

[54] **HAND TOOL FOR REACHING
REMOTE LOCATIONS**

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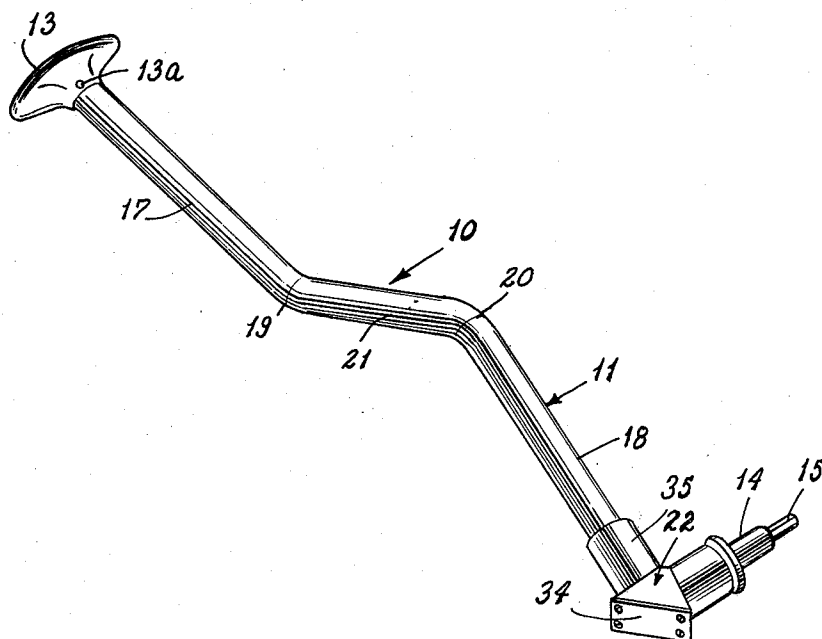
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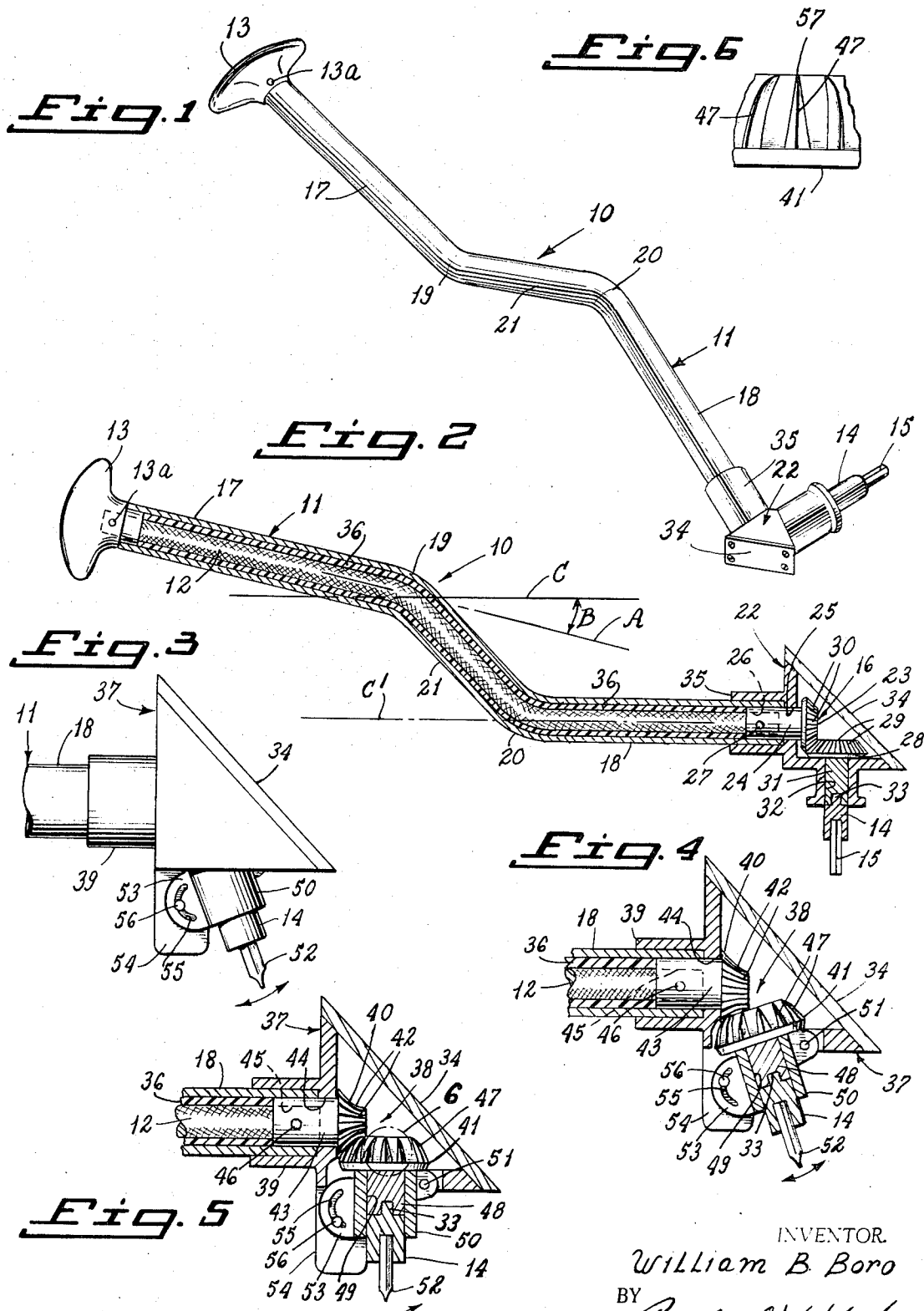
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[57] **ABSTRACT**

A hand tool for reaching remote locations that includes an elongated hollow tube having two substantially straight end sections whose inner terminal portions are offset from each other and a center section that connects these end sections. A flexible cable is rotatably mounted within the tube and one end of the cable is securely fastened to a handle that projects beyond the one end of the tube. The opposite end of the cable is securely connected to a bevel gear that meshes with another bevel gear which is in turn connected to a chuck that is adapted to hold a tool bit. In one embodiment of the invention, the teeth of the bevel gears are rounded so that the bevel gear that is connected to the chuck can be rotated in order to present the tool bit at various angles with respect to the adjacent end section of the tube.

8 Claims, 6 Drawing Figures





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HAND TOOL FOR REACHING REMOTE LOCATIONS

BACKGROUND OF THE INVENTION

Many vehicles and machinery are very complex and thus many locations about such vehicles and machinery are difficult to reach although in many instances it is necessary to reach such remote and difficult to reach locations in order to perform maintenance or to make necessary adjustments. In view of such complexity, it is frequently necessary to dismantel or remove parts or access covers in order to perform the required maintenance or to make the adjustments. This is time consuming and can greatly increase the difficulty and expense associated with performing necessary maintenance or adjustments.

These problems are particularly present in aircraft where it is frequently necessary to remove access covers to gain access to equipment to perform necessary adjustments. For example, it is necessary to frequently make adjustments to the potentiometers that control the engine temperatures of various types of aircraft. For instance, with C-130 type aircraft that have four engines, engine temperature adjustments are accomplished by rotating the shafts of four potentiometers that are part of a temperature datum amplifier that is installed under the engine cowling. The temperatures that are controlled through these potentiometers and the amplifier are checked during various engine run operations, at engine start, at normal ground idle, at flight idle, and at maximum power. If the temperatures are found to be outside of the specified tolerances, then the appropriate potentiometer or potentiometers must be adjusted to bring the temperatures back into the required range. In order to adjust the potentiometers, the engine involved must be shut down and a stand brought along side the engine. Some thirty-seven camlocks on the cowling must then be loosened and the cowling opened. The appropriate potentiometer or potentiometers must then be adjusted, the cowling closed and the camlocks tightened. The stand must then be removed to an appropriate distance from the engine, the engine restarted and the temperatures rechecked. Considering the fact that some four engines are involved and a total of some sixteen potentiometers may require adjustments, such adjustments are quite time consuming with current tools and procedures.

With the tool of the present invention, it is possible to greatly reduce the time and difficulties associated with such adjustments. With the present tool, a mechanic can crawl out of the cockpit through the emergency exit and across the top of the wing to the engine. Then, using the tool of the present invention, he can insert it through the air intake and make the necessary adjustments to the appropriate potentiometers, and all of this can be accomplished without the use of stands and without the necessity of opening and closing cowlings.

Although the tool of the present invention is particularly useful in making adjustments to equipment on aircraft, it also has a variety of other uses related to other types of equipment.

SUMMARY OF THE INVENTION

This invention relates to hand tools and more particularly to a hand tool for reaching remote locations.

Accordingly, it is an object of the present invention to provide a hand tool that is capable of being used to reach remote locations in machinery and the like.

It is also an object of the present invention to provide a hand tool that is capable of being used to get around intervening objects.

It is also an object of this invention to provide a hand tool that is capable of making precise adjustments in remote locations.

The present invention provides a hand tool having a hollow tube and a gear housing connected to one end of the hollow tube. A flexible connecting member is rotatably mounted within the hollow tube and a handle is connected to the end of the flexible connecting member which is opposite the end that is located adjacent to the gear housing. A first gear is connected to the opposite end of the flexible connecting member and at least a portion of this gear is located within the gear housing. The hand tool also has a second gear having teeth which mesh with the teeth of the first gear, tool holding means for holding a tool bit operatively connected to the second gear and means connected to the gear housing for pivotally mounting the second gear and the tool holding means on the gear housing and for permitting the teeth of the second gear to be slidably movable with respect to the teeth of the first gear as the second gear and the tool holding means are pivoted on the gear housing. Means connected to the gear housing are also provided for selectively securing the pivotal mounting means in place to prevent pivotal movement of the pivotal mounting means, the second gear and the tool holding means.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be hereinafter more fully described with reference to the accompanying drawings in which:

FIG. 1 is a perspective view of the hand tool of this invention;

FIG. 2 is a cross section of the hand tool illustrated in FIG. 1;

FIG. 3 is a side elevational view of an alternative embodiment of a portion of the tool of the present invention;

FIG. 4 is a cross sectional view of the structure illustrated in FIG. 3;

FIG. 5 is a view of the structure illustrated in FIG. 3 and FIG. 4 showing its movable mechanism in a moved position; and

FIG. 6 is a broken view of a portion of the structure illustrated in FIG. 5 taken within the circle 6 thereof.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1 and FIG. 2 there is shown a hand tool 10 of this invention that comprises a hollow tube 11 and a elongated flexible connecting member comprising a cable 12 rotatably mounted within the hollow tube, and a handle 13 fixedly connected to one end of the connecting member by means of a pin 13a. The hand tool 10 also comprises tool holding means comprising a chuck 14 for holding a tool bit 15 and gear means designated generally as 16 operatively connected to the opposite end of the connecting cable 12 and to the chuck for transmitting rotary motion from

the cable to the chuck. The elongated hollow tube 11 comprises two elongated substantially straight end sections 17 and 18 whose respective inner terminal portions 19 and 20 are offset from each other and a center section 21 connected to the inner terminal portions for interconnecting the end sections. The longitudinal axes of the end sections 17 and 18 have an angular relationship with each other that is best illustrated in FIG. 2 where the longitudinal axis A of the end section 17 forms an angle B with the axis or line C which is a line that is parallel to the longitudinal axis C of the end section 18. It is important that the inner terminal portions 19 and 20 of the respective end sections 17 and 18 be offset and that the longitudinal axes of these end sections have an angular relationship since this permits the tube 11 to be inserted into machinery and the like and around intervening obstacles.

The gear means 16 is located within a gear housing 22 that is connected to the end of the tube end section 18 and the gear means comprises a first bevel gear 23 that has an integral cylindrical shank 24 that rides and is rotatably mounted in a cylindrical aperture 25 in the gear housing. The shank 24 has a hole 26 in its end that receives the end of the cable 12 and the shank 24 and the bevel gear 23 are rigidly secured to the end of the cable by a pin 27 that passes through a hole in the shank and in the end of the cable so that rotation of the cable results in corresponding rotation of the bevel gear. Another or second bevel gear 28 has teeth 29 that mesh with teeth 30 of the bevel gear 23 so the rotation of the bevel gear 23 results in rotation of the bevel gear 28. The bevel gear 28 has an integral cylindrical shank 31 that is rotatably mounted in a cylindrical aperture 32 in the lower portion of the gear housing 22 and the end of the shank has a threaded hole that is adapted to receive a threaded cylindrical projection 33 on the upper end of the tool bit chuck 14 so that rotation of the bevel gear 28 results in rotation of its integral shank, the connected chuck and the tool bit 15 that has been inserted into the chuck. The integral cylindrical shanks 24 and 31 are mounted in the gear housing 22 in such a manner that the longitudinal axes of the shanks are perpendicular to each other and the long axis of the tool bit 15 is perpendicular to the longitudinal axis of the adjacent tube end section 18.

The gear housing 22 has a generally triangular shaped central body section that houses the bevel gears 23 and 28 and a removable cover 34 is located on the central body section in order to provide access to the gears for lubrication and similar maintenance. The gear housing 22 has a hollow cylindrical projection 35 whose longitudinal center axis coincides with the longitudinal center axis of the cylindrical recess 25. This hollow cylindrical projection 35 is adapted to receive and slip over the end of the end section 18 and to be securely fastened to the end section.

In order to permit the cable 12 to be easily rotated within the tube 11 and to prevent kinking and binding of the cable as it is being rotated, a plastic tubular sleeve 36 is located within the tube around the cable between the cable and the inner tube wall and it surrounds a substantial portion of the length of the cable. In the preferred embodiment of the invention, the plastic material of the tubular sleeve should comprise polytetrafluoroethylene which is sold under the trade-

mark Teflon of the E. I. DuPont de Nemours and Company, Inc. since sleeves made from this material have been found to eliminate virtually any kinking or binding of the cable 12.

An alternative gear housing 37 and gear means 38 that can be utilized with the tube 11, cable 12, handle 13 and chuck 14 are illustrated in FIG. 3 through FIG. 6. The gear housing 37 is generally similar to the previously described gear housing 22 and has a generally triangular shaped body section and a hollow cylindrical extension 39 that is adapted to receive and slip over the end of the end section 18 and to be securely fastened to the end section. The gear means 38 is located within the gear housing 37 and comprises two special bevel gears 40 and 41. The special bevel gear 40 has teeth 42 and corresponding grooves adjacent to the teeth that are dished inward or concave shaped when viewed from the side or have a concave profile as illustrated in FIGS. 4 and 5. The bevel gear 40 has an integral cylindrical shank 43 that is rotatably mounted in a cylindrical aperture 44 in the gear housing 37 whose central axis coincides with the central axis of the hollow cylindrical projection 39. The shank 43 has a hole 45 in its end that receives the end of the cable 12 and the shank and the bevel gear 40 are rigidly secured to the end of the cable by a pin 46 that passes through a hole in the shank and a corresponding hole in the end of the cable.

The other special bevel gear 41 has teeth 47 and grooves adjacent to the teeth that are dished or curved outward or convex in shape when viewed from the side or have a convex profile as illustrated in FIGS. 4 and 5 and these teeth mesh with the teeth 42 of the bevel gear 40 so that rotation of the bevel gear results in rotation of the bevel gear 41. The bevel gear 41 has an integral shaft 48 that is rotatably mounted in a cylindrical aperture 49 in a movable member 50 that is pivotally mounted on the lower portion of the gear housing by means of the pin 51 which passes through an extension on the side of the movable member 50. The lower end of the shank 48 has a threaded hole that is adapted to receive the threaded cylindrical projection 33 on the upper end of the tool bit chuck 14 so that rotation of the bevel gear 41 results in rotation of its integral shank, the connected chuck and the tool bit 52 that has been inserted into the chuck. The member 50 has an integral flange 53 on its side that is movable against a flat surfaced projection 54 that extends below and is connected to the gear housing 37. The flange 53 has a curved slot 55 in which the shank of a cap screw 56 rides and the cap screw is threaded into a hole in the flat surfaced projection 54 so that when the cap screw is loosened the member 50, bevel gear 41, the shank 48 of the bevel gear and the tool bit chuck 14 are free to pivot inward and outward as illustrated in FIGS. 3 through 5 and the teeth of the gear 41 are slidably movable with respect to the teeth of the gear 40. When the screw 56 is tightened, the flange 53 is forced against the flat surfaced projection 54 so that the long axis of the integral shank 48 and the long axis of the tool bit 52 are held in a fixed angular relationship with respect to the long axis of the adjacent tube end section 18. In view of this arrangement, the tool bit 52 can be presented so that its long axis is perpendicular to the long axis of the adjacent tube end section 18 as illustrated in FIG. 5 or the tool bit can be presented so its

long axis forms an acute angle with the long axis of the adjacent end section 18 as illustrated in FIGS. 3 and 4. The ability of the member 50 to be moved to present the tool bit 52 at various angles is made possible by the curved shape of the teeth 42 and 47. It will also be appreciated that it is necessary that rather large tolerances exist between the teeth 42 and 47 so that the member 50 can be pivoted inward or outward without having binding occur between these teeth. In the preferred embodiment of the invention, the teeth 47 come to a point 57 toward the upper end of the bevel gear 41 as illustrated in FIG. 6 since this shape of the teeth virtually eliminates the possibility of binding between the teeth 47 and the teeth 42 particularly when the teeth are oriented as illustrated in FIG. 4.

In the preferred embodiment of the invention, the bevel gears 23 and 40 that are operatively connected to the cable 12 are smaller in diameter than the respective bevel gears 28 and 41. The bevel gear 23 and 40 also have fewer respective teeth 30 and 42 than the respective bevel gears 28 and 41 and this results in an output to input gear ratio greater than 1 and gives an increased mechanical advantage that increases the torque available to exerted against the tool bit 15 or 52.

Although a screwdriver type tool bit 52 and an Allen type or hexagonal head tool bit 15 are shown in the drawings, it will be appreciated that numerous other types of tool bits can be utilized with the tool of the present invention and that the type of tool bit will depend upon the type of work or adjustments that are to be performed.

In order to utilize the embodiment of the invention illustrated in FIGS. 1 and 2, the mechanic selects the proper type tool bit to complete the job that is to be performed and he inserts it into the chuck 14. He then passes the tube 11 tool end first around any intervening obstacles and inserts the end of the tool bit into the appropriate part such as a screw of the like that is to be loosened, tightened, or adjusted. Then, he grasps the handle 13 and rotates it in the appropriate direction and this causes rotation of the attached cable 12 and rotation of the bevel gear 23 that is secured to the cable. The rotation of the bevel gear 23 and its teeth 30 causes rotation of the intermeshed teeth 29 and the bevel gear 28 and this results in rotation of the integral shank 31, the attached tool bit chuck 14 and the tool bit. The operation of the embodiment of the invention illustrated in FIGS. 3 through 6 is similar to that for the embodiment illustrated in FIGS. 1 and 2, however, the angle that the long axis of the tool bit 52 makes with the long axis of the adjacent end member 18 can be selected by loosening the cap screw 56, pivoting the member 50, and tightening the cap screw to clamp the flange 53 against the flat surfaced projection 54 to secure the member 50, the gear 41, and the connected chuck 14 and tool bit in place. This ability, to change the angle that the long axis of the tool bit 52 makes with the long axis of the adjacent end section 18, permits the embodiment of the tool of the invention illustrated in FIGS. 3 through 6 to reach into very confined and hard

to reach locations.

Although the invention has been described with reference to certain preferred embodiments, it will be understood that variations and modifications may be made within the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A hand tool comprising a hollow tube, a gear housing connected to one end of said hollow tube, a flexible connecting member rotatably mounted within said hollow tube, a handle connected to the end of said flexible connecting member opposite the end thereof located adjacent to said gear housing, a first gear connected to the opposite end of said connecting member and having at least a portion thereof located within said gear housing, a second gear having teeth meshing with the teeth of said first gear, tool holding means for holding a tool bit operatively connected to said second gear, means connected to said gear housing for pivotally mounting second gear and said tool holding means on said gear housing and for permitting the teeth of said second gear to be slidably movable with respect to the teeth of said first gear as said second gear and said tool holding means are pivoted on said gear housing and means connected to said gear housing for selectively securing said pivotal mounting means in place to prevent pivotal movement of said pivotal mounting means, said second gear and said tool holding means.

2. The hand tool of claim 1 wherein the teeth of one of said gears have a concave profile and the teeth of the other gear have a convex profile to assist in permitting pivotal movement of said pivotal mounting means, said second gear and said tool holding means.

3. The hand tool of claim 2 wherein said pivotal mounting means comprises a mounting member for rotatably mounting said second gear and said tool holding means and means extending from said mounting member for permitting said mounting member to be pivotally connected to said gear housing.

4. The hand tool of claim 3 wherein said securing means comprises a projection extending from said gear housing, a flange extending from said mounting member and means for clamping said flange against said projection.

5. The hand tool of claim 4 wherein said flange has a curved slot and said clamping means comprises a member connected to said projection and having a portion thereof riding in said slot.

6. The hand tool of claim 2 wherein said hollow tube has two elongated substantially straight end sections whose inner terminal portions are offset from each other, and a center section interconnecting the inner terminal portions of said end sections.

7. The hand tool of claim 6 wherein the longitudinal axes of said end sections have an angular relationship with each other.

8. The hand tool of claim 7 further comprising a plastic tubular sleeve located within said tube and surrounding a substantial portion of said flexible connecting member.

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