May 19, 1942. C. C. CADDEN 2,283,665

APPARATUS FOR INSTALLING RIVETS

Filed July 1, 1939 2 Sheets-Sheet 1

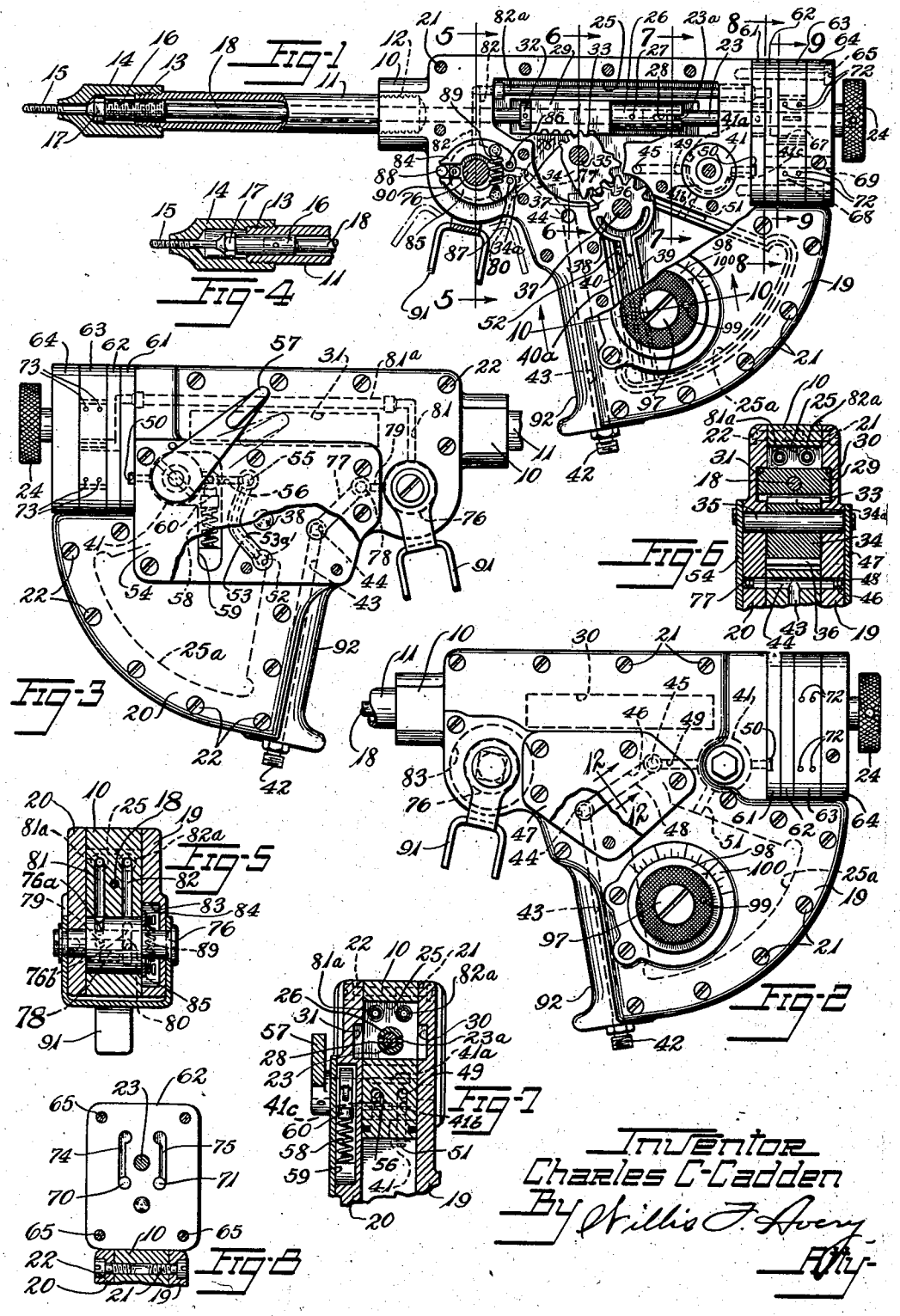

Fig-1

Fig-4

Fig-3

Fig-6

Fig-5

Fig-2

Fig-7

Fig-8

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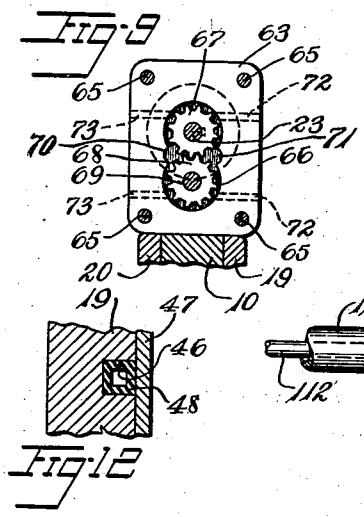
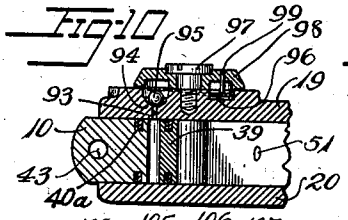
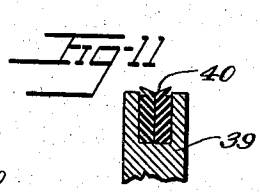


Fig-12





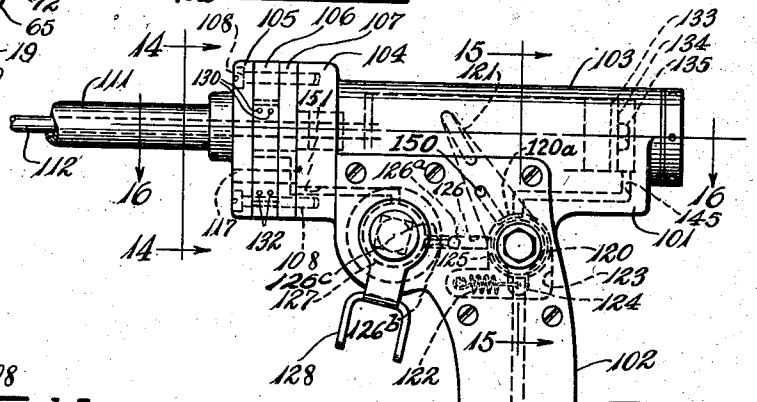


Fig-13

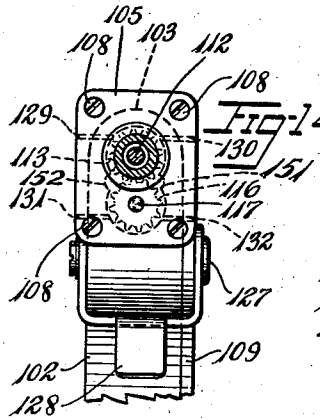


Fig-14

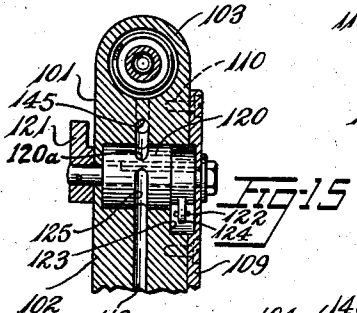


Fig-15

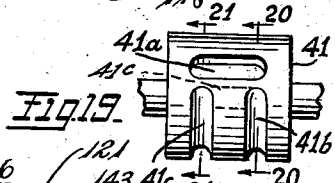


Fig-19

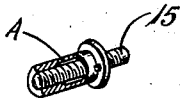


Fig-17

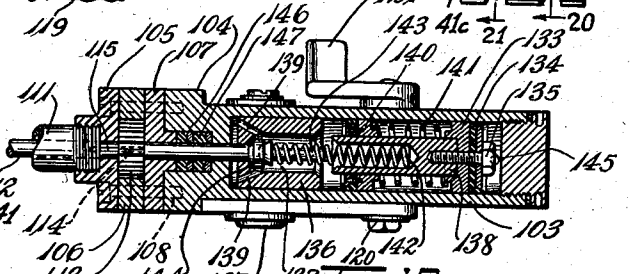
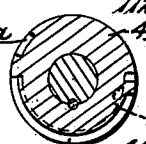


Fig-16

Fig-20



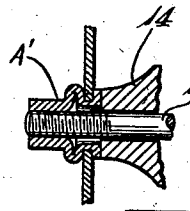


Fig-18

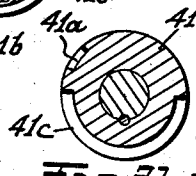


Fig-21.

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UNITED STATES PATENT OFFICE

2,283,665

APPARATUS FOR INSTALLING RIVETS

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Application July 1, 1939, Serial No. 282,537

23 Claims. (Cl. 218—19)

This invention relates to apparatus for installing tubular rivets and is especially useful in inserting and upsetting tubular rivets such as those of the Waner Patent No. 2,149,199, issued February 28, 1939, which rivets are applied from one side only of the work.

The present invention contemplates the provision of power-operated mechanism for placing and upsetting the tubular rivet, and withdrawing the tool.

The principal objects of the invention are to provide effective and compact power-operated mechanism for the purpose, to provide for the employment of fluid pressure in the operation thereof, to relieve the operator of fatigue, to provide for control of pressure, to provide simplicity of construction, and to provide for convenience of operation.

These and other objects will appear from the following description and the accompanying drawings.

Of the drawings,

Fig. 1 is a side elevation of one embodiment of the invention, with parts broken away and parts shown in section to expose the mechanism.

Fig. 2 is a similar view with certain parts replaced, parts being broken away.

Fig. 3 is a side elevation of the opposite side, with parts broken away.

Fig. 4 is a detail sectional view of the rivet-holding tip or anvil of the apparatus.

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

Fig. 6 is a detail sectional view taken on line 6—6 of Fig. 1.

Fig. 7 is a detail sectional view taken on line 7—7 of Fig. 1.

Fig. 8 is a detail sectional view taken on line 8—8 of Fig. 1.

Fig. 9 is a detail sectional view taken on line 9—9 of Fig. 1.

Fig. 10 is a detail sectional view taken on line 10—10 of Fig. 1.

Fig. 11 is a detail sectional view of the sealing strip shown in Fig. 10 drawn to a larger scale, other parts being broken away.

Fig. 12 is a detail sectional view taken on line 12—12 of Fig. 2.

Fig. 13 is a side elevation of another embodiment of the invention, the rivet-holding tip being broken away.

Fig. 14 is a detail sectional view taken on line 14—14 of Fig. 13.

Fig. 15 is a detail sectional view taken on line 15—15 of Fig. 13.

Fig. 16 is a detail sectional view taken on line 16—16 of Fig. 13.

Fig. 17 is a perspective view of the tubular rivet with the draw-rod engaged therein before upsetting the rivet, the rivet being shown partly in section, other parts being broken away.

Fig. 18 is a sectional view of the upset rivet engaging a wall member, the anvil and draw-rod being shown in place, other parts being broken away.

Fig. 19 is a side view of the control valve 41, parts being broken away.

Fig. 20 is a section thereof taken on line 20—20 of Fig. 19.

Fig. 21 is a section thereof taken on line 21—21 of Fig. 19.

The invention is useful especially in applying internally threaded tubular rivets of the construction shown in Figs. 17 and 18 by application from one side only of the work. In Fig. 17 the rivet A is shown positioned upon the applying tool, ready for mounting. In Fig. 18 is shown the rivet expanded in place, before removal of the tool.

Referring to the embodiment of the invention illustrated in Figs. 1 to 12, the numeral 10 designates the frame or stock from which a hollow barrel 11 extends. The barrel is threaded at one end as at 12 to engage a threaded opening in the stock and at the other end as at 13 to removably engage a tubular tip or anvil 14. A draw-rod 15, for engaging the threaded bore of the tubular rivet, extends through the bore of the anvil for free axial movement with respect thereto.

The draw-rod is threaded at its shank end to engage an internally threaded coupling sleeve 16 which has sliding engagement with the bore of the barrel 11. The draw-rod is also formed with a polygonal flange 17 for engaging a wrench. The coupling sleeve 16 is threaded on a draw-bar 18 extending through the barrel 11 whereby the draw-rod 15 may be rotated to engage in or to disengage a tubular rivet, and may be drawn back with respect to the anvil 14 for the purpose of upsetting the rivet as hereinafter explained. The arrangement is such that by removing the anvil 14 from the barrel 11 the draw-rod 15 may be removed and replaced and draw-rods and anvils of different sizes or shapes may be provided or worn or broken ones replaced.

The mechanism for operating the draw-rod is contained within the stock 10 which is chambered for this purpose and a pair of removable cover plates 19, 20 are attached to opposite sides of the stock to support certain of the mechanism

and to enclose the chambered portions and provide passages for confining and directing the operating fluid, the plates being retained by screws 21, 22.

For rotating the draw-rod by hand, as an optional mode of operation, a shaft 23 is rotatably mounted in a bore provided therefor in the stock in alignment with the draw-bar 18. A knurled knob 24 is fixed to the shaft at the rear of the stock. The upper longitudinal portion of a recess 25 in the stock surrounds the spaced apart and aligned ends of the draw bar 18 and the shaft 23. A sleeve 26 surrounding the ends of the draw-bar 18 and the shaft 23, is pinned, as at 27, to the end of the draw-bar, and is formed with an axial slot 28 to receive a cross pin 23a extending through shaft 23. The arrangement is such that the draw-bar 18 may have axial movement with respect to shaft 23 without disturbing the driving relation of one to the other.

For providing power-actuated reciprocal movement of the draw-bar, a block 29 is fixed longitudinally thereof and is slidably mounted in the recess 25 for movement in a direction axially of and with the draw-bar which extends therethrough and is rotatably journaled in said block, grooves 30, 31 being formed in the side plates for guiding the block. A collar 32 is fixed to the draw-bar with sleeve 26 to retain the block 29. The block is retained between the collar 32 and the sleeve 26 and has rack teeth 33 in its lower face. A segmental gear member 34 is rotatably mounted on a shaft 35 within the central portion of recess 25, the shaft being supported in bearings formed in the side plates 19, 20. Gear member 34 has pinion teeth 34a formed on one margin thereof to engage the rack teeth 33 and at its diametrically opposite margin has gear teeth 36 formed therein at a greater pitch radius, said teeth being adapted to be driven by a segmental gear 37 rotatably mounted on a cross shaft 38 also extending between the side plates. Gear 37 is neatly fitted in a cylindrical recess formed in the stock at a bottle neck central portion of the recess 25 and between the side plates.

That portion of the recess 25 below the gear 37 is of triangular form with one arcuate wall 25a concentric with shaft 38. Gear 37 has a radial vane 39 integral therewith which contacts with the arcuate face 25a of the recess and its edge margins slidably engage the side plates to provide an air tight partition capable of acting as a piston within the triangular recess to drive the draw-bar. To insure a sealing fit, the vane 39 is grooved around its margins to receive resilient packing strips 40 (see Figs. 10 and 11), and the stock 10 is similarly grooved adjacent the margins of the triangular lower portion of the recess 25 to receive similar packing strips 40a (see Figs. 10 and 11).

Pressure fluid, such as compressed air, for reciprocating the draw-bar 18 to collapse and release the rivet, is controlled and supplied by way of a rotatable valve 41, seated in a cylindrical recess in the stock between side plates 19, 20. A hose connection 42 is fixed to the stock and supplies air to the valve through a passage in the stock connecting with a cross-passage 44 therethrough and through side plates 19 and 20 (see Fig. 6). The cross-passage 44 is connected to a second cross-passage 45 by a groove 46 in the outer face of the side plate 19 (see Fig. 2) said groove being covered by a cover plate 47 and lined by a tube 48 of square cross section (see Figs. 6 and 12) and of resilient rubber-like material, retained in the groove to conduct the pressure fluid therealong. Cross-passage 45 extends through side plate 19 and far enough into stock 10 to connect with an inlet port 49 leading to groove 41b in the valve 41 (see Figs. 1, 2 and 7). An outlet port 50, substantially diametrically opposite to inlet port 49, extends from the valve through stock 10 to the atmosphere. A port 51 connects the valve to the triangular cylinder portion of recess 25 at the right side of the vane 39, as seen in Fig. 1, and the cylinder portion at the other side of the vane is connected through a port 52, extending through side plate 20 to the valve, by way of a tube 53 of rubber-like material, and of square cross section, confined in a groove 53a in the outer face of plate 20, covered by plate 54, to a passage 55 extending through side plate 20 and far enough into stock 10 to connect with a port 56, leading to groove 41c of the valve 41. The valve 41 is of the four-way type, and is formed with an axial groove 41a in its face, adapted at the position of the valve shown in Fig. 1, to connect none of the ports, a circumferential groove 41b, which at the same position of the valve (see Fig. 1) connects ports 49 and 51 to each other, and a third groove 41c, extending circumferentially and then axially of the valve in an L-shaped path, which in the same position of the valve connects ports 50 and 56 with each other. In a second position of the valve, resulting from rotating the valve in a counterclockwise direction, as viewed in Fig. 1, through a small angle, groove 41a connects ports 49 and 56 to each other, groove 41b connects ports 50 and 51 with each other, and groove 41c connects none of the ports. In the position shown in Fig. 1, air under pressure is admitted to the right side of the cylinder recess sequentially through passages 43, 44, 46, 45, 49, 41b and 51, and the left side of the cylinder recess is open to the atmosphere through passages 52, 53a, 55, 56, 41c, and 50, so that the vane is held in the position shown.

For operating the valve 41, handle 57 is fixed thereto. A coil spring 58, of the compression type, is located in a recess 59, formed in the outer face of the side plate 20 and beneath cover plate 54. The spring is compressed between the end of the recess 59 and an arm 60 fixed to the valve. The arrangement is such that lever 57 is normally held in a raised position, as shown in Fig. 3, and with the valve 41 as shown in Fig. 1, and the draw-bar 18 is normally held in advanced position, as in Fig. 1, by air flow to the cylinder recess at the right side of the vane, as seen in Fig. 1, from the air passage 43 sequentially through passages 44, 46, 45, 49, 41b, and 51, the other passages 52 to the cylinder recess being open to the atmosphere through passages 53, 55, 56, 41c, and 50.

Upon depressing the lever 57, the valve 41 is rotated in a counterclockwise direction in Fig. 1 and the recess at the right side of vane 39 is opened to the atmosphere through passages 51, 41b and 50, and compressed air flows from passage 43 through passages 44, 46, 45, 49, 41a, 56, 55, 53, and port 52 into the chamber at the left side of vane 39 as seen in Fig. 1, and the draw-bar 18 will be retracted until the lever 57 is released, whereupon the spring 58 will return the valve 41 to the position shown in Fig. 1, and passage 43 will again be connected with passage 51, through passages 44, 46, 45, 49, and 41b, and the draw bar will be moved toward the anvil.

For rotating the draw-bar by fluid pressure in-

dependent of its retracting movement, a fluid pressure motor and control valve are provided as follows: The motor is conveniently constructed of a plurality of plates 61, 62, 63, 64 held together and to the side plates 19, 20 by screws 65 which pass through all the plates and are threaded into bosses on the side plates. Plate 63 has an eight-shaped aperture 66 in which a pair of spur gears 67, 68 are positioned (see Fig. 9). Gear 67 is fixed to shaft 23 while gear 68, which meshes therewith, rotates on a stud 69 fixed to plate 62. A pair of inlet ports 70, 71 are provided through plate 62 to communicate with the eight-shaped cavity, one at each side thereof, near the bite of the gears (see Fig. 8). Exhaust openings 72, 72 73, 73 are provided to the atmosphere through the edges of plate 63 above and below the centers of the gears. The arrangement is such that when air under pressure is admitted from port 70, gear 67 will be rotated in a clockwise direction in Fig. 9 and when air is admitted from port 71 rotation will be in the opposite direction.

A three-way valve 76 is rotatably mounted in a cylindrical opening in the stock 10. Air is supplied to the valve from the end of cross passage 44 by means of a groove 77 formed in the outer face of side plate 20 and covered by plate 54. Groove 77 connects with a cross passage 78 through side plate 20 and about three-quarters of the way through stock 10 and passage 78 in turn connects to the valve by passages 79, 80 (see Figs. 1, 3 and 5). Valve 76 has a pair of spaced circumferential grooves 76*a*, 76*b* in its cylindrical surface. Groove 76*a* extends throughout one quadrant of the cylindrical surface so as to connect passages 79 and 81 at one position of the valve and to disconnect them at a second position thereof, and groove 76*b* extends through an adjoining quadrant of the valve so as to disconnect passages 80 and 82 at said first position of the valve and to connect them at said second position, and in an intermediate position passages 81 and 82 are both disconnected from the fluid supply, it being understood that passages 43, 77, 78, 79 and 80 are at all times under pressure. Ports 81, 82 are respectively connected to ports 70, 71 in plate 62 by means of pipes 81*a*, 82*a* across recess 25 and by way of apertures in plate 61 and grooves 74, 75 in plate 62 (see Fig. 8). The arrangement is such that normally grooves 76*a*, 76*b* do not connect passages 81 and 82 with the inlet ports 79, 80, respectively, but by rotation of valve 76 in a clockwise direction as seen in Fig. 1, passage 79 is connected with port 81 through groove 76*a* while groove 76*b* remains closed and the draw bar is rotated in a clockwise direction when looking at it from the left in Fig. 1 to unscrew rod 15 from the rivet, and by rotation of valve 76 in the opposite direction to another position, passage 80 is connected with port 82 through groove 76*b* while passage 79 remains closed and the draw bar is rotated in a counter-clockwise direction.

To hold the valve in neutral position, that is, with grooves 76*a* and 76*b* not in communication with inlet ports 79, 80, the inner face of side plate 19 is recessed about the spindle of the valve 76, as at 83 (Fig. 5). A pair of arcuate levers 84, 85 are located within the recess and are pivoted on pins 86, 87 on the stock 10 with their concave sides facing each other about the valve spindle. Their opposite ends normally rest against a pin 88 fixed to the stock 10. A coil spring 89 has one end fixed to the lever 84 and the other end to lever 85 and is under tension. At its neutral position, the valve 76 has a pin 90 which extends between the free ends of the arms 84, 85 which, together with pin 88, hold the valve in neural position. The arrangement is such that when the valve is rotated in either direction the pin 90 will deflect one or the other of the levers 84, 85 tensioning the spring 89, the other lever being prevented from movement by the pin 88. Tensioning of the spring causes the valve to return to neutral position when it is released. A trigger 91 is fixed to valve 76 in a position to be engaged by the finger of the operator whose hand engages a portion 92 of the stock.

Movement of the trigger 91 toward the stock surface 92 rotates the draw rod 15 in a clockwise direction to screw it into a rivet and movement away from the stock surface 92 rotates the draw rod in the opposite direction to unscrew the draw rod from the rivet.

To provide for regulating the force exerted in upsetting the rivet an adjustable bleeder valve is mounted on the side plate 19 in position to vent that portion of the triangular recess in which pressure is exerted on the vane to upset the rivet. For this purpose a vent opening 93 (see Fig. 10) is formed in the side plate 19 and terminates in a conical valve seat 94. A ball 95 is seated therein and held in place by a flat ring 96 of spring metal held against the ball, which contacts it near its rim, the spring ring being loosely retained about the stud which receives stud 97 screwed into a threaded opening in side plate 19. A graduated dial 98 is rotatably mounted on the stud 97 and has an annular groove in its under face to clear the disc 96. A similar annular groove is provided in the face of the side plate 19 about the stud for the same purpose. A pin 99 projects downwardly from the dial and impinges against the ring 96 depressing the ring locally within the groove. The arrangement is such that as the dial is rotated the pin 99 moves closer or farther away from the valve ball and changes the tension thereon. The dial may be adjusted to release air at any pressure over a maximum desired pressure and the dial may be set for different pressures by setting it with respect to a scale 100 on the side plate 19.

In the embodiment of the invention illustrated in Figs. 13 to 16, a stock 101 is formed with a grip portion 102 and a cylinder portion 103 terminating forwardly thereof in a flange 104 to which plates 105, 106, 107 comprising a fluid pressure-operated motor housing are held in assembled relation by bolts 108. The grip has a removable cover plate 109 on the side thereof secured thereto by screws 110. The operating ends of the barrel 111 and draw bar 112 are not shown as these are identical with similar parts of the embodiment of Fig. 1. In this embodiment, means similar to that employed in the embodiment of Fig. 1 are employed for rotating the draw-bar 112 in either direction. To this end, plates 105 and 107 are formed with aligned bearings on the same axis as the cylinder 103 and the draw-bar 112 is rotatably mounted therein. The plate 106 is formed with an eight-shaped aperture therethrough and a pair of gears intermeshing with each other are rotatably mounted in the respective in the respective lobes of the aperture. Gear 113 is slidably mounted on the draw-bar 112 and has a key 114 (see Fig. 16) which engages in a keyway 115 in the bar so that the bar and the gear rotate together, the gear driving the bar. The other gear 116 is ro-

tatably mounted on a pin 117 rigidly mounted on plate 105.

Air is supplied for operating the air motor and for upsetting the rivet through an air connection 118 and an opening 119 through the grip of the stock to a valve 120. The valve 120 is seated in a cylindrical aperture in the stock and is operated by a lever 121. A tension spring 122 located in a recess 123 has one end fixed to the stock and the other end fixed to a lever 124 fixed to the valve. The arrangement is such that the valve is normally held in the position illustrated in Figs. 13 and 15, that is, with the lever 121 pulled up to its elevated position by spring 122. In this position, a groove 125 in the valve extending approximately 270° around the periphery of the valve provides communication between passage 119 and a passage 126 at 90° thereto in the stock which passage 126 is centrally located in the stock and is connected by a cross passage 126*a* through the stock with a branch passage 126*b* parallel to and at one side of passage 126 and with a second branch passage 126*c* parallel to and located on the opposite side of passage 126 and each communicating with a groove in a second rotary valve 127. Valve 127 is seated in a cylindrical opening through the stock and is arranged to supply air from passage 119 sequentially through groove 125, passages 126, 126*a*, 126*b* and one of the grooves in valves 127, or through groove 125, passages 126, 126*a*, 126*c* to the other of said grooves in the valve 127 and thence to one of two ports 151, 152 communicating through the stock and plate 107 with the spaces at each side of the bite of the gears 113 and 116. Valve 127 is identical with the valve 76 of Fig. 1 and has similar means for holding it in neutral position. It is controlled by a trigger lever 128 which may be moved to two operating positions whereby air is alternately supplied to drive the gears in either direction. Exhaust ports 129, 130, 131, 132 are formed through the plate 106 for escape of air from the gear chamber. The arrangement is such that when the trigger 128 is moved toward the grip portion 102 air is delivered to the right side of the gears as seen in Fig. 14 causing the gear attached to rod 112 to rotate in a counter-clockwise direction, and when the trigger is moved in the opposite direction air is delivered to the left side of the gears causing said gear attached to rod 112 to rotate in a clockwise direction.

For operating the draw-bar to upset the tubular rivet, a piston 133 is slidably fitted in the cylinder 103, a cup gasket 134 being attached thereto by a screw 135 to prevent leakage. A second piston 136 is mounted in the same cylinder and has a cylindrical recess 137 formed therein concentric therewith and facing the piston 133. A ram 138 is fixed to piston 133 and extends toward recess 137 and is a sliding fit therein. Apertures 139, through the piston 136 provide for passage of fluid from the recess 137 to the cylinder 103 in front of the piston 136. A third piston 140 of annular form fits within the cylinder 103 and about the ram 138 and is urged toward the piston 136 by a compression coil spring 141 having a bearing on piston 133. A compression coil spring 142 is seated at one end in a cavity in ram 138 and extends into cylindrical recess 137 where it encompasses a plunger 143. Piston 136 has a central bore through which the draw-bar 112 slidably extends. The draw-bar has a head 144 thereon which fits a conical seat in piston 136. Plunger 143 carries a conical bead which spring 142 presses against the head of the draw-bar and holds it in the conical seat. The space between pistons 136 and 140 is filled with oil or other relatively incompressible liquid, as is also cylindrical recess 137, ports 139 and the space between the front end of cylinder 136 and the front end of cylinder 103. A port 145 in the rear of cylinder 103 supplies air or other fluid under pressure from valve 120 when the valve lever 121 is depressed, but in the normal position of the valve lever shown in Fig. 13 the chamber to the rear of piston 133 connects through a circumferential groove 120*a* of the valve with the atmosphere through a port 150 in the stock. When such fluid is admitted behind the piston 133, that piston is driven forward and the ram 138 enters recess 137 where it forces the liquid through apertures 139 to the space to the left of piston 136 in Fig. 16, where the liquid forces the piston and draw-bar to the right. As the piston area of piston 136 is greater than the area of the ram 138 the force tending to withdraw the draw-bar is greater than the force tending to advance piston 133. During the drawing movement of the draw-bar 112 the spring 142 is placed under compression and when the air is exhausted from the cylinder, the spring returns the pistons and the draw-bar to their original positions. The piston 140 assists in supporting the ram 138 concentric with the recess 137 and keeps the recess constantly supplied with oil even though some oil may leak out past the pistons. The draw-bar passes through a stuffing box 146 having a packing 147 for sealing the joint against oil leakage.

In either of the embodiments of the invention, all operations of setting the rivet may be accomplished by pressure fluid from a single source, requiring only one pressure fluid supply line, and adequate pressure for upsetting the rivets is attained while rotation of the draw-rod for entering it in and removing it from the threaded portion of the rivet is accomplished without use of such force as might strip the threads or otherwise injure the rivets. The application of power to all steps of securing the rivet relieves the operator from excessive physical exertion and the entire apparatus is convenient and simple to operate.

The operation of the apparatus of Figs. 1 to 12 is as follows: With the elements related as in Figs. 1 and 3, that is, with the chamber at the left of vane 39 connected to exhaust through passages 52, 53*a*, 55, 56, 41*c*, and 50 and with the chamber at the right of vane 39 connected to the pressure fluid supply through passages 43, 44, 46, 45, 49, 41*b*, and 51, the operator holds the stock in his right hand, his fingers, with the exception of the index finger, grasping the surface 92. The index finger engages the trigger 91. The rivet is held in the left hand and is held with its threaded aperture against the draw rod 15. The thumb of the right hand is used to depress valve lever 57 when a rivet is to be collapsed. With the rivet against the draw rod, trigger 91 is moved toward the surface 92 and compressed air from connection 42 passes sequentially through passages 43, 44, 77, 78, 80, 76*b*, 82, 82*a*, 75 and 71 and thus is directed to the motor gears 67, 68 in a direction to rotate the draw rod and screw it into the rivet. As the rivet reaches the anvil it can go no further and trigger 91 is released, the spring 89 returning it to neutral position. The operator then releases his left hand from the rivet. The rivet supported by the draw

rod, is then entered in the work and valve lever 57 is then depressed by the thumb to the dot and dash position of Fig. 3, whereupon the cross portion of groove 41c is disconnected from exhaust port 50 and groove 41b is shifted to shut port 51 off from port 49 and open port 51 to the atmosphere through port 50 and to bring cross passage 41a into line with passages 49 and 56, whereupon compressed air flows sequentially through passages 43, 44, 46, 45, 49, 41a, 56, 55, 53a, and enters the port 52, moving the piston-vane counterclockwise in Fig. 1, thereby drawing the draw rod 15 through anvil 14 to collapse the rivet. After collapse of the rivet, lever 57 is released and spring 58 returns it to the full line position where air is admitted from port 49 through groove 41b and port 51 to the opposite or right side of the piston-vane 39 as seen in Fig. 1, while the pressure on the left side or driving face of said piston-vane 39 is relieved by groove 41a having moved out of engagement with ports 49 and 56, thus cutting off the flow of compressed air to said driving face, and by the cross portion of groove 41c having been established in engagement with exhaust port 50 to exhaust air from said left side sequentially through passages 52, 53a, 55, 56, 41c, and 50, and the draw rod 15 returns to the position of Fig. 1. Trigger 91 is then pushed away from surface 92 to admit air sequentially from passages 43, 44, 77, 78, 79, 76a, 81, 81a, 74, 70 and thus rotate the rod 15 in a direction to unscrew the rod from the collapsed rivet after which the trigger is released and returned to its neutral position by spring 89. The mechanism is then back in the relationship shown in Figs. 1 and 3 and is ready for another cycle.

In operating the form of the invention shown in Figs. 13 to 16 the stock grip 102 is gripped in the right hand with the index finger on the lever 128 and the rivet is held in the left hand against the threaded draw rod. Air is supplied through connection 118 and passages 119 in the stock and groove 125 in the valve 120 to valve 127 which is held by its springs in neutral position. The trigger 128 is moved toward grip 102 causing the draw rod to rotate in a direction to screw it into the rivet. Trigger 128 is released when the draw rod stops turning because rivet A^1 has encountered the anvil 14. Lever 121 is now depressed against spring 122 and air is admitted by valve 120 through groove 125 and port 145 to the rear end of cylinder 103 causing piston 133 to move forward driving ram 138 into recess 137 which shuts off any flow of oil to the right of piston 136 as seen in Fig. 16 and forces oil through apertures 139 into the forward end of cylinder 103 against piston 136 which draws draw rod 15 through anvil 14 collapsing the rivet. After collapse of the rivet, lever 121 is released and is returned by spring 122 to its normal position, shown in Fig. 13, in which port 145 running to cylinder 103 is opened to exhaust through passage 120a and port 150 and springs 141 reacting against end 144 of rod 112 moves the stock 102 and nose 114 away from the work until the parts are reestablished in the relationship shown in Figure 16, thus releasing tension on the draw rod. Trigger 128 is then moved away from the grip and admits air to the geared motor to rotate the draw rod in a direction to unscrew the draw rod from the collapsed rivet.

In the operation of either form of apparatus the direction of rotation of the draw rod would be the reverse with rivets and draw rods having left hand threads, and left hand tools may be made for operation by left handed people.

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

I claim:

1. Apparatus for installing internally threaded tubular rivets, said apparatus comprising an anvil adapted to be pressed against the rivet, a threaded rod adapted to extend through and beyond said anvil to engage the threaded portion of rivets in succession, fluid-pressure responsive means for effecting relative longitudinal movement between said rod and said anvil to upset a rivet, fluid-pressure responsive means for rotating said rod, a single source of pressure fluid for both said responsive means, and a valve means for initiating and terminating the application of pressure fluid to said responsive means.

2. Apparatus for installing internally threaded tubular rivets, said apparatus comprising an anvil adapted to be pressed against the rivet, a threaded rod adapted to extend through and beyond said anvil to engage the threaded portions of rivets in succession, fluid-pressure responsive means for reciprocating said rod with respect to said anvil for upsetting a rivet, said means comprising a fluid pressure chamber and a piston member therein, fluid pressure responsive means for rotating said rod to engage and disengage a rivet, a single source of pressure fluid for both said responsive means, and valve means for initiating and terminating the application of fluid pressure to said responsive means.

3. Apparatus for installing internally threaded tubular rivets, said apparatus comprising a portable stock, a single source of pressure fluid connected thereto, an anvil adapted to be pressed against a rivet, a rotatable threaded draw-rod extending through said anvil to engage the threaded portions of a plurality of rivets in succession and adapted to be reciprocated with respect to said anvil, a fluid-pressure operated motor on said stock for rotating said draw-rod in either direction to engage or release a rivet, a second fluid-pressure operated motor on said stock for reciprocating said draw-rod to collapse a rivet, and valve means on said stock for initiating, and terminating the application of pressure-fluid to said motors from said single source of pressure fluid.

4. Apparatus for installing tubular rivets, said apparatus comprising a draw rod having a threaded end for engaging an internally threaded rivet, an apertured anvil through which the draw rod extends, means for manipulating said draw rod including means for imparting longitudinal movement to the rod and means for rotating the rod, power means for driving said manipulating means, and manually-operable means for initiating operation of said power means.

5. Apparatus for installing internally threaded tubular rivets, said apparatus comprising an anvil, a threaded draw-rod extending through and beyond the anvil and adapted to engage in the threaded portion of the rivet, fluid-pressure responsive means for effecting a relative longitudinal movement between the draw-rod and the anvil to upset the rivet, fluid-pressure responsive means for effecting a rotary movement of the draw rod to release the rivet, and means for effecting successive operation of said fluid-pressure responsive means.

6. Apparatus for installing tubular rivets, said apparatus comprising a stock having an aper-

tured reaction member, a draw rod extending through the aperture in said member and having a threaded end for engaging an internally threaded rivet, power-operated means in said stock for effective relative movement between said rod and said member including means for effecting a relative longitudinal movement between said rod and said anvil and means for rotating the rod, and manually-operable means associated with said stock for initiating operation of the power-operated means.

7. Apparatus for installing internally threaded tubular rivets, said apparatus comprising a stock and an anvil to be pressed against the rivet, a threaded draw-rod extending through and beyond the anvil and adapted to engage the threads in the rivet, power-operated means for effecting a longitudinal movement of the draw-rod to collapse the rivet, power-operated means for urging the draw-rod to its advanced position through the anvil, power-operated means for rotating the draw-rod to release the rivet and means associated with said stock for initiating and terminating the movements of all said power-operated means.

8. A fluid operated tool for installing internally threaded tubular rivets comprising a stock adapted to be grasped by the operator a barrel extending therefrom and supporting a hollow anvil to be pressed against the rivet, a draw-rod extending through said barrel and anvil and adapted to engage in the threaded portion of the rivet, fluid-pressure operated means in said stock for effecting longitudinal movement of said draw-rod to collapse the rivet, and fluid-pressure operated means in said stock for effecting a rotative movement of the draw-rod to engage and disengage the rod with respect to the rivet, said stock having valve means for initiating and terminating said movements of the draw-rod.

9. Apparatus for installing a rivet, said apparatus comprising anvil means for pressing against a rivet, a draw-rod extending through and beyond said anvil means for engaging a rivet to collapse the same, and power-operated means for manipulating the draw-rod, said power-operated means comprising control means for initiating and terminating the application of power by said power-operated means to said draw-rod to impart movement to the latter for engaging the same with the rivet, and additional control means for initiating and terminating the application of power by said power operated means to said draw-rod to retract the same for imparting a collapsing force to the rivet against the anvil means.

10. Apparatus for installing a rivet, said apparatus comprising anvil means for pressing against a rivet, a threaded draw-rod extending through and beyond said anvil means for engaging the rivet to collapse the same, and power-operated means for manipulating the draw-rod, said power-operated means comprising control means for initiating and terminating the application of power by said power-operated means to said draw-rod to impart rotary movement to the latter for engaging and disengaging the same with the rivet, and additional control means for initiating and terminating the application of power by said power-operated means to said draw-rod to retract the same for imparting a collapsing force to the rivet against the anvil means.

11. Apparatus for installing a rivet, said apparatus comprising anvil means for pressing against a rivet, a housing structure including a barrel and a stock depending therefrom, a threaded draw-rod extending through said barrel and through and beyond said anvil means for engaging a threaded opening in the rivet, a fluid-pressure motor mounted in said housing structure and engaging said draw-rod for rotating said rod in a direction to engage the rivet and in a direction to disengage the rivet, valve means in said housing structure for connecting said fluid-pressure motor to a source of fluid-pressure, a fluid-pressure cylinder in said housing structure having movable means therein for retracting and advancing said draw-rod to collapse the rivet, and additional valve means in said housing structure for connecting said cylinder to said source of fluid-pressure.

12. Apparatus for installing collapsible internally threaded tubular rivets, said apparatus comprising means for applying a reactive force to the rivet, a draw-rod extending through and beyond said means and having means adapted to engage the threads of a plurality of rivets successively, power-operated means for effecting a longitudinal movement of the draw-rod with respect to the first said means to collapse each rivet, power-operated means for releasing the draw-rod from each rivet, and means for initiating and terminating the operation of said power-operated means.

13. Apparatus for installing internally threaded tubular rivets, said apparatus comprising an anvil adapted to bear against a rivet, a threaded draw-rod extending through and beyond the anvil and adapted to engage the threads in the rivet, power-operated means for effecting a longitudinal movement of the draw-rod to collapse the rivet, power-operated means for rotating the draw-rod to release the rivet and means for initiating and terminating the operation of said power-operated means.

14. Apparatus for installing an internally threaded tubular rivet, said apparatus comprising a housing having an anvil at one end, a draw-rod in the housing and extending through and beyond the anvil and adapted to engage the threaded portion of the rivet, means in said housing urging the rod to its advanced position through the anvil, 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, and power-operated means for rotating the rod with relation to the rivet.

15. Apparatus for installing internally threaded tubular rivets, said apparatus comprising an anvil adapted to bear against a rivet, a threaded draw-rod extending through and beyond the anvil and adapted to engage in the threaded portion of the rivet, power-operated means for effecting a longitudinal movement of the draw-rod with respect to the anvil to collapse the rivet, and means for regulating the force exerted by the draw-rod.

16. Apparatus for installing internally threaded tubular rivets, said apparatus comprising an anvil adapted to bear against a rivet, a threaded draw-rod extending through and beyond the anvil and adapted to engage in the threaded portion of the rivet, fluid-pressure operated means for effecting a longitudinal movement of the draw-rod with respect to the anvil to collapse the rivet, and a pressure regulating valve for regulating the force exerted by the draw-rod.

17. Apparatus for installing internally thread-

ed tubular rivets, said apparatus comprising an anvil adapted to bear against a rivet, a threaded draw-rod extending through and beyond the anvil and adapted to engage in the threaded portion of the rivet, fluid-pressure operated means for effecting a longitudinal movement of the draw-rod with respect to the anvil to collapse the rivet, and fluid-pressure operated means for effecting a rotary movement of the draw-rod to release the rivet.

18. Apparatus for installing internally threaded tubular rivets, said apparatus comprising an anvil adapted to bear against a rivet, a threaded draw-rod extending through and beyond the anvil and adapted to engage in the threaded portion of the rivet, a fluid-pressure operated means for effecting a longitudinal movement of the draw-rod with respect to the anvil in alternate directions, and fluid-pressure operated means for effecting a rotary movement of the draw-rod.

19. Apparatus for installing internally threaded tubular rivets, said apparatus comprising an anvil adapted to bear against a rivet, a threaded draw-rod extending through and beyond the anvil and adapted to engage in the threaded portion of the rivet, a fluid-pressure operated means for effecting a longitudinal movement of the draw-rod with respect to the anvil, and fluid-pressure operated means for effecting a rotary movement of the draw-rod in alternate directions.

20. A fluid-pressure operated tool for installing internally threaded tubular rivets comprising a stock adapted to be grasped by the operator, a barrel extending therefrom and supporting a hollow anvil adapted to bear against a rivet, a draw-rod extending through said barrel and anvil and adapted to engage in the threaded portion of the rivet, fluid-pressure operated means in said stock for effecting longitudinal movement of said draw-rod to collapse the rivet, and fluid-pressure operated means in said stock for effecting a rotative movement of the draw-rod to engage and disengage the rod with respect to the rivet.

21. A fluid-pressure operated tool for installing internally threaded tubular rivets comprising a stock adapted to be grasped by the operator, a barrel extending therefrom and supporting a hollow anvil adapted to bear against a rivet, a draw-rod extending through said barrel and anvil and adapted to engage in the threaded portion of the rivet, fluid-pressure operated means in said stock for effecting longitudinal movement of said draw-rod and for effecting a rotative movement of the draw-rod to engage and disengage the rod with respect to the rivet, said stock comprising means for regulating the force exerted by the draw-rod.

22. Apparatus for installing tubular rivets, said apparatus comprising a stock having 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, power-operated means in said stock for effecting relative movement between said rod and said member including means for effecting a relative longitudinal movement between said rod and said reaction member, means for rotating the rod, and manually operable means associated with said stock for initiating operation of the power-operated means.

23. Apparatus for installing internally threaded tubular rivets, said apparatus comprising an anvil adapted to bear against a rivet, a threaded draw-rod extending through and beyond the anvil and adapted to engage the threads in the rivet, power-operated means for effecting a longitudinal movement of the draw-rod to collapse the rivet, spring means for urging the draw-rod to its advanced position through the anvil, and power-operated means for rotating the draw-rod to release the rivet.

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