

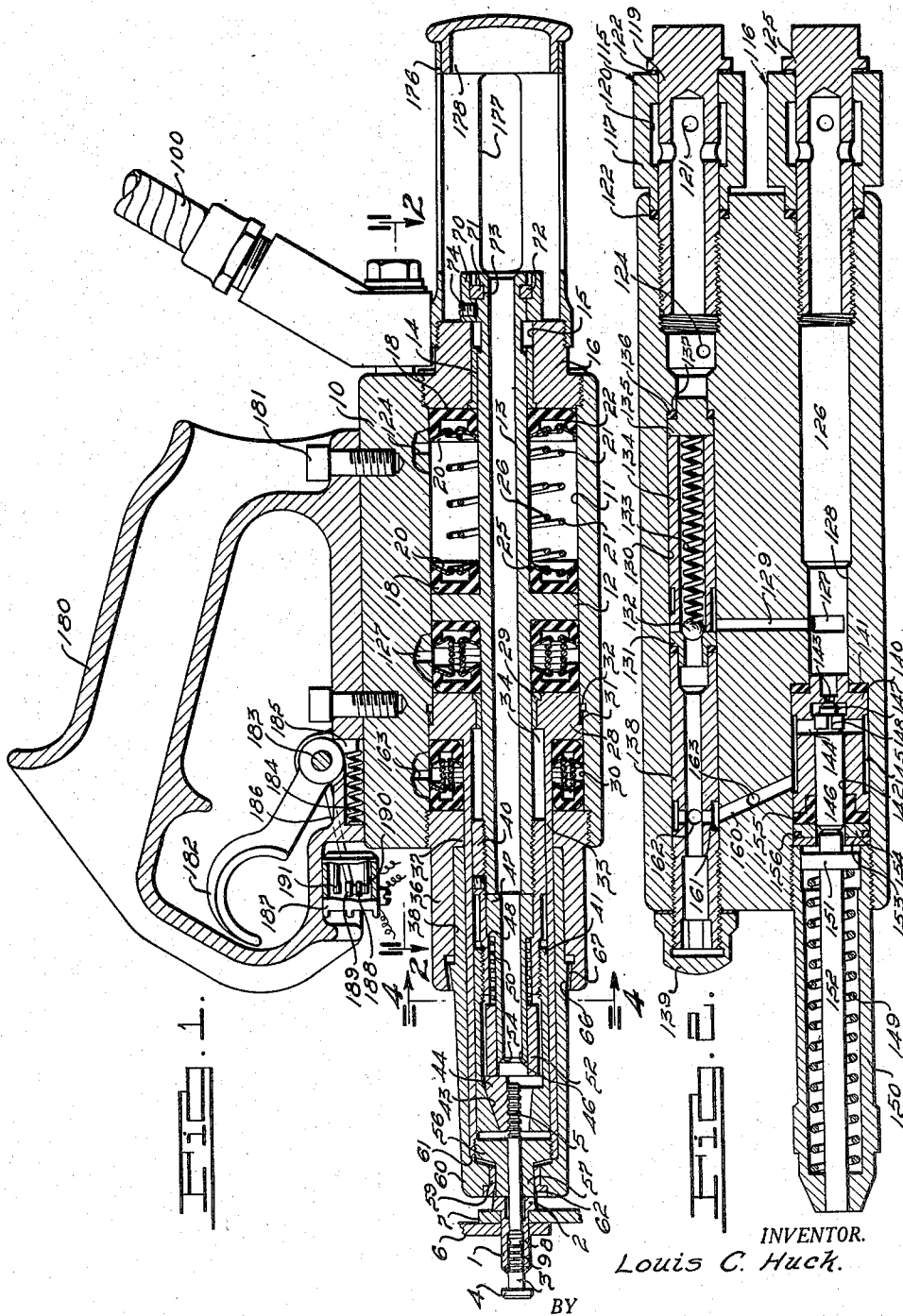
Aug. 3, 1937.

L. C. HUCK
RIVETING MACHINE

2,088,859

Filed May 14, 1935

2 Sheets-Sheet 1



INVENTOR.
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BY
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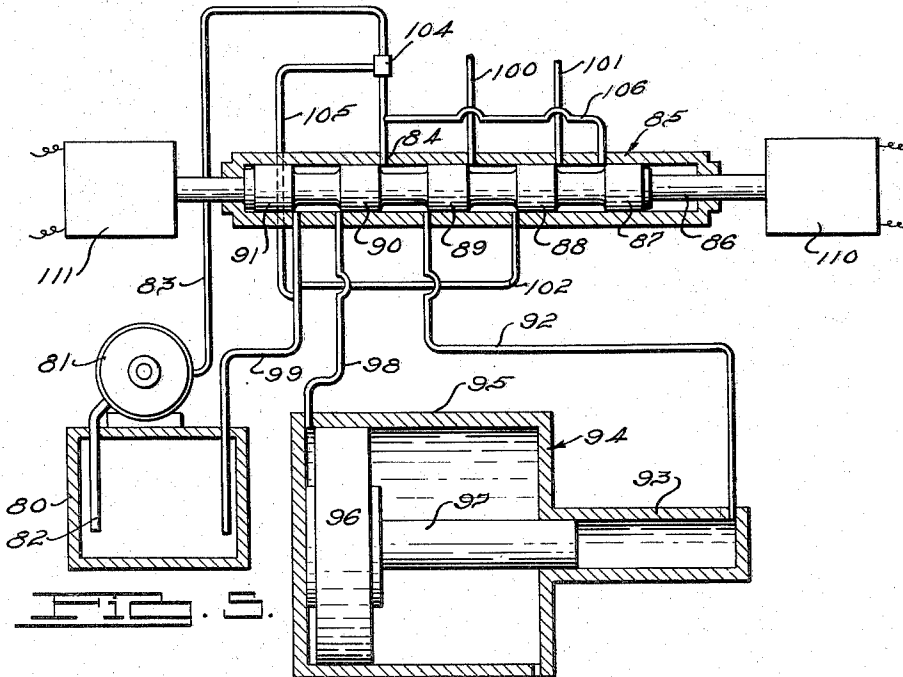
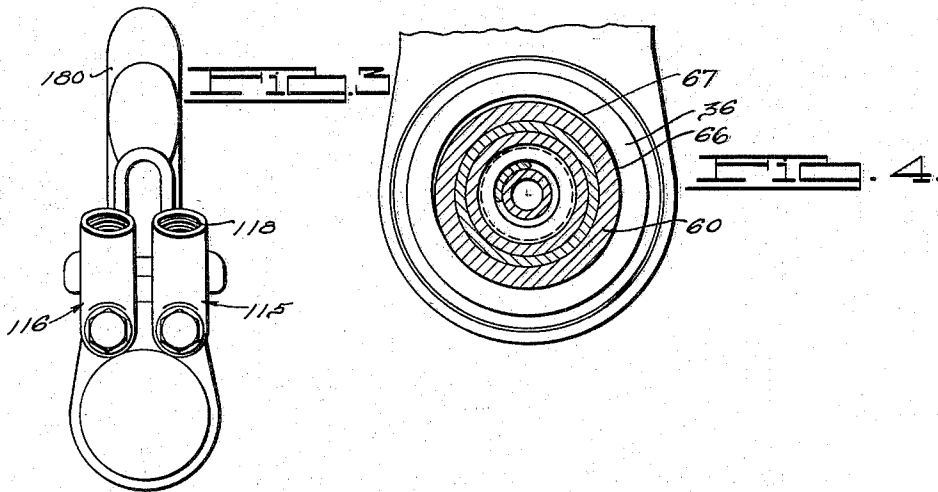
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UNITED STATES PATENT OFFICE

2,088,859

RIVETING MACHINE

Louis C. Huck, Grosse Pointe Village, Mich., assignor to Huxon Holding Corporation, a corporation of Michigan

Application May 14, 1935, Serial No. 21,474

23 Claims. (Cl. 218—19)

The invention relates to a rivet setting mechanism and system and in certain respects is related to the system and mechanism disclosed in the co-pending application for patent of Huck et al., Serial No. 636,480, filed October 6, 1932.

The invention particularly is designed to set a two-part rivet, such as disclosed, for example, in Huck co-pending application for patent 681,362, filed July 20, 1933. This type of rivet generally comprises a tubular member adapted to project through openings in the structure to be riveted, and having one end adapted to be bulbed into a head at one side of the structure and a preformed head adapted to engage the other side of the structure. A pin passing through the tubular member and beyond said preformed head is adapted to be pulled to form the bulbed head and while the preformed head is held by reactionary force to the pull. The mechanism disclosed in the first mentioned application includes an anvil for applying the reactionary force to the preformed head on the tubular member and a second anvil for swaging the preformed head to cause a flow of metal therein into locking grooves on the pin, after the bulbed head has been formed. Operation of this second anvil becomes automatic when the pull on the pin reaches a predetermined amount, that is greater than that required to form the bulbed head and less than that required to break the pin at a groove provided for this purpose.

One object of the present invention is to provide an improved rivet setting mechanism and system for setting a rivet of the general character set forth previously.

Another object of the invention is to provide such a mechanism and system for setting the type of rivet mentioned which is less expensive and is simpler in design.

Another object of the invention is to provide a rivet setting mechanism and system for setting a two-part rivet wherein the entire system is operated by a liquid fluid under pressure.

Another object of the invention is to provide a rivet setting mechanism and system for setting a two-part rivet wherein liquid under pressure from a pump is employed to return the parts to inoperative positions and wherein this liquid pressure is boosted for operation of the system to set the rivet.

Another object of the invention is to provide a riveting mechanism which is electrically controlled.

Other objects of the invention will become

apparent from the following specification, the drawings relating thereto, and from the claims hereinafter set forth.

For a better understanding of the invention, reference may be had to the accompanying drawings forming a part of the specification wherein:

Figure 1 is a longitudinal, cross-sectional view of a riveting mechanism constructed according to one form of the invention;

Fig. 2 is a cross-sectional view on a larger scale, taken substantially along the line 2—2 of Fig. 1;

Fig. 3 is an end view on a smaller scale, of the mechanism shown by Fig. 1;

Fig. 4 is a cross-sectional view on a larger scale, taken substantially along the line 4—4 of Fig. 1;

Fig. 5 is a diagrammatic view of a liquid supplying and pressure boosting part of the system which is connected to the mechanism shown by Fig. 1 for operating the latter.

A rivet adapted to be set is shown at the left end of the mechanism in Fig. 1 and corresponds to the type disclosed in co-pending application Serial No. 681,362. Briefly, it comprises a tubular member 1 having a preformed head 2, and a pin 3 having a head 4 at one end for causing forces to be applied to the end of the tubular member and grooves 5 at its opposite end for enabling the pin to be gripped and pulled. Plates to be riveted are shown at 6 and 7. Setting of the rivet is effected by pulling the grooved end of the pin and applying the reactionary force against the head 2. Continued pull is adapted to break the pin at a groove 8 then disposed adjacent the outer side of head 2 but before this occurs, metal in the head is swaged into locking grooves 9 on the pin, at that time disposed within the head, so as to provide a lock against recoil movement of the pin when it is broken under tension.

Referring to Fig. 1, the riveting mechanism comprises a cylinder body 10 having a bore 11. Within the bore, a reciprocatory piston 12 is provided and this piston is integral with a tubular piston rod 13 which, at its right end, is slidably mounted in a sleeve bearing 14 disposed in an opening 15 in a head 16 threaded into the right end of the bore. Cup shape sealing rings 18 are mounted on the rod 13 next to the piston and head 16 and the lip edges of the rings are maintained against the wall of the bore by annular and conical plate rings 20 which are urged longitudinally apart by means of a helical spring 21.

It will be noted that the plate rings 20 have their

inner edges curled as indicated at 22, for receiving the end coils of the spring and that the lip edges of the sealing rings are tapered in accordance with a conical formation of the rings

20. It will be appreciated that the pressure of the spring 21 through the plates will tend to maintain the lip edges of the sealing rings against the wall of the bore at all times and that when there is liquid pressure in the bore, the pressure will forcefully hold the lips of the sealing rings against the wall of the bore. A similar arrangement, including smaller plate rings 25 and a smaller spring 26 maintains the inner lip edges of the sealing rings against the periphery of the piston rod 13.

A second piston 28 having a sleeve bearing 29 is slidably mounted on the piston rod 13 to the left of the piston 12. In this connection it may be noted that the left end of the bore 11 is enlarged, as indicated at 30, and that the left end of the piston 28 is of larger diameter to fit this enlarged portion of the bore, while the remainder of the piston fits the smaller right end portion of the bore. This relation provides a shoulder 31 on the piston periphery and a corresponding shoulder 32 in the bore 11. The purpose of this larger outside diameter of the piston 28 at the left side and the shoulders will be mentioned presently.

Also at its left side, the piston 28 is integral with a tubular member 33 and while this member is adjacent the piston rod 13 a substantial space is provided between it and the rod as indicated at 34. The member 33 is slidable through a tubular head 36 threaded into the left end of the bore and it will be noted that the head has an inner portion 37 substantially fitting the member, but that outwardly of the portion 37 the head has a bore 38 substantially larger than the tubular member 33 thereby providing a substantial space around the member outwardly of the portion 37.

Sealing rings substantially like the rings 18 are provided between the piston 28 and piston 12 and the legs of the sealing rings are maintained against the wall of the bore and against the piston rod in the same manner as previously described. Similarly sealing rings are provided between the inner end of the head 36 and the piston 28, but the springs are shorter and owing to the presence of the tubular member 33, the sealing rings will be of larger inside and outside diameter. The purpose of increasing the diameter of the bore portion 30 and similarly increasing the diameter of the left end of the piston 28 is to compensate for the decrease in effective area on the left end of the piston 28 caused by the tubular member projecting therefrom. It is intended to so enlarge the bore 30 and the diameter of the left end of the piston 28 that the effective area on the left side of the piston 28 will substantially be the same as the effective area on the right side of the piston 28.

The left end of the piston rod 13 is threaded into a sleeve 40 slidable in the tubular member 33 and beyond the end of the piston rod the sleeve is of reduced outer diameter and is threaded into a tubular jaw actuating member 41 also slidable on the tubular member 33. The left end of the jaw holding member 41 has tapered jaw receiving sockets 43 each of which receives a jaw 44. The arrangement of the jaws and sockets and the manner in which they cooperate is substantially the same as disclosed in the co-pending application of Huck et al. first mentioned herein. It may be mentioned briefly, however,

that upon movement of the jaw holding member 41 to the right with respect to the jaws 44, the inner gripping surfaces of the jaws are contracted for the purpose of gripping the rivet pin.

For the purpose of normally urging the jaws to the left and also for the purpose of assisting in absorbing the throw of the jaws to the right when the rivet pin breaks under tension, an arrangement is provided which includes a tubular element 46 having an enlarged right end 47 abutting the left end of the rod 13 and which engages a shoulder 48 on the outer portion of the sleeve 40. Thus the element 46 is locked in axial position on the rod 13 so as to move therewith. To the left of the shoulder 48 and between the outer surface of the element 46 and the outer end portion of the sleeve 40, a spring 50 is provided which at its right end engages the left side of the enlarged portion 47 on the element. The spring at its left end engages a relatively heavy sleeve 52 slidably mounted on the element 46 and this sleeve at its left end engages the right end faces of the jaws 44. With the jaws in their gripping positions as shown, a substantial space exists between the right end of the sleeve 52 and the left end of the sleeve 40 and consequently when the rivet pin breaks and the jaws are thrown to the right, some movement of the sleeve 52 can occur before it positively abuts the left end of the sleeve 40. While the spring 50 partially cushions the movement of the jaws to the right when the rivet pin breaks, the sleeve 52 cooperates for this purpose in that it acts as an inertia member and when the jaws move to the right they must, so to speak, pick up the inertia member and move it with them. The effect of the spring and the inertia member is such that while the jaws will carry the inertia member and cause it to engage the end of the sleeve 40 rather forcefully, the force of the jaw movement is reduced to such extent that danger of breaking the jaws or any of the other parts is avoided. It will be appreciated that the broken off part of the rivet may be moved rearwardly through the jaws, tubular element 46 and piston rod 13 and finally be ejected from the right end of the latter to the exterior of the mechanism at the right side of the head 16. It may be mentioned in this connection that the left end of the element 46 has a beveled entry 54 and this is mainly provided to prevent the broken part of the pin in passing rearwardly, from engaging any exposed end face on the tubular element that might interfere with this movement.

The left end of the tubular member 33 has a primary anvil 56 threaded thereinto, and this anvil terminates in a smaller tubular portion 57 adapted to engage the preformed head on the tubular rivet member. A secondary anvil 59 is mounted in the left end of a barrel element 60 and it will be noted that the anvil surrounds the tubular portion 57 of the anvil 56, is slidable with respect thereto and that an interior shoulder 61 is provided on the barrel for engaging the end of the member 33 so as to limit movement of the member and anvil 56 to the left. Attention also is directed to a tapered socket 62 provided in the anvil 59 and it will be understood that this tapered socket is adapted to move over the preformed head of the tubular rivet member and cause the head to be swaged into interlocking relation with locking grooves provided in the rivet pin. The barrel 60 is rotatable and slidable on the tubular member 33 and at its right end projects between the latter and the outer portion of the head 36. For the purpose of locking the barrel in the head

36, an arrangement is provided which is shown by Fig. 1 in conjunction with Fig. 4. This comprises a conical surface 66 on the barrel the center of which is slightly offset with respect to the axis of the barrel, and a similarly arranged conical socket 67 provided in the end of the head 36, and it will be noted that the conical surface and socket decrease in diameter toward the outer end of the barrel. The conical surface on the barrel is of such dimensions that it may be moved into the end of the head 36 when the high sides of the surface and socket are in axial alignment, as there is sufficient space between the surface and socket when they are so aligned to permit this movement. Then, by turning the barrel with respect to the head 36, an interlocking engagement between the socket and surface will be obtained and furthermore this engagement tends to draw the barrel inwardly until its right end engages the portion 37 on the head. Any other suitable form of lock between the barrel and head may be used, but it is desirable to have one which is readily releasable or applicable merely by turning the barrel.

The right end of the piston rod 13, outwardly of the head 16, is locked to a collar 70 by means of a pair of semi-circular ring segments 71 and 72 and these parts limit movement of the piston rod to the left by the collar engaging the head. The segments 71 and 72 fit in a groove 73 in the end of the piston rod and may be inserted when the rod projects substantially from the head 16 and when the collar 70 has been moved to the left to expose the groove. Then the collar may be moved to the right and finally be locked in place by a set screw 74.

Now referring to Fig. 5, a tank 80 is provided and a pump 81 mounted adjacent the tank has an inlet connection to the tank indicated at 82, by means of which liquid in the tank may be withdrawn through the pump. The outlet conduit of the pump is indicated at 83 and this extends to a port 84 in a valve casing 85. A slide valve element 86 in the casing is provided with spools 87, 88, 89, 90 and 91 disposed in spaced relation and with the valve in the position shown, the conduit 83 from the pump communicates with the space between the spools 89 and 90. Also at this time this space communicates by means of a conduit 92 with the end of a small barrel 93 forming part of a booster mechanism 94. The booster mechanism includes a large cylinder 95 having a piston 96 therein provided with a plunger 97 reciprocatory in the barrel 93. The left end of the cylinder 95 is connected by means of a conduit 98 with the right end of the space in the valve between the spools 90 and 91 and the left end of this space is connected by means of a conduit 99 to the tank 80. A conduit 100 communicating with the space between the spools 88 and 89 at the left end of such space, is adapted to be connected to the riveting mechanism shown by Fig. 1 and a similar conduit 101 communicating with the left end of the space between heads 87 and 88 also is adapted to extend to the riveting mechanism. The right end of the space between heads 88 and 89 communicates by means of a conduit 102 with the conduit 99 extending to the tank 80. It may be noted also that in the conduit 83 a relief valve 104 is provided and from this relief valve a conduit 105 also communicates with the conduit 99 extending to the tank. The purpose of the relief valve 104 and the conduit 105 is to permit liquid in the line 83 to discharge into the tank 80 if the pressure

in the line 83 exceeds a predetermined pressure. A conduit 106 communicates with the right end of the space between spools 87 and 88 and is connected to the conduit 83. Movement of the valve element 86 is effected by solenoids 110 and 111.

If the pump is now operating, liquid under a pressure of 1000 pounds per square inch, for example, is supplied to the space between heads 89 and 90 and, hence, through the conduit 92 to the right end of barrel 93 and against the right end of the plunger 97. At the same time the left end of the cylinder 95 is open to exhaust through the conduits 98 and 99. Liquid under pressure from the conduit 83 is also supplied to the space between heads 87 and 88, and through the conduit 101 extending to the riveting mechanism. The conduit 100 extending to the riveting mechanism communicates with the tank 80 through the conduits 102 and 99. Further explanation of the operation of this liquid part of the system will be deferred until the rest of the riveting mechanism is described. It may be mentioned, however, that the conduit 101 is connected to the inlet 115 shown by Fig. 3, and the conduit 100 is connected to the inlet 116, also shown in this figure.

Now, referring to Fig. 2, the connection 115 comprises a rotary joint 117 having a threaded open end 118 shown by Fig. 3, and this joint is rotatably adjustable on a tubular element 119 threaded into the upper part of the body 10. The outer end of the element 119 has a closed hexagonal head and communication between the joint 117 and the interior of the element 119 is effected by means of an annular space 120 in the joint and openings 121 through the wall of the tubular element. It may be mentioned that sealing means 122 are provided for preventing the escape of liquid at the ends of the joint 115 and that the latter is tightly held by the element 119 against turning but that the position of the joint may be varied upon loosening the element and then tightening it after the adjustment is made. The inner end of the tubular element 119 communicates with a port 124, which, as best shown by Fig. 1, communicates with the bore 11 adjacent the right end thereof.

The joint 116 is substantially the same as the joint 115 and a tubular element 125 corresponding to the element 119 is provided. The inner end of the tubular element 125 communicates with a bore 126, in turn communicating with a port 127 located in a smaller intermediate portion 128 of the bore, which, as shown by Fig. 1, communicates with the space between the pistons 12 and 28. A passageway 129 across the body and communicating with bore 127 also communicates with a bore 130 at the right side of a valve seat 131. A ball valve 132 normally closes the valve seat 131 and a helical spring 133 pressing against the ball 132 normally holds the ball in its seated position. The spring 133 is disposed in a sleeve 134 which maintains a head 135 at its right end against a seal 136 and shoulder 137 in the bore. The seat 131, sleeve 134 and the head 135 are held positively in position by means of a sleeve 138 threaded into the left end of the bore and the left end of the sleeve is closed by means of a threaded cap 139.

Beyond the port 127, a tubular valve element 140 is provided in the bore and is sealed against the shoulder at the end of the bore portion 128 by a sealing ring 141. The element has an internal bore 142 terminating in a smaller valve

seat opening 143 at its right end, and to the left of the opening, radial openings 144 in the wall of the element communicate with an annular space 145 around the element. A valve pin 146 is reciprocatory in the bore 142 and the right end of the pin terminates in a reduced portion 147 having a tapered peripheral portion adapted to engage the end of the opening 143 and to close it. It will be noted that liquid under pressure at the right of the valve seat will initially act against only the end of the portion 147, but when this portion is unseated, the pressure will also act against the end of the larger part of the pin around the portion. Thus a pressure lower than that required to unseat the valve, will maintain it open.

It will also be noted that the outer surface of the pin adjacent its right end has minute grooves 148 communicating with the radial openings 144 and with the space around the pin portion 147, and these are provided to permit small amounts of liquid in the space mentioned to escape through the radial openings 144 in the event liquid under high pressure at the right of the valve seat should for any reason slightly leak through the valve. This will prevent the liquid in said space from being subjected to the pressure at the right of the valve if there is minor leakage through the latter, and, therefore, prevent an application of pressure on the end face of the pin around the portion 147 which might cause opening of the valve at a relatively low pressure. The grooves are so small, however, that when the valve is open it still will be maintained open by a much lower pressure than that required to open it.

The pin 146 is strongly urged to the right and into valve closing position by a spring 149 provided in a tubular cap 150 threaded into the left end of the bore. This spring acts against a collar 151 on a pin 152 passing through the spring and slidable through the end wall of the cap, and the right end of the pin directly engages the pin 146.

The seat element 140 is tightly maintained against the seal 141 by engagement of the inner end of the cap with a collar 153 in turn engaging a collar 154 and the latter in turn pressing against an angular and confined sealing element 155 disposed around the pin 146 between the left end of the seat element and the collar. A second sealing element 156 is provided between the collars at their outer edges. The seals may be constructed of leather, rubber or the like and effectively prevent liquid escaping between the pin and seat element, and between the latter and the wall of the bore 126.

The space 145 communicates with a passageway 160 that in turn communicates with the interior bore of the element 138 through an annular passageway 161 and radial openings 162. It will be noted also and in conjunction with Fig. 1 that the passageway 160 communicates with the space between the piston 28 and the head 36 by means of a passageway 163.

With the arrangement as shown by Fig. 5 in the condition explained and illustrated, liquid under pump pressure is provided in the conduit 101, joint 115, tubular member 119 and communicates through port 124 with the space between the piston 12 and the head 16. Now since the port 163 communicating with the space between piston 28 and the head 36 communicates with the passageway 129 through the ball valve 132, and since the space between pistons 12 and 28 communicates with the port 127 and the latter is open to the conduit 100, it will be appreciated

that piston 12 will be maintained in its left position. It will be apparent that the ball 132 may readily open to allow any liquid in the space between piston 28 and head 36 to be forced into passageway 129.

Now if the riveting mechanism is applied to a rivet for setting the latter, the pin of the rivet is projected between the jaws 44 with the anvil 56 engaging the head 2 on the rivet. If solenoid 110 is now energized and solenoid 111 is de-energized, the valve element 86 will move to the right and the following operation will occur. Referring to Fig. 5 shifting of the valve element 86 will cause the spool 90 to move to the right until the port 84 is in communication with the conduit 98 and at the same time spool 91 will cut off the conduit 99 leading to the tank. Shifting of the spool 89 will place conduit 100 in communication with conduit 92 and shifting of spool 88 to the right will place conduit 101 in communication with conduit 102. Then the liquid will flow under pressure from the pump 81 to the left end of the cylinder 95 and it will cause the piston 96 to move to the right. Since the plunger 97 and barrel 93 are smaller, liquid in the barrel 93 will be subjected to a much greater pressure and since this liquid pressure flows through conduit 92 and conduit 100 to the riveting mechanism, liquid under a high pressure will be supplied to the connection 116 shown in Fig. 2. This liquid under pressure, as will be seen by Fig. 2, cannot flow through passageway 129 and past the ball 132 because it acts to hold the ball seated, but it can flow through port 127 to the space between pistons 12 and 28. The pressure against the left side of the piston 12 will cause it and the jaw operating member to move and the jaws to grip and begin to pull the pin. If the anvil 56 is not initially against the head 2 on the rivet, piston 28 will then be moved to the left as soon as there is a little pull on the pin until the anvil either engages the head or the member 33 carrying the anvil engages the shoulder 61 in the barrel 60. If the member 33 first engages the shoulder in the barrel, pressure between the pistons 12 and 28 then will cause the latter, acting through member 33 and barrel 60, to move the entire mechanism to the left relative to piston 12 and the jaw members, until the anvil does engage the rivet head. With anvil 56 engaging the rivet head, the pull on the pin will increase and the latter will move and cause the portion 1 of the tubular rivet member to be bulbed into a head. After formation of said head, resistance to movement of the piston 12 increases, thereby causing the pressure of the liquid to increase and when this pressure is sufficient to overcome the spring 149, the smaller end 147 on the valve stem 146 shown by Fig. 2, is unseated and liquid flows in against the larger end face of the stem. As previously stated, a certain pressure will unseat the valve stem but if the pressure thereafter drops somewhat, the stem will still remain unseated because after the smaller portion is unseated, the pressure acts on the larger area end of the stem around the smaller portion 147. Movement of the stem uncovers the openings 144 and then liquid flows through the space 145 and passages 160 and 163, into the space between the piston 28 and the head 36. The liquid pressure then becomes equalized in the spaces between the piston 28 and the head 36 and between the piston 12 and the piston 28 and, since the left end of the piston 28 has substantially the same effective area as the right

end thereof, piston 28 will be balanced or floating between the piston 12 and the head 36.

This equalizing of pressure on both sides of piston 28, immediately eliminates it, substantially at least, as a reactionary force applying means, and what really happens is, that introduction of high pressure between piston 28 and head 36 causes application of the reactionary force to be shifted from the piston 28 and anvil 56, to the head 36 and anvil 60. Since piston 12 is urged to the right by the pressure, the result obtained is that head 36 and the entire mechanism, excepting pistons 12 and 28, will move to the left immediately and the anvil 59 will move over the rivet head and swage metal into the locking grooves 9. Piston 28 would remain stationary owing to anvil 57 abutting the rivet head 2, but as swaging is effected some axial extrusion of the head may cause the anvil and piston to move to the right and relative to piston 12, but this is unimpeded owing to the spaces between the pistons and between piston 28 and head 36 being in communication so as to permit displacement from the space between the pistons to the space between the head 36 and piston 28. However, swaging is definitely interrupted before the anvil 59 can engage and apply its reactionary force also against the structure being riveted by the shoulder 32 in the bore 11 engaging the shoulder 31 on piston 28. When this occurs, the reactionary force applied through head 36 is positively directed through both anvils and further movement of the head 36 and cylinder body is stopped. This operation prevents the anvil 59 from forcefully engaging the structure being riveted and applying the reactionary force thereto. If this were permitted, the pull on the pin then would tend to pull the tubular rivet member through the structure and head 2 away from the side of the structure and at the same time tend to shear off the bulbed head.

It now follows that movement of the entire mechanism to the left becomes resisted highly and the liquid pressure increases and finally the pressure on piston 12 is sufficient to break the rivet pin under tension at the groove 8. The jaws then will fly backwardly and be cushioned as previously explained and the broken off part of the pin will move backwardly through the jaws. Ordinarily the broken off part of the pin will not pass entirely through the jaws owing to the presence of a shoulder on the pin for expanding the tubular rivet portion, but insertion of the next rivet will move the broken off pin of the previous rivet to move on and into the sleeve 46. Successive setting of rivets will normally cause the broken off parts to be ejected from the right end of the piston rod.

Upon breakage of the pin, the piston 12 will move more rapidly to the right, but this movement is interrupted by engagement of the right end of the sleeve 40 with the piston 28 and it will be appreciated that the shoulder 32 limits movement of the latter to the right. The arrangement is such that the pistons will be limited in their movements so as to prevent undesirable compression of the springs holding the sealing cup members and to prevent undesirable engagement of the cups with one another.

Now, if solenoid 110 is de-energized and solenoid 111 is energized, the valve member 86 will return to its former position and then liquid under the lower pump pressure will flow into the space between piston 12 and the head 16 and exhaust from the spaces between the two pistons and between the piston 28 and the head 36 and the parts

will return to their original positions as shown by Fig. 1.

A guard housing 176 is threaded on the head 16 and is provided with slots 177 to permit ejection of the broken off parts of the pin. This housing has a cap 178 removably mounted in its outer end preferably by a pressure engagement of overlapping metal parts. The guard housing is provided mainly to prevent an operator from becoming injured perhaps by having his finger in the path of the return movement of the collar 70 when the piston rod moves to the left. The removable cap 178 is provided on the outer end of the housing to normally close its ends but to permit forced removal of the cap in the event, for example, the mechanism is vertically disposed above the work being riveted, and broken off parts of the pin stand in a vertical column in the piston rod. In this case, one pin portion might so project from the right end of the piston rod, that it would engage the cap during movement of the piston rod to the right in the riveting operation, and by having the cap removable, the pressure of the projecting pin portion could push the cap off the housing.

For operating the mechanism, a handle 180 is provided which is bolted to the casting 10 as indicated at 181. Adjacent the front end of the handle a trigger 182 is provided which is pivoted as indicated at 183 and a spring 184 engaging a projection 185 on the trigger adjacent the pivot normally holds the trigger in its down position. An arm 186 on the trigger cooperates with a switch 187 and is provided with contact points 188 and 189 adapted respectively to engage contact points 190 and 191. With the trigger in its down position as shown, the contacts 188 and 190 are in engagement and it will be understood that a circuit is provided which thereby energizes the solenoid 111. When the trigger is raised, contact 188 leaves contact 190 and contact 189 engages contact 191 and this causes solenoid 111 to be deenergized and solenoid 110 to be energized. Thus operation of the valve element 86 and the entire mechanism may be controlled by manipulation of a remote control trigger on the mechanism.

If desired, the mechanism could be operated by a single high pressure liquid system so that the same high pressure would operate the mechanism both in its working movements and its return movements. This could readily be accomplished by a pump or other source of high liquid pressure and connections to both joints 115 and 116 that would cause the liquid pressure to be applied through one joint and to exhaust through the other and vice versa, according to the working or return movement. Manifestly a valve generally along the line shown by Fig. 5 may be used to throw the high pump pressure into one line while opening the other to exhaust, and vice versa.

While only one form of the invention has been illustrated and described in detail it will be apparent to those skilled in the art that various modifications may be made without departing from the scope of the appended claims.

I claim:

1. A rivet setting apparatus for setting a rivet wherein a part is pulled and the reactionary force is applied to a second part, comprising a hollow body, movable means in the body for pulling the first part of the rivet, movable means in the body for applying the reactionary force to the second rivet part, means movable through movement of the

body for also applying reactionary force to said second part, and means for automatically causing the latter means to function subsequently to operation of the first mentioned reactionary force applying means.

2. A rivet setting apparatus for setting a rivet wherein a part is pulled and the reactionary force is applied to a second part, comprising a hollow body, movable means in the body for pulling the first part of the rivet, movable means in the body for applying the reactionary force to the second rivet part, means movable through movement of the body for also applying reactionary force to said second part, and means for automatically causing the latter means to function subsequently to operation of the first mentioned reactionary force applying means and when the pull on the first rivet part reaches a predetermined amount.

3. A rivet setting apparatus for setting a rivet wherein a part is pulled and the reactionary force is applied to a second part, comprising a cylinder body, a pair of pistons movable in the body with each of the adjacent sides of the pistons constantly subjected to the same fluid pressure as that acting on the other of such adjacent sides, means connected to one piston for pulling the first rivet part, means operatively engaged by the other piston for applying the reactionary force to introducing fluid under pressure between the pistons.

4. A rivet setting apparatus for setting a rivet wherein a part is pulled and the reactionary force is applied to a second part, comprising a pair of pistons, a body having a bore slidably receiving the pistons with the bore continuing between the adjacent sides of the pistons so that any fluid pressure between the pistons constantly acts upon both of such adjacent sides of the latter, means connected to one piston for pulling the first rivet part, means operatively engaged by the other piston for applying the reactionary force to the other rivet part, and means for introducing fluid under pressure to the bore between the pistons.

5. A rivet setting apparatus for setting a rivet wherein a part is pulled and the reactionary force is applied to a second part, comprising a cylinder body, a head on one end of the body, a pair of pistons movable in the body, means connected to one piston for pulling the first rivet part, means operatively engaged by the other piston for applying the reactionary force to the second rivet part, means for introducing fluid under pressure between the pistons, and automatically and subsequently operable means for applying the reactionary force to said second rivet part through said head.

6. A rivet setting apparatus for setting a rivet wherein a part is pulled and the reactionary force is applied to a second part, comprising a cylinder body, a head on the end of the body, a pair of movable pistons in the body, means connected to one piston for pulling the first rivet part, means operatively engaged by the other piston for applying the reactionary force to the second rivet part, means operatively engaged by said head for also applying the reactionary force to said second rivet part, means for introducing fluid under pressure between said pistons, and means for subsequently introducing fluid under pressure between the second piston and said head.

7. A rivet setting apparatus for setting a rivet of a type comprising a tubular part having a head at one end, and a pin in the tubular part

and projecting from the head, which comprises a cylinder body, a piston movable in the body, means connected to the piston for gripping and pulling the pin, a second piston in the body, an anvil connected to the second piston for applying the reactionary force of the pull to the end face of the rivet head, an anvil movable by the body for applying the reactionary force to said head so as to swage the latter radially towards the pin, means for introducing fluid under pressure between the pistons, and means subsequently operable for shifting the application of said reactionary force from the first anvil to the second anvil.

8. A rivet setting apparatus for setting a rivet of a type comprising a tubular part having a head at one end, and a pin in the tubular part and projecting from the head, which comprises a cylinder body, a piston movable in the body, means connected to the piston for gripping and pulling the pin, a second piston in the body, an anvil connected to the second piston for applying the reactionary force of the pull to the end face of the rivet head, an anvil movable by the body for applying the reactionary force to said head so as to swage the latter radially towards the pin, means for introducing fluid under pressure between the pistons, and means automatically operable depending upon the pull on the pin for shifting the application of said reactionary force from the first anvil to the second anvil.

9. A rivet setting apparatus for setting a rivet of a type comprising a tubular part having a head at one end, and a pin in the tubular part and projecting from the head, which comprises a cylinder body, a piston movable in the body, means connected to the piston for gripping and pulling the pin, a second piston in the body, an anvil connected to the second piston for applying the reactionary force of the pull to the end face of the rivet head, an anvil movable by the body for applying the reactionary force to said head so as to swage the latter radially towards the pin, means for introducing fluid under pressure between the pistons, means automatically operable depending upon the pull on the pin for moving the body and shifting the application of said reactionary force from the first anvil to the second anvil, and means depending upon the movement of the body for subsequently rendering the first anvil active to apply reactionary force against the end face of said head.

10. A rivet setting apparatus for setting a rivet of a type comprising a tubular part having a head at one end, and a pin in the tubular part and projecting from the head, which comprises a cylinder body, a piston movable in the body, means connected to the piston for gripping and pulling the pin, a second piston in the body, an anvil connected to the second piston for applying the reactionary force of the pull to the end face of the rivet head, an anvil movable by the body for applying the reactionary force to said head so as to swage the latter radially towards the pin, means for introducing fluid under pressure between the pistons, means automatically operable depending upon the pull on the pin for moving the body and shifting the application of said reactionary force from the first anvil to the second anvil, and means for subsequently interrupting the application of reactionary force through said second anvil.

11. A rivet setting apparatus for setting a rivet of a type comprising a tubular part having a head at one end, and a pin in the tubular part and

projecting from the head, which comprises a cylinder body, a piston movable in the body, means connected to the piston for gripping and pulling the pin, a second piston in the body, an anvil connected to the second piston for applying the reactionary force of the pull to the end face of the rivet head, an anvil movable by the body for applying the reactionary force to said head so as to swage the latter radially towards the pin, means for introducing fluid under pressure between the pistons, means automatically operable depending upon the pull on the pin for moving the body and shifting the application of said reactionary force from the first anvil to the second anvil, means subsequently operable for applying the reactionary force through the second anvil so as to swage the head, and means automatically operable to limit the swaging movement of the second anvil.

12. A rivet setting apparatus for setting a rivet of a type comprising a tubular member having a head at one end for engaging one side of the structure to be riveted and a pin projecting through the tubular member and which is adapted to enlarge the opposite end of the tubular member against the opposite side of the said structure when the pin is pulled through the member, wherein such apparatus comprises means for pulling the pin, means for applying the reactionary force to the head on the tubular member, means axially movable over the head on the tubular member by such reactionary force to swage the head radially towards the pin, and means automatically operable for limiting the swaging action, so as to prevent the swaging means from engaging the structure being riveted.

13. A rivet setting apparatus for setting a rivet of a type comprising a tubular member having a head at one end for engaging one side of the structure to be riveted and a pin projecting through the tubular member and which is adapted to enlarge the opposite end of the tubular member against the opposite side of the structure when the pin is moved through the member, wherein such apparatus comprises means for moving the pin so as to enlarge the end of the tubular member, means for applying the reactionary force to the head on the tubular member, means subsequently movable over the head on the tubular member by the reactionary force for swaging the head radially towards the pin, and means automatically operable for limiting the axial movement of the swaging means so as to prevent engagement thereof with the structure being riveted.

14. An apparatus for setting rivets of a type including a tubular member having a head at one end for engaging one side of a structure to be riveted and a pin movable through the tubular member for enlarging the opposite end of the tubular member against the opposite side of the structure, which comprises means for applying reactionary force, means for moving the pin to form such enlargement, means for applying the reactionary force to the head on the tubular member, means axially movable over the head by the reactionary force for swaging the head radially towards the pin, means automatically operable for shifting application of the reactionary force from the first means to the swaging means, and means subsequently operable for limiting axial movement of the swaging means to prevent engagement thereof with the structure being riveted and including means for

causing application of the reactionary force through both of such means simultaneously.

15. A rivet setting apparatus for setting a rivet of a type comprising a tubular part having a head at one end, and a pin in the tubular part and projecting from the head, which comprises means for gripping and pulling the pin, means for applying the reactionary force to the head, means subsequently operable by the reactionary force to swage the head radially towards the pin, and means for automatically joining the first reactionary force applying means to the swaging means after a predetermined amount of swaging is effected so as to limit the swaging action.

16. A rivet setting apparatus comprising a riveting mechanism, fluid pressure responsive means in the mechanism for setting the rivet, a source of fluid under pressure, means connecting said source to the mechanism, remotely located means for boosting the pressure of said fluid, and electrical means for controlling the operation of the boosting means and including a manually controlled switch on the mechanism.

17. A rivet setting apparatus comprising a riveting mechanism, fluid pressure responsive means in the mechanism for setting the rivet, a source of fluid under pressure, means connecting said source to the mechanism, remotely located means for boosting the pressure of said fluid, a valve connected to the boosting means for controlling the operation of the mechanism by the fluid, and electrical means including a manually controlled switch on the mechanism for operating the valve.

18. A rivet setting apparatus comprising a mechanism for setting a two part rivet, fluid pressure responsive means in the mechanism, a source of liquid fluid pressure, means for boosting the pressure of the fluid, means connecting said source and boosting means to the mechanism, and means operable to cause the fluid pressure from said source to operate the fluid pressure responsive means in one direction and to cause the fluid pressure from said boosting means to operate the responsive means in the other direction.

19. A rivet setting apparatus comprising a mechanism for setting a two part rivet, fluid pressure responsive means in the mechanism, a pump for supplying liquid fluid under pressure, a pressure boosting device, means for connecting the mechanism to said source and said boosting mechanism, and control means operable to cause liquid to be supplied under pump pressure to operate the responsive means in one direction and to supply liquid at the boosted pressure to operate the responsive means in the other direction.

20. A rivet setting apparatus comprising a mechanism for setting a two part rivet, fluid pressure responsive means in the mechanism, a pump for supplying liquid fluid under pressure, a pressure boosting device, means for connecting the mechanism to said source and said boosting mechanism, and control means operable to cause liquid to be supplied under pump pressure to operate the responsive means in one direction and to supply liquid at the boosted pressure to operate the responsive means in the other direction, said control means comprising a valve adapted alternatively to connect the pump and boosting means directly to the mechanism.

21. A rivet setting apparatus comprising a mechanism for setting a two part rivet, fluid pressure responsive means in the mechanism,

a pump for supplying liquid fluid under pressure, a pressure boosting device, means for connecting the mechanism to said source and said boosting mechanism, and control means oper-
5 able to cause liquid to be supplied under pump pressure to operate the responsive means in one direction and to supply liquid at the boosted pressure to operate the responsive means in the other
10 direction, said control means comprising an electrically operated valve adapted alternatively to connect the pump and boosting means directly to the mechanism, and a switch on the mechanism for controlling the valve operation.

22. A rivet setting mechanism for setting a
15 rivet wherein a part of the rivet is broken off, comprising means for setting the rivet and effecting the breaking off of the rivet part, said means including a tubular piston rod through which the broken off parts of the rivet pass during re-

peated rivet setting operations and from which such broken off parts are ejected from the mechanism, and a guard adjacent the ejecting end of the tubular piston rod for interrupting the movement of the broken off parts.

23. A rivet setting mechanism for setting a rivet, wherein a part of the rivet is broken off, comprising means for setting the rivet and effecting the breaking off of the rivet part, said means including a tubular piston rod through
10 which the broken off parts of the rivet pass during repeated rivet setting operations and from which such broken off parts are ejected from the mechanism, and a guard disposed adjacent
15 the ejecting end of the tubular piston rod for altering the direction of movement of the broken off parts.

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