

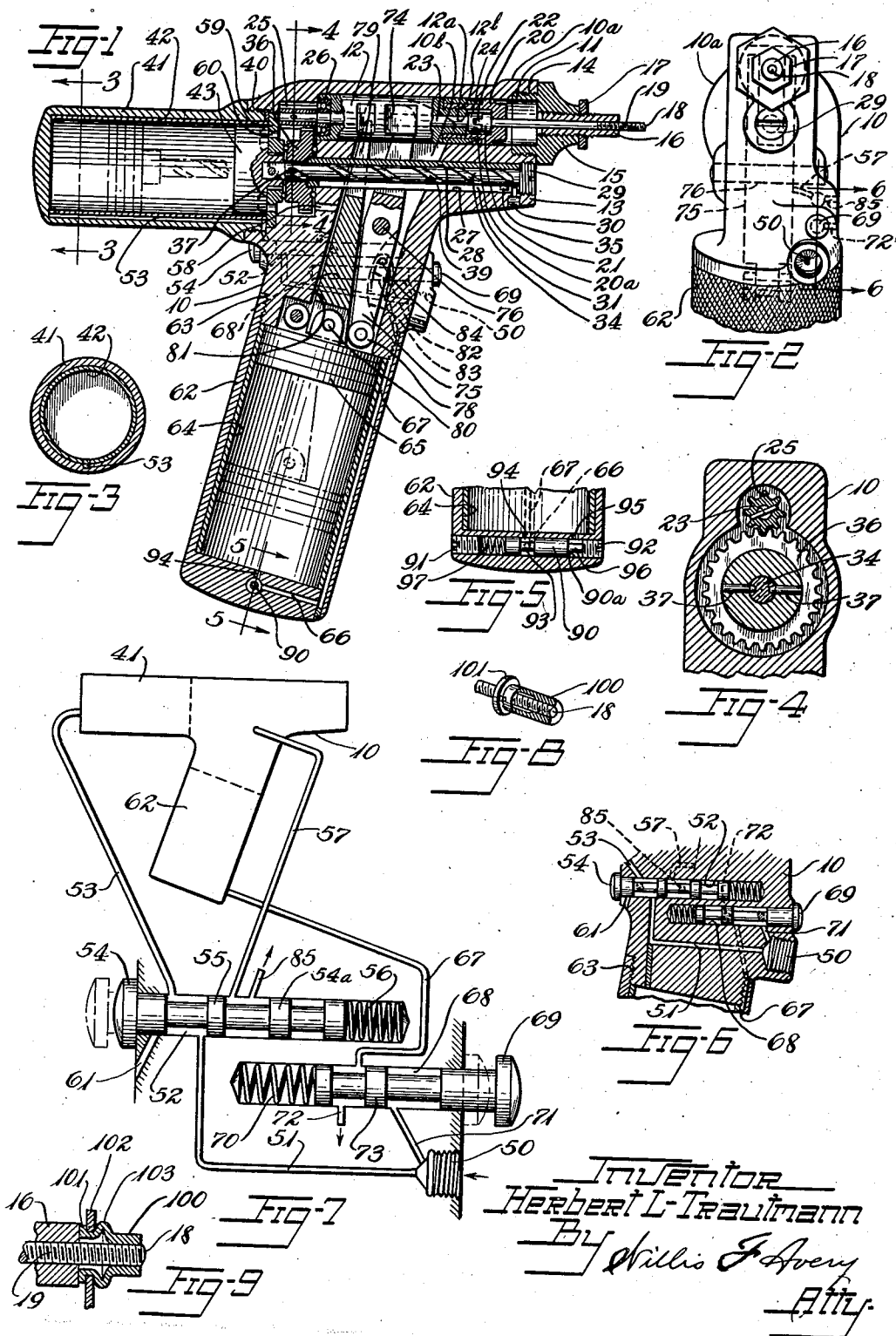
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APPARATUS FOR INSTALLING COLLAPSIBLE TUBULAR RIVETS.

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APPARATUS FOR INSTALLING COLLAPSIBLE  
TUBULAR RIVETS

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This invention relates to apparatus for installing and collapsing tubular collapsible rivets and is especially useful for installing rivets of the tubular type shown in the Waner patents, Nos. 2,149,199 and 2,188,422. In the manufacture and repair of airplanes and of other articles having a thin metal surface, it has often been necessary to insert collapsible tubular rivets from the outer face of the article through apertures provided therefor in the metallic surface covering. When the inner surface of the metal covering is inaccessible it is desirable to provide means for applying pressure to both ends of the rivet from the outside. Rivets of the type used for this purpose comprise a collapsible tubular stem portion having a flange at one end thereof for seating against the surface of the sheet metal.

The tubular stem portion of the rivet may be open or closed at its unflanged end and is reduced in internal diameter at that end and threaded to engage a screw for securely fastening other parts to the surface of the sheet metal. The stem between the flanged end and the threaded end of the rivet is adapted to be axially compressed and circumferentially expanded so as to provide a second flange at the rear face of the sheet metal to hold the rivet in place. A key formed on the flanged end of the rivet is adapted to engage a keyway in the opening to prevent turning of the rivet.

The present invention contemplates the provision of power operated means for inserting and collapsing the rivet in place. The principal objects of the invention are to provide for the application of controlled mechanical force to the rivet in an axial direction to compress the same; to provide power means for engaging and disengaging the compressing means with the rivet, to provide simplicity of structure; to provide speed and efficiency of operation; to provide uniformity of compression of the rivets, and to provide convenience of operation. These and other objects will appear from the following description and the accompanying drawing:

Of the drawing:

Fig. 1 is a cross-sectional elevation of the apparatus with the comprising mechanism shown in its retracted position and with the draw-rod twirling mechanism shown in the position it assumes in fully engaging the rivet, the disengaged position of the twirling mechanism and the advanced position of the rivet collapsing mechanism being indicated in dot-and-dash lines, the rivet not being shown;

Fig. 2 is an end view of the apparatus looking

toward the rivet engaging face thereof, the lower part of the apparatus being broken away;

Fig. 3 is a cross-sectional view taken on line 3—3 of Fig. 1;

Fig. 4 is a cross-sectional view taken on line 4—4 of Fig. 1;

Fig. 5 is a detailed sectional view taken on line 5—5 of Fig. 1;

Fig. 6 is a detailed sectional view of the valve taken on line 6—6 of Fig. 2;

Fig. 7 is a valve diagram illustrating the operation of the control valves;

Fig. 8 is a perspective view of the operating end of the draw-rod with a rivet in place thereon before collapse of the rivet, the rivet being partially broken away and shown in section; and

Fig. 9 is a cross-sectional view of the collapsed rivet and the sheet metal facing with the draw-rod and anvil engaging the same, the draw-rod and anvil being broken away.

Referring to the drawing:

The apparatus comprises a hollow body or stock 10 having a cylindrical barrel portion 10a formed with a bore 11 of substantially uniform diameter in which a plunger 12 is slideably mounted. The bore 11 terminates at the front face 13 of the stock and is enlarged adjacent thereto and threaded as at 14 to engage an externally threaded nose 15. The nose 15 is also internally threaded to engage the threaded end of reaction means such as a tubular anvil 16 adjustable with respect to the nose and adapted to be locked by a lock nut 17 engaging the threads of the anvil and the face of the nose. A threaded draw-rod 18 for use in collapsing the rivet by motion relative to the anvil is slidably mounted in the bore of the anvil and its projecting end is threaded as at 19 or otherwise adapted to engage the bore of the rivet at the end thereof remote from the flange. The rear end of the draw-rod extends through the bore of a threaded tubular cap 20 which engages over the plunger 12 and is formed with an enlarged head 21 freely rotatable within the cap 20 and having a tang 22 extending crosswise thereof by which it may be rotated. The plunger 12 has an axial bore 12a extending to cap 20 in which a shaft 23 is rotatably mounted. This shaft has an enlarged head 24 on its forward end located within cap 20 and slotted crosswise thereof to engage the tang 22. The other end of the shaft 23 has a pinion 25 fixed thereto whereby the shaft 23 and draw-rod 18 may be rotated. A ball bearing 26 is mounted in a rebate in the rearward end of the plunger 12 and about the shaft 23 to reduce friction of rotation. The en-

larged ends 21 of the draw-rod and 24 of the shaft are rotatably retained by the cap 20 in a cylindrical pocket 20a formed between the plunger 12 and the cap, the cap being secured to the plunger by threads 12b. The pinion 25 is of such axial width as to engage a gear 36, hereinafter described, at any position of the plunger 12.

To provide for power driven rotation of the draw-rod a second bore 27 is formed in the body 10 with its axis parallel to the axis of the draw-rod. A tubular bearing 28 is mounted in the bore and retained by the screw plug 29 at one end thereof threaded in the forward end of the bore and a set screw 30 engaging a side face of the bearing. The tube 28 has a longitudinal slot 31 therethrough extending substantially the entire length thereof. A helically grooved cam rod 34 is slideably mounted in the tube and is prevented from turning with respect thereto by a key 35 slideably engaging in the slot 31 of the tube. This rod has a groove 39 of relatively long pitch formed in its face and in engagement with a key 37 of a gear 36, the arrangement being such that movement of the cam rod lengthwise of the tube will rotate the gear 36 which in turn will rotate the draw-rod through the pinion 25 fixed to shaft 23.

For moving the cam rod 34 lengthwise, a threaded recess 40 is formed in the rear face of the stock 10 and a cylinder 41 having an externally threaded portion at its open end engages in the recess. A wear resisting tubular liner 42 is fitted in the bore of the cylinder. A piston 43 is fitted in the liner for sliding movement lengthwise of the cylinder and is attached to the cam rod 34. For supplying fluid under pressure to the cylinder 41, a threaded aperture 50 is formed in the stock 10 to receive a hose connection and is connected by a passage 51 formed in the body 10 to a valve chamber 52 formed therein from which a passage 53 leads to the closed end of the cylinder 41. The passage 53 may be constructed as a longitudinal groove formed in the wall of the cylinder between the cylinder wall and the liner 42. A valve 54 is slideably mounted in the valve chamber 52. This valve is of the piston type and a piston flange 55 thereon normally is located between passages 51 and 53 and therefore normally closes off the passage 51 from the passage 53 by reason of the valve spring 56 normally maintaining said flange 55 between said passages 51 and 53.

The valve 54 may be shifted by hand pressure against the resistance of the spring 56 to the position shown in Fig. 7 where the flange 55 uncovers the passage 51 and admits fluid under pressure to the cylinder 41, thereby advancing the piston 43 to the position shown in Fig. 1. Return of the piston 43 is provided for by a second passage 57 which extends from the valve chamber 52 to a chamber 58 formed in the stock 10 adjacent the threaded end of the cylinder 41 and in which the gears 25 and 36 are rotatably mounted. A disc 59 having ports 60 therethrough for flow of fluid is clamped between the cylinder 41 and the stock 10 and separates the chamber 58 from the cylinder 41. The arrangement is such that in the normal position of the valve 54, the flange 55 thereof is between the passage 51 and the passage 53 and prevents the passage of fluid from passage 51 to passage 53. At the same position passage 51 connects to passage 57 permitting fluid under pressure to flow to chamber 58 and through the ports 60 in disc 59 so that the piston 43 is forced to the left in Fig.

1. At this position of the valve an exhaust passage 61 is connected through the valve chamber 52 to the cylinder 41 through passage 53 permitting exhaust fluid from the left end of the cylinder 41 in Fig. 1 to escape to the atmosphere. When valve 54 is pushed in against the pressure of spring 56, passage 57 connects chamber 58 to an exhaust port 85 which is closed by a piston flange 54a when valve 54 is released.

To provide for power operation of the draw-rod to collapse the rivet, a cylinder 62 having a liner 64, is internally threaded as at 63 to engage over a threaded portion on the lower end of the stock 10 and communicates by means of a passage 67 with a valve chamber 68 formed in said stock. A piston type valve 69 is slideably mounted in the valve chamber 68 as shown in Fig. 7 and is held in the position shown in full lines by a coil spring 70 between the valve and the end of its chamber. The valve chamber is connected to the fluid pressure supply opening 50 by a passage 71. The passage 67 in the normal position of the valve shown communicates with an exhaust passage 72 and is shut off from the fluid supply passage 71 by a piston flange 73 of the valve. When the valve is depressed against the spring 70 the flange 73 is moved to the left to a position where it disconnects the passage 67 from the exhaust passage 72 and connects it to the supply passage 71 thereby supplying fluid pressure to the lower side of the piston 65 in the cylinder 62.

The plunger 12 which controls the draw-rod 18 is formed with notches such as 74 on opposite sides thereof and a lever 75 is pivoted within the hollow stock 10 on a pin 76 fixed to the stock. The upper end of the lever is bifurcated and its limbs are rounded at their ends to straddle the plunger 12 so as to engage in the notches 74. The lower end of the lever 75, which is of the first class, carries an anti-friction roller 78. A wedge-shaped cam member 79 is pivotally fixed to the piston 65 by a pin 80 and extends upwardly from the piston along a surface 81 of the stock 10 on which it is adapted to slide. The inclined face of the wedge 79 engages the anti-friction roller 78 and in the upward movement of the piston 65 forces the lower end of the lever 75 in a counter-clockwise direction in Fig. 1, whereby the draw-rod 18 is retracted. When the piston 65 is lowered the roller 78 follows the inclined surface of the wedge due to the fact that the lever 75 is rotated in a clockwise direction by a spring 82 located in a recess 83 of the lever 75 about a pin 84 fixed to the lever, one end of the spring, which is of hairpin shape, impinging against the lever 75, and the other end impinging against a wall of the stock 10. Such lowering of the piston is accomplished by fluid pressure in chamber 58 to which the upper side of piston 65 is exposed, and is simultaneous with return of piston 43 as hereinbefore described.

Provision is made for regulation of the pressure used in the compressing of the rivet so that all rivets are compressed with equal pressure even though the pressure of the fluid supply fluctuates. For this purpose a piston valve 90 is slideably mounted in the valve chamber 90a at the lower end of the cylinder. The chamber 90a is in the form of a passage extending diametrically across the end of the cylinder through its end wall and this passage is closed at opposite ends by screw plugs 91, 92 slotted for engagement by a screw driver or similar implement for adjustment. At the normal position of the valve

90, a reduced portion 93 thereof is opposite the passage 66 and communicates with a port 94 formed in the end of the cylinder. Another port 95 is also formed in the end of the cylinder and at this position is opposite a reduced portion 96 of the valve 90. A coil spring 97 is located between the end of the valve 90 and the plug 91 and tension on the spring may be adjusted by adjustment of the screw plug 91. The screw plug 92 limits the normal position of the valve 90.

The arrangement is such that as the fluid under pressure from the passage 67 enters the cylinder through the port 94 it builds up pressure in the cylinder until the fluid pressure acting through the port 95 against the end of the piston valve 90 forces it to the left in Fig. 5 thereby closing the port 94 and preventing the pressure in the cylinder from increasing further. The screw plug 91 may be adjusted to so compress the spring 97 as to regulate the pressure in the cylinder to that desired for collapsing the rivet. The upper side of the piston 65 is exposed to the air pressure in the chamber 10b of the stock 10 which communicates with chamber 58 so that when the chambers are charged with fluid under pressure to return the piston 43 the piston 65 is also returned. The ends of the valves 54, 69 are conveniently located so as to be engaged by the thumb and forefinger respectively of the operator when the cylinder 62 is grasped in the right hand of the operator.

The anvil member 16, due to its threaded connection to the nose 15 of the instrument, may be adjusted to extend over the draw-rod any desired amount to suit rivets of different lengths, or may be easily removed for replacement by anvils having various shapes or contours to adapt them to different types of rivets. The draw-rod may also be removed for replacement in case of breakage or for the purpose of substituting draw-rods of different dimensions by removing the nose 15 and the anvil attached thereto and then removing the cap 20 which holds the draw-rod to the end of the plunger 12. The operation of the apparatus is as follows:

The apparatus is ordinarily supported by the right hand of the operator, the cylinder 62 acting as a grip or handle. Air or other fluid under pressure is supplied to the connection 50 by a flexible hose. The operator rests his thumb upon the end of the valve 54 and his forefinger upon the end of the valve 69. The rivet 100, shown in Fig. 8, is held in the left hand of the operator and the end of the draw rod 18 is entered into the unthreaded bore of the rivet. The valve 54 is then depressed by the thumb of the operator causing chamber 10b to be opened to the atmosphere through passage 59, valve chamber 52, and exhaust port 85 and causing fluid under pressure from the connection 50 to pass through the passage 51 past the valve 54 and through passage 53 to the rear of the cylinder 41 where it forces the piston 43 forward and with it the helical cam rod 34 which causes the gear 36 and pinion 25 to rotate thereby rotating the shaft 23 extending through the plunger 12 and the draw-rod 18 operatively connected thereto so that the draw-rod is threaded into the rivet. During this operation, the draw-rod is in its forwardly extended position due to the pressure of the spring 83 and the presence of the piston 65 in the lower end of the cylinder 62.

The apparatus with the rivet 100 in place thereon is then advanced to enter the stem of the rivet in an aperture in the work, the flange

101 of the rivet being pressed against the work by the anvil 16 under pressure exerted by the operator, the valve 54 being held in depressed condition until after compression of the rivet. With the rivet held in proper position by the anvil 16 the operator then depresses the valve 69 while holding the valve 54 in its depressed position whereupon fluid under pressure is supplied to cylinder 62 below the piston 65 from the connection 50 through the passage 71, around valve 69 and through passage 67.

The fluid under pressure entering the passage 67 passes the valve 90 until sufficient pressure is built up in the cylinder 62, port 95 and around the reduced portion 96 of valve 90 to cause the valve 90 to compress spring 97 and close port 94 leading into cylinder 62. The pressure in the cylinder raises the piston 65 driving the wedge cam 79 along the surface 81 and thereby causing rotation of the lever 75 in a counterclockwise direction by contact of the roller 78 with the inclined surface of the wedge, thereby forcing the plunger 12 rearwardly and withdrawing the draw-rod 18 through the anvil 16, resulting in collapse of the rivet, as illustrated in Fig. 9 where the draw-rod 18 is shown as engaging in the threaded portion of the rivet, and the work 102 is engaged between the flange 101 of the rivet and the collapsed portion 103 of the rivet. Thereupon the operator releases both valves 54 and 69 and the pressure fluid in the cylinder 41 is permitted to escape through the passage 53 past the valve 54 and through the exhaust passage 61, and the fluid pressure in the cylinder 62 is permitted to escape through the passage 67 past the valve 69 through the exhaust passage 72.

In this position of the valve portion 54a of valve 54 blocks exhaust passage 85 and fluid pressure is supplied to the chamber 10b of the stock of the instrument by way of passages 51 and 57 and pistons 43 and 65 are returned toward the closed ends of cylinders 41 and 62. The return of piston 43 causes rotation of gear 36 and pinion 25 thereby rotating the draw-rod 18 in a direction to detach it from the threaded portion of the rivet. The return of the piston 65 to the lower end of cylinder 62 permits the lever 75 to be rotated in a clockwise direction under influence of the spring 83, thereby forcing the draw-rod 18 to an extended position where it is in position for the next riveting operation.

Variations may be made without departing from the spirit of the invention as it is defined by the following claims.

I claim:

1. Apparatus for installing an internally threaded tubular rivet, said apparatus comprising a housing having an anvil at one end, a threaded draw-rod in the housing and extending through and beyond the anvil and adapted to engage the threaded portion of the rivet, and power-operated means associated with said housing and rod for effecting a longitudinal movement of the rod with respect to the anvil to collapse the rivet, the rod moving means comprising a fluid-pressure cylinder mounted upon the housing, a piston therein and cam means actuated by said piston for actuating said rod.

2. Apparatus for installing a rivet, said apparatus comprising means for applying a reactive force to the rivet, a draw-rod extending through said means and adapted to engage the rivet, power-operated means for effecting a longitudinal movement of the draw-rod with respect to the first said means to collapse the rivet, said

power-operated means comprising means for retracting the draw-rod, cam means having an inclined surface for actuating the means for retracting said draw-rod, and a fluid pressure cylinder for actuating said draw-rod.

3. Apparatus for installing a rivet, said apparatus comprising means for applying a reactive force to the rivet, a draw-rod extending through said means and adapted to engage the rivet, power-operated means for effecting a longitudinal movement of the draw-rod with respect to the first said means to collapse the rivet, and power-operated means to rotate the draw-rod to engage and release the rivet, said last named means comprising a helically formed member, means for imparting a movement of translation thereto, and means engaging said helically formed member for rotating said draw-rod.

4. Apparatus for installing a rivet, said apparatus comprising means for applying a reactive force to the rivet, a draw-rod extending through said means and adapted to engage the rivet, power-operated means for effecting a longitudinal movement of the draw-rod with respect to the first said means to collapse the rivet, and power-operated means to rotate the draw-rod to engage and release the rivet, said last named means comprising a rod having a helical groove, means for imparting a movement of translation to said rod, and a rotatable member engaging said helical groove and adapted to be rotated by translational movement of said rod.

5. Apparatus for installing a rivet, said apparatus comprising means for applying a reactive force to the rivet, a draw-rod extending through said means and adapted to engage the rivet, power-operated means for effecting a longitudinal movement of the draw-rod with respect to the first said means to collapse the rivet, and power-operated means to rotate the draw-rod to engage and release the rivet, said last named means comprising a rod having a helical groove, a fluid operated cylinder for imparting a movement of translation to said rod, and a rotatable member adapted to be rotated by translational movement of said rod.

6. Apparatus for installing tubular rivets, said

apparatus comprising an apertured reaction member, a draw rod extending through the aperture in said member and having a threaded end for engaging an internally threaded rivet, and means for effecting relative longitudinal movement of said rod and member, said means comprising a cam structure and a cam follower and power-operated means for moving said cam structure including a pressure fluid cylinder having a cam piston, and said cam structure comprising an elongated cam member mounted for advance and retraction by movement of said piston.

7. Apparatus for installing a rivet, said apparatus comprising means for applying a reactive force to the rivet, a draw-rod extending through said means and adapted to engage the rivet, and power-operated means for effecting a longitudinal movement of the draw-rod with respect to the first said means to collapse the rivet, said power-operated means comprising means for retracting the draw-rod, and cam means having an inclined surface for actuating the means for retracting said draw-rod.

8. Apparatus for installing a rivet, said apparatus comprising means for applying a reactive force to the rivet, a draw-rod extending through said means and adapted to engage the rivet, power-operated means for effecting a longitudinal movement of the draw-rod with respect to the first said means to collapse the rivet, said power-operated means comprising means for retracting the draw-rod, cam means having an inclined surface for actuating the means for retracting said draw-rod and fluid pressure means for actuating said cam means.

9. Apparatus for installing tubular rivets, said apparatus comprising an apertured reaction member, a draw-rod extending through the aperture in said member and having a threaded end for engaging an internally threaded rivet, and means for effecting relative longitudinal movement of said rod and member, said means comprising a cam structure and a cam follower and power-operated means for moving said cam structure.

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