Nov. 26, 1957 W. J. KUPFRIAN 2,814,322

FLEXIBLE SHAFT HAND TOOL

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FIG. 1

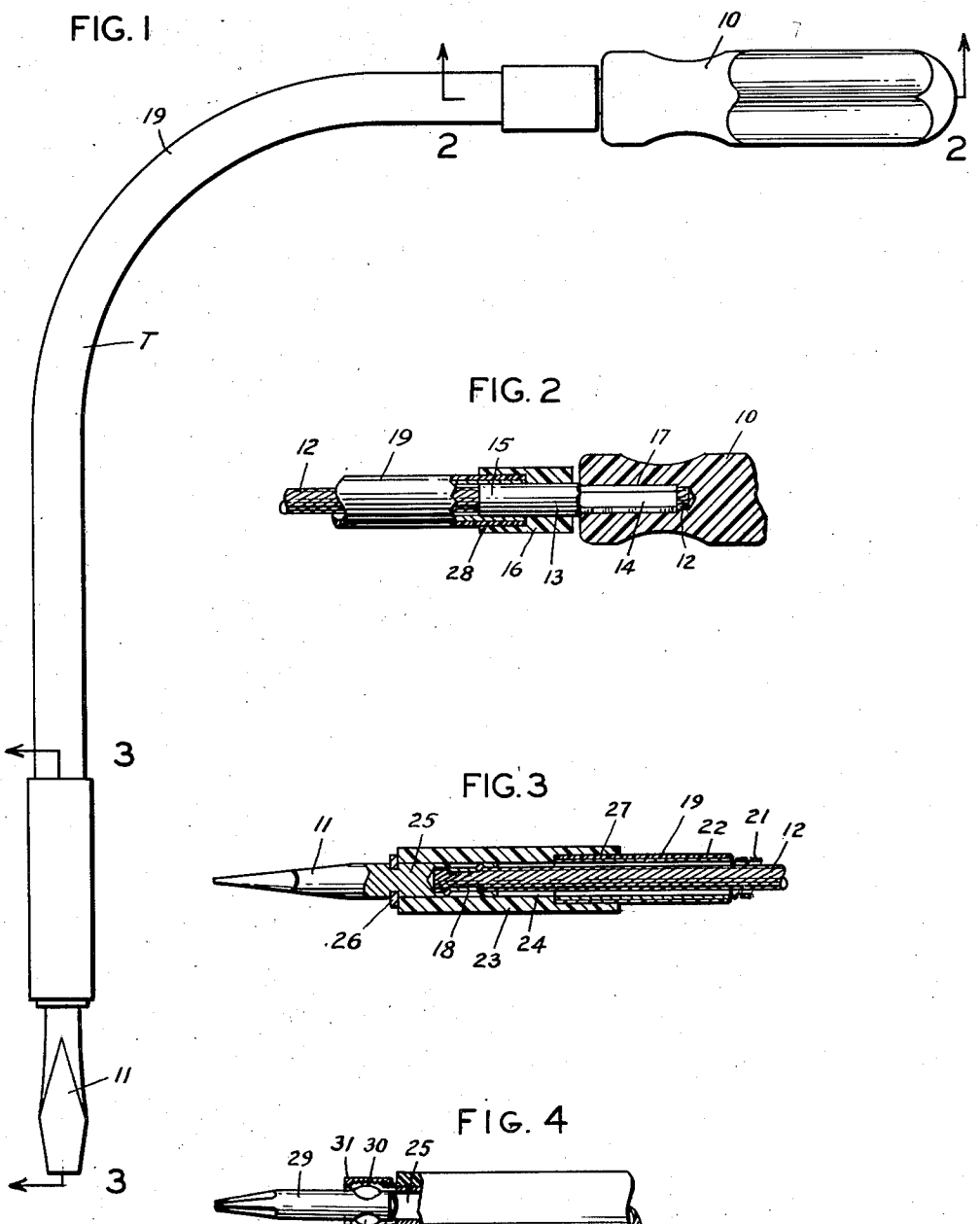


FIG. 2




FIG. 3




FIG. 4




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# FLEXIBLE SHAFT HAND TOOL

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3 Claims. (Cl. 145—61)

This invention relates to hand tools and more particularly to a screw or nut driver having a flexible shaft member extending between the handle and the tool bit. Tools of this type have been in general use for some time, but have not been completely successful because they lacked certain details essential to good trade performance.

The principal object of the present invention is to provide an improved flexible shaft hand tool that overcomes many of the defects found in earlier structures; to provide a flexible shaft type screwdriver or similar tool having improved means for journalling the casing to the flexible shaft at both ends; to provide an improved flexible shaft type screwdriver having an improved means for securing the flexible shaft within the handle; to provide an improved flexible shaft tool having a bit portion, a handle portion, and a flexible shaft connection between the two with a covering extending between the bit and the handle that provides complete electrical insulation along its entire length; to provide improved means for interchanging bits, and for providing suitable thrust for the bits. These and other objects will become more apparent from the drawing and from the accompanying description.

In the drawing:

Fig. 1 is an elevational view of one form of the invention, showing the two ends disposed at 90° from the normal aligned position.

Fig. 2 is a partial sectional view taken on the line 2—2 of Fig. 1.

Fig. 3 is a sectional view of the bit end of the tool taken on the line 3—3 of Fig. 1; and

Fig. 4 is a view similar to Fig. 3 showing a modified tip construction allowing for interchangeability of bits.

Referring again to the drawing, the improved tool "T" is shown as a screwdriver for convenience in illustrating and describing the invention, though it will be understood that the principles of the invention are applicable to other similar tools, such as tap holders, reamers, nut setters, and the like. As shown, the tool comprises a handle **10** and a tool bit **11** such as a screwdriver bit or other tool element as previously described. The handle and bit are operatively connected by means of a flexible shaft **12** of conventional design, and preferably consisting of a single center wire upon which successive layers of wires are wrapped, each layer being wound in a direction opposite from that of the preceding layer. I prefer to employ flexible shafting known in the trade as remote-control flexible shafting which exhibits similar strength characteristics in either direction of operation. Such shafting employs more wires per layer, and smaller diameters of wire than are found in other types. The shaft should employ steel wires in its construction, though for non-magnetic or non-corrosive properties, other materials such as bronze or nickel-containing alloys may be used. The size of the shaft is selected so as to be capable of imparting the full torque load that ordinarily can be imparted to the handle **10** when it is gripped in the hand. Although this load varies according to the diameter of the handle, it has been found that with a handle of approximately ⅞" in diameter a torque of approximately 25 lb. in. is satisfactory, and flexible shafts meeting this load requirement are obtainable in 3/16" diameter size.



Most shafts of the remote-control type are wound under an essential initial tension, which tends to cause the layers to unravel when cut unless special precautions are taken. I prefer to deform the shaft into polygonal cross-section in the region of the cutting zone, so that it safely may be severed in the deformed region. The shaft is attached in any convenient manner to the handle **10** and to the tool bit **11**, though preferred methods are illustrated in Figs. 2 and 3. The connection to the handle preferably is made by means of a terminal or tubule **13** which initially may be passed freely over the end of the flexible shaft **12**, following which the end portion may be deformed from the round cross-section to form a polygonal shaped section **14** for keying the shaft within the handle. By forming the section **14** with the same number of sides as the deformed section on the flexible shaft, a better bond between the parts is obtained. The deformed end of the flexible shaft otherwise may be inserted directly within the handle **10**, but the tubule **13** offers advantages in that it strengthens the shaft at the point of connection within the handle, and at the same time provides an inflexible cylindrical portion **15** adjoining the handle that may be journalled within a ferrule **16** and within the casing **19** as will be more fully described.

The terminal **13** may be imbedded within the handle **10** in any conventional manner. If the handle consists of wood, the parts may be cemented together. I prefer, however, to use a plastic handle in which case the terminal **13** may be molded directly within the handle at the time the handle is formed, or it may be inserted later. I prefer to use a preformed thermoplastic handle having a cavity **17** to receive the deformed section **14**. Cement or a press fit may be used, though I prefer to heat the deformed section **14**, so that it softens the plastic material, forms longitudinal grooves therein corresponding with the shape of the deformed section, and automatically cements itself to the thermoplastic material. Experience has shown that the cavity **17** should have a diameter slightly greater than the distance across flats on the deformed section **14** to accommodate the normal flow of softened material, and to allow for the adequate escape of entrapped air.

At the opposite end, the flexible shaft **12** is secured to the tool **11**, preferably by crimping it within a cavity formed directly in the tip. As before, the resulting crimped portion **18** preferably is of polygonal cross-section, of a shape corresponding with the crimp previously imparted to the shaft **12** at the end region. The crimped portion on the tip preferably starts at a point spaced from the opening of the cavity, whereby the wall portion forming the opening to the cavity retains its original circular shape to provide a better bearing surface as will appear, and to avoid weakening the edges of the aperture.

The region between the handle **10** and the bit **11**, surrounding the flexible shaft, is enclosed within a suitable casing **19** which contributes substantially to the capacity of the tool, lessens objectionable buckling tendencies under heavy load conditions, and protects the flexible shaft **12** from injury, corrosion, and from loss of surface lubricant. I prefer to use a casing that bends substantially about a neutral axis to minimize changes in length when the casing arcs. For this purpose I prefer a casing composed of a liner member **21** preferably employing spring wire of rectangular cross-section, formed into spaced turns as illustrated in Fig. 3. When casing of this type bends in an arc, the turns on the inside radius tend to compress, and the turns on the outer radius tend to expand, resulting

in little or no overall change in length. The casing liner **21** preferably is enclosed within a flexible cover **22**, typically a tube of rubber, or plasticized thermoplastic, such as vinyl or ethylene compounds. This covering effectively closes the turns in the liner member, making a leak-proof enclosure, and also electrically insulates the enclosed metallic parts from contact with electrically charged members.

A handpiece or journal member **23** is provided adjacent to the tool bit **11**, and is provided with a bore **24** for rotatively receiving a spindle portion **25** of the bit **11**. The handpiece **23** is relieved at one end with a larger diameter portion **27** for receiving the forward end of the casing **19**. A thrust collar **26** comprising a shoulder on the spindle **25**, or a retaining ring as shown in Fig. 3, is employed to impart end thrust to the tool bit **11**. For the handpiece **23**, I prefer to use a plastic tube formed of an extruded thermoplastic, or a wrapped phenolic tube reinforced with paper or fabric. The latter is available under various trade names and finds frequent application where high strength and wear-resistance are desirable. In any event, both the handpiece **23** and the ferrule **16** are made of electrically insulating materials, so that the entire structure from the handle to the tip is completely enclosed and electrically insulated. The ferrule **16** may be relieved with an enlarged diameter portion **28** as was employed on the handpiece **23**, and the casing may be inserted freely within the enlarged diameter portion, or may be secured within the opening in any suitable manner, as by cementing.

The handpiece and tip construction shown in Fig. 4 differs from Fig. 3 primarily in that the spindle **25** is made hollow at its forward end, having an inside diameter suitable for receiving interchangeable bits **29**. Any conventional collet or chuck **30** may be employed, though for purposes of illustration I show the spindle **25** provided with an enlarged portion threaded to receive nut **31**. The threaded portion also may be provided with diametrally opposed slots **32** for slidable engagement with cooperating members such as lugs or ears **33** formed in the bit **29**. The nut **31** and the threaded portion may have cooperating conical faces as indicated at **34** operative when the nut **31** is tightened to constrict the halves of the collet **30** locking the bit **29** in position. As an alternative, the nut and/or the threaded spindle may employ taper threads causing a similar constricting action when the parts are fully mated. The slopnig conical faces **34** are to be preferred because they allow a more exact positioning of the nut **31** in the fully engaged position. This is particularly important where I may prefer to locate the rear face **35** of the nut directly adjacent to the forward wall of the handpiece **23** to operate as a thrust collar as shown in Fig. 4. As illustrated also in Fig. 4, the



threads on the spindle **25** may be relieved adjacent to the rear part of the nut, and the nut wall may be crimped inwardly after assembly to preclude subsequent removal and possible accidental loss of the nut from the spindle **25**.

Although I have shown several variant forms of the invention to illustrate the novel principles, it is to be understood that I do not wish to limit myself by the disclosure of the drawings, as I contemplate any structure properly within the scope of the appended claims.

I claim:

1. A hand tool comprising a tool chuck, a handle, a flexible shaft extending between said chuck and said handle, a casing for said flexible shaft, ferrules on said casing at each end thereof, and a tubular member surrounding a terminal portion of said flexible shaft and projecting within said handle, at least a part of said member and said terminal portion being deformed to preclude relative motion between them, said tubular member being fixed within said handle.

2. A hand tool comprising a tool support, a handle, a flexible shaft connected to said support and projecting within said handle, a casing for said flexible shaft, and a tubular member encircling the handle end of said flexible shaft, said member being deformed so as to anchor said shaft within said member, said member in turn being anchored within said handle.

3. A hand tool comprising a tool chuck, a handle, a flexible shaft extending between said chuck and said handle, a casing for said flexible shaft, ferrules on said casing at each end thereof, and a tubular member surrounding a terminal portion of said flexible shaft and projecting at one end within the end of said casing nearest said handle, said member being secured to said terminal portion of said flexible shaft, said tubular member also extending within said handle and being securely attached thereto.


**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 871,155 | Wood | Nov. 19, 1907 |
| 1,225,249 | Holtschneider | May 8, 1917 |
| 1,343,101 | Weaver | June 8, 1920 |
| 1,507,990 | Donaldson | Sept. 9, 1924 |
| 1,624,530 | Caruso | Apr. 12, 1927 |
| 1,902,438 | Foley | Mar. 21, 1933 |
| 1,903,660 | Smith et al. | Apr. 11, 1933 |
| 1,999,051 | Kennedy | Apr. 23, 1935 |
| 2,023,693 | Miller | Dec. 10, 1935 |
| 2,619,860 | Gray | Dec. 2, 1952 |

FOREIGN PATENTS

| | | |
|---|---|---|
| 605,130 | Great Britain | July 16, 1948 |