Oct. 6, 1953 J. N. HENSHAW 2,654,257

ELECTRICALLY POWERED BLIND RIVETING TOOL

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Fig. 1

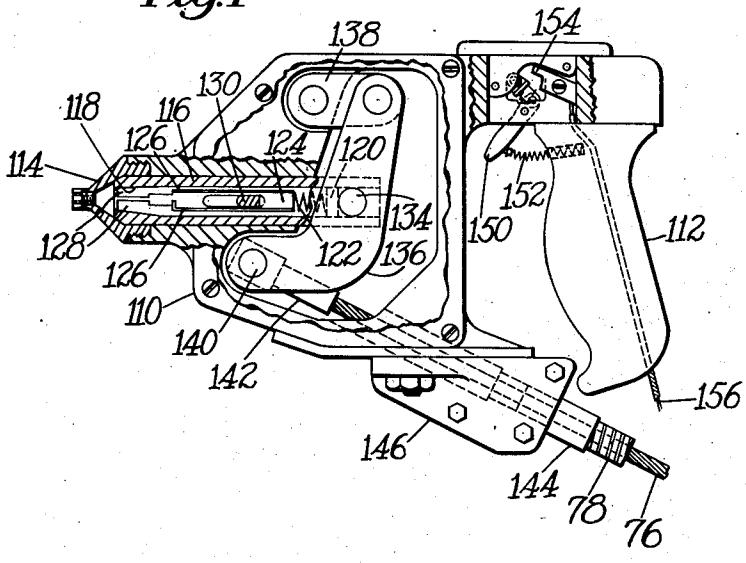
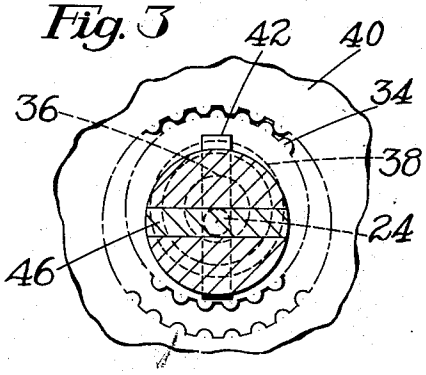


Fig. 3



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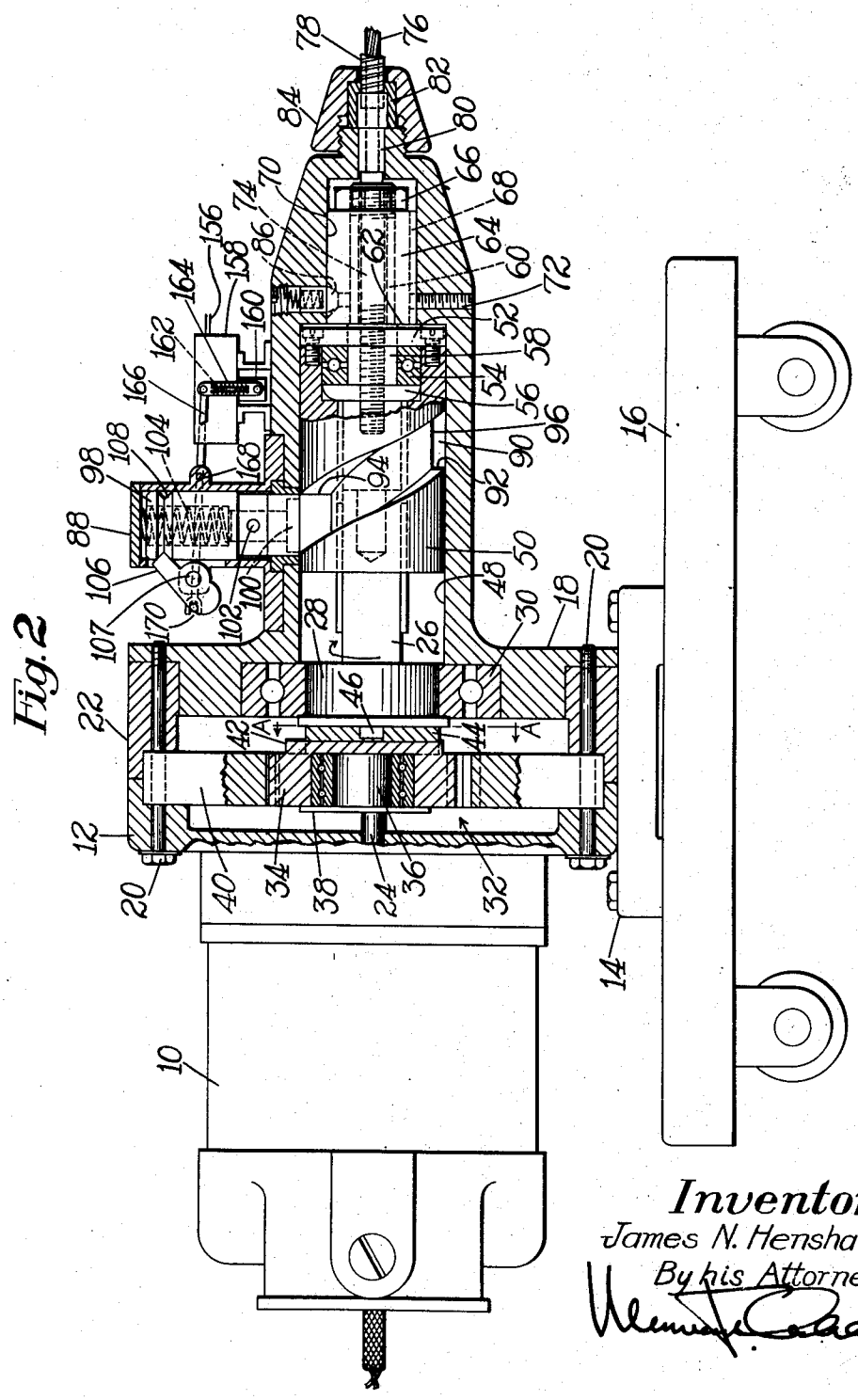


Fig. 2

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ELECTRICALLY POWERED BLIND RIVETING TOOL

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1 Claim. (Cl. 74—57)

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This invention relates to means for imparting reciprocating motion to a tool powered by a rotor. As hereinafter exemplified the invention pertains especially to power-operated blind riveting tools and more particularly to an electrically driven tool of a type adapted to install a two-part rivet in a structure accessible from one side only. It will be understood that use of the invention is by no means necessarily limited to application in riveting tools.

A common form of blind rivet comprises a tubular member of ductile metal having a preformed head and a nail-like mandril extending axially through the throat of the member. A powerful riveting tool is required first to grip and retract the stem of the mandril endwise relative to the member so that the mandril head will upset and expand the inaccessible end of the member, and second, to tension the mandril further after the upsetting so that the expendable mandril stem is separated from the installed rivet. A manual-type tool used to insert such rivets and employing mandril-gripping tongs with high mechanical advantage is, for example, disclosed in U. S. Letters Patent No. 1,829,696 granted to H. N. Wylie et al. Also, power-operated tools of pneumatic and hydraulic types have hitherto been quite extensively used for setting blind rivets. For developing the requisite fluid operating pressures in these devices rather cumbersome and costly apparatus and controls therefor have usually been needed, although in some instance the organizations have included separately maneuverable hand tools for applying the rivet setting forces transmitted to them.

A primary object of this invention is to provide an improved means for changing rotary motion, such as that of an electric motor, to reciprocating motion for effectively actuating a remote instrument such as a riveting tool which may be readily manipulated at the rivet setting locality.

In accordance with this object a feature of the invention is the provision in a blind riveting tool comprising a normally stationary power unit including a member rotatably driven by electrical means, of a rivet manipulating hand unit, a flexible cable for transmitting axial movement of the member to actuate the hand unit, and means for deriving such axial movement of the member during its rotation.

The above and other features of the invention, together with novel arrangements and combinations of parts will now be more fully described in connection with one illustrative embodiment and the accompanying drawings thereof, in which:

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Fig. 1 is a side elevation, partly in section, of the rivet manipulating hand unit of a preferred form of tool embodying the invention, portions of the casing being broken away to reveal details of construction;

Fig. 2 is a side elevation, partly in central longitudinal section, of the power unit portion of the illustrative tool; and

Fig. 3 is a detail of speed reduction parts taken on a plane connecting arrows A and as viewed when looking in the direction of the arrows A in Fig. 2.

The power unit comprises an electric motor 10 (Fig. 2), preferably of about ¼ H. P., to which is affixed a reduction gear housing 12 having a base plate 14 secured by bolts to a cradle 16. A housing 18 for the major portion of the actuating mechanism is secured by bolts 20 to the housing 12, the housings 12 and 18 being spaced by a cylindrical member 22.

A drive shaft 24 of the motor 10 is coaxial with a driven shaft 26 rotatably mounted within the housing 18. Viewing Fig. 2 from the left, rotation of the shaft 24 is in a counterclockwise direction. An enlarged portion 28 of the shaft 26 is carried in a ball bearing 30. Speed reduction mechanism of any type and herein generally designated 32 may be used in coupling the shaft 24 and shaft portion 28. The reduction gearing about to be described is of well-known type and is, in this instance, preferably arranged to rotate the shaft 26 at 1/60 of the speed of the shaft 24. A gear 34 is rotatably mounted on an eccentric portion 36 of the shaft 24 and held against endwise movement in one direction by a flange 38 of the latter. An internal gear 40 (Figs. 2 and 3) is fixedly mounted on the bolts 20, has 61 teeth, and meshes with the gear 34 having 60 teeth. The gear 34 is accordingly rotated 1/60 the speed of the shaft 24 but in the opposite direction. Rotation of the gear 34 is transmitted to the shaft 26 by a coupling of the well-known Oldham type, the gear 34 having an integral spline 42 arranged to slide in a keyway of a coupling disk 44. The disk 44 is provided with a second keyway at right angles to the one just mentioned in order to accommodate a spline 46 integral with the shaft portion 28.

The housing 18 is provided with an internal cylindrical bearing or surface 48 for a cylindrical cam 50 mounted on the shaft 26. This cam 50 of the power unit is capable of piston-like movement axially of the bearing 48 to actuate the hand unit in a manner hereinafter to be described. Accordingly, the cam 50 is splined to the shaft 26 for rotation therewith and is se-

cured to means connecting with the hand unit as will now be explained. An annular plate 52, secured to an end of the cam 50 having a cavity, serves to maintain a thrust bearing 54 therein and against a flanged portion 56 of a sleeve 58 which extends coaxially of the cam 50 and through the bearing and through the plate 52. A portion 60 of the sleeve 58 is of reduced diameter providing a shoulder 62 against which a sleeve 64 is clamped by means of a nut 66 threaded on the sleeve 58. The sleeve 64 is provided with a keyway 68 and is arranged for axial movement in a bearing 70 formed in the housing 18, a pin 72 projecting from the latter and engaging the keyway 68 to lock the sleeve 64 against rotation. A rod 74 threaded into the sleeve 58 receives one end of a stranded central wire or cable portion 76 of a Bowden cable. A flexible outer casing 78 of the cable terminates in a sleeve 80, a reduced portion of which fits in a bore in the housing 18. An outer sleeve 82 and a cap 84 screwed onto a boss of the housing 18 secure the sleeve 80 in position.

When the tool is not in operation, and though its motor 10 be running, the sleeve 58 is stationary, its relative position being as shown in Fig. 2. In this initial position the sleeve 58 is releasably held by engagement of a spring-pressed plunger 86 with a recess in the sleeve 64. Also, as viewed in Fig. 2, the plunger 86 is then holding the idling cam 50 at the right-hand end of the bearing 48.

Means for cooperating with the cam 50 to move it axially of the housing 18 are mounted in a cylindrical member 88 secured thereon. A cam slot 90 formed in the cam 50 is of rectangular cross section, having opposite side walls 92, 94 and a bottom wall 96. The walls 92, 94 are radial, and a bearing 98 mounted for vertical movement in the member 88 rotatably supports a cam roll 100 by means of a stud 102. The bearing 98 is backed by a compression spring 104 which urges it downward to effect engagement of the roll 100 with the slot 90. To permit free rotation of the cam 50, the roll is normally retained above the slot by means of a pawl 106 pivotally affixed by means of a pin 107 to the member 88 and engageable with an annular groove 108 formed in the bearing 98. The bottom wall 96 of the groove, if considered as progressing in one direction around the cam 50, is of gradually diminishing depth until the bottom wall merges with the external cylindrical surface of the cam 50. In this locality of the merging, the wall 96 is in a position so to raise the bearing 98 and roll 100 that the pawl 106 may engage the groove 108 and maintain the roll 100 in its lifted and inoperative position.

The hand portion of the tool, shown in Fig. 1, comprises a casing 110 to which a pistol grip handle 112 is affixed. The casing 110 has a centrally bored, conical anvil 114 secured to one end and provides a cylindrical bearing for a sleeve 116 coaxial with the anvil. Connections with the cable 76, to be described, are provided for moving the sleeve 116 relatively to the anvil, and mechanism within the sleeve and actuated thereby is employed to grip and retract the mandril portion of a rivet to be installed. Any suitable mandril gripping and tensioning mechanism may be used, a preferred type somewhat similar to that disclosed in the above cited Wylie et al. patent being hereinafter described.

An end of the sleeve 116 adjacent to the anvil has an internal frusto-conical surface 118. A plug 120 secured in the other end of the sleeve 116 engages one end of a compression spring 122, its other end engaging a block 124. The latter supports a pair of leaf springs 126, 126 to each of which a collet jaw 128 is affixed. The arrangement is such that the jaws are urged apart, the spring 122 urging the jaws 128 toward the surface 118. Actual movement of the jaws into cooperative relation with that surface is controlled by a spring-backed latch 130 (one form of which is more fully disclosed in my copending application Serial No. 188,930, filed October 7, 1950, now United States Letters Patent No. 2,575,416, granted November 20, 1951) extending transversely through the casing 110. A pivot pin 134 extends transversely of the sleeve 116 to bridge a pair of parallel and opposite flat links 136, 136. Each of the upper ends of the links 136 is pivotally connected to an end of a link 138, the links 138, 138 being pivotally affixed at their other ends to the casing 110. The lower ends of the links 136, 136 are bridged by a pin 140 to which a sleeve 142 fast to the cable 76 is pivotally secured. The cable casing 78 terminates in a sleeve 144 clamped in an extension piece 146 of the casing 110.

For controlling the pawl 106 of the power unit a trigger 150 associated with the handle 112 is arranged to be manually depressed against the resistance of a spring 152, thereby closing a switch 154. A wire 156 preferably bound to the cable casing 78 connects the switch 154 with a source of electrical energy and a solenoid 158 (Fig. 2) mounted on the housing 18. A core 160 of the solenoid is arranged to be drawn against the resistance of a spring 162 when the solenoid is energized by pressing the trigger 150. A pair of links 164, 164 (only one shown in Fig. 2) is pivotally supported on the core 160 and has pivotal connection with a shifter yoke 166. The latter straddles the member 88 and is fulcrumed on the pin 168 affixed thereto. A forked end of the yoke 166 embraces a pin 170 secured to the pawl 106.

In operating the illustrative tool, its parts initially being in the relative positions indicated in Figs. 1 and 2, the mandril stem of a blind rivet is first inserted in the bore of the anvil 114 and extends between the collet jaws 126, the preformed head of the tubular portion of the rivet abutting the anvil externally. The latch 130 is next actuated to enable the spring 122 to move the jaws against the surface 118 and so cause them to engage and grip the mandril. When the hand unit has been moved as required to insert the projecting portion of the rivet assembly in the hole in a structure to be riveted, the anvil 114 should hold the preformed rivet head against the accessible side of the structure. The trigger 150 is then depressed, the energized solenoid 158 acting against the spring 162 via the core 160, links 164, and yoke 166 to pivot the pawl 106 on the pin 107 and so disengage the pawl from the groove 108. The released bearing 98 and the roll 100, under the influence of the spring 104, are moved toward the cam 50. As soon as the latter has rotated its cam groove 90 so as to permit entry of the roll 100 therein, the roll and groove cooperate to effect axial movement of the cam 50 together with the sleeves 58 and 64. The path of the groove 90 is such that during rotation of the cam 50 through the initial 180° its axial movement is to the left as viewed in Fig. 2, the sleeve 58 and the rod 74 also thereby being pulled to the left. As a result the recess in the sleeve 64 is shifted to the left and

out of alignment with the plunger 86, and the cable 76 is pulled in a working stroke in one direction relative to its casing 78. But in the next 180° of a working cycle the effect of the groove 90 and roll 100 is to move the cam to the right and back to its initial position, the cam acting against the flanged portions 56 of the sleeve 58 and relatively shifting the cable 76 and the sleeve 64 until the plunger 86 is again seated in the sleeve recess.

As a consequence of the cable 76 being retracted within the casing 78 by operation of the power unit during the first half of its cycle, the mandril gripping mechanism of the hand unit is actuated, the links 136, 136 being swung counterclockwise (viewing Fig. 1) by the cable. Accordingly, the sleeve 116 and closed collet paws 128 are separated from the anvil 114 to tension the mandril, upset the tubular rivet, and finally strain and break the mandril stem. The operator releases the trigger 150 as soon as the mandril has broken, thereby deenergizing the solenoid 158 and freeing the pawl 106 for engagement with the groove 108 under the influence of the spring 162. The groove 108 is positioned for this engagement during the second half of the cycle by means of the bearing 98 being raised by the lifting action of the bottom wall 96 on the roll 100. Also, the return movement of the cable 76 relative to its casing 78 during this second half of the cycle seats the plunger 86, returns the sleeve 116 and jaws 128 to the relative positions indicated in Fig. 1, the jaws then being apart for the reception of the next rivet to be installed.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

A power unit for driving reciprocable remote mechanism of a manually movable tool, including a cable connected to said mechanism, and normally fixed power means for shifting said cable to operate said mechanism, said means comprising a motor, a rotary cam connected to said cable and driven by the motor, said cam having a peripheral groove extending with increasing depth through 360° of rotation and between axial extremes spaced to correspond with 180° of rotation, a member mounted on the power means and engageable with the cam groove to move the cam back and forth axially, means associated with the power means for retaining the member disengaged from the groove when the cam has completed a cycle, and means, responsive to the closing of an electrical circuit, for releasing said member retaining means.

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