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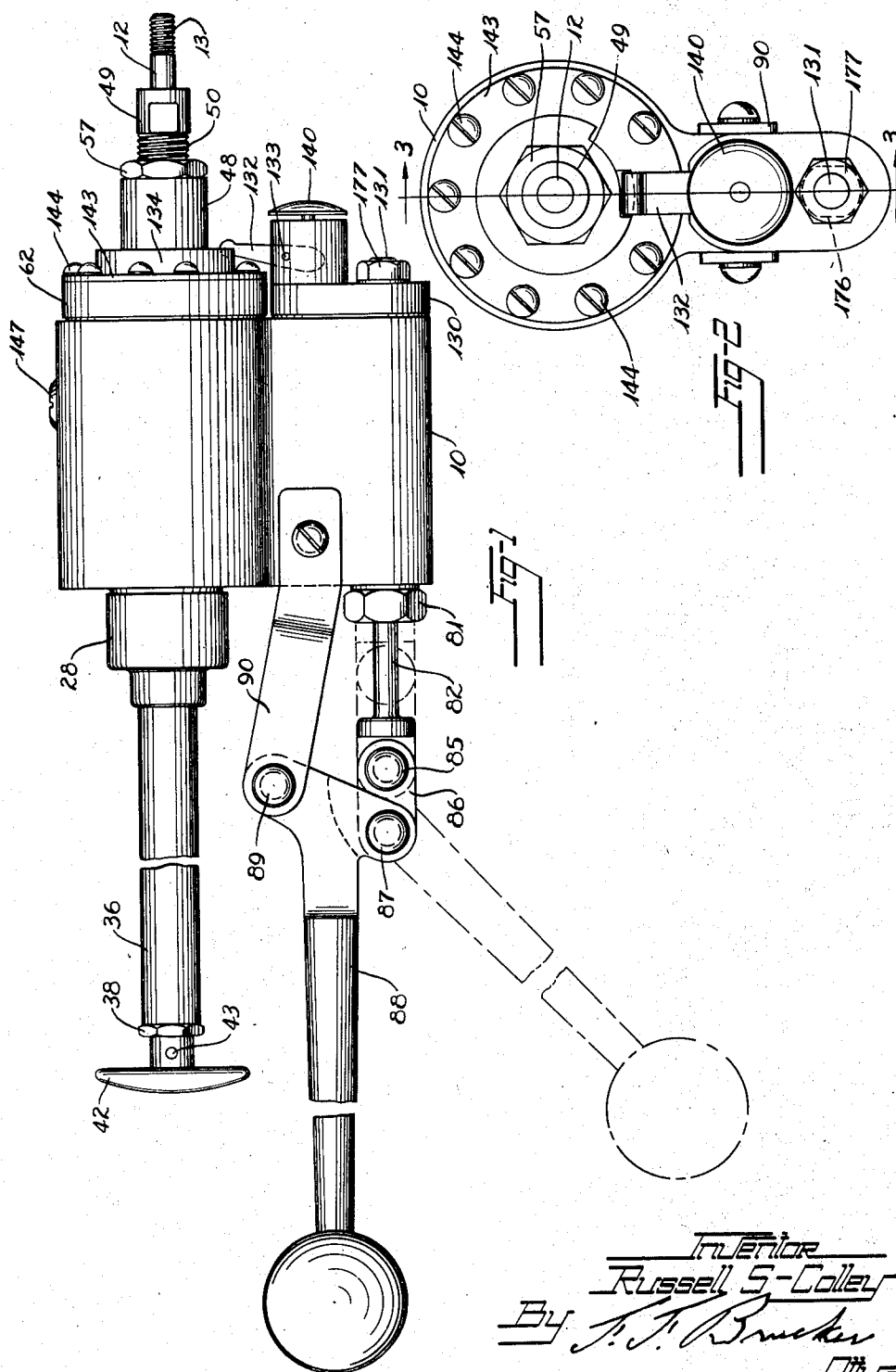
R. S. COLLEY

2,403,262

TOOL FOR COLLAPSING HOLLOW RIVETS

Filed May 22, 1945

4 Sheets-Sheet 1



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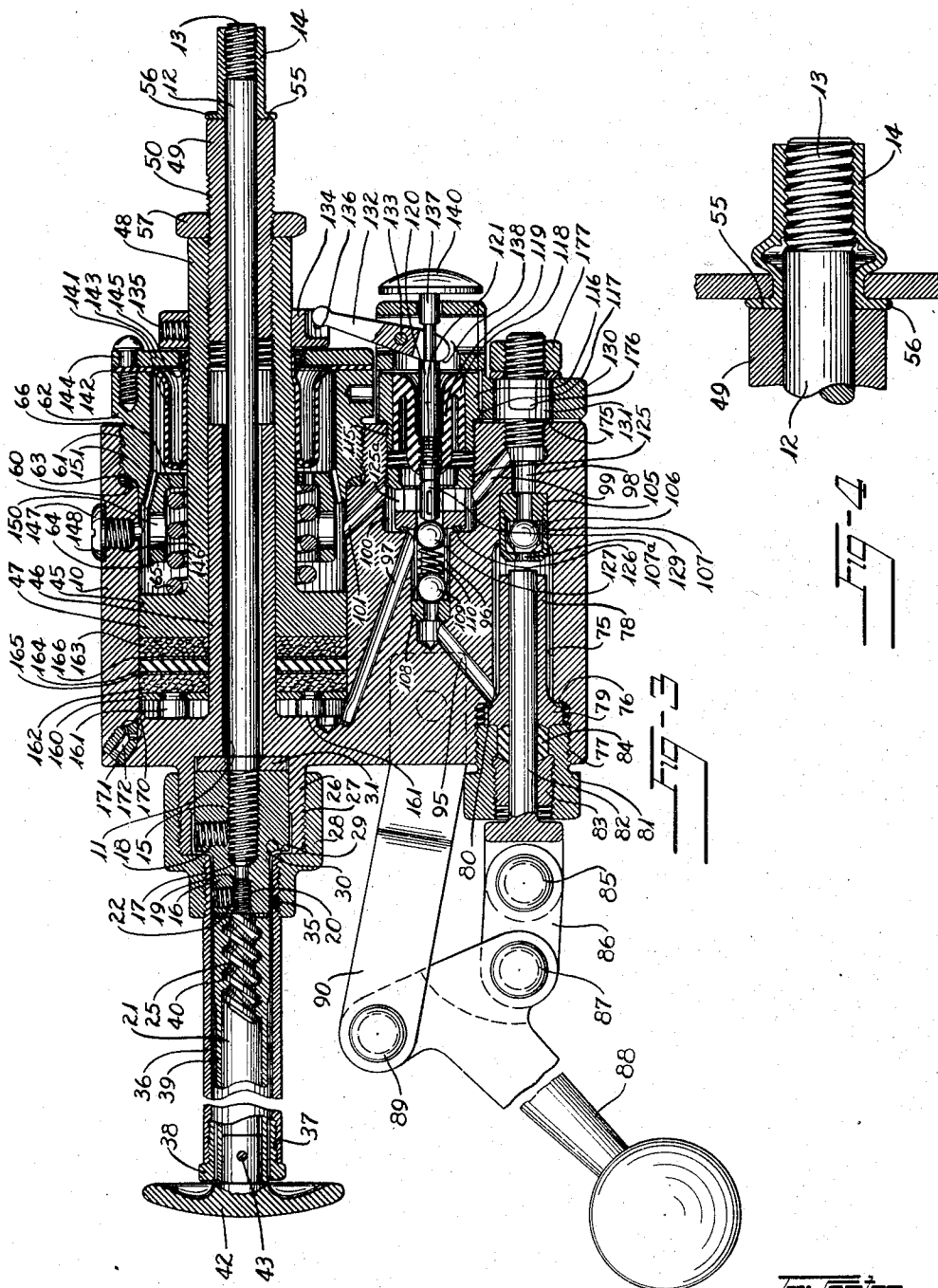
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4 Sheets-Sheet 2



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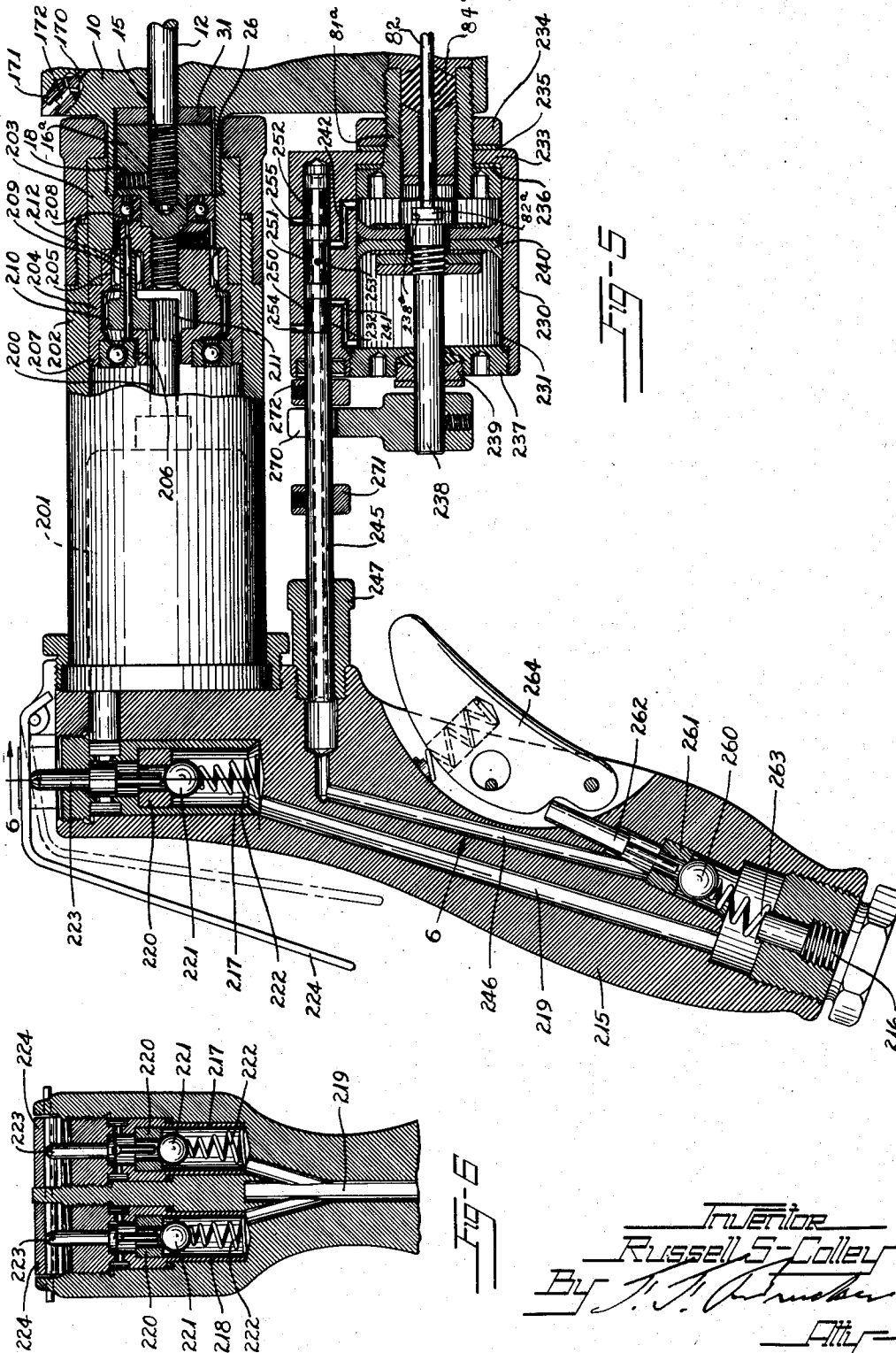
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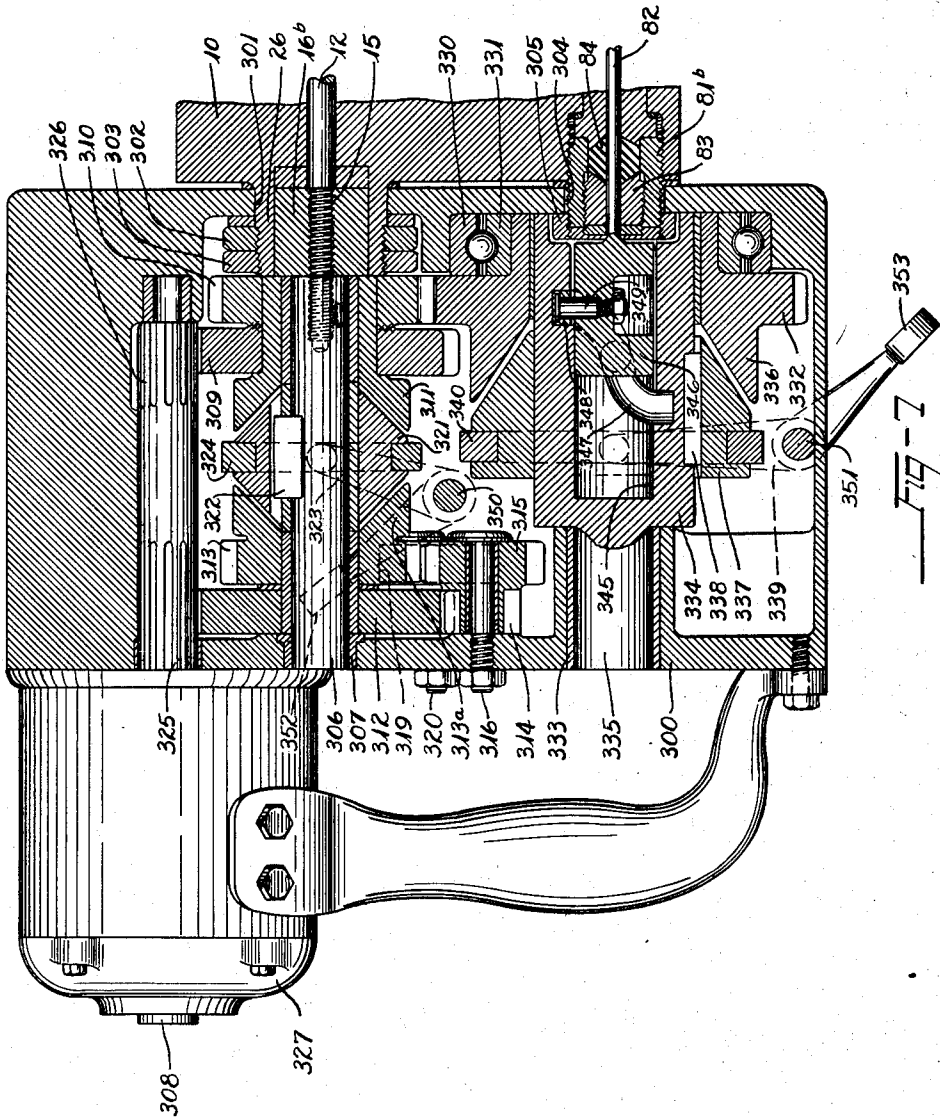
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TOOL FOR COLLAPSING HOLLOW RIVETS

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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TOOL FOR COLLAPSING HOLLOW RIVETS

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Application May 22, 1945, Serial No. 595,066

15 Claims. (Cl. 218—19)

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This invention relates to apparatus for installing tubular rivets, and is useful especially in inserting and upsetting tubular rivets such as those of the Waner Patent #2,149,199, issued February 28, 1939, which rivets are applied from one side only of the work.

The principal objects of the invention are to provide effective and compact hydraulic mechanism for upsetting the rivet and especially to provide mechanism capable of producing great rivet-upsetting force; to provide hydraulic apparatus operable in any position in space; to provide a unitary apparatus having a self-contained pressure-building and utilizing apparatus; to provide for determinately limiting the degree of upset of the rivet; to provide for effective sealing of the pressure liquid within the apparatus; to provide power controlled operation of the hydraulic mechanism; to provide quick-acting means for entering and releasing the rivet; 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 an apparatus constructed in accordance with and embodying the invention, the anvil being shown in the retracted position.

Fig. 2 is an end elevation of the apparatus as seen from the right of Fig. 1.

Fig. 3 is a longitudinal cross-sectional view of the apparatus, taken on line 3—3 of Fig. 2, parts being broken away.

Fig. 4 is a detail view of the working end of the apparatus with a rivet in the upset condition, the view being shown in section.

Fig. 5 is a side elevation partly in section and partly broken away showing a modification of the invention.

Fig. 6 is a detail sectional view thereof, taken on line 6—6 of Fig. 5.

Fig. 7 is a side elevation, partly in section and partly broken away, showing a further modification of the invention.

Referring to the drawings, and first to Figs. 1 to 4 thereof, the numeral 10 designates a body, preferably of metal, and of convenient size to enclose the mechanism and to be held by the operator. The body is formed with a bore 11 extending therethrough for receiving a rotatable rod 12 which extends through the body and has a threaded end 13 for engaging in the threads of a hollow rivet 14. The opposite end of the rod

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is preferably threaded as at 15 to engage in a coupling member 16 having a correspondingly threaded bore 17. A set screw 18 extends through a threaded side opening in the coupling member and locks the rod in place. The opposite end of the coupling member has a threaded bore 19 in alignment with bore 17 for receiving the threaded end 20 of the rod 21. A set screw 22 engages a threaded side opening in the coupling member and locks the rod 21 to the coupling member and therefore to the rod 12.

Provision is included for manually rotating the rod 12 for entering its threaded end 13 into and releasing it from the tubular rivet. To this end, the rod 21 is formed with an external thread 23 of relatively high pitch, that is, having sufficient pitch angle to permit rotation of the rod 21 by axial movement of a threaded member engaging the thread. The body 10 of the apparatus is formed with a tubular extension 24 adapted to surround and retain the coupling member 16 and formed with external threads 27. An internally threaded collar 28, is secured about the tubular extension 24, and has an internal shoulder 29 which extends inwardly to engage a complementary shoulder 30 of the coupling member to limit axial movement of the coupling member, while a thrust collar 31 about the draw rod 12 between the coupling member 16 and the body 10 reduces friction and limits axial movement of the coupling member in the opposite direction. The collar 28 is also internally threaded, as at 35, to engage the externally threaded end of a tubular housing 36 extending axially of the rod 12 and enclosing the rod 21 while providing a convenient handle for supporting the tool. The opposite end of the housing 36 is internally threaded as at 37 to receive a threaded stop bushing 38. A tubular plunger 39 is slideably fitted through the bushing 38 and is internally threaded as at 40 to engage the threads 25 of the rod 21. The plunger handle 42, provided with a central stud, is secured to the tube 39 as by a cross pin 43. The arrangement is such that axial movement of the tube 39 within the housing 36 rotates the draw rod 12. Where the rivet threads are right hand, as is usually the case, the threads 25, 40 are made left handed and movement of the plunger handle 42 toward the housing 10 causes the rod 12 to rotate in a clockwise direction as seen when looking at the left side of Fig. 1, causing it to enter the rivet, and withdrawal of the plunger away from the housing 10 will cause rotation of the draw rod in the opposite direction to release the rod 12 from the rivet.

Provision is made for upsetting the rivet. To this end, the body 10 is formed to provide a cylinder 45 coaxial with the rod 12 and open at the rivet engaging end of the apparatus and is also formed with an integral quill 46 also coaxial with the rod 12 and within the cylinder, the quill surrounding the rod and providing a continuation of the bore 11 for receiving the rod 12. Slideably mounted in the cylinder 45 about the quill 46 is an annular piston 47 having an integral tubular extension 48 adapted to extend beyond the quill 46 and the body 10, the extended portion being internally threaded to receive a tubular anvil 49 externally threaded as at 50, and having a face 55 at its outer end adapted to engage against the flange 56 of the rivet. The anvil is adjustable with respect to the piston to adjust the projection of rod 12 beyond the anvil for rivets of different sizes, the adjustment being provided by the threads 50, and a lock nut 57 is provided for locking the anvil in any position of adjustment with respect to the piston.

For retaining the piston in the cylinder 45, the body 10 is counterbored to provide the shoulder 60 and the counterbored portion is threaded as at 61 to receive a threaded stop collar 62, a gasket 63 being provided between a shoulder of the stop collar and the shoulder 60 of the body to provide a liquidtight connection. The stop collar 62 has a stop face 64 for engaging the piston and limiting outward movement thereof.

For returning the piston, a compression coil spring 65 extends between a shoulder 66 of the stop collar and the face of the piston and is under compression at all positions of the piston.

For advancing the piston and, therefore, the anvil face 55 toward the rivet with respect to the rod 12, means is provided for attaining a superior fluid pressure against the left side of the piston, such means consisting of a pump for pumping a liquid of low compressibility, such as a suitable oil or glycerine, and the entire pump mechanism with the exception of the operating lever but including the liquid storage space is also contained in the body 10 of the apparatus. This mechanism is as follows: The body 10 is formed with a cylindrical cavity 75 and is counterbored to provide a shoulder 76 and a threaded enlarged portion 77 at the open end thereof. A bushing 78 extends into the cavity and is provided with a flange 79 for engaging the shoulder 76 against which it is sealed by the gasket 80. An externally threaded stuffing box 81 engages the threads of the counterbore 77 and holds the bushing 78 in place. The bushing 78 is provided with a bore for receiving the pump plunger 82 which extends therethrough. A gland nut 83 is threaded into the stuffing box 81 against a gland packing 84 which seals the pump plunger 82 to the cylinder.

Provision is made for reciprocating the pump plunger. In the illustrated embodiment the plunger is pivotally connected as at 85 to a link 86 which in turn is pivotally connected as at 87 to a lever 88. The lever 88 is fulcrumed on a pin 89 fixed to an arm 90 which in turn is fixed to the body 10. The arrangement is such that by moving the lever 88 about its pivot 89 the plunger 82 is reciprocated in the cylinder provided by bushing 78. The cavity 75 is connected by a delivery passage 95 to a valve cavity 96 formed in the body 10. This valve cavity 96 is connected by an outlet passage 97 to the left end of cylinder 45 as seen in Figs. 1 and 3. Cavity 75 is also connected at its right end as seen in Fig. 3

by a suction passage 98 and by way of a connecting passage 99, a cavity 100, and a passage 101, to the cylinder 45 at the right side of the piston 47 as seen in Fig. 3. Seated in the suction passage 98 is a valve seat 105 against which a valve ball 106 is adapted to seat. The ball is held close to the seat by a retainer 107. A valve seat 108 is provided in the valve cavity 96 and a valve ball 109 is normally held seated thereagainst by a compression coil spring 110. The arrangement is such that when the plunger 82 is forced to the right in Figs. 1 and 3, valve ball 106 is driven against its seat by the force of liquid passing the reduced opening 107a in retainer 107 and valve ball 109 is raised from its seat against spring 110, permitting liquid under pressure to pass from the cavity 75 to the left end of cylinder 45, thereby advancing the piston 47 to the right, and when the plunger 82 is moved to the left in Figs. 1 and 3, valve ball 109 is seated automatically by the spring 110 and the reduced pressure in the cavity 75 permits valve ball 106 to open its valve whereby liquid in cylinder 45 to the right of piston 47 is drawn through passages 101, cavity 100, and passages 99 and 98 past the valve ball 106 into the cavity 75. By repeated reciprocation of the plunger the piston 47 carrying the anvil 49 may be forced toward the rivet until the piston 47 engages the stop 64, or is otherwise prevented from moving.

To provide for hand actuated return of the piston 47 and also to provide for automatically limiting advance of the piston short of the amount limited by the stop 64, the body 10 is formed with a cavity 100 extending from the right side thereof, as seen in Fig. 3, threaded as at 115 near its mouth to receive an externally threaded bushing 116. The bushing has a shoulder engaging the outer face of the body and sealed thereagainst by a gasket 117. Bonded to the bore of the bushing 116 is an annular body 118 of soft vulcanized oil-resisting and elastic rubber-like material having a reversed tubular portion 119, the inner end of which is vulcanized about a plunger 120 extending therethrough, as at the ribbed portion 121 thereof, the arrangement being such that the plunger 120 is held in coaxial alignment with the bushing 116 and the body 118 completely seals the cavity from the atmosphere while permitting limited axial movement of the plunger under stress of the rubber-like material. A lantern ring 125 is secured in the cavity 100 by having threaded engagement with the threads 115 and is sealed against a shoulder of the body 10 by a gasket 126, and has a central bore in alignment with the plunger 120 and the valve seat 108, and provides a seat at its left end for a valve ball 127.

The valve ball 127 is normally held against its seat by the coil spring 110 previously mentioned, which extends between the valve balls 109 and 127. A longitudinal ribbed plunger 129 is loosely arranged in the bore of the lantern ring between the plunger 120 and the ball 127 permitting passage of liquid therealong. The arrangement is such that when the plunger 120 is forced to the left of Fig. 1, it completes a metal to metal contact through plunger 129 and unseats the ball 127 from its seat permitting high pressure liquid from the passage 97 and valve passage 96 to flow past the ball by way of side openings 125a through the lantern ring and cavity 100, passage 101 to the right end of cylinder 45 thereby relieving pressure on the left side of the piston 47 and permitting the coiled spring 65 to force the

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piston 47 to the left. A bracket 130 is secured by a stud 131 to the body 10. A lever 132 is pivoted as at 133 to the bracket 130. A stop collar 134 is adjustably secured to the tubular extension 48 of the piston 47 by a set screw 135 in a position to engage and end 136 of the lever 132 during outward movement of the piston. The opposite end of the lever 132 is bifurcated to straddle a reduced portion 137 of the plunger 120 and has a cam face 138 adapted to engage the plunger 120 and force it inwardly to the left to unseat the ball 127, in the manner hereinbefore described, when the anvil has advanced to the right the desired distance. While the action of the stop 134 limits forward movement of the anvil toward the rivet, the unseating of the ball 127 is only momentary and in order to provide for a complete return of the piston a plunger handle 140 is fixed to the plunger 120 permitting continued unseating of the valve 127 by manual pressure.

For sealing the right end of the cylinder 45 to prevent escape of operating liquid while permitting movement of the piston, a thin tubular reversed body of rubber-like material 141 is provided with an outwardly directed flange 142 which is clamped against the outer face of the collar 62 by a clamp ring 143 secured by screws 144. The reverse tubular portion is bound to the tubular extension 48 of the piston by a binding 145 of wire or the like. The arrangement is such that the flexible body 141 is looped in any axial cross section thereof permitting longitudinal motion of the piston while providing a liquid tight seal for the operating liquid for sealing the body 10 with liquid, and the flexibility of the body 141 permits change of its shape without change of volume of the liquid which it confines.

A filling opening 146 is provided in the wall of the cylinder 45, and is normally closed by a plug 147 engaging against a gasket 148. The stop collar 62 is provided with side openings 150 and passages 151 to provide greater space for operating liquid and to permit free circulation thereof.

For sealing the piston 47 to the cylinder 45, a follower ring 160 of metal is loosely fitted in the cylinder and has spacing studs 161 thereabout at spaced intervals for spacing it at all times from the closed end of the cylinder. Between the follower ring and the piston are ring packings 162, 163 of leather and a distorable packing 164 of oil resistant soft vulcanized rubber material having facings 165, 166 of metal, the sealing rings being loosely mounted between the piston and the follower ring and the arrangement being such that fluid pressure against the follower ring distorts the packing ring of rubber-like material against the cylinder wall and against the wall of the quill 46 while the leather packing rings act as wipers.

To provide for bleeding any entrapped air from the apparatus, a bleeder vent 170 is formed in the wall of the body 10 connecting with the cylinder 45 and a threaded plug 171 having a needle point is mounted in the body so as normally to close the vent. A passage 172 is formed in the plug to permit passage of air upon slight loosening of the plug. The stud 131, previously described, serves to close an opening desirable for the drilling of passage 99 and is sealed against the body 10 by a gasket 175. It is formed with flats 176 for application of a wrench for driving it in place. A nut 177 engages the outer threaded end of the stud to hold a bracket 130 in place.

The operation of the apparatus heretofore described is as follows:

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Assuming that the parts of the apparatus are in the positions shown in Fig. 3, the operator holds the body 10 of the tool in one hand by the handle 36 and grasps the handle 42 with the other hand withdrawing the threaded plunger 39 to the left of Fig. 1 as far as it will go and then manipulates the tool to bring the threaded end 13 of the rod 12 against the threaded bore of the rivet which is usually held in an aperture in the work against rotation by a key thereon. The operator then forces the handle 42 and plunger 39 to the right, thereby rotating the rod 12 and entering it in the rivet until the flange 56 of the rivet impinges against the anvil face 55 of anvil 49. At this time, the parts are in the position shown in Fig. 3. The operator then oscillates the handle 38 causing the plunger 32 to reciprocate. Oil or other operating liquid in the right end of cylinder 45 is drawn by action of the plunger through the passages 101, 100, 99 and 98, past the valve ball 106 into the cavity 75 at each outward movement of the plunger 32 and, upon each inward movement of the plunger, the valve 106 closes and the liquid is forced from the cavity 75 through the passage 95 past the ball valve 109 and by way of the passage 97 to the left end of the cylinder 45 where it increases the pressure upon the left side of the piston 47 forcing the piston and with it the anvil 49 to the right against the flange 56 of the rivet. Assuming that the work is immovable, such movement of the anvil forces the tool to the left of Fig. 1 with respect to the anvil thereby drawing the rod 12 toward the anvil for upsetting the rivet. Upon upsetting of the rivet to the desired degree, the lever 132 engages the stop 134 thereby forcing the plunger 121 to the left of Fig. 1 lifting the ball 127 from its seat and equalizing the pressure at opposite sides of the cylinder. The rod 12 may then be withdrawn from the upset rivet by pulling the handle 42 to the left of Fig. 1 thereby rotating the rod 12 in a counter clock-wise direction and releasing the rivet. The piston 47 may then be returned by pressing the plunger handle 140 to the left thereby lifting the ball valve 127 from its seat for a sufficient time to permit the spring 65 to return the piston.

If desired, provision may be made for power operation of the mechanism hereinbefore described. To this end, referring to the embodiment of the invention shown in Figs. 5 and 6 of the drawings, the body 10 and the working parts therein contained are the same as in the embodiment first described. Means are provided for rotating the rod 12 and for reciprocating the pump plunger 32 pneumatically. For this purpose, the hand operated shaft 21 of Fig. 3 is replaced by a power driven shaft 200 arranged in alignment with rod 12 with its end axially spaced from coupling member 16^a. Shaft 200 is the shaft of a rotary reversible air motor 201 mounted in a housing 202. Housing 202 is secured to a threaded coupling member 203 which engages over the tubular extension 26 of the body 10. A gear speed reduction unit is also contained in the housing 202 and is of the planetary type. It has an outer sleeve member 204 fixed within housing 202 and having internal ring gear teeth 205. A hollow gear carrier 206 is mounted in ball bearing 207, 208, retained by sleeve 204 and coupling member 203 for rotation about shaft 200, and is secured by coupling member 16^a to rod 12. Carrier 206 has a shaft 209 secured thereto parallel to its axis of rotation. A planet gear 210 is rotatably mounted on shaft 209 and its teeth engage pinion teeth 211 formed on the motor shaft 200. A smaller

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gear 212 fixed to gear 210 engages the ring gear teeth 205. The arrangement is such that motor shaft 200 drives rod 12 in either direction at a greatly reduced speed.

For providing for support of the tool and control of compressed air, a handle 215 is secured to the left end of housing 200. An air connection 216 is provided at the end of the handle. A pair of valves 217, 218 are mounted in recesses formed in the handle. The valves are connected by a passage 219 through the handle to the air connection 216. Each valve has a seat 220 against which a ball 221 is held by a spring 222. A plunger 223 is adapted to be actuated by a lever 224 to depress the ball from its seat. The arrangement is such that by depressing one lever 224 air is admitted to turn the air motor in one direction and by depressing the other lever a similar valve is opened to rotate the motor shaft in the opposite direction.

For operating the pump plunger 82, a cylinder block 230 is mounted on the stuffing box 81^a and is formed with a cylinder 231 and a valve chamber 232 on axes parallel to each other. An inwardly directed flange 233 at one end of the cylinder engages back of the enlarged head of the stuffing box, and is held thereto by a nut 234 threaded on the stuffing box, packings 235, 236 being provided to seal the joint. A threaded cylinder head 237 closes the opposite end of the cylinder. A piston rod 238 is slideably mounted in the cylinder head, a stuffing gland 239 being provided to seal the joint. Fixed to the piston rod is a piston 240. Pump plunger 82 is secured loosely to the piston rod 238, as by having a head 82^a thereon engaged in a cross-slot 238^a permitting slight relative lateral movement and restricting relative axial movement to accommodate any misalignment. Ports 241, 242 from opposite ends of the cylinder connect it with the valve chamber 232 in which a valve 245 is slideably mounted. The valve is in the form of a tubular rod adapted to extend into the handle 215 where it connects with an air supply passage 246. A stuffing box 247 is fitted about the valve where it enters the handle.

The valve has annular spool portions defining annular grooves 250, 251, 252 therebetween. A hole 253 through the wall of the valve at groove 251 connects the chamber 232 with the bore of the valve and consequently with the passage 246. Exhaust ports 254, 255, extend from chamber 232 to the atmosphere through the wall of the cylinder block. The ports are so arranged that when the valve 245 is to the right as in Fig. 5, groove 251 connects the right end of cylinder 231 by means of port 242 and hole 253 and the bore of the valve 245 to passage 246, while at the same time the left end of cylinder 231 is connected by port 241, groove 250 and port 254 with the atmosphere. With valve 245 moved to the left from the position of Fig. 5, the right end of cylinder 231 will be connected by port 242 by way of groove 252 and port 255 with the atmosphere, while the left end of cylinder 231 will be connected by port 241, groove 251 and opening 253 with the bore of the valve 245 and therefore with passage 246. A valve ball 260 is seated against a seat 261 in air passage 246 and is adapted to be displaced by a plunger 262 acting against a coil spring 263. A hand lever 264 pivoted on the handle is adapted to move the plunger to unseat the valve. The arrangement is such that when lever 264 is depressed, compressed air from passage 219 may pass the valve ball 260 to act upon the piston 240.

The end of valve 245 extending into handle 215

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acts as a piston to urge the valve to the right in Fig. 5. An arm 270 is fixed to piston rod 238 and its free end is positioned between adjustable stop collars 271, 272 on valve 245. The arrangement is such that when valve 260 is opened and piston 240 moved to the left, in Fig. 5 due to air pressure thereon, arm 270 eventually engages stop 271 and, due to the superior area of piston 240 over that of valve 245, the valve is moved to the left until the air supply is connected to the left end of the cylinder and the right end of the cylinder is connected to exhaust port 255. This causes the piston to move to the left end of the cylinder and the reciprocatory movement is repeated as long as the valve 260 is held open.

The operation of the apparatus is the same as that for the embodiment of Fig. 3 except that when the rod 12 is to be rotated one valve lever 224 is pressed down to admit compressed air through valve 217 to motor 201 to rotate the rod in one direction and when the rod is to be operated in the opposite direction the other valve lever is depressed to open valve 218 and rotate the motor 201 in the opposite direction. Also when a rivet is to be upset valve lever 264 is depressed to open valve 260 and thereby cause pump plunger 82 to reciprocate until the rivet is upset as previously described.

Referring to the embodiment of the invention shown in Fig. 7, the body 10 and all parts therein contained are the same as in the embodiment of Figs. 1 to 4 except for the stuffing box 81^b which is externally threaded throughout its length. A transmission housing 300 is secured to housing 10 by having an opening 301 in a side thereof adapted to fit over the tubular extension 26 and to be held in place thereon by a pair of nuts 302, 303, and also by a second opening 304 in the same side adapted to fit over stuffing box 81^b and to be held thereon by a nut 305.

For rotating the rod 12, a shaft 306 is mounted for rotation in the housing 300, as by a bearing 307, and is secured to the rod 12 by the coupling member 16^b through which the rod 12 is threaded, the rod 12 also having threaded engagement with the shaft 306. A motor shaft 308 is rotatably mounted in housing 300, parallel to shaft 306. At one end of shaft 306 a pair of gears 309, 310 are fixed to each other and to a female cone clutch member 311, all of which are freely rotatable as a unit about the shaft. At the opposite end of the shaft, a gear 312 is freely rotatable about the shaft, and a gear 313 integral with a female cone clutch member 313^a is independently rotatable about shaft 306. A pinion 314, integral with a gear 315 is in mesh with gear 312 and is mounted for free rotation about a stub shaft 316 fixed to housing 300. Gear 315 is in alignment with gear 313 but their teeth clear each other. An idler gear 319 is rotatably mounted on a stub shaft 320 and meshes with gears 313 and 315 so as to turn gear 313 in the opposite direction to gear 312. A double-ended cone clutch member 321 is slideably mounted on shaft 306 between clutch members 311 and 313^a and is held against rotation with relation to the shaft by a feather-key 322. The arrangement is such that clutch member 321 may be moved into frictional engagement with either clutch member by operation of a shifter lever 323 engaging a shifter fork 324 engaging a groove in clutch member 321.

Motor shaft 308 is formed with gear teeth 325 to mesh with gear 312, and with gear teeth 326 to mesh with gear 309. An electric motor 327

drives shaft 308. The arrangement is such that with clutch member 321 engaging clutch member 311, shaft 306 and with it rod 12 are driven in a direction to screw rod 12 into a rivet, and with clutch member 321 engaging clutch member 313a, shaft 306 and with it rod 12 are rotated in the opposite direction to screw rod 12 out of the rivet. At the neutral position of clutch member 321, shaft 306 is not rotated by shaft 308.

For causing the same motor 327 to reciprocate the pump plunger 82, an annular seat 330 for a ball bearing 331 is formed in the housing 309 about the stuffing box 81 and concentric therewith. A gear 332 has a hub mounted within the ball bearing in position for the gear to mesh with gear 310. A bearing 333 is also formed in housing 309 in alignment with bearing 330. A shaft 334 has a reduced portion 335 rotatably mounted in bearing 333, the large end of the shaft being journaled within gear 332. A female cone clutch member 336 is formed integral with gear 332. A cooperating male clutch member 337 is slideably mounted on shaft 334 and is held against relative rotation therewith by a feather-key 338. A shifter lever 339 is arranged to engage a shifter fork 340 journaled in a groove in the clutch member 337 for shifting the cone into engagement with gear 332 to drive shaft 334.

Shaft 334 is formed with a bore 345 to slideably receive the head 346 of pump plunger 82. The shaft is also formed with a continuous cam groove 347 extending outwardly from the bore 345. A cam roller 348 is slideably mounted in the groove and is rotatable about a pin 349 fixed to the head 346. The groove is of sine curve type providing reciprocation of the plunger 82 upon rotation of shaft 334. The arrangement is such that with clutch member 321 in the neutral position and clutch member 337 engaged, rotation of motor 327 causes rotation of shaft 308 and gears 309, 310 and 332. Gear 332 through clutch members 336 and 337 rotates shaft 334 which causes reciprocating movement of plunger 82.

Clutch lever 323 is fixed to a shaft 350 and clutch lever 339 is fixed to a shaft 351. These shafts extend through bearings in the wall of housing 309 and are fixed to levers 352, 353, respectively for hand operation.

The operation of the apparatus of Fig. 7, is the same as that of Figs. 1 to 3 except that when rod 12 is to be rotated in a direction to enter the rivet, shifter lever 353 being in the unclutched position as seen in Fig. 7 to disengage the cam clutch members 336, 337, lever 352 is moved to the right in Fig. 7 to engage clutch member 321 with clutch member 311, which is in mesh with continuously rotating shaft 308, thereby rotating the shaft 306, and with it the rod 12, in a clockwise direction as seen from the left of Fig. 7. The shifter lever 352 is then moved to the neutral position shown in the drawing.

When the rivet is to be collapsed, the shifter lever 353 is moved to the left of its Fig. 7 position, thus engaging clutch member 336, 337 to permit gear 332, which is under continuous rotation through shaft 308 and gear 310, to start the pump, through reciprocation of head 346. After collapse of the rivet the shifter lever 353 is moved back to the neutral position shown in Fig. 7. The shifter lever 352 is then moved to the left of Fig. 7 to engage clutch member 321 with continuously rotating clutch member 313, thereby rotating the rod 12 in the opposite direction to disengage it from the rivet.

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 a tubular internally-threaded rivet, said apparatus comprising a rod having a threaded portion for engaging the threaded interior of the rivet, a hollow anvil through which said rod extends, means for rotating said rod to engage and disengage its threaded portion from the rivet, a body supporting said rod and said anvil, and hydraulic means entirely enclosed by said body for providing relative axial movement of said rod and said anvil for upsetting said rivet.

2. Apparatus for installing a tubular internally-threaded rivet, said apparatus comprising a threaded rod for engaging the threaded interior of the rivet, means for rotating said rod to engage and disengage it from the rivet, an anvil through which said rod extends, a housing for said rod, means for imparting relative axial movement to said rod and anvil, said means comprising a liquid-pressure operated member in said housing, and means in said housing for pumping liquid from one side of said member to the other side thereof.

3. Apparatus for installing a tubular internally-threaded rivet, said apparatus comprising a rod having a threaded portion for engaging the threads of the rivet, a hollow anvil through which said rod extends, means for rotating said rod to engage and disengage its threaded portion from the rivet, a body for supporting said rod and said anvil, and hydraulic means within said body comprising a reservoir, an operating cylinder, a piston therein for imparting relative axial movement between said anvil on the one hand and said rod and said body on the other, and hydraulic pump means for actuating said piston.

4. Apparatus for installing a tubular internally-threaded rivet, said apparatus comprising a rod having a threaded portion for engaging the threads of the rivet, a hollow anvil through which said rod extends, reciprocating means comprising threaded plunger means for rotating said rod to engage and disengage its threaded portion from a rivet, and hydraulic pressure means for effecting relative axial movement of said rod and said anvil to upset said rivet, said hydraulic pressure means being entirely enclosed by a housing supporting said rod and said anvil.

5. Apparatus for installing a tubular internally-threaded rivet, said apparatus comprising an apertured anvil for applying a force to a rivet, a threaded rod extending through said anvil to engage the threaded bore of the rivet, means for rotating said rod to engage and disengage it in the bore of the rivet, a body for supporting said rod and said anvil, liquid-pressure operated means entirely enclosed by said body for actuating said rod and said anvil relative to each other for upsetting a rivet, and means for determinately controlling the amount of such relative movement.

6. Apparatus for installing a tubular internally-threaded rivet, said apparatus comprising an apertured anvil for applying a force to a rivet, a threaded rod extending through said anvil to engage the threaded bore of the rivet, means for rotating said rod to engage and disengage it in the bore of the rivet, a body for supporting said rod and said anvil, said body enclosing a liquid supply and means to develop pressure on said liquid for actuating said rod and said anvil relative to each other for upsetting a rivet, means

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for sealing said body against escape of said liquid, and means for determinately controlling the amount of relative movement of said rod and said anvil.

7. Apparatus for installing a tubular internally-threaded rivet, said apparatus comprising a rod having a threaded portion for engaging the threads of the rivet, a hollow anvil through which said rod extends, means for rotating said rod to engage and disengage its threaded portion from the rivet, a body for supporting said rod and said anvil, and hydraulic means entirely enclosed by said body for moving said anvil axially with respect to said rod and said body for upsetting said rivet.

8. Apparatus for installing a tubular internally-threaded rivet, said apparatus comprising a rod having a threaded portion for engaging the threads of the rivet, a hollow anvil through which said rod extends, means for rotating said rod comprising a reciprocating plunger having threaded engagement with said rod to engage and disengage its threaded portion from the rivet, a body for supporting said rod and said anvil, and hydraulic means entirely enclosed by said body for moving said anvil axially with respect to said rod and said body for upsetting said rivet.

9. In an apparatus for installing an internally-threaded tubular rivet and having a threaded rod for engaging the threaded interior of the rivet, a hollow anvil through which said rod extends, and a hydraulic pressure operated cylinder for axially moving said anvil with relation to said rod, means for confining a liquid between said anvil and said cylinder, said means comprising a tubular body of rubber-like material reversed upon itself and having a portion for sealing it to said cylinder and a portion for sealing it to said anvil.

10. In an apparatus for installing a tubular rivet and having a threaded rod for engaging in the threaded bore of the rivet, a hollow anvil about said rod, a hydraulic cylinder, a piston therein for axially moving said anvil with relation to said rod, a hydraulic pump for actuating said piston and valve means for controlling flow of liquid between said cylinder and said pump, valve throttling means engageable with said valve means to limit movement of said piston, and stop means on said anvil for engaging said throttling means to limit rivet upsetting movement.

11. Apparatus for installing a tubular internally-threaded rivet, said apparatus comprising a threaded rod for engaging the threaded interior of the rivet, means for rotating said rod to engage and disengage it from the rivet, an anvil through which said rod extends, a housing for

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said rod having a cylinder and a coaxial tubular portion therewithin providing a bearing for said rod, means for imparting relative axial movement to said rod and said anvil, said means comprising a liquid pressure operated piston in said cylinder, and means in said housing for pumping liquid from one side of said piston to the other.

12. Apparatus for installing a tubular internally-threaded rivet, said apparatus comprising a rod having a threaded portion for engaging the threaded interior of the rivet, a hollow anvil through which said rod extends, means for rotating said rod to engage and disengage its threaded portion from the rivet, a body supporting said rod and said anvil, and hydraulic means entirely enclosed by said body for providing relative axial movement of said rod and said anvil for upsetting said rivet, and power-operated means on said body for developing hydraulic pressure in said hydraulic means.

13. Apparatus for installing a tubular internally-threaded rivet, said apparatus comprising a rod having a threaded portion for engaging the threaded interior of the rivet, a hollow anvil through which said rod extends, power-operated means for rotating said rod to engage and disengage its threaded portion from the rivet, a body supporting said rod and said anvil, and hydraulic means entirely enclosed by said body for providing relative axial movement of said rod and said anvil for upsetting the rivet.

14. Apparatus for installing a tubular internally-threaded rivet, said apparatus comprising a rod having a threaded portion for engaging the threaded interior of the rivet, a hollow anvil through which said rod extends, power-operated means for rotating said rod to engage and disengage its threaded portion from the rivet, a body supporting said rod and said anvil, and hydraulic means entirely enclosed by said body for providing relative axial movement of said rod and said anvil for upsetting the rivet, said power-operated means being mounted on said body and comprising means for actuating said hydraulic means.

15. Apparatus for installing a tubular internally threaded rivet, said apparatus comprising a rod having a threaded portion for engaging the threaded interior of the rivet, a hollow anvil through which said rod extends, motor means for rotating said rod to engage and disengage its threaded portion from the rivet, a body supporting said rod and said anvil, hydraulic means including a pump entirely enclosed by said body, and means for selectively connecting said motor means to said rod and said pump.

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