March 14, 1944. C. W. CHERRY 2,344,127

RIVETING APPARATUS

Filed Aug. 3, 1940 3 Sheets-Sheet 1

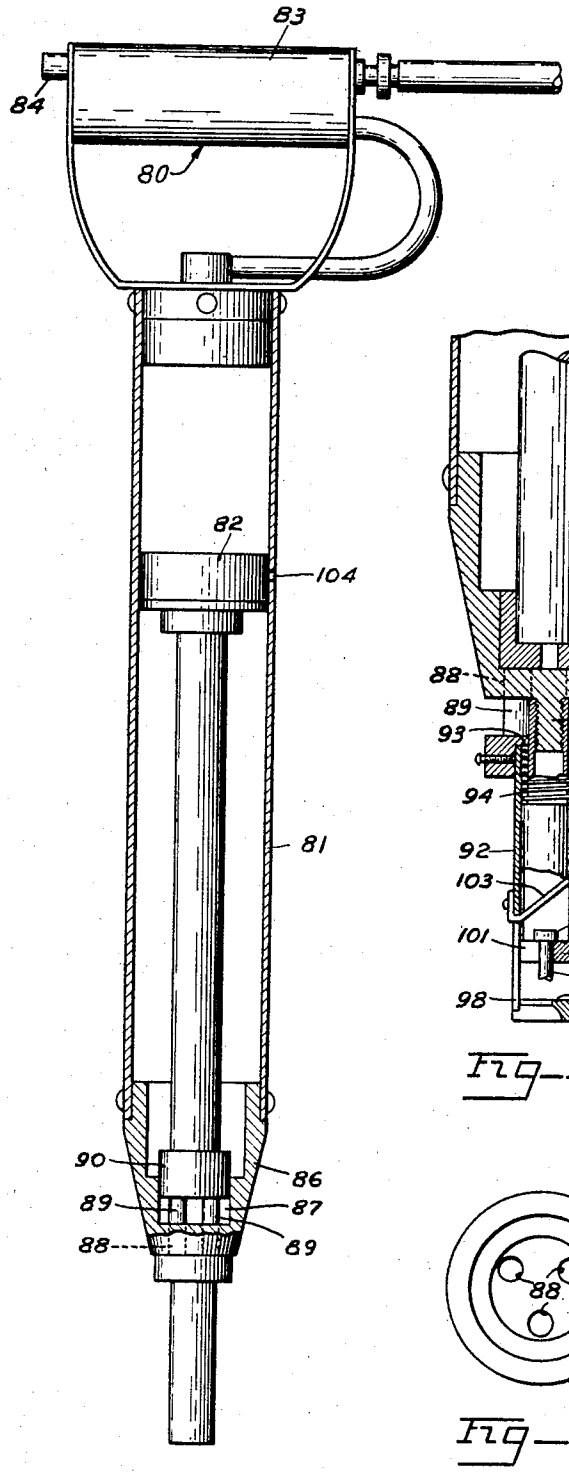


Fig. 1.

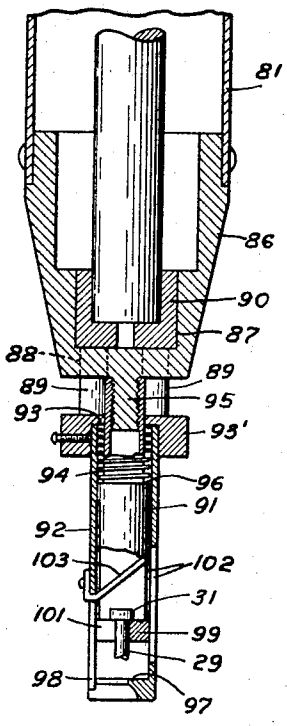


Fig. 2.

Fig. 3.

Fig. 4.

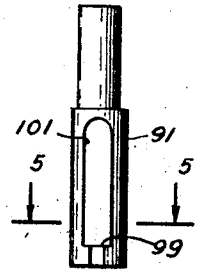
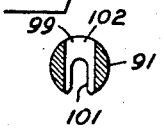


Fig. 5.



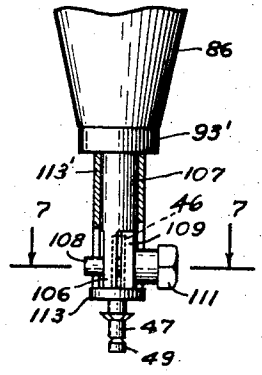


Fig. 6.

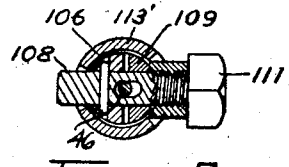


Fig. 7.

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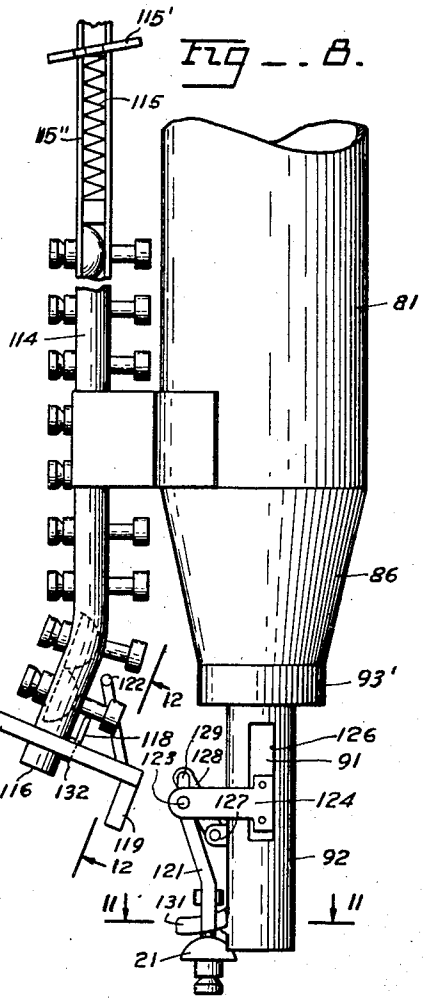

Fig. 8.

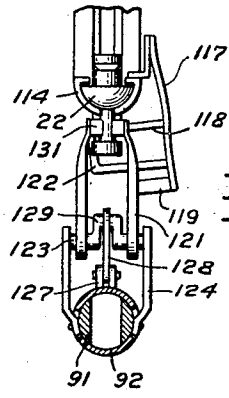

Fig. 10.

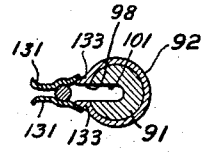

Fig. 11.

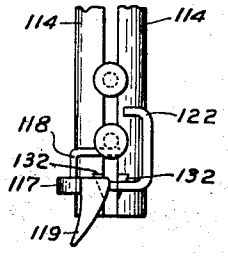

Fig. 12.

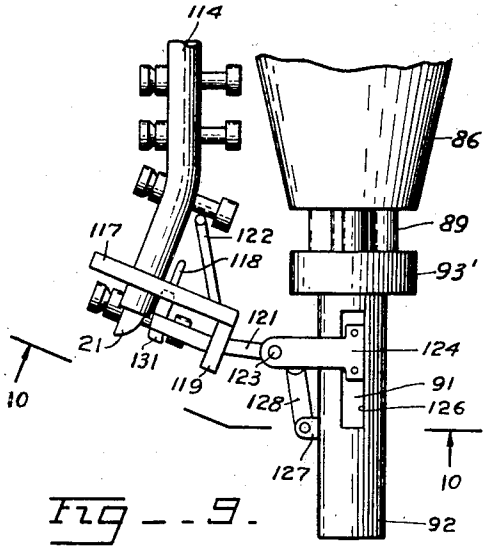

Fig. 9.

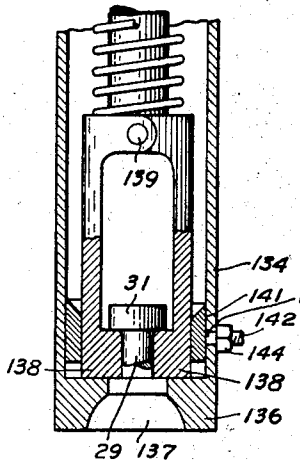

Fig. 13.

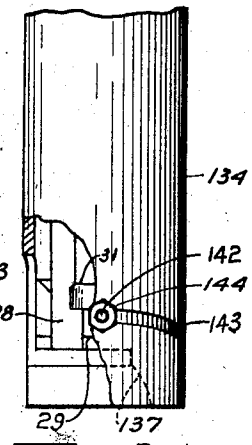

Fig. 14.

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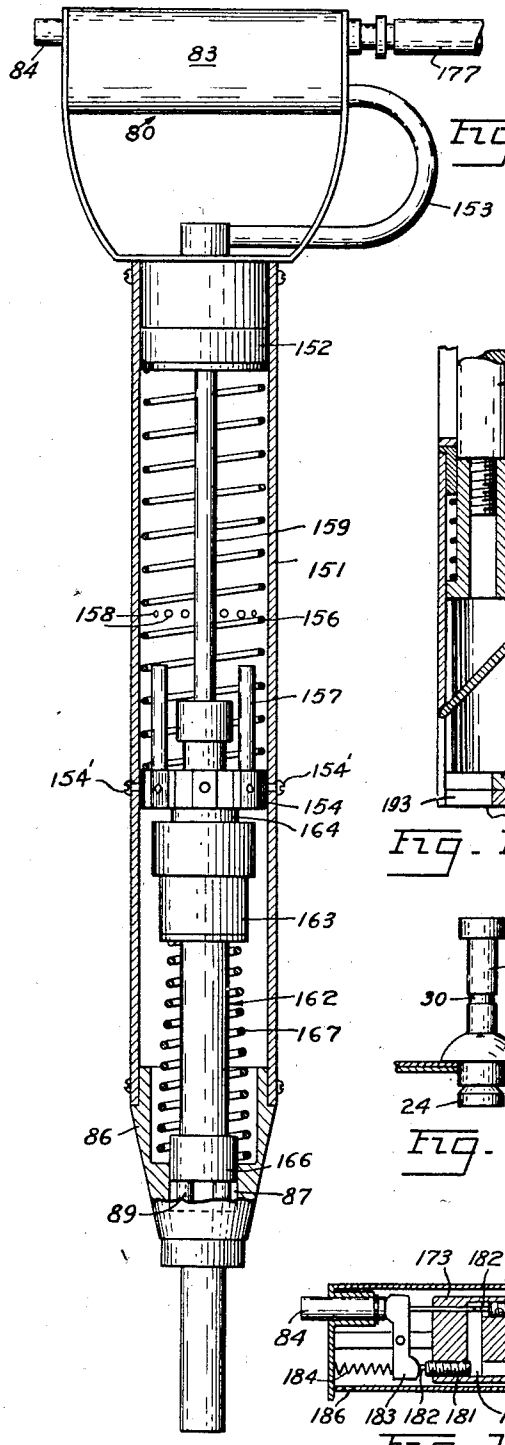


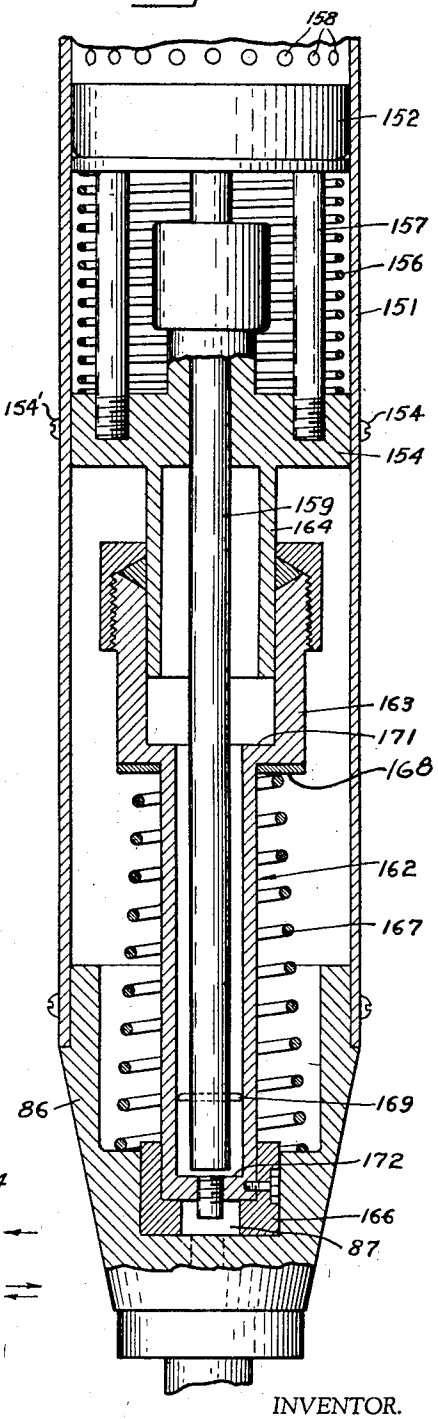
Fig. 15.

Fig. 17.

Fig. 18.

Fig. 19.

Fig. 16.



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Patented Mar. 14, 1944

2,344,127

UNITED STATES PATENT OFFICE

2,344,127

RIVETING APPARATUS

Carl W. Cherry, Carmel, Calif.

Application August 3, 1940, Serial No. 351,278

16 Claims. (Cl. 218—19)

This invention relates to a riveting apparatus.

An object of this invention is the provision of a riveting tool into which rivets can be quickly and easily inserted and by which the rivets can be held in the material to be riveted for the application of aligned riveting forces to said rivet. This riveting tool is particularly adapted for use with rivets having relatively movable parts for performing the riveting operation from one side of the object to be riveted; for instance the rivets herein used are the type provided with a movable tension member in a tubular rivet with a tail-former on the tension member at the tail end of the rivet for fastening the rivet in place. Such a rivet is illustrated in my said patent and that form is utilized herein for illustrating the operation of this riveting apparatus.

Another object of this invention is to provide a riveting apparatus whereby all riveting forces may be applied from one side only although aligned forces are exerted at both ends of the rivet.

Another object of this invention is to provide a riveting apparatus which receives the rivets to be applied, holds each in position for riveting, and applies riveting forces with great efficiency; the apparatus including a riveting tool suitably connected to relatively movable elements for application of forces in aligned opposite directions but from one side of the object to be riveted; said apparatus being adapted to receive the rivets for the riveting operation rapidly, and assure speedy, yet uniform riveting.

I am aware that some changes may be made in the general arrangements and combinations of the several devices and parts, as well as in the details of the construction thereof without departing from the scope of the present invention as set forth in the following specification, and as defined in the following claims; hence I do not limit my invention to the exact arrangements and combinations of the said device and parts as described in the said specification, nor do I confine myself to the exact details of the construction of the said parts as illustrated in the accompanying drawings.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for the illustrative embodiment of the invention, wherein:

Fig. 1 is a side view of my fluid riveting apparatus, partly in section.

Fig. 2 is an enlarged sectional view of the riveting end of the apparatus.

Fig. 3 is a detail plan view of the tool head of my apparatus.

Fig. 4 is a detail view of the shank holder of the apparatus.

Fig. 5 is a sectional view the section being taken on the lines 5—5 of Fig. 4.

Fig. 6 is a fragmental sectional view of a modified rivet holder for my apparatus.

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 6.

Fig. 8 is a fragmental view of a fluid riveting apparatus for my rivet with automatic feed.

Fig. 9 is a fragmental view of the discharge end of the riveting apparatus showing the rivet feeder in refilling position.

Fig. 10 is partly an end view and partly a cross sectional view of the riveting apparatus on the line 10—10 of Fig. 9.

Fig. 11 is an end view of the riveting apparatus, in section taken on the line 11—11 of Fig. 8.

Fig. 12 is a fragmental side view of the rivet feeder of the apparatus.

Fig. 13 is a fragmental sectional view of a modified rivet holder for my riveting apparatus.

Fig. 14 is a fragmental side view of the last mentioned modified riveting apparatus.

Fig. 15 is a sectional view of a form of my riveting apparatus showing a manner of application of forces.

Fig. 16 is a fragmental sectional detail view of the riveting apparatus shown in Fig. 15, showing the application of pressure in stages.

Fig. 17 is a sectional view of a modified form of the rivet holder tool head of the riveting apparatus, and

Fig. 18 is a sectional view of a rivet of the type used with my apparatus.

Fig. 19 is a sectional view of the arrangement of the actuating valves in the handle of the riveting apparatus.

My riveting apparatus is best fitted for the type of rivets shown in Fig. 18 herein, namely a rivet assembly 19, made of a tubular rivet body 20 with the usual rivet head 21 and a shank 29 extended through the passage of the rivet body. The rivet shank 29 has a tail former 24 at one end opposite the tail end of the rivet body 20, and has a pulling portion, in this form a pulling head 31 on its end outside of the head of the rivet body 20. A line of weakness or constriction may be provided at 30 to form a point of breakage under a desired stress after the tail is completely formed by the pulling of the shank 29. It is advisable for auto-

matic operation that the relative position of the shank 29 and the rivet body 20 be fixed until the riveting pull is applied to the shank 29. This may be accomplished by a tight fit of the shank 29 into the passage 22 of the rivet body 20 so that the rivet shank 29 cannot change its relative position in the rivet body 20 except by the application of actual riveting forces.

My apparatus herein provides a holder for accommodating the contour of the rivet assembly 19 and to receive and hold the rivet assembly 19 in riveting position, a riveting apparatus so related to the holder as to exert relative forces on the shank 29 and the rivet body 20 for forming the tail of the rivet against the objects to be riveted, and a feeding mechanism for automatically feeding the rivet assemblies 19 one by one into said holder. In general a rivet assembly 19 is fed into the holder and is held thereby so that the tail of the rivet assembly 19 protrudes from the holder and can be inserted into the rivet hole 27 and through the objects to be riveted, such as plates 26 in Fig. 18. The holder is carried by the riveting apparatus, such as a so-called riveting gun, which presses one part of the holder against the rivet head 21 and pulls another part of the holder with the shank 20 oppositely so as to cause the tail former 24 to spread the tail of the rivet body 20 against the adjacent plate 26.

In carrying out my invention I make use of a cylinder 81 and a piston 82 which is actuated by compressed air or the like admitted through a suitable valve mechanism 86 located in a handle 83 of the tool. The valve may be opened and closed by a conveniently located pushbutton 84 in the usual manner. The cylinder 81 terminates in a frusto conical tool head 86 in which is a recess 87. In the bottom of the recess are a plurality, in this illustration three, holes 88, through which latter are movable three pins 89. The end of a piston rod 90 is guided in the recess 87 and bears against the inner ends of the pins 89. The other ends of the pins 89 bear against the collar 93' of the pressure sleeve 92.

On the tool head 86 is supported the holder which is the actual riveting tool and which includes an inner pulling tube 91 threadedly secured at its upper end to a central boss 95 on the bottom of the tool head 86. On the pulling tube 91 is slidably supported an outer pressure sleeve 92 which latter is secured in a shouldered recess 93 in collar 93' secured to said sleeve 92, a coil pressure spring 94 bearing against the bottom of the recess 93 and against a shoulder 96 of the tube 91 so as to normally urge the outer sleeve 92 upwardly and against the bottom of the tool head 86 and the pins 89 into recess 87. It is to be noted that the spring 94 is sufficiently strong to push the pins 89 into the tool head 86 when there is no pressure exerted on the piston 82. The pressure sleeve 92 terminates at its free end in a pressure seat 97 which may be so shaped as to fit the rivet head or the adjacent end of the tubular rivet. The pressure seat 97, as well as the sleeve 92, is provided with cut away portions or slots 98 which fit the contour of the particular rivet in use so as to permit the rapid insertion and removal of the rivets from the sleeve 92. The free end of the pulling tube terminates in a suitably slotted wall or flange 99 so arranged that the slot 101 thereof accommodates the former shank 29 of the rivet assembly 19 with its pulling head 31 engaged by the flange. In order to facilitate the ejection of the broken part of the shank from the tool after riveting, the outer sleeve 92 and the tube 91 have aligned slots 102, opposite to said intake slots 98 and 101. A deflector plate 103 is secured to the outer sleeve 92 and extends across between the slots 101 and 102 on an incline so as to direct broken rivet ends out through the slots 102.

In operation a rivet assembly 19 is fed into the tool head through the side slots 98 and 101, the flange 99 being held by spring 94 in contact with the pressure seat 97 to permit this insertion of the rivet into the tool, as seen in Fig. 1, and the rivet is then placed into the rivet holes endwise from one side and tail end first. The pressure seat 97 of the tool is pressed against the head of the rivet and as the button 84 is pressed pressure is applied to the piston 82. But since piston 82, piston rod 90, pins 89, collar 93', sleeve 92 and pressure plate 97 constitute a solid connection pressing against the rivet head, piston 82 cannot move under the impetus of the fluid which entered the cylinder. However, the cylinder-head opposite piston 82 can move under said impetus against the force exerted by the operator in pressing plate 97 against the rivet head and in so moving it pulls the inner sleeve 91 and the frame 81 away from plate 92 to the position shown in Fig. 2. Thereby the pins 89 are urged relatively outwardly through the bottom holes 88 as shown in Fig. 2. The cylinder is thus forced away from the collar 93' of the pressure sleeve 92 to the position shown in Fig. 2. In so doing the cylinder 81 will pull with it the pulling tube 91 so as to pull the tension member or shank 29 of the former for spreading and forming the rivet tail as heretofore described. Therefore the relative movement of the opposed elements of the tool in opposite directions to each other is accomplished in a definite operation so that the pulling force of one of said elements is transmitted to the farther end or to the tail of the rivet by means extended through the rivet itself. The stroke of the tool may be limited and predetermined by the length of the pins 89, or by the suitable location of an exhaust port 104 on the cylinder 81 if it is desired to limit the stroke to less than that permitted by the length of pins 89.

In the modified form of tool shown in Figures 6 and 7 a chuck-like grip is shown to be used with shanks having surface portions to be gripped instead of having a pulling head. This form includes two jaws 106 fixed on the end of a pulling bar 107 which takes the place of the pulling tube 91. From the jaw 106 extends laterally a guide pin 108 fixed to the jaws 106 and threaded at one end into the nut 111. Two jaws 109 are also fixed on the end of the pulling bar 107 and the jaws 106 and 109 are forced toward each other by means of a nut 111. The gripping faces of the jaws 106 and 109 are provided with teeth or the like to firmly engage the shank 46 of a former 49 gripped between said jaws. The pressure seat 113 of the outer sleeve 113' of this embodiment is adapted for central insertion and removal of the rivet former shank 46 and to bear against the head of the rivet 47. The sleeve 113' is fixed to the collar 93' and the pulling bar 107 is connected to the tool head 86 and after insertion of the rivet into the tool operate in the manner heretofore described in connection with the embodiment illustrated in Fig. 2.

The embodiment illustrated in Figures 8 to 12 inclusive shows how the rivets may be automatically fed into the tool of Figures 1 through 5

for instance, by means of a chute 114 which in cross-section conforms to the cross section of the particular rivet head, such as the rivet head 21. The chute 114 is suitably secured to the outside of the cylinder 81 and is so spaced therefrom as to accommodate the rivets in substantially horizontal position. The row of rivets is urged toward the discharge end 116 of the chute 114 by a feed spring 115, the position of which is longitudinally adjustable in the chute 114 by any usual follower, such as a suitable catch member 115' shown in Fig. 8 which is adjustable in slots 115'' on the opposite sides of the chute 114 at its top. At the discharge end 116 the chute has fixed thereto one end of a spring bar 117 which holds a gate consisting of an L shaped bar 118 under the last rivet in the chute to prevent its accidental removal. An abutment cam 119 on the free end of the spring bar 117 is adapted to be struck by a feeding arm 121 so as to move the bar 118 out of the way of the lowermost rivet. The spring 117 has a U shaped projection 122 extended from it in spaced relation from the bar 118 and with its attached end farther from the chute than the ends of the rivets and with its free end betwen the two bottom rivets, and with said free end of a length so as to be normally in an out of the way position but to move with the gate 118 so that when the gate 118 is moved out of the line of travel of the rivets the projection 122 is moved under the next rivet in the row at said chute discharge end 116. Thus the discharge of more than one rivet at a time is prevented. After the arm 121 is swung away from the chute end 116 the spring 117 returns the gate 118 and the projection 122 therewith into their initial positions for the next feeding operation.

There are two feeding arms 121 fixed in spaced relation on a rocker shaft 123 which latter is journalled on brackets 124. There is one bracket 124 on each side of the outer sleeve 92 of the tool and the brackets 124 extend through suitable slots 126 through said outer sleeve 92 and are fixed to the inner or pulling tube 91. On a fixed lug 127 of the outer sleeve 92 is journalled a lever 128 which is journalled at its other end to a crank 129 of the shaft 123 at such an angle relatively to said bracket 124 that when the lug 127 and the lever 128 are pushed away from the tool head 86 together with the outer sleeve 92 then the shaft 123 is rocked to move the arms 121 to the discharge end 116 of the chute 114, and when the outer sleeve 92 and the pulling member 91 are returned to their initial relative position, then the arms 121 are swung into a parallel position with and along the sleeve 92.

Each arm 121 has a leaf spring 131 fixed across its free end so that the said leaf springs 131 can grip a rivet between them. In order to receive a rivet from the chute the ends of the leaf springs 131 nearest the chute are spread apart by ears 132 extended from the chute discharge end 116 so that a rivet can drop between the leaf springs 131. The other unspread ends of the leaf springs 131 prevent the falling out of the rivet. As the arms 121 are pulled away from the fixed ears 132 they spring toward each other and hold and carry the rivet into such position that the rivet is aligned with the slots 98 and 101 of the pressure sleeve 92 and of the pulling tube 91 as shown in Fig. 8. In this returned position said other ends of the leaf springs 131 strike against spreading projections 133 at the edges of the slot 98 of the pressure sleeve 92 so as to be pried apart and thereby to release the rivet and drop it into the slot 98. In this manner the entire riveting operation may be rendered automatic.

The extent of pressure exerted in forming the tail of a rivet is determined by the breaking of the shanks, which are preferably made of uniform elastic limit so as to break at the same ultimate stress. But the same may be also determined by the length of the stroke to which the former shank is pulled. This can be also accomplished by releasing the grip on the shank of the former after a predetermined stroke. An embodiment of such adjustable grip is shown in Figures 13 and 14. In this embodiment the outer pressure sleeve 134 has a pressure seat 136 the central aperture 137 of which is large enough to accommodate the removal of the gripped end 31 of the former shank 29 therethrough. The inner or pulling tube is split at its gripping end so as to form two opposed jaws 138 pivoted together at 139. The outer surfaces of the jaws are spaced from the inner periphery of the sleeve 134. A circular cam ring 141 in the sleeve 134 holds the jaws 138 together in gripping position. This cam 141 is of limited length so that as the jaws 138 are withdrawn from the cam ring 141 the same can swing apart sufficiently to release the former shank. By adjusting the position of the cam ring 141 axially in the sleeve 134 the length of stroke of the jaws 138 in gripping position is determined. If the cam 141 is adjusted farther away from the pressure seat 136 then the pull will be exerted through a longer stroke before the jaws 138 are spread apart and vice versa. The cam ring 141 may be fixed in numerous adjusted positions by means of a pin 142 extended from it through an inclined slot 143 in one side of the pressure sleeve 134 and may be drawn tight by a locking nut 144 or the like. The cam 141 is split at one side so as to provide a gap of sufficient width to allow insertion of the shank of the rivet assembly therethrough within the range of the average adjustment of its position.

The application of forces for the riveting operation with a comparatively small stroke but with great power is accomplished in this apparatus in the manner shown in Figures 15 and 16. In the cylinder 151 of this form works a primary piston 152. The piston 152 is operated by either hydraulic or pneumatic pressure through a conduit 153 which is connected to the valve mechanism 80 in the handle 83. The valve mechanism 80 is controlled by the pushbutton 84. The cylinder 151 is divided into two chambers by a transverse partition wall 154, said wall being secured to the outer shell 81 by screws 154'. A coil spring 156 between the partition wall 154 and the piston 152 normally urges the piston 152 toward the handle end of the cylinder 151. Abutment pins 157 extend from the partition wall 154 toward the piston 152 so as to limit the stroke of said piston 152 to a predetermined distance from the partition wall 154. Vents 158 around the periphery of the cylinder 151 are located at a level slightly above the position of the piston 152 at the end of its power stroke. Through these vents 158 the pressure from the cylinder 151 may be released at the end of the power stroke of the piston 152 thereby facilitating the return of the piston 152 by the action of the spring 156. A piston rod 159 extends from the piston 152 through suitable packing glands and through the partition wall 154 into a secondary piston 162, which latter is a long hollow tube with an enlarged hollow head 163.

The top of the piston head 163 is suitably packed and slidably guided on a hollow boss 164 which latter is extended from the under face of the partition wall 154. On the lower end of the tubular secondary piston 162 is fixed a pressure tip 166 which is guided on the recess 87 of the tool head 86 and bears against the pins 89 in the manner heretofore described in connection with the operation of the piston rod 90 of the form shown in Figures 1 and 2. A second coil spring 167 bears at one end thereof against a shoulder inside the tool head 86 and at its other end against the underside 168 of the piston head 163 so as to urge the secondary piston 162 toward the partition wall 154. This second spring 167 is shown herein as an upwardly tapering conical coil spring. A cross pin 169 extended through the piston rod 159 near its free end limits the stroke of the piston rod 159 outwardly of the partition wall 154. This secondary piston 162 and its hollow head 163 are filled with grease or like fluid so that the secondary piston 162 may be pressed into contact with pins 89 by the hydraulic pressure created by the displacement action of the piston rod 159 on the fluid in the closed chamber of the hollow secondary piston 162. This fluid pressure acts on the interior shoulder 171 of the hollow piston head 163 and on the inner surface 172 of the closed bottom of the piston rod 162 and against the fixed inner surface of the hollow boss 164. The force thus exerted moves the secondary piston 162 toward and into the tool head 86 and applies the ultimate power to the outer shell 81 of the rivet holder which operates as heretofore described in connection with the operation of the apparatus shown in Figures 1 and 2.

By the differential action between the operation of the primary piston 152 and the secondary or booster piston 162 the power is stepped up and the stroke is shortened resulting in a short and powerful stroke for riveting. As the first piston 152 is returned from its power stroke by the spring 156 the second spring 167 returns the secondary piston 162 to its initial position according to the withdrawal of the piston rod 159. The return movement of the secondary piston 162 is limited by the length of the hollow boss 164 against which the inner shoulder 171 of the piston head 163 abuts at the top of its stroke. In the form of this apparatus as herein illustrated it was found that about a four and three-eighths of an inch stroke of the primary piston 152 will cause a displacement of about three-eighths of an inch stroke of the secondary piston 162, with corresponding boosting of the power applied for riveting.

An embodiment of the handle valve mechanism 80 for the control of the apparatus is shown in Fig. 19 somewhat diagrammatically. In the handle 83 is a valve body 173 with parallel passages 174 and 176 the former connected to a hose 177 and the latter connected to the control conduit 153. The passages 174 and 176 are connected to each other by a bypass 178 extended transversely in the valve body 173. A suitable valve, such as a tire valve 179, in case of pneumatic operation of the first piston 152, is provided between the intake passage 174 and the by-pass 178. Another similar valve 181 is provided between the by-pass 178 and outside of the valve body 173 leading into the hollow handle 83. The latter valve 181 is in registry with the passage 176. Both valves 179 and 181 face with their release stems 182 toward the push button 84 in said handle 83. The stem 182 of the intake valve 179 is extended through the end of the valve body 173. The stem 182 of the other valve 181 also protrudes from the end of the valve body 173. A lever 183 is fulcrumed at its middle portion in front of the end of the valve body 173 so that the opposite ends of the lever 183 abut the respective valve stems 182 and act simultaneously and oppositely on said stems 182. The lever 183 is so positioned that in its normal position the intake valve 179 is allowed to close, but the other valve 181 is held open. A compression spring indicated at 184 normally urges the lever 183 into a position where the valve 179 is open and the other valve 181 is closed. The pushbutton 84 is in engagement with the end of the lever 183 opposite the intake valve 179 so that as the button 84 is pushed it moves the lever 183 so as to open the intake valve 179 and close the exhaust valve 181. Therefore when the button 84 is pushed the pressure medium is admitted through the intake valve 179, by-pass 178 and passage 176 to the conduit 153 so as to act on the primary piston 152 as heretofore described. When the button 84 is released the lever 182 is automatically returned to its starting position thereby closing the intake valve 179 and opening the exhaust valve 181 so that the pressure medium is discharged from the path of the returning piston 152 through the conduit 153, passage 176 and the exhaust valve 181 into the chamber in the handle 83. The pressure medium can be discharged then from the handle 83 through a vent 186 which may have an exhaust conduit connected thereto for use with pressure medium other than air.

The modified form of the holder or riveting tool shown in Fig. 17 is substantially the same as the holder heretofore described, except that this modified form shows a mounting of the holder on a riveting gun or apparatus wherein a reciprocating rod 187 is connected to the pulling member 188 so as to pull said pulling member 188 when power is applied to the rod 187. The outer pressure sleeve 189 of this form is fixedly mounted on the face 191 of the riveting gun. In this form the pressure seat 192 is flat and has a slot 193 to fit the neck of the stem or shank 29. In this form the rivet is placed into the slots of the holder so that the pulling head is nested on the end of the pulling member 188, as in the form shown in Fig. 2. Pressure on the rivet head is exerted by holding the riveting apparatus or gun so that the pressure seat 192 is pressed manually against the rivet head holding the rivet in position in the rivet hole. The power is applied in suitable manner for relative axial movement of the pulling member 188 relative to the pressure seat 192 so as to form the rivet tail as heretofore described.

It is to be noted that the relation between the head engaging ends of the pulling tube 91 or the pulling member 188, the respective pressure seats 97 and 192, and the respective side slots of the holder is such that a rivet assembly 19 can be inserted sidewise into the holder through the side slots and assume its operative position wherein the rivet head is at the pressure seat of the holder and the pulling head of the rivet assembly is interlocked with the end of the pulling tube or pulling member ready for the riveting operation. The holder then holds the rivet assembly in this position for insertion into the rivet hole and throughout the riveting operation. The predetermined relative position of the shank and the rivet tube of the rivet assembly holds the

rivet head and the pulling head of the rivet shank in a uniform constant spacing and contour which substantially fits into the contour of the side slots, pressure seat and end of the pulling member of the respective holders. The feeding mechanism can handle such rivet assemblies of uniform constant contour quickly and feed them into the holder to be acted upon uniformly during the riveting operation. This with the uniform predetermined stroke of the apparatus combines in quickly and efficiently performing the riveting operations herein described.

I claim:

1. In a riveting apparatus for setting a rivet assembly of the type in which a tension member with a tail former on it is assembled in predetermined position within a tubular rivet; a pair of relatively movable riveting elements, a pressure member on one of said elements for engagement with the head of said rivet assembly, engagement means on the other riveting element for engaging a portion of the tension member of said rivet assembly spaced from the rivet head, means to exert opposite forces on said riveting elements to move one of said riveting elements oppositely to the other for forming a fastening rivet tail on said rivet, said riveting elements having coacting receiving side apertures substantially corresponding to the contour of the rivet assembly from the rivet head to the end of the tension member outside of said rivet head, and being adapted to laterally receive each rivet assembly when said riveting elements are in their initial position for engaging said rivet head and tension member of said rivet assembly.

2. In a riveting tool for a rivet assembly in which a tension member with a tail former is extended through a tubular rivet, a pair of coacting elements being movable axially relatively to each other, a pressure member on one of said elements being adapted to be pressed against the rivet head, engagement means on the other element to engage a portion of the tension member outside of said head so as to pull said tension member during the relative movement of said elements, said coacting elements, said pressure member and said engagement means having aligned openings in the sides thereof for the sidewise insertion of the portion of the rivet assembly from the rivet head to the free end of the tension member, and means to apply oppositely acting forces to said coacting elements.

3. In a riveting tool for a rivet assembly in which a tension member with a tail former is extended through a tubular rivet, a pressure element adapted to exert pressure on the head of the rivet, a pulling element adjacent the pressure element, said elements being axially movable relatively to each other, engagement means on the pulling element to engage a portion of the tension member outside the rivet head for pulling the same, said pressure element, pulling element, and engagement means having recesses on a side thereof aligned in the initial position of said elements so as to receive a rivet assembly in alignment with said pressure element, pulling element and engagement means, and means to exert forces on said elements in opposite directions to each other for forming the fastening rivet tail.

4. In a riveting tool for setting a rivet assembly of the type in which a tension member with a tail former is extended through a tubular rivet and there is an engagement head on the tension member outside the rivet head; a pair of coacting elements movable axially relatively to each other, one of said elements being adapted to be pressed against the rivet head, an engagement portion of the other element fitting to the underside of the engagement head of the tension member for exerting a pull on the engagement head, the spacing of said engagement portion and the pressure face of said pressing element when said elements are in their initial position being the same as the spacing between the rivet head and the engagement head of the rivet assembly.

5. In a riveting apparatus, a riveting tool for use with a rivet assembly having a tension member extended through a tubular rivet and having an engagement head on the tension member outside of the rivet head, a pair of elements telescoped one into the other and being movable axially relatively to each other, a pressure end on one of said elements adapted to bear against the rivet head, a pulling head on the other element adapted to engage the engagement head of the rivet tension member, said elements having aligned side inlets for the insertion of a rivet assembly in a predetermined position into said telescoping elements so that the rivet head is engaged with the pressure end and the engagement head is engaged with the pulling head, and means to apply riveting forces to said telescoped elements.

6. In a riveting apparatus, a riveting tool for use with a rivet assembly having a tension member extended through a tubular rivet and having an engagement head on the tension member outside of the rivet head, a substantially tubular element, a second substantially tubular element axially movable within the first tubular element, a pressure seat at the end of the first tubular element for engaging the rivet head, a pulling head on the end of the second tubular element for engaging the engagement head on the tension member, said tubular elements having registering openings on the sides thereof for receiving said rivet assembly therethrough so that the rivet head and the engagement head of said rivet assembly are in operative relation respectively to the pressure seat and the pulling head of said tubular elements; and means to apply force for the relatively opposite movement of said tubular elements so as to form the fastening rivet tail.

7. In a riveting apparatus, a riveting tool for use with a rivet assembly having a tension member extended through a tubular rivet and having an engagement head on the tension member outside of the rivet head, a substantially tubular element, a second substantially tubular element axially movable within the first tubular element, a pressure seat at the end of the first tubular element for engaging the rivet head, a pulling head on the end of the second tubular element for engaging the engagement head on the tension member, said tubular elements having registering openings on the sides thereof for receiving said rivet assembly therethrough so that the rivet head and the engagement head of said rivet assembly are in operative relation respectively to the pressure seat and the pulling head of said tubular elements; means to apply force for the relatively opposite movement of said tubular elements so as to form the fastening rivet tail until the tension member is broken, and an ejector guide extended substantially across said tubular elements to guide the broken portion of the tension member to the outside of said tubular elements, said tubular elements having registering discharge apertures for the dis-

charge of the broken part of the tension member therefrom.

8. In a riveting apparatus for setting a rivet assembly of the type in which a tension member with a tail former on it is assembled in predetermined position within a tubular rivet; a pair of relatively movable riveting elements, a pressure member on one of said elements for engagement with the head of said rivet assembly, engagement means on the other riveting element for engaging a portion of the tension member of said rivet assembly spaced from the rivet head, said pressure member and said engagement means having intake recesses in a side thereof aligned to receive a rivet assembly in the initial position of said pressure member and engagement means, means to exert opposite forces on said riveting elements at will so as to move one of said riveting elements oppositely to the other for forming a fastening rivet tail on said rivet, means to automatically feed said rivet assemblies to said riveting elements, said last means including a mechanism connected to the apparatus to carry a plurality of rivet assemblies, and means to transfer said rivet assemblies one at a time from said carrying means into said recesses.

9. In a riveting apparatus for setting a rivet assembly of the type in which a tension member with a tail former on it is assembled in predetermined position within a tubular rivet; a pair of relatively movable riveting elements, a pressure member on one of said elements for engagement with the head of said rivet assembly, engagement means on the other riveting element for engaging a portion of the tension member of said rivet assembly spaced from the rivet head, said pressure member and said engagement means having intake recesses in a side thereof aligned to receive a rivet assembly in the initial position of said pressure member and engagement means, and means to exert opposite forces to said riveting elements at will so as to move one of said riveting elements oppositely to the other for forming a fastening rivet tail on said rivet, means connected to the apparatus to carry a plurality of rivet assemblies, and means actuated by the relative movement of said riveting elements to feed a rivet assembly from said carrying means into said recesses upon the riveting elements being returned to their rivet receiving relationship.

10. In a riveting apparatus for setting a rivet assembly of the type in which a tension member with a tail former on it is assembled in predetermined position within a tubular rivet; a pair of relatively movable riveting elements, a pressure member on one of said elements for engagement with the head of said rivet assembly, engagement means on the other riveting element for engaging a portion of the tension member of said rivet assembly spaced from the rivet head, means to apply forces to said riveting elements so as to move said riveting elements oppositely to each other for forming a fastening rivet tail on said rivet, said riveting elements having coacting receiving apertures substantially corresponding to the contour of the rivet assembly from the rivet head to the end of the tension member outside of said rivet head so as to receive each rivet assembly in the initial position of said riveting elements, and means connected to said apparatus and actuated by the relative movement of said riveting elements after each riveting operation to feed a rivet assembly to said receiving apertures of said riveting elements.

11. In a riveting apparatus for rivet assemblies having a tension member with a tail former extended through a tubular rivet, the combination with a pair of coacting riveting elements engaging respectively the rivet head and the tension member so as to transmit opposite forces thereto for forming a fastening rivet tail, a power applying mechanism comprising, a casing, the riveting element engaging the tension member being connected to said casing, a power applying member in said casing, means to normally maintain the rivet head pressing element in contact with the riveting element connected to the tension member, and means of connection between said power applying member and said rivet head pressing element to exert pressure on said rivet head pressing element so that the power applied through said power applying means moves said casing and said riveting element connected to the tension member away from said rivet head pressing element so as to pull the tension member for forming the rivet tail.

12. In a device of the character described, a cylinder, a piston working in the cylinder, means to connect said cylinder to a working tool, a partition in the cylinder, a hollow guide extended from said partition, a fluid filled chamber in said piston, a displacement element slidably extended through said partition and reciprocable into and out of said chamber, another piston of a different stroke than the first piston connected to said displacement member for moving the same in its forward stroke, resilient means to move said pistons on the return stroke and pressure elements at the end of said first piston slidable through the end of the cylinder to bear against said working tool.

13. In a power applying device of the character described, a cylinder, a primary piston working in the cylinder, a secondary piston in said cylinder, a partition between said pistons, a guide on said partition to guide said second piston in the cylinder, said second piston having a fluid filled chamber therein bounded partly by said partition and said guide, a displacement element slidably extended from said primary piston through said partition and said guide and into said fluid filled chamber in the secondary piston, resilient means to act to cause the return stroke of said pistons, means to connect said cylinder to a work tool, and pressure elements at the end of said secondary piston being slidable through the end of the cylinder adjacent said work tool to bear against said work tool.

14. In a power applying device of the character described, a cylinder, a primary piston working in the cylinder, a secondary piston in said cylinder, means to guide said second piston in the cylinder, said second piston having a closed fluid filled chamber therein bounded partly by a relatively stationary surface in said cylinder, a displacement element extended from said primary piston into said fluid filled chamber in the secondary piston, resilient means to act to cause the return stroke of said pistons, means to connect said cylinder to a work tool, and pressure elements at the end of said secondary piston being slidable through the end of the cylinder adjacent said work tool to bear against said work tool the ratio between the displacement of said displacement element in said fluid chamber and the displacement of the primary piston being such that the resultant stroke of the secondary piston is shorter than the stroke of the primary piston to thereby exert an increased force.

15. A riveting tool for setting tubular rivets having a tubular rivet body with a head at one end for engaging one side of the riveted structure, and a former stem extending through said rivet body with a former thereon at the other end of the rivet body, said stem extending beyond the rivet head and having a pulling head thereon spaced from said rivet head, said tool comprising a pressure member having an end to bear upon said rivet head, a pulling member axially movable in said pressure member, and means on said pulling member to engage said pulling head on the rivet so as to pull said former stem so as to form a rivet tail on said other end of the rivet body against the other side of the riveted structure, the distance between said pulling head engaging means and said pressure end of said pressure member being substantially the same as the distance between the rivet head and said pulling head at the start of the riveting operation, said pressure member and said pulling member having registering openings on a side thereof conforming to the contour of the rivet assembly from said rivet head to said pulling head at the start of the riveting operation to permit insertion of a rivet assembly sidewise into said riveting tool members, said pressure members and pulling member being adapted to be engaged by means for simultaneously exerting pressure on the pressure member and a pulling force on said pulling member.

16. A riveting tool for setting tubular rivet assemblies having a tubular rivet body with a rivet head on it and a stem extending through the rivet body with a former at the tail end of the rivet body and a pulling head thereon spaced outside said rivet head, said rivet body and stem being held together to uniformly space the pulling head from the rivet head of each rivet assembly, said tool comprising a pressure member having an end to bear on the rivet head, a pulling member axially movable in said pressure member, a shoulder in said pulling member to engage the underside of said pulling head of the rivet, and means to pull said pulling member from an initial position relatively to said pressure end of said pressure member and exert a reaction force on said pressure member for pulling said rivet stem and form a tail on said rivet body for setting the rivet in the riveted structure, the distance between said shoulder on the pulling member and the pressure end of said pressure member in said initial position being substantially equal to the distance between the rivet head and the pulling head of the stem of said rivet assembly, said pressure member and said pulling member having registering apertures on a side thereof conforming in said initial position to the contour of the rivet assembly from the rivet head to the pulling head for the sidewise insertion of said rivet assembly into the riveting tool.

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