United States Patent

Bosten et al.

[15] **3,696,693**

[45] **Oct. 10, 1972**

[54] **IMPACT WRENCH**

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[73] Assignee: **Rockwell Manufacturing Company,** Pittsburgh, Pa.

[22] Filed: **Nov. 18, 1969**

[21] Appl. No.: **877,688**

[52] **U.S. Cl.**.....**81/52.3,** 81/56

[51] **Int. Cl.**.....**B25b 17/00,** B25b 19/00

[58] **Field of Search** 81/52.3, 56, 125; 51/170; 77/7; 145/61; 16/114; 143/43.1; 74/548, 543

[56] **References Cited**

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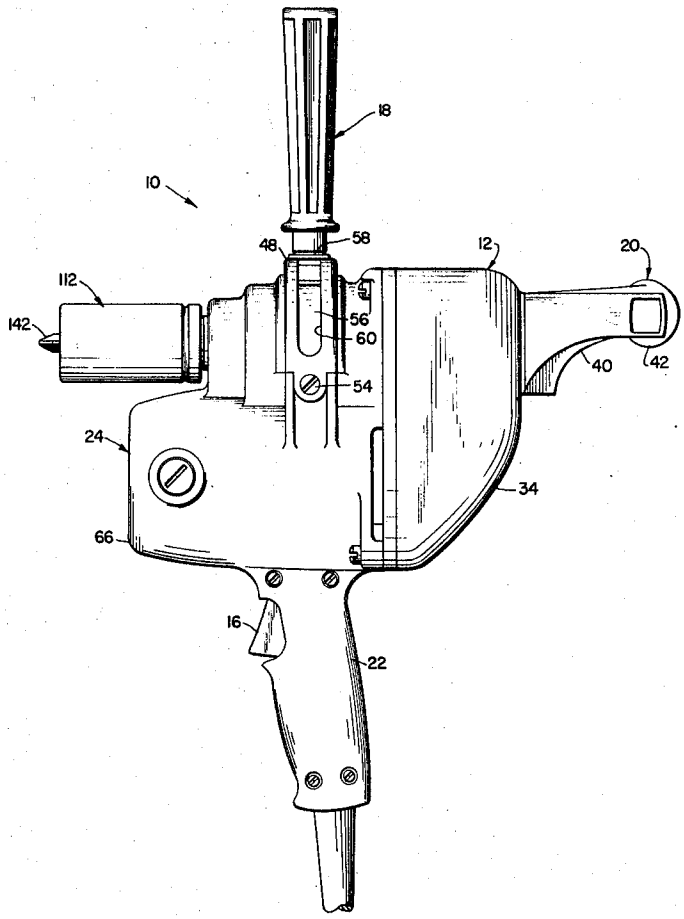
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[57] **ABSTRACT**

Impact wrenches comprising a casing housing an axially movable, non-rotatable, fastener-engaging component, a retainer engaging component, and a motor for rotating the retainer-engaging component.

10 Claims, 4 Drawing Figures



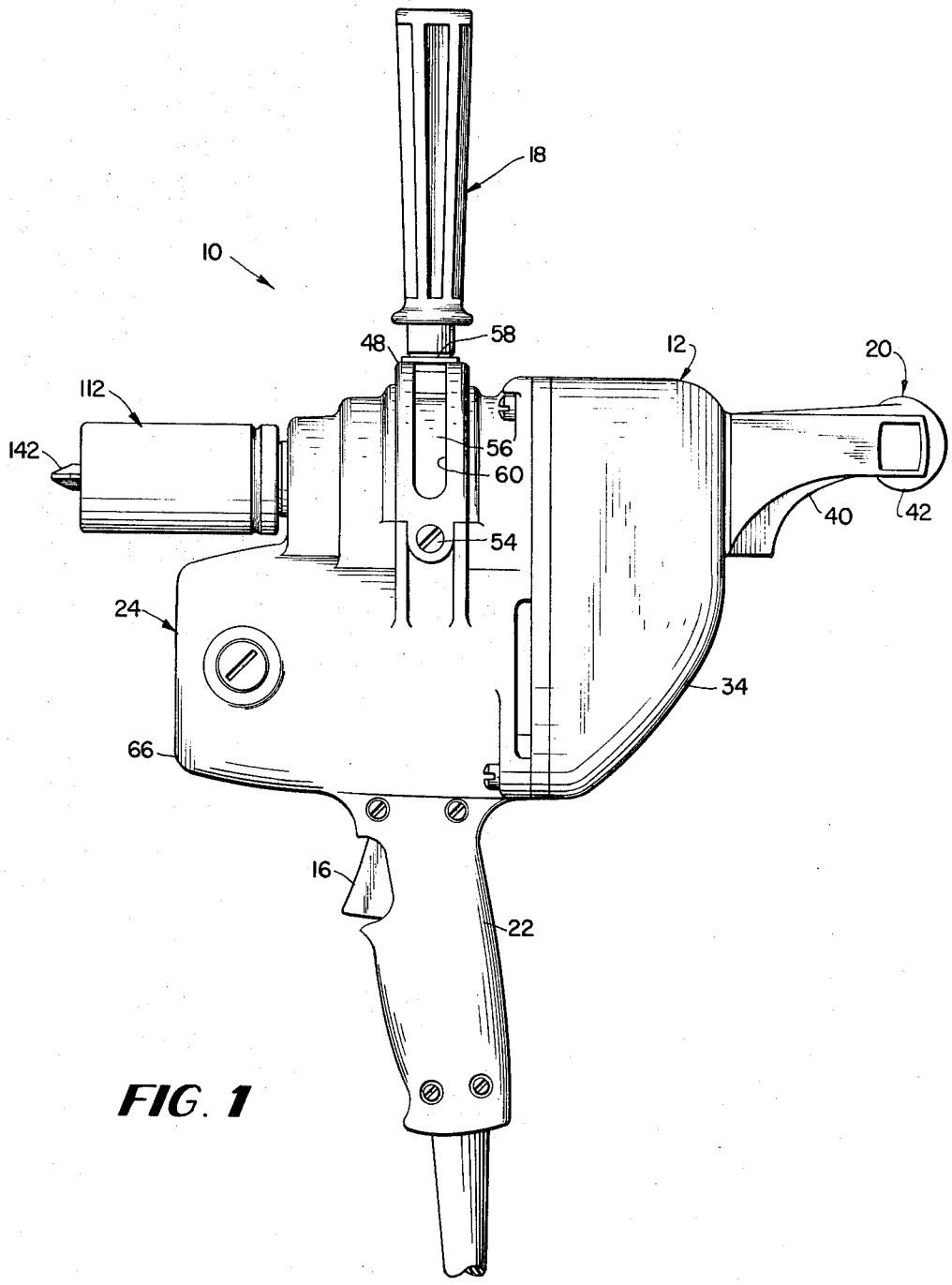


FIG. 1

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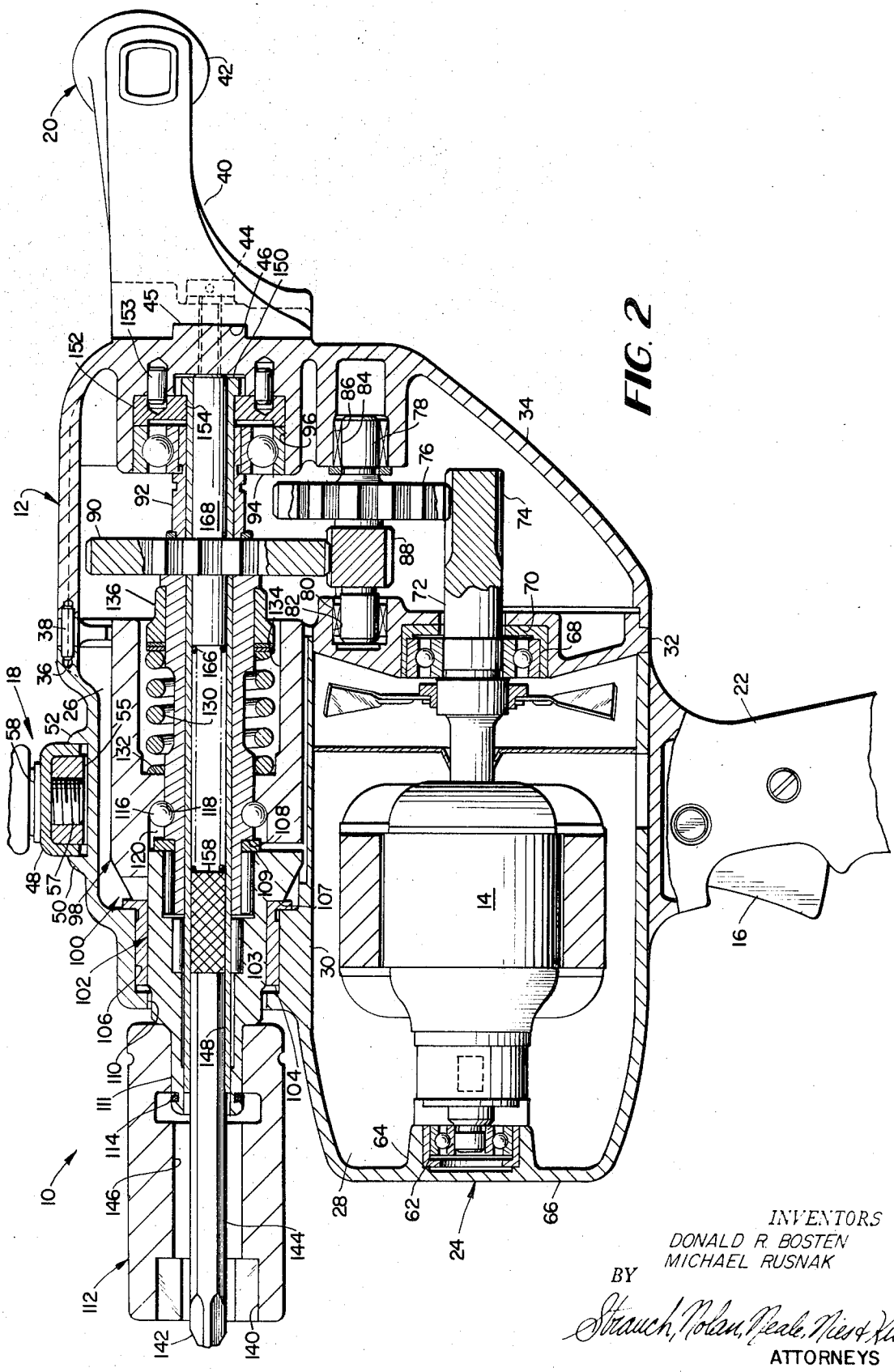


FIG. 2

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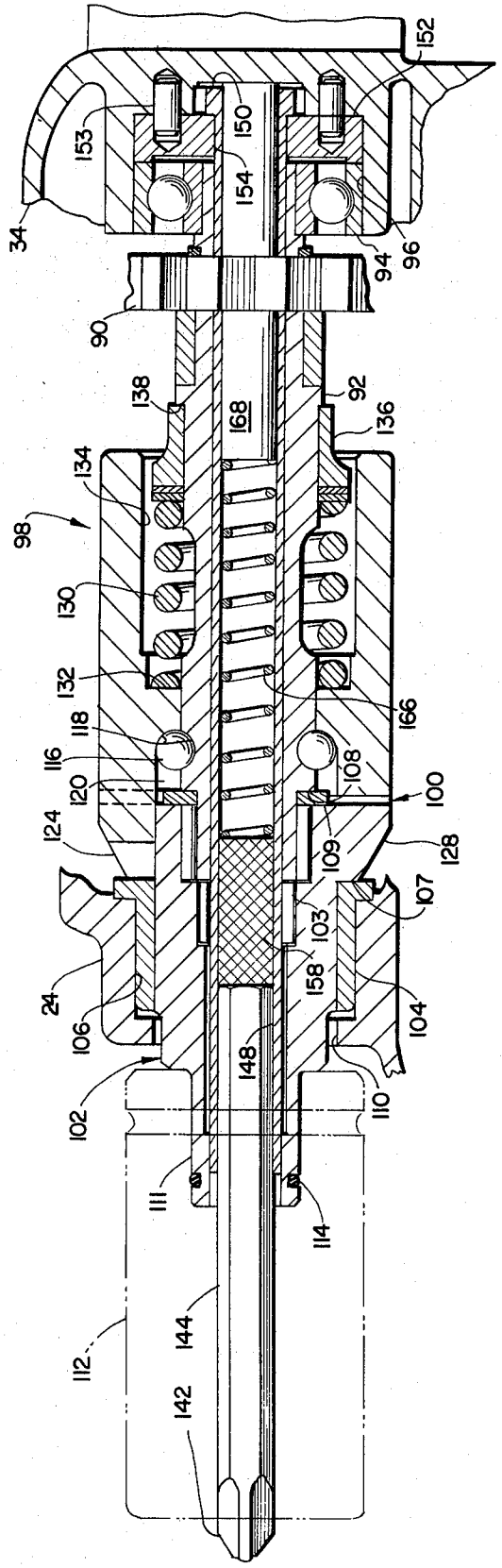


FIG. 3

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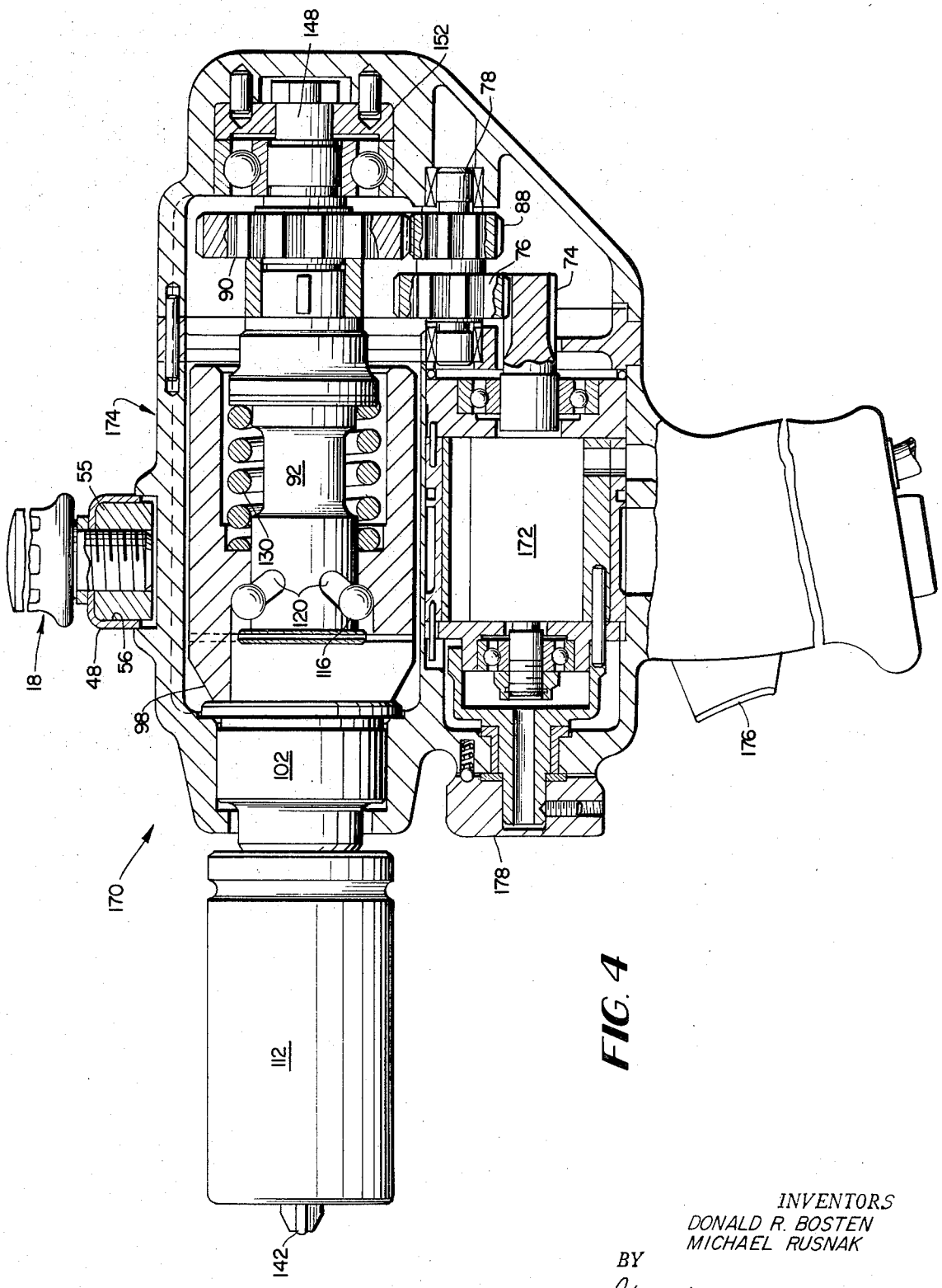


FIG. 4

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IMPACT WRENCH

This invention relates to novel, improved tools for threading a retainer onto a fastener while holding the fastener against rotation.

In many instances it is necessary to fasten two members together in a confined space or in other circumstances where a fastener and retainer can be reached from only one side of an assemblage of members being joined. There have been developed for such applications fasteners which have a socket in their shank end so that they can be held against rotation from the side of the assemblage on which the retainer is threaded onto the fastener. Accordingly, in circumstances of the type just described, access to one side of the fastener is all that is required.

Power tools have heretofore been developed for installing or setting fasteners of the type just described. Typical of these are the bolt-holding wrenches described in La Torre U.S. Pat. No. 2,955,496 and Bangerter U.S. Pat. No. 3,323,394. These include an axially movable, non-rotatable mandrel for holding a bolt against rotation while a rotatable socket threads a retainer onto the fastener.

One of the disadvantages of the tools described in the patents just mentioned are that they lack compactness. Accordingly, they do not lend themselves to use in numerous applications for which fasteners of the type described above were developed.

Other disadvantages of heretofore available tools of the type in question are excessive weight and lack of proper balance, which make them difficult to handle in many circumstances, and lack of sufficient output torque. Also, prior art tools are difficult to handle in some orientations due to the utilization of fixed grips or handles. Further, it is commonly undesirably difficult in such tools to change the fastener-engaging working component or bit.

Also, in many is not most instances, it is desirable to impart a rotary impact to the retainer as it is tightened to prevent the retainer from loosening later. Tools such as those described in the La Torre patent mentioned above have the disadvantage that there is no provision for supplying such an impact.

It is one important and primary object of the present invention to provide novel, improved tools for holding fasteners against rotation while threading retainers thereon which do not have the disadvantages of previously proposed tools of this character.

In the lightweight, high output torque tools of the present invention, by which the foregoing and other important objects are obtained, much the same types of components are employed as in the tools described in the patents identified above. However, a novel over and under arrangement is employed with the motor of the tool being disposed beneath the operating mechanism. The result is a more more compact tool, which can accordingly be used in close quarters where the heretofore available tools cannot. Another advantage of this novel arrangement is that it produces an extremely well balanced tool, which is a significant advantage for obvious reasons.

In conjunction with the foregoing the tools of the present invention are preferably provided with a novel handle which can be quickly adjusted to extend from either side of or upward from the tool casing or to intermediate positions. This further facilitates the handling of the tool, especially in otherwise awkward positions or orientations.

Still another novel feature of the present invention is the use of a magnetic holder to retain the fastener restraining work performing component or bit in place. This arrangement makes the changing of bits a much simpler procedure than it is in heretofore available tools of the type with which the present invention is concerned.

From the foregoing it will be apparent that other important but more specific objects of the present invention reside in the provision of tools of the type in question:

1. which are light, compact, and well balanced, and therefore relatively easy to handle in what would normally be awkward orientations or positions or cramped quarters. cramped

2. which, in conjunction with the preceding object, have a novel over and under arrangement of components in which the motor of the tool is located beneath its operating mechanism.

3. which are capable of exerting rotary impacts on retainers to insure that they are securely tightened.

4. which have a novel adjustable handle that further makes them easy to manage in a variety of positions or orientations.

5. which may be equipped with a novel magnetic bit holder arrangement that facilitates the removal and replacement of the fastener engaging component.

6. which have various combinations of the novel attributes just listed.

Other objects and advantages and further novel features of the present invention will become apparent from the appended claims and as the ensuing detailed description and discussion proceeds in conjunction with the accompanying drawing, in which:

FIG. 1 is a side view of a power tool constructed in accord with the principles of the present invention;

FIG. 2 is a partial longitudinal section through the tool of FIG. 1;

FIG. 3 is a longitudinal section through the upper part of the tool of FIG. 1 to an enlarged scale; and

FIG. 4 is a longitudinal section through a second form of the invention.

Referring now to the drawing, FIGS. 1–3 depict a power tool **10** constructed in accord with the principles of the present invention and designed to thread a retainer on a fastener while restraining the fastener against rotation. Power tool **10** includes a casing **12** housing a motor **14**, the operation of which is controlled by an on-off switch **16** and a forward-reverse switch (not shown). A novel adjustable handle **18** intermediate the ends of casing **12** and a removable handle **20** at the rear end of the casing are provided for use in conjunction with pistol grip **22** to manipulate tool **10**.

The details of casing **12** are not important as far as the present invention is concerned and they will accordingly not be described in detail herein. Briefly speaking, however, casing **12** includes a forward section **24** divided into upper and lower compartments **26** and **28** by a horizontal partition **30**, a vertical partition member **32**, and rear section **34**. The three casing components **24**, **32**, and **34** are maintained in assembled relationship by screw-locks **36** in "HELI-COIL" inserts **38**.

The handle 20 at the rear of casing 12 includes a rearwardly extending leg 40 and a laterally extending grip 42. The handle is fixed to the casing as by a cap screw 44. A cooperating lug 45 on the rear of the casing and notch 46 in the handle keep the latter from rotating relative to the casing.

Referring now particularly to FIGS. 1 and 2, it was pointed out briefly above that tool 10 is also preferably equipped with an adjustable handle 18 intermediate the ends preferably casing 12 to facilitate manipulation of the tool. As best shown in FIG. 1, a generally semicircular, laterally oriented bracket 48 is fixed to forward casing section 24 between forward and rear projections 50 and 52 as by screws 54. Disposed between bracket 48 and casing section 24 is an internally threaded retainer 55, which is dimensioned for a sliding fit without rotation in the channel or track 56 between the member and casing 12. The lower end 57 of handle 18 is threaded and extends through a washer 58 and an elongated groove 60 in bracket 48 into channel 56, where it is threaded into retainer 55. Accordingly, when handle 18 is tightened, bracket 48 is clamped between handle 18 and retainer 55, immobilizing the handle. The handle is adjusted by loosening it and sliding it together with retainer 55 to the desired new position and then retightening it.

The handle can be adjusted to extend horizontally to the left and right and vertically from tool 10 and to intermediate positions therebetween. As indicated above, this makes it possible to use tool 10 with ease in positions or orientations in which it would otherwise be difficult to manipulate.

Referring again to FIG. 2, the motor 14 of tool 10 is housed in the lower compartment 28 of casing 12. It is supported by a bearing 62 seated in a boss 64 extending rearwardly from the front wall 66 of casing member 24 and by a bearing 68 seated in an aperture 70 in vertical casing member 32.

The output shaft 72 of motor 14 extends toward the rear of tool 10, and a gear or pinion 74 is formed on its free rear end. Gear 74 is one member of a gear pair including, in addition, a gear 76 keyed or otherwise fixed to an intermediate drive shaft 78 for rotation therewith. Shaft 78 is disposed above and in parallel spaced relationship to motor output shaft 72. It is supported for rotation in a bearing 80 seated in a recess 82 in casing member 32 and by a bearing 84 seated in a recess 86 in the rearmost part of casing member 34.

Also fixed to intermediate drive shaft 78 for rotation therewith is a second pinion or gear 88 constituting one member of a second gear pair, which also includes gear 90. Gear 90 is keyed or otherwise fixed for rotation therewith to a hollow final drive shaft 92 disposed above and in parallel spaced relationship to the previously discussed intermediate drive shaft 78 and motor output shaft 72.

As shown in FIG. 2, the rear end of final drive shaft 92 is rotatably supported in casing 12 by a bearing 94 seated in a recess 96 formed in the rearmost part of rear casing member 34. Adjacent its forward end shaft 92 extends through the axially displaceable input element or hammer 98 of a torque responsive, rotary impact impacting mechanism 100, which also includes an anvil 102 in which the shaft is journalled by bearing 103.

The anvil is supported in casing 12 in axial alignment with hammer 98 in a sleeve bearing 104, which is seated in a recess 106 in the forward end and upper compartment of casing member 24. Anvil 102 is fixed against axial movement in the casing by bearing 104, which abuts a shoulder 107 on the anvil and by a shoulder 108 on final drive shaft 92 from which the anvil is separated by bearing member 109.

The anvil projects from casing member 24 through an opening 110 in the forward end of the casing section and terminates in a necked down socket receiving portion 111. This projecting, necked down section 111 of the anvil will typically have a square or other non-circular cross section to provide a drive connection between the anvil and a retainer engaging socket 112 seated on the forward portion of the anvil and retained in place as by a conventional spring type retainer 114.

Final drive shaft 92 and hammer 98 are fixed together for concomitant rotation by balls 116 seated in recesses 118 in the drive shaft and elongated grooves 120 in the hammer. Hammer 98 is, in turn, normally drive connected to anvil 102 (see FIG. 3) by cooperating drive elements or lugs 124 on the hammer and 128 on the anvil. These drive elements are biased into engaging relationship by a spring 130 surrounding final drive shaft 92. As shown in FIGS. 2 and 3, the forward end of drive spring 130 abuts a radial shoulder 132 in the bore 134 of the hammer. The rear end of the spring is fixedly positioned by a member 136 which surrounds drive shaft 92 and is fixed against rearward movement by a radial shoulder 138 on the drive shaft.

The tool components just described provide a drive path from motor 14 to socket 112 through motor output shaft 72, gear pair 74, 76, intermediate drive shaft 78, gear pair 88, 90, final drive shaft 92, balls 116, hammer 98, and anvil 102. Accordingly, when on-off switch 16 is depressed to energize motor 14, socket 112 is rotated to thread a retainer seated in recess 140 onto or off of an associated fastener, depending upon the position of the forward-reverse switch.

As indicated above, tool 10 also functions to restrain the fastener against rotation while the retainer is threaded onto it. Fasteners of the type with which tool 10 is intended to be used, have a Phillips or similar socket formed in their shank end. In the operation of tool 10, such fasteners are restrained against rotation by engaging in these apertures a similarly configured tip 142 formed on the forward end of a work performing component or bit 144 having a hexagonal or other non-circular cross sectional configuration. As these in both FIGS. 2 and 3, bit 144 extends through the bore 146 of socket 112 into a sleeve-like guide 148 having an internal configuration matching the external configuration of the bit.

Guide 148 extends through hollow drive shaft 92 to the rear end of casing 12 where it terminates in a head 150. Guide 148 is positioned longitudinally in casing 12 and restrained against rotation by the rear wall of casing member 34 and by a fitting 152 fixed to the casing member by fasteners 153. More specifically, the head 150 of the guide is confined against the rear wall of the casing member and fitting 152 to fix the guide longitudinally in the casing. An aperture 154 in fitting 152 through which guide 148 extends is configured to match the non-circular external configuration of the

guide. Accordingly, the fitting prevents rotation of guide **148**.

Referring still to FIGS. **2** and **3**, the bit **144** just described may be retained in guide **148** in any desired fashion. One exemplary scheme of retaining the bit, shown in FIG. **2**, involves the use of a magnet **158** slidably received in guide **148**. Bit retainer **158** and bit **144** are biased to the left as shown in FIGS. **2** and **3** by a compression spring **166** fixed to magnet **158** and to a pin or rod **168** fitted in the rear end of guide **148**.

To fit a retainer onto a fastener with tool **10**, the retainer is inserted into the retainer receiving recess **140** in the front end of socket **112** or started on the fastener, and the tip **142** of bit **144** is engaged in the socket in the shank end of the fastener. Switch **16** is then depressed to energize motor **14**, effecting a rotation of socket member **112** through the drive train discussed above. This threads the retainer onto the fastener, which is held against rotation by bit **144**. As the retainer moves down the shank end of the fastener, compression spring **166** accommodates movement of bit **144** to the right as shown in FIGS. **2** and **3** so that the retainer remains seated in the recess **140** at the forward end of socket **112**.

The threading of the retainer onto the fastener continues until the retainer is tightened. At this point, socket **112** and anvil **102** are restrained against rotation by the retainer. Since hammer **98** is still being rotated through the drive train discussed above, the drive elements **124** on its forward end ride over those on the anvil, the hammer moving toward the rear of the tool against the bias exerted by spring **130** and balls **116** moving forwardly in grooves **120** as the hammer retracts. This disengages the driving elements **124** and **128** on the hammer and anvil respectively. As the hammer continues to rotate, the driving elements reengage, imparting a rotary impact to the anvil and, therefore, socket **112** and the retainer to insure that the latter is securely tightened.

In the embodiment of the invention just described the tool is powered by an electric motor. This is not a prerequisite of the present invention, however, since an air motor can equally well be employed as in the tool **170** illustrated in FIG. **4**. In this tool, the source of motive power is air motor **172**. Motor **172** is mounted in the casing **174** of tool **170** in much the same manner that motor **14** is mounted in the casing **12** of tool **10**. The operation of the motor is controlled by a trigger type valve actuator **176** which controls the flow of air to the motor through a valve (not shown) of conventional type. The direction of rotation of the motor is controlled by a forward-reverse knob **178** in a manner which is also conventional.

In this embodiment of the invention the positions of the output gear in the first gear pair and the input gear to the second gear pair are reversed on the intermediate drive shaft. Otherwise, this embodiment of the invention is the same as that described earlier with the exception of minor structural differences as indicated by the use of identical reference characters. This embodiment of the invention will typically be even more compact and lighter than the tool **10** described previously; and it may accordingly be preferred in applications where a source of compressed air is readily available.

Tools employing the principles of the present invention may of course take many different forms than those illustrated in FIGS. **1-4** and described above. To the extent that these other forms of the invention are not expressly excluded from the appended claims, they are fully intended to be covered therein.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by Letters Patent is:

1. A tool for threading retainers onto bolts and other fasteners comprising a casing; a first rectilinearly displaceable, non-rotatable component engageable with the fastener to prevent it from rotating housed in and protruding from one end of said casing; a second component for rotating the retainer relative to the fastener to thread the retainer therealong rotatably housed in said casing; a motor having an output shaft housed in said casing; means drive-connecting said motor output shaft to said second component to rotate said component and said retainer; a handle for supporting said tool; and means for fixing said handle to said casing at selectively variable orientations relative thereto to thereby facilitate the handling of said tool, the end of the handle adjacent the casing being threaded and the means for fixing the handle to the casing comprising a track providing member oriented laterally relative to and extending at least partially around said casing, said track member having an elongated groove through which the threaded end of the handle extends, and an internally threaded retainer slidable in said member and adapted to have said handle threaded thereinto to clamp said track providing member between said retainer and said handle to fix the handle relative to the casing.

2. The tool of claim **1**, wherein the means for rotating said second component comprises said motor output shaft, an intermediate drive shaft, and a final drive shaft, said shafts being disposed in parallel, spaced apart relationship, a first gear pair drive-connecting said motor output shaft to said intermediate drive shaft, a second gear pair distinct from said first gear pair drive-connecting said intermediate drive shaft to said final drive shaft, and means providing a drive connection between said final drive shaft and said second component.

3. The tool of claim **2**, wherein the means drive-connecting the final drive shaft to the retainer rotating component comprises a torque responsive, rotary impact imparting mechanism which includes a hammer rectilinearly movable on said final drive shaft, means connecting said hammer to said shaft for rotation therewith, a rotatable anvil aligned with said hammer, there being cooperating means on said hammer and said anvil which are engageable to provide a drive connection therebetween and, during the existence of a restraining torque of predetermined magnitude on said anvil, to effect a rotary motion of said hammer relative

to said anvil and an appurtant production of rotary impacts on said anvil, and said second component being fixed to said anvil for rotation therewith.

4. The tool of claim 3, together with means engaged with and biasing said hammer toward said anvil to maintain said cooperating means in drive connection providing engagement in the absence of said restraining torque.

5. The tool of claim 1, together with a magnetic type retainer means for retaining said first component in said guide, said retainer means including a magnet mounted in said guide, and a compression spring having one end fixed relative to said guide and the other end fixed to said magnet and biasing said first component toward the end of the casing from which said first component protrudes.

6. A tool for threading retainers onto bolts and other fasteners comprising a casing; a first component protruding from said casing and engageable with the fastener to prevent it from rotating, a guide for said first component fixed against rotation in said casing, said first component being slidable in said guide and said guide and said component being so configured as to restrain said component against rotation in said guide; a second component for rotating the retainer relative to the fastener to thread the retainer therealong; and means for rotating said second component including a motor, a drive shaft, means drive-connecting said motor to said drive shaft, and a torque responsive, rotary impact imparting mechanism; said drive shaft surrounding said guide to thereby foreshorten and increase the compactness of the tool and said impact imparting mechanism including a hammer axially movable relative to said drive shaft and fixed to said shaft for rotation therewith, an anvil rotatably mounted in said casing and having said second component rotatable therewith, there being cooperating drive connection providing elements on said hammer and said anvil, means biasing said hammer toward said anvil and toward the end of the casing from which said first component protrudes to engage said elements, and bearing means interposed between said guide and said anvil and between said anvil and said drive shaft for making said anvil rotatable relative to said guide and said drive shaft.

7. The tool of claim 6, wherein said motor has an output shaft parallel to and spaced from said guide surrounding drive shaft and wherein the means drive connecting said motor to said drive shaft comprises an intermediate drive shaft disposed in parallel relationship to said motor output shaft, a first gear pair drive-connecting said motor output shaft to said intermediate drive shaft, and a second gear pair drive-connecting said intermediate drive shaft to the guide surrounding drive shaft.

8. The tool of claim 6, together with a magnetic type retainer means for retaining said first component in said guide, said retainer means including a magnet mounted in said guide, and a compression spring having one end fixed relative to said guide and the other end fixed to said magnet and biasing said first component toward the end of the casing from which said first component protrudes.

9. A tool for threading retainers onto bolts and other fasteners comprising a casing; a first component protruding from said casing and engageable with the fastener to prevent it from rotating; a guide for said first component fixed against rotation in said casing, said first component being slidable in said guide and said guide and said component being so configured as to restrain said component against rotation in said guide; a second component for rotating the retainer relative to the fastener to thread the retainer therealong; means for rotating said second component including a motor, a drive shaft surrounding said guide, means drive-connecting said motor to said drive shaft, and a torque responsive, rotary impact imparting mechanism including a hammer axially movable relative to said drive shaft and fixed to said shaft for rotation therewith, an anvil rotatably mounted in said casing and having said second component rotatable therewith, there being cooperating drive connection providing elements on said hammer and said anvil, and means surrounding said drive shaft for biasing said hammer toward said anvil to engage said drive connection providing elements; a handle for supporting the tool; and means for fixing said handle to said casing at selectively variable orientations relative thereto to thereby facilitate the handling of said tool, one end of the handle being adjacent the casing, said one handle end being threaded, and the means for fixing the handle to the casing comprising a track providing member oriented laterally relative to and extending at least partially around said casing, said track providing member having therein an elongated groove through which the threaded end of the handle extends, and an internally threaded retainer slidable in said member and adapted to have said handle threaded thereinto to clamp said track providing member between said retainer and said handle to fix the handle relative to the casing.

10. A tool for threading retainers onto bolts and other fasteners comprising a casing; a first component protruding from said casing and engageable with the fastener to prevent it from rotating; a guide for said first component fixed against rotation in said casing, said first component being slidable in said guide and said component being so configured as to restrain said component against rotation in said guide; a second component for rotating the retainer relative to the fastener to thread the retainer therealong; means for rotating said second component including a motor, a drive shaft surrounding said guide, means drive-connecting said motor to said drive shaft, and a torque responsive, rotary impact imparting mechanism including a hammer axially movable relative to said drive shaft and fixed to said shaft for rotation therewith, an anvil rotatably mounted in said casing and having said second component rotatable therewith, there being cooperating drive connection providing elements on said hammer and said anvil, means biasing said hammer toward said anvil to engage said elements, and bearing means interposed between said guide and said anvil and between said anvil and said drive shaft for making said anvil rotatable relative to said guide and said drive shaft; a handle having one end adjacent said casing; and means for fixing said handle to said casing at selectively variable orientations relative thereto to thereby facilitate the handling of said tool, the end of the handle adjacent the casing being threaded and the means for fixing the handle to the casing comprising a track providing member

oriented laterally relative to and extending a at least partially around said casing, said track member having therein an elongated groove through which the threaded end of the handle extends, and an internally threaded retainer slidable in said member and adapted to have said handle threaded thereinto to clamp said track providing member between said retainer and said handle to fix the handle relative to the casing.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,696,693 Dated October 10, 1972

Inventor(s) Donald R. Bosten and Michael Rusnak

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 40, change "is" (first occurrence) to --if--.

Column 1, line 58, after "a" delete the word "more".

Column 2, line 18, after the period delete "cramped".

Column 3, line 10, after "ends" delete the word "preferably" and insert --of--.

Column 3, line 65, change "impacting" to --imparting--.

Column 4, line 50, change "these" to --shown--.

Column 5, line 20, after "shank" delete "end".

Column 8, line 43, before "component" insert --guide and said--.

Column 9, line 1, after "extending" delete "a".

Signed and sealed this 20th day of February 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334