

[54] BATTERY POWERED HAND TOOL

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[56] References Cited

UNITED STATES PATENTS

1,107,179	8/1914	Norberg.....	173/163
2,037,890	4/1936	Dow.....	173/163 X
2,476,486	7/1949	Ferguson	173/163
2,483,727	10/1949	Frisbie	173/163
3,109,238	11/1963	Marks	173/163 X
3,494,799	2/1970	Pedone, Jr.	310/47 X

3,733,935 5/1973 Tsuji 173/163 X

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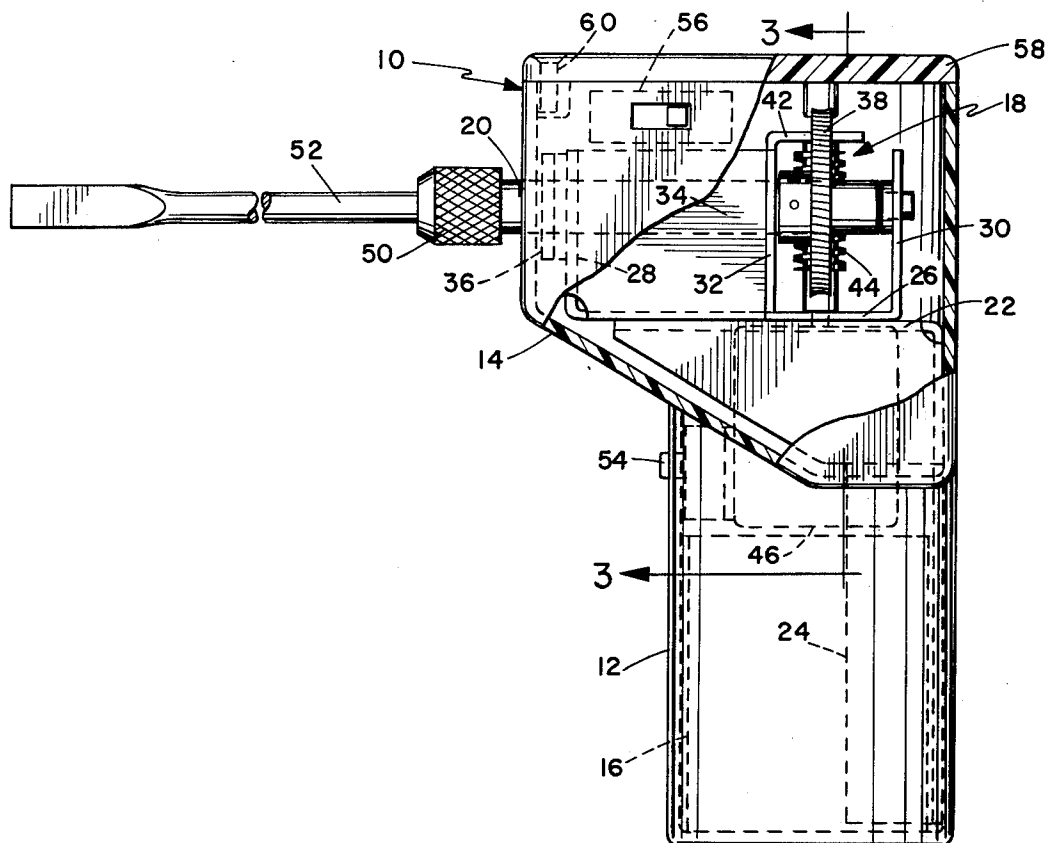
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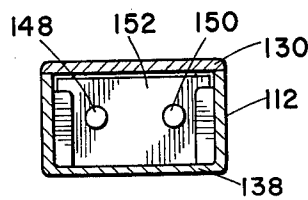
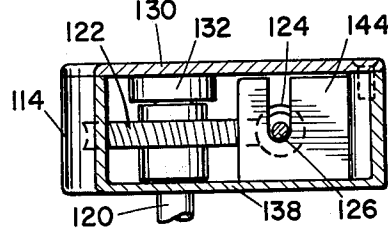
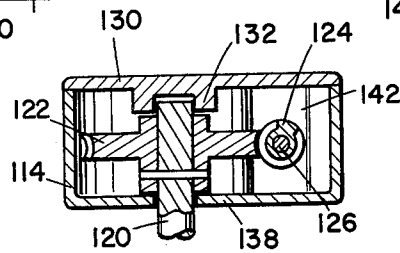
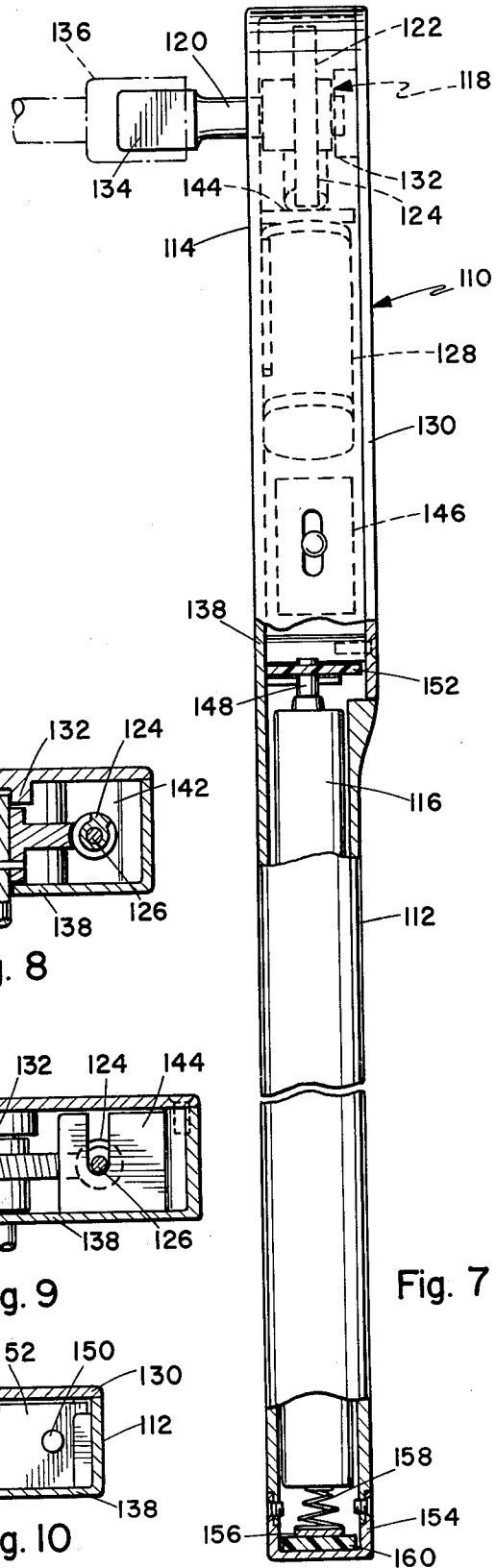
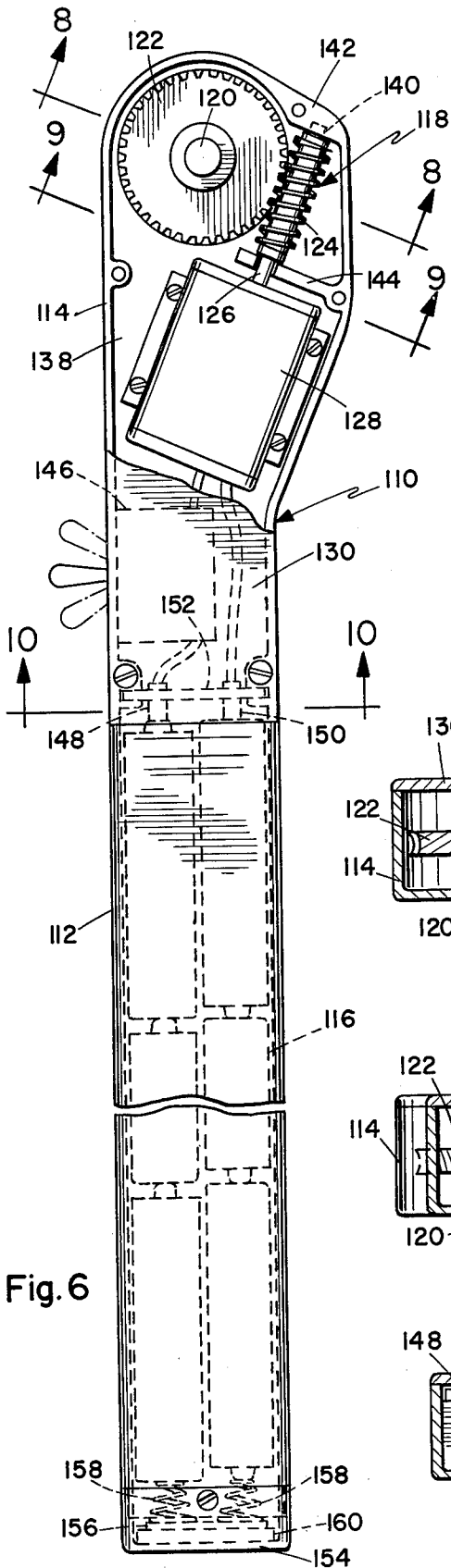
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ABSTRACT

A battery powered hand tool having a rotary output shaft with a worm gear drive, which provides a large reduction ratio in a single stage and prevents mechanical feedback load to the motor. The tool is self-contained with the batteries enclosed in a hand grip portion and an actuating and reversing switch conveniently positioned for the operator. The output shaft is adaptable to a wide range of screwdriver, socket and similar rotary tool elements, and the housing for the tool may be a compact pistol type or an elongated wrench type configuration.

3 Claims, 10 Drawing Figures





BATTERY POWERED HAND TOOL**BACKGROUND OF THE INVENTION**

Electrically driven hand tools and adapters for driving screwdriver and other rotary type tool bits, usually have multiple stage or planetary type gearing to achieve the required low speed and high torque from a high speed motor. Such tools are satisfactory for inserting or removing screws, tightening or loosening nuts and bolts and similar operations, but do not have the power for final seating or breaking loose of very tight screws and the like. This is often done by hand with the power turned off, but the action is fed back through the gears and can cause undue strain on the gears and the motor. Some drive units have locking means or clutches to permit hand torquing of tight fittings, but these result in bulky and complex mechanisms.

SUMMARY OF THE INVENTION

The hand tool described herein is battery powered and is adaptable to a wide range of screwdriver, socket wrench and other rotary type tool bits. A motor drives the output shaft through a single stage worm gear mechanism, which provides low rotary speed and high torque from a small high speed motor. The worm element is supported against axial movement, so that all mechanical feedback is against the frame or housing of the tool and not against the motor. One configuration of housing illustrated is a pistol type, which is suitable for most normal uses. The other type is of elongated wrench configuration, for driving nuts and bolts with standard socket tools, and can be used in confined spaces. In both forms, convenient switches are provided for forward or reverse operation.

The primary object of this invention, therefore, is to provide a new and improved battery powered hand tool.

Another object of this invention is to provide a new and improved battery powered hand tool having a reversible worm gear drive.

Another object of this invention is to provide a new and improved battery powered hand tool which is adaptable to most types of screwdriver, socket wrench and similar rotary drive tool bits.

A further object of this invention is to provide a new and improved battery powered hand tool which can be made in pistol type or wrench type configurations.

Other objects and advantages will be apparent in the following detailed description, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a side elevation view, partially cut away, of the pistol type tool.

FIG. 2 is a top plan view with the top cover removed.

FIG. 3 is a sectional view taken on line 3—3 of FIG. 1.

FIG. 4 is a sectional view taken on line 4—4 of FIG. 3.

FIG. 5 is a wiring diagram of the pistol type tool.

FIG. 6 is a top plan view, partially cut away, of the wrench type tool.

FIG. 7 is a side elevation view, partially cut away, of the wrench type tool.

FIG. 8 is a sectional view taken on line 8—8 of FIG. 6.

FIG. 9 is a sectional view taken on line 9—9 of FIG. 6.

FIG. 10 is a sectional view taken on line 10—10 of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The pistol type tool 10, illustrated in FIGS. 1 - 5, is contained in a substantially cylindrical elongated housing 12 having an upper extension 14, enlarged forward and to one side. A battery pack 16 is enclosed in the housing 12, the lower portion of which serves as a hand grip. A worm gear drive unit 18 is mounted in the extension 14 and has an output shaft 20 projecting from the extension, substantially perpendicular to the housing 12.

The drive unit 18 is mounted on a frame having a platform 22 with an extended wall portion 24, which fits closely against the inside of housing 12. Wall portion 24 is secured to the housing by any suitable means, such as screws, adhesive, or the like, depending on the materials used, so that operating loads are distributed to the hand grip portion of the tool. Secured on top of platform 22 is a bracket 26 having an upright front plate 28, an upright back plate 30 and an upright intermediate plate 32. The front plate is braced to the intermediate plate by side webs 34 to provide a rigid frame structure. Output shaft 20 is journaled in the three plates 28, 30 and 32 and has a thrust bearing 36 seated against the front face of front plate 28 to carry axial loads. A worm gear 38 is fixed to output shaft 20 between intermediate plate 32 and back plate 30.

Bracket 26 has a horizontally extending lower arm 40 and intermediate plate 32 has a horizontally extending upper arm 42, spaced above the lower arm. A worm 44 is journaled between arms 40 and 42 in a vertical position in mesh with worm gear 38. Mounted on the side of platform 22 is a motor 46, having a drive shaft 48 on which worm 44 is fixed. The worm 44 fits closely between arms 40 and 42 and is held by the arms against axial movement, so that axial loads applied to the worm by rotation of worm gear 38 are not applied to the motor. The specific configuration of platform 22 will depend on the particular motor and mounting arrangement used.

Output shaft 20 has a collet 50 adapted to receive a variety of tool bits, such as the screwdriver bit 52. Standard collets for specific sets of tools are well known and any convenient type may be used.

For convenient operation an actuating switch 54, preferably of pushbutton or microswitch type, is installed in the forward portion of housing 12, below the extension 14. A reversing switch 56 is installed in extension 14. The electrical wiring is omitted from the structural drawings for clarity, the simple wiring diagram being illustrated in FIG. 5. Battery pack 16 is connected through reversing switch 56 to the motor 46, which is reversible DC type. The actuating switch 54 can be in either line between the motor and the reversing switch.

The configuration of the housing may vary from that shown, to incorporate shaped hand grips and for styling and manufacturing convenience. As illustrated the housing has a removable top cover 58 held by screws 60, which provides access to the internal mechanism. If required the lower end of the housing could have a removable cap, not shown, to facilitate battery replacement, or a charging jack could be included for rechargeable batteries, the arrangement being well known.

The wrench type tool 110, illustrated in FIGS. 6-10, has an elongated housing 112, forming a hand grip, with an extension 114 at one end. Housing 112 contains a battery pack 116, which can be individual batteries as shown, or a pre-assembled pack. Drive unit 118 is mounted in extension 114 and has an output shaft 120 projecting perpendicular to housing 112. Fixed to output shaft 120 is a worm gear 122, which is engaged by a worm 124 on the drive shaft 126 of a motor 128. Extension 114 is shown as having a removable cover 130 for accessibility, the cover having a thrust bearing 132 to carry the axial load on output shaft 120. The extended end of the output shaft has a plug portion 134, of square or otherwise non-circular cross section, to receive a range of tools such as a socket extension 136. It will be obvious that either the tool 10 or tool 110 could be fitted with either a collet or plug type shaft to suit the required set of accessory tool bits.

As illustrated, the tool 110 has a base wall 138 which is continuous from extension 114 through the housing 112 to distribute loads. Output shaft 120 is journaled through base wall 138 and motor 128 is mounted on the wall. Worm 124 has one end bearing in a socket 140 in the side wall 142 of extension 114, the drive shaft 126 passing through a rigid web 114 extending between the side wall and base wall 138. The worm is thus held against axial movement between web 144 and side 142, to prevent loads from damaging the motor.

The electrical connections may be made in any suitable manner. As shown, an actuating and reversing switch 146 is installed in extension 114, the switch having a center off position and forward and reverse positions, as indicated in full and broken line, respectively. The batteries make connection with contacts 148 and 150 in an insulated plate 152 secured in the housing at the junction with extension 114, the short wiring connections extending from the contacts, through the switch to the motor, as in FIG. 6. At the other end of housing 112 is a removable end cap 154 for battery access. The batteries are coupled in series through a connector plate 156, with springs 158 to contact and hold the batteries in place. To avoid any short circuit to the housing, the connector plate 156 is preferably mounted on an insulating pad 160 in the end cap 154.

In both forms of the tool the output shaft is securely mounted with a load carrying thrust bearing and the load is distributed throughout the tool. The firmly supported worm prevents any feedback load from damaging the motor. With the high ratio worm drive necessary in the tool to obtain the required driving power, the worm drive cannot be driven in reverse by feedback

torque from the drive shaft. In fact, with the motor shut off, the output shaft is effectively locked relative to the housing, making it practical to apply manual torque for final seating or initial breaking loose of tight screws or fittings.

The worm mechanism provides the highest possible speed reduction in a single stage, with a positive non-feedback drive, and a very compact installation. For maximum power the battery pack may have a voltage higher than the rated voltage of the motor, since most motors can withstand reasonable overspeed conditions for the short period operation normally associated with the tool.

Having described my invention, I now claim:

1. A battery powered hand tool, comprising:
an elongated housing for containing a battery pack therein;

said housing having an extension at one end;

a worm gear drive unit mounted in said extension and having an output shaft projecting substantially perpendicular to said housing, with means on the output shaft for attachment thereto of accessory tool bits;

a platform in said extension on which said drive unit is mounted, the platform having a wall portion extending into and secured to said housing;

a bracket fixed on said platform, said output shaft being journaled in said bracket and having bearing means holding the output shaft against axial movement in the bracket;

said drive unit including a worm gear fixed on said output shaft, and a worm mounted in said bracket in mesh with the worm gear;

a drive motor mounted on said platform and having a drive shaft on which said worm is fixed;

said bracket having arms in which said drive shaft is journaled and between which said worm is held against axial movement;

and a motor actuating switch mounted in said housing.

2. A battery powered hand tool according to claim 1, said bracket having extended plate portions in which said output shaft is journaled;

and side webs interconnecting said plate portions in a rigid structure.

3. A battery powered hand tool according to claim 2, wherein said plate portions include a front plate adjacent the projecting portion of said output shaft, a back plate and an intermediate plate, said worm gear being held against axial movement between said back and intermediate plates.

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