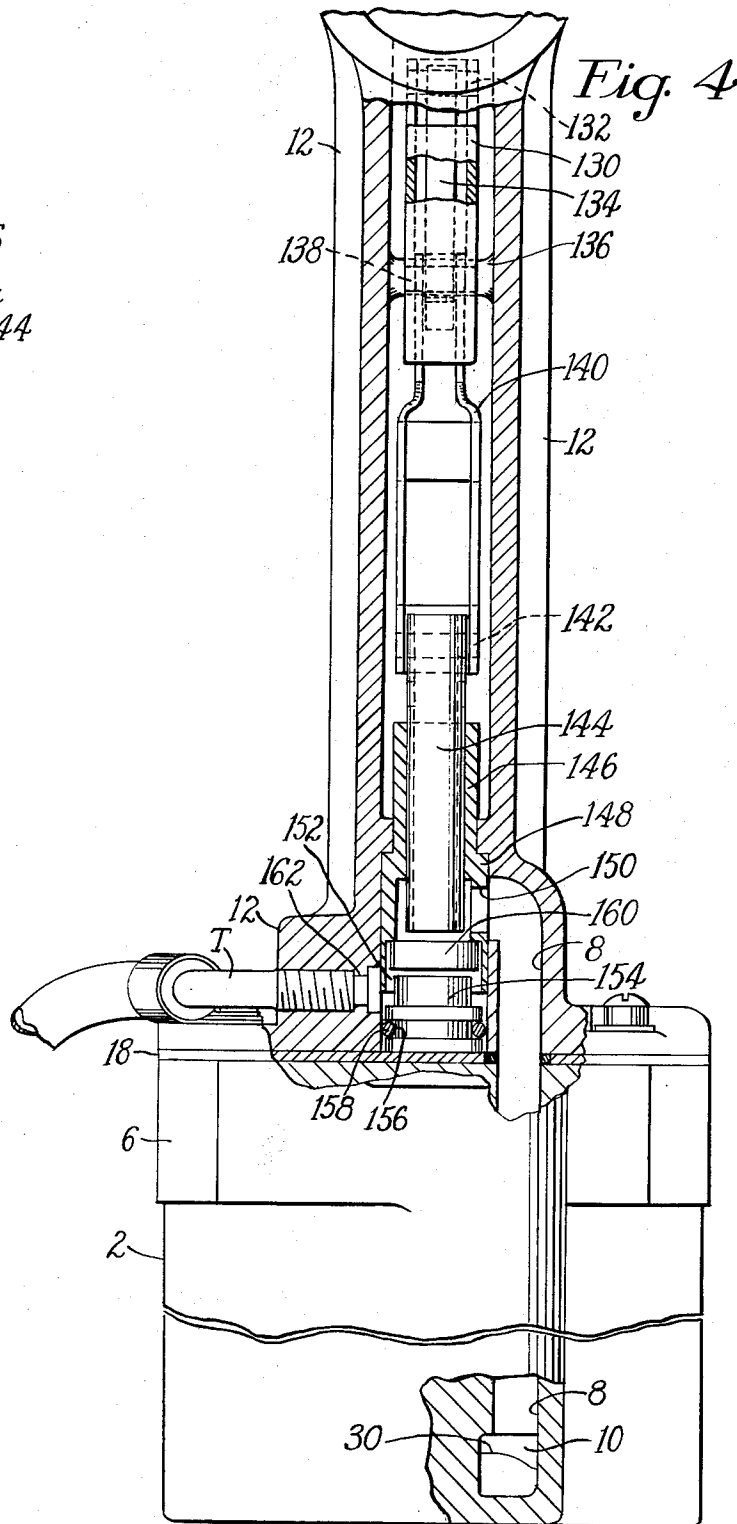
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Fig. 5

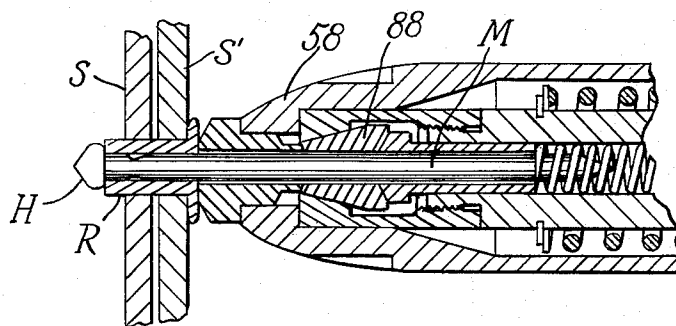


Fig. 6

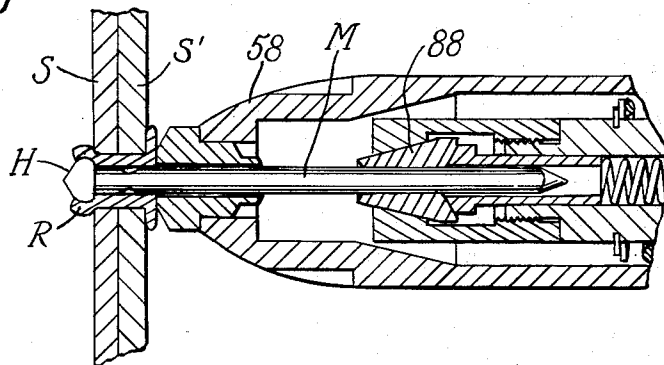
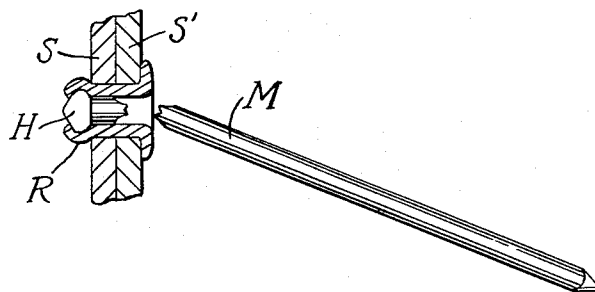


Fig. 7



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HYDRAULIC POP RIVETERS

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Filed Jan. 29, 1964, Ser. No. 340,975

3 Claims. (Cl. 72—391)

This invention relates to power tools, and more particularly to a fluid-actuated pull gun for the setting of blind rivets and the like.

In the manufacture of many articles it is desirable to connect two or more work sheets or work pieces together by means of rivets under circumstances in which it is impossible or inconvenient to obtain access to opposite ends of the rivets for the performance of ordinary rivet upsetting operations. To accomplish the desired result, it has grown to be the practice to employ blind rivets of the type in which a rivet body is provided with a longitudinal bore which receives a mandrel having an enlarged head disposed adjacent the remote end of the rivet body. The mandrel extends through the rivet and projects beyond the rivet body to be gripped by a pulling tool. After the rivet has been inserted from one side of the assembled work pieces, a pulling force may be exerted by the pulling tool from that same side, pulling the mandrel head into the rivet body, upsetting the remote end thereof and securing the rivet in the work pieces.

In the usual blind rivet setting operation, a force is exerted upon the mandrel sufficient not only to pull the mandrel head through its upsetting motion, but also to break off the mandrel once the rivet is set. The shock of the sudden release of strain when the mandrel breaks is usually sufficiently severe to cause the tool to "jump" uncontrollably. In most applications the sudden "jump" of the tool when the mandrel breaks causes little or no harm to the work pieces. However, it has been found that where extremely thin sheets of material are to be subjected to a blind riveting operation, the occurrence of "dimpling" must be expected from the rivet setting tools now available. After a rivet setting operation, an inspection of the thin sheet material generally reveals a series of small indentations or dimples.

It is accordingly an object of the invention to provide a hand tool for applying a smooth pulling force to the mandrel and in which there is no substantial shock imparted to the tool upon the severance of the mandrel.

To this end there is provided a rivet setting tool having a one-way check valve arrangement which restricts the flow of hydraulic fluid in one direction through the valve during a pulling operation so as to effect a smooth pulling and breaking operation, but which allows the fluid to readily pass in an opposite direction through the valve after completion of a rivet setting operation.

The above and other features of the invention, including novel details of construction and combinations of parts, will now be described in the following specification and will be pointed out in the appended claims. It will be understood that the particular device embodying the invention is shown by way of illustration only and not as a limitation of the invention. The principles and features of this invention may be employed in varied and numerous embodiments without departing from the scope of the invention.

In the drawings,

FIG. 1 is a vertical sectional view illustrating the details of construction of a blind rivet setting tool constructed in accordance with the preferred embodiment of our invention;

FIG. 2 is a vertical sectional view similar to FIG. 1

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but showing the relative dispositions of the movable parts at the end of a rivet pulling stroke;

FIG. 3 is an exploded detail perspective view of the one-way check valve mechanism;

FIG. 4 is a front sectional view of the trigger and air inlet mechanism of the tool; and

FIGS. 5-7 show the rivetting process diagrammatically.

Referring to FIG. 1, the preferred embodiment of the invention includes a pneumatic cylinder 2 for receiving pressurized air from a source not shown. The pneumatic cylinder 2 has at one end a recessed bottom 4 and at the other end an enlarged collar portion 6. An air pipe 8 (FIG. 4) communicates with an annular air chamber 10 formed by the recessed bottom 4. Attached to the enlarged collar 6 is an upper housing 12 which serves as a handle and contains a trigger assembly 14 for actuating the device and a hydraulic cylinder 16. Separating the pneumatic cylinder 2 and the upper housing 12 is a metal diaphragm 18 having an aperture 20.

Operatively connecting the hydraulic cylinder 16 and the pneumatic cylinder 2 is a common rod 22. Mounted upon the end of the rod 22 disposed in the pneumatic cylinder 2 is a piston 24 carrying a seal ring 26 and having a hub portion 28 which in its extreme low position rests upon a raised portion 30 of the bottom of the cylinder 2, the raised portion 30 being defined by the recess 4. Mounted upon the other end of the rod 22 disposed in the hydraulic cylinder 16, are sealing members 32.

The metering feature of the invention is located at the upper end of the hydraulic cylinder 16, as viewed in FIGS. 1 and 2 where there is arranged a flanged restrictor housing 34 having a barrel portion 36 which is disposed within the hydraulic cylinder 16, a flange portion 38 which rests upon a sealing ring 40 on the end of the cylinder 16 and an interior shoulder 39. The restrictor housing 34 has a bore 42 which is enlarged at its upper portion, the enlargement defining the shoulder 39. In the enlarged portion there is disposed a restrictor 44 which has an edge width of less than the axial length of the enlarged portion of the bore 42 so that the restrictor 44 fits loosely, with axial "play," in the bore 42. The restrictor 44 is essentially an orifice plate having a relatively small central orifice 44a and several relatively large peripheral orifices or recesses 44b (FIG. 3). A restrictor seat 46, having a relatively large orifice 48, rests upon the upper face of the flange 38. When the tool is not performing a pulling stroke, the restrictor 44 is supported by the interior shoulder 39 in the enlarged portion of the bore 42 of the restrictor housing 34. The restrictor seat 46, the restrictor housing 34 containing the restrictor 44, the sealing ring 40, and the extreme upper end of the hydraulic cylinder 16 are fitted into a cylindrical recess 50 in the upper regions of the upper housing 12.

Formed integral with the upper housing 12 at its upper extremity is a draw cylinder 52 which houses the rivet pulling apparatus of the invention. The draw cylinder 52 communicates with the hydraulic cylinder 16 through a channel 54 which, together with the restrictor housing 34, constitute a conduit for the flow of fluid between the hydraulic cylinder and the draw cylinder. Threadedly received in the forward end of the cylinder 52 is a nose housing 56 which at its forward end threadedly receives a nosepiece 58 having an axial bore 59 suitable for receiving a blind rivet. The nose housing 56 is provided with wrench flats 60 for receiving the jaws of a wrench. The rivet pulling mechanism includes a seal sleeve 62, disposed in the draw cylinder 52, having a flange portion 64 fitting into a recess 66 in the inside wall of the cylinder 52. A sleeve retainer ring 68 is located in the recess 66 and is fitted between the flange 64 and the nose housing 56. A sleeve "O" ring 70 is received in a recess in the

outer wall of the seal sleeve 62. An axial bore 72 in the seal sleeve 62 has an enlarged section 74 toward the front of the tool. In recesses in the bore 72 are received sealing members 76.

A draw rod 78 is axially disposed in the draw cylinder 52, being slidably retained in the bore 72, and has an axial bore 80 throughout its length and an enlarged head 82 at its rearward end. The draw rod 78 is threadedly connected to a pulling head adapter 84 which is in turn threadedly connected to a jaw guide 86 which encircles jaws 88. The pulling head adapter 84 has an axial bore 90 in alignment with the bore 80. A jaw pusher 92 is received in the pulling head adapter 84 and has a flange portion 94 spaced from the forward face of the pulling head adapter 84. The jaw pusher 92 has an axial bore 96 in alignment with the bore 90. A coil spring 98 is inserted in the bore 90 of the pulling head adapter 84 and at its forward end abuts the rearward face of the jaw pusher 92 and at its rearward end abuts the forward face of the draw rod 78. The bore 74 receives an annular face plate 100 which is disposed around the draw rod 78. Mounted on the pulling head adapter 84 are retaining rings 102, one recessed in the outer wall of the pulling head adapter 84, and one fitted around the adapter 84 and abutting the recessed retaining ring. Extending from the retaining rings 102 to the face plate 100 is a return spring 104 which is coiled around portions of the outer surfaces of the adapter 84 and the draw rod 78, and is disposed within the bore 74 of seal sleeve 62 and within a portion of the nose housing 56. The return spring 104 urges the draw rod 78 towards the nose section of the draw cylinder.

Rearward of the flanged seal sleeve 62 there is fixed to the draw rod a draw cylinder piston assembly which includes a collar portion 106 of the draw rod 78 abutting an annular disc 108 mounted on the draw rod. A sleeve member 110 is disposed upon the draw rod 78 with its forward face abutting the disc 108. An enlarged portion 112 of the sleeve member 110 has a recess 114 in its outer wall which receives sealing members 116 which slidably engage the inner wall of the draw cylinder 52. Between the disc 108 and the enlarged portion 112 of the sleeve 110 are located sealing members 118 which slidably abut the inside wall of the draw cylinder 52. The enlarged portion 112 of the sleeve member 110 receives in its axial bore the head 82 of the draw rod 78. The disc 108, the sealing members 118, and the sleeve member 110 form, in effect, a piston on the operator end of the draw rod, slidable in the draw cylinder 52.

A threaded hole 120 is located on the top of the draw cylinder 52, for the purpose of admitting fresh hydraulic fluid, and is closed by a screw 122. A bead 124 extends around the periphery of the rearward end of the draw cylinder 52 for the purpose of receiving a deflector 126 having a recess 128 in its inner wall for receiving the bead.

FIGS. 1, 2 and 4 illustrate the trigger and air inlet mechanism of the invention which includes a trigger 130 pivoted about a pivot pin 132 by which the trigger is connected to the upper housing 12. A trigger spring 134 rests upon the pivot pin 132 and is attached at its ends to a spring pin 136 in the upper housing 12 and a connecting pin 138 on the trigger 130. The trigger spring 134 urges the trigger 130 in a forward direction and resists movement of the trigger rearward.

The connecting pin 138 retains one end of a toggle 140 which at its other end is connected by another connecting pin 142 to one end of a tube 144. The tube 144 is slidably received in a sleeve 146 having an enlarged portion 148 which is retained by the upper housing 12 and which has an aperture 150 (FIG. 4) in alignment with the air pipe 8. The lower end of the sleeve 146 forms the upper portion of a valve chamber 152 defined by the upper housing 12. The valve chamber 152 retains a valve plug 154 having a peripheral recess 156 with a sealing ring 158 disposed therein. A "floating" rubber valve disc 160 is

disposed in the lower end of the sleeve 146 and the upper portion of the valve chamber 152. A channel 162 (FIG. 4) in the upper housing 12 connects the valve chamber 152 to a tube T which is in turn connected to a source of pressurized air.

Before using the tool, the hydraulic system is completely filled with a suitable hydraulic medium, such as oil and the like, through the hole 120, and capped with the screw 122. The tool is connected to a source of compressed air so that the air is available in the tube T. The mandrel of a blind rivet is inserted through the bore 59 of the nosepiece 58 into the aperture formed by the jaws 88 and into the bore 96 of the jaw pusher 92. The body of the rivet is then inserted into aligned apertures provided in the work pieces which are to be fastened together.

The trigger 130 is squeezed so as to move the connecting pin 138 in a rearward and downward direction. The downward movement of the pin 138 causes the toggle 140 to exert a downward force on the tube 144. As is illustrated in FIG. 4 air from the tube T is readily admitted through the channel 162 into the valve chamber 152. The air is restricted by the lower portion of the sleeve 146 to entering the valve chamber 152 at a point beneath the valve disc 160 which, when the tool is inoperative, rests upon the valve plug 154. Accordingly, when pressurized air is admitted to the valve chamber 152 it lifts the valve disc 160 off the valve plug 154 and pushes it against a downward facing shoulder in the sleeve 146 thereby effecting an air tight seal. However, when the tube 144 is pushed downward, its lower end engages the valve disc 160 and forces it downward, breaking the seal and permitting the pressurized air to escape through the aperture 150 into the air pipe 8.

Air under pressure is accordingly channeled into the pneumatic cylinder 2, to the annular chamber 10 around the raised portion 30 of the bottom of the cylinder 2. Acting against the underface of the piston 24, the air forces the piston 24 upwards. The aperture 20 provides for atmospheric pressure only on the upper surface of the piston 24. Upward movement of the piston 24 effects an upward movement of the rod 22 into the hydraulic cylinder 16. It will be understood that the references to "upward" movements and the like are for convenience in referring to the drawings, and that actually the device is usable in any attitude, for example upside-down.

As the rod 22 progresses into the hydraulic cylinder 16 the hydraulic fluid therein is forced toward the draw cylinder 52. The path of the hydraulic fluid leaving the hydraulic cylinder 16 is narrowed in the bore 42 where the fluid presses against the restrictor 44 urging it against the underside of the restrictor seat 46 (FIG. 2). When the restrictor 44 is flush with the underside of the restrictor seat 46, the central orifice 44a of the restrictor (FIG. 3) is in alignment with the orifice 48 of the restrictor seat, allowing the flow of hydraulic fluid therethrough. The peripheral recesses 44b of the restrictor are covered or masked by the underside of the restrictor seat and so do not afford a passage for the flow of fluid. Thus, when the hydraulic medium is being forced from the hydraulic cylinder 16 into the draw cylinder 52 it must pass through the single channel defined by the orifice 44a.

Fluid emitting from the channel 54 enters the draw cylinder 52 at a point forward of the disc 108 mounted on the draw rod 78. The medium acts on the disc 108 so that the draw rod 78 is displaced in a rearward direction. At the same time the pulling head adapter 84 and the jaw guide 86 are moved in the same direction, away from the nosepiece 58. The coil spring 98 acting through the jaw pusher 92, tends to push the jaws 88 forward against the conical back surface of the jaw guide 86. The jaws 88 accordingly oppose the rearward movement and there occurs a relative movement between the opposed and adjacent surfaces of the jaws

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88 and the conical section of the jaw guide 86. Because of this relative movement the jaws 88 are moved toward one another and the rivet is firmly gripped. The jaws are drawn rearwardly by the conical section of the jaw guide 86, causing the jaws to be further wedged together and the rivet mandrel to be still more firmly gripped by the jaws. The mandrel is thereby moved rearwardly until the mandrel tears off at its designed breaking point.

It is at this point that a recoil is experienced in devices heretofore available. However, because of the restricted flow of hydraulic fluid into the draw cylinder, with its attendant smoother application of pressure, the present device operates with negligible recoil, making the device suitable for work on extremely thin sheets.

FIGS. 5-7 illustrate the fastening together of a pair of work pieces S, S' by a blind rivet R. FIG. 5 shows the rivet R in place prior to its being pulled by the pulling means of the tool. The rivet has been placed in the nosepiece 58 and has been inserted through aligned apertures of the two sheets S and S'. Referring to FIG. 6, when the jaws 88 of the tool grip a mandrel M and pull away from the work pieces, an enlarged head portion H of the mandrel M is caused to upset the end of the rivet R remote from the nosepiece 58 of the gun. FIG. 7 shows the work pieces S, S' joined together by the rivet R, the mandrel M having broken away and the gun having been removed.

After the rivet has been broken the operator releases the trigger 130. The valve disc 160, no longer held down by the tube 144, is again forced by the pressurized air into a sealing position. Referring to FIG. 4, it may be seen that when the tube 144 is raised off the valve disc 160 a channel from the pneumatic cylinder to the atmosphere exists through the air pipe 8, the aperture 150, and the tube 144 which is in communication with the interior of the upper housing 12 which is open to atmospheric pressure. As the return spring 104 moves the draw rod 78 toward the nosepiece 58, the hydraulic fluid is forced back through the channel 54.

The check valve which metered the flow of fluid into the draw cylinder 52 now acts to expedite the return of the fluid into the hydraulic cylinder 16. The downward flow of fluid from the draw cylinder forces the restrictor 44 downward until it rests upon the shoulder 39 in the restrictor housing 34. The shoulder permits substantial alignment of the peripheral recesses 44b of the restrictor 44 with the bore 42. The orifice 48 is still aligned with the orifice 44a. Accordingly, when flowing into the hydraulic cylinder the fluid passes through the orifice 44a of the restrictor 44 and also through the peripheral recesses 44b. Thus, the restrictor 44 represents one small channel for flow in the working stroke and several large channels for flow in the return stroke, facilitating a smooth working stroke and a rapid return stroke.

The entrance of hydraulic fluid into the upper end of the hydraulic cylinder 16 forces the rod 22 into the pneumatic cylinder until the pneumatic piston 24 again rests upon the raised portion of the pneumatic cylinder bottom 30. The tool is then ready for another operation. The broken shank generally falls from the nosepiece 58; however, on some occasions it has been known to eject out the back of the draw rod. To protect the operator from such a possibility the deflector 126 is provided on the operator end of the draw cylinder 52. The deflector 126 is readily removable and replaceable.

Having thus disclosed our invention and described in detail a preferred embodiment thereof, we claim as new and desire to secure by Letters Patent of the United States:

1. In a rivet setting tool for the pulling of blind rivets and the like which contain a mandrel member to be broken at the completion of the rivet setting operation, said tool having a fluid supply cylinder and piston as-

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sembly, a draw cylinder connected to the fluid supply cylinder, a draw rod slidably disposed in the draw cylinder having rivet gripping means on one end and a piston on the other end, a conduit extending from the fluid supply cylinder to the draw cylinder, and means for forcing fluid from the supply cylinder to the draw cylinder to initiate a working stroke of said tool, that improvement comprising means for preventing recoil action of said tool, said last means including metering means disposed in said conduit and responsive to the flow of the fluid from the fluid cylinder to the draw cylinder to restrict said flow during said working stroke, whereby said restricted flow of fluid prevents recoil action by retarding excessive travel of said piston when the mandrel of the rivet is broken.

2. In a rivet setting tool for the pulling of blind rivets and the like which contain a mandrel member to be broken at the completion of the rivet setting operation, said tool having a fluid supply cylinder and piston assembly, a draw cylinder connected to the fluid supply cylinder, a draw rod slidably disposed in the draw cylinder having rivet gripping means on one end and a piston on the other end, a conduit extending from the fluid supply cylinder to the draw cylinder, and means for forcing fluid from the supply cylinder to the draw cylinder to initiate a working stroke of said tool, that improvement comprising means for preventing recoil action of said tool, said last means including metering means disposed in said conduit and responsive to the flow of the fluid from the fluid cylinder to the draw cylinder to restrict said flow during said working stroke, whereby said restricted flow of fluid prevents recoil action by retarding excessive travel of said piston when the mandrel of the rivet is broken, and said metering means being responsive to a reversal in the direction of said flow to assume a substantially non-restricting attitude in said conduit.

3. In a rivet setting tool for the pulling of blind rivets and the like which contain a mandrel member to be broken at the completion of the rivet setting operation, said tool having a fluid supply cylinder and piston assembly, a draw cylinder connected to the fluid supply cylinder, a draw rod slidably disposed in the draw cylinder having rivet gripping means on one end and a piston on the other end, and a conduit extending from the fluid supply cylinder to the draw cylinder, that improvement comprising means for forcing fluid from said supply cylinder to said draw cylinder to initiate a working stroke of said tool, said means being operable to cause flow from said draw cylinder to said fluid supply cylinder, means for preventing recoil action of said tool, said last means including metering means disposed in said conduit and responsive to the flow of the fluid from the fluid supply cylinder to the draw cylinder to restrict said flow during said working stroke, whereby said restricted flow of fluid prevents recoil action by retarding excessive travel of said piston when the mandrel of the rivet is broken, and said metering means being responsive to flow of the fluid from the draw cylinder to the fluid supply cylinder to assume a substantially non-restricting attitude in said conduit.

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