July 16, 1968 R. P. SCHANEN ETAL 3,392,608

LUG WRENCH WITH HIGH MECHANICAL ADVANTAGE

Filed Feb. 14, 1967 3 Sheets-Sheet 1

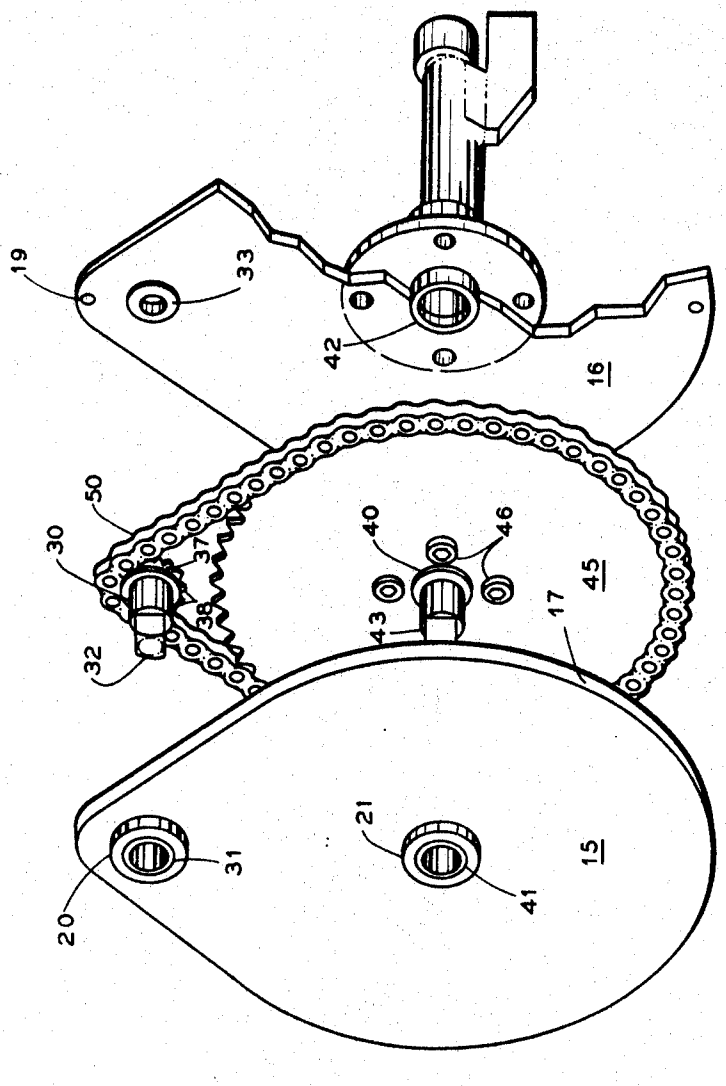


FIGURE 1

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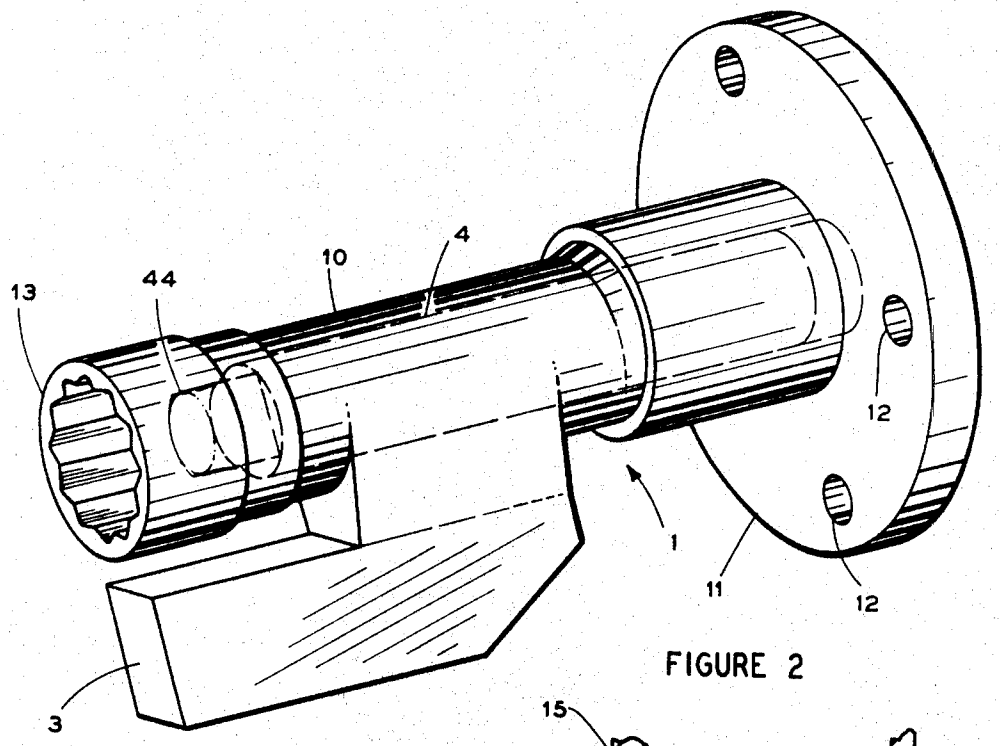


FIGURE 2

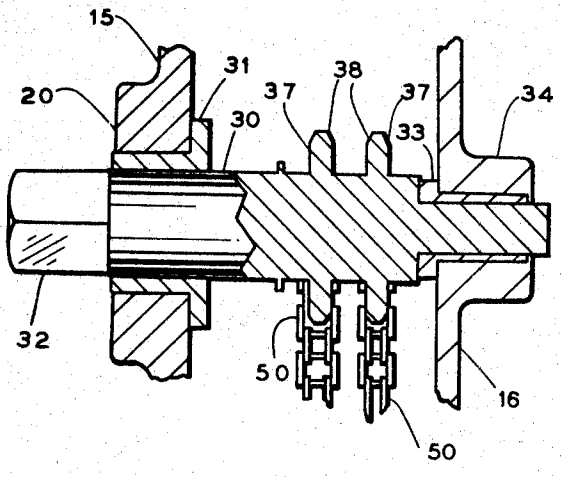


FIGURE 3

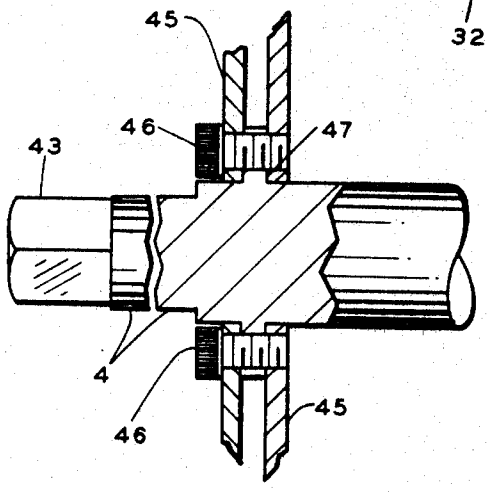


FIGURE 4

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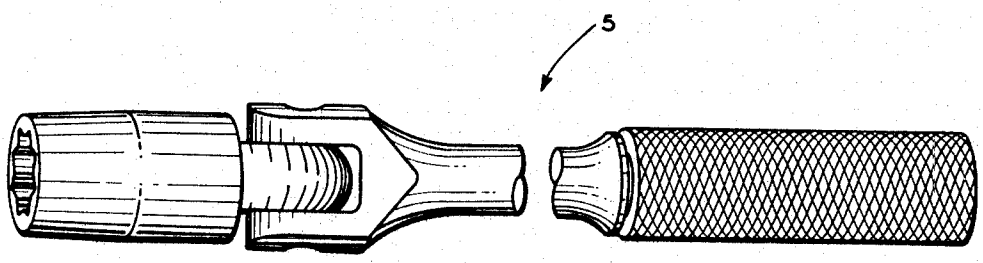


FIGURE 5

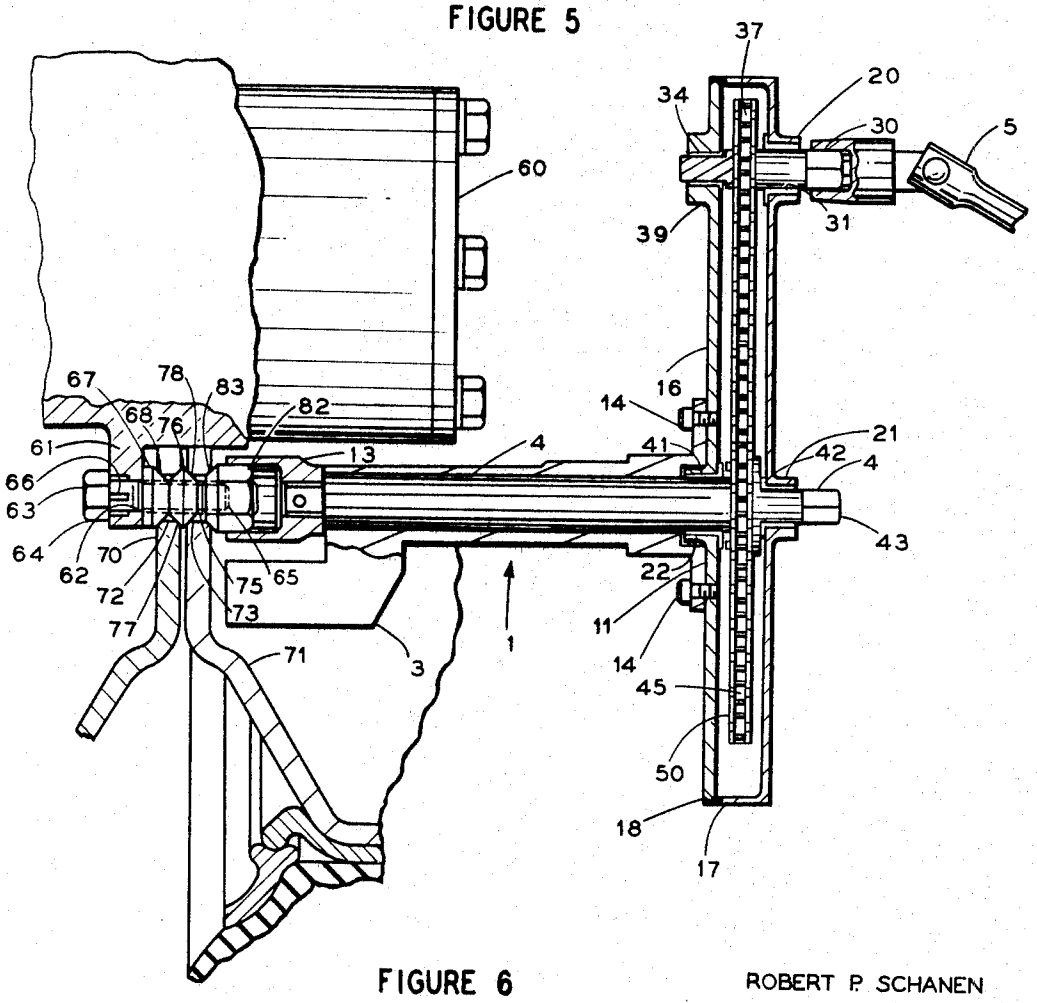


FIGURE 6

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LUG WRENCH WITH HIGH MECHANICAL ADVANTAGE

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ABSTRACT OF THE DISCLOSURE

A gear driven wrench in which the principal components are a gear box having two shafts journaled therein and a countertorque member fixed to the housing to prevent it from rotating. One shaft is driven by a conventional hand drive, while the other shaft projects from the gear box to receive a conventional socket wrench that engages the lug nut to be loosened. The countertorque member includes a finger extending the same length as the driven shaft, and this finger is offset from the shaft so that it engages either the hub or a lug nut adjacent that being loosened or tightened. The countertorque member may also include a sleeve surrounding the main shaft and serving as a bearing therefor.

The present invention lies in the field of hand operated wrenches, and more particularly hand operated wrenches which include gear means to increase the mechanical advantage of the tool. A particular use of the wrench is the loosening or tightening of the lug nuts and sleeve nuts on the dual wheels of trucks and similar vehicles.

The main object of the present invention is to furnish a hand operated wrench having a large mechanical advantage and equipped with means to steady the tool and furnish the countertorque needed when the tool is engaged with a nut which is either to be tightened on or loosened from a second threaded member. Other objects are to furnish such a wrench which may be readily moved from one nut to the next, may quickly be disassembled and stored as a compact package, is simple in design and construction, and is completely reliable in operation.

These and other objects are achieved in an illustrated preferred embodiment in which the principal parts are a relatively thin gear box having protruding therefrom a number of polygonal-ended shafts adapted to be engaged by a tubular wrench member and a hand operated crank, and a simple countertorque member in the form of a hollow sleeve integrally attached to the housing of the gear box and including an offset finger at its free end. This finger contacts the lug nut adjacent the one being loosened to prevent the gear box from rotating, i.e., to provide the needed countertorque. In addition to supporting the countertorque finger, the hollow sleeve supports the drive shaft extending from the gear box and engaging the lug nut to be loosened (or tightened). A bushing is preferably mounted in the free end of the sleeve to serve as a bearing for the main shaft.

The invention will become more apparent from a consideration of the attached drawing and the following detailed description illustrating a preferred embodiment. In the drawing, which of course is to be considered as illustrative and not limiting,

FIGURE 1 is a perspective exploded view of a preferred embodiment of the invention, looking at the wrench largely from the face of the gear box confronted by a person who is about to use it,

FIGURE 2 illustrates the countertorque member which contacts a lug nut and supports the main drive shaft,

FIGURE 3 is a vertical cross section through the upper part of the FIGURE 1 embodiment, showing the mounting of the small upper sprockets on a short shaft and the bearings for this shaft in the front and back plates of the gear box,

FIGURE 4 is a detail in vertical cross-section showing the lower shaft and the mounting on it of the large lower sprockets,

FIGURE 5 illustrates a standard drive or crank member which engages one of the polygonal ends on either the upper or lower shaft and is operated by hand in the use of the wrench, and

FIGURE 6 is an overall vertical section through the center of the gear box of the preferred embodiment of FIGURE 1, showing the wrench engaged with the outer lug nut of a dual wheel assembly.

The principal parts of the wrench are the countertorque number 1, the gear box or housing 2 to which one end of member 1 is fixed, the finger or lug 3 of member 1 which contacts a lug nut other than the one being loosened or tightened, the main drive shaft 4, and the hand drive 5 shown in FIGURE 5. Countertorque member 1 is basically a sleeve 10 fixed to a radially outturned flange 11. The finger or lug 3 is integrally secured to sleeve 10 and extends outwardly and forwardly therefrom to terminate at about the same longitudinal spacing from the gear box 2 as a socket wrench 13 which is mounted on the forward end of the main drive shaft. Machine screws 14 in the circumferentially spaced openings 12 in flange 11 secure the countertorque member to gear box 2 to prevent the gear box from rotating.

Gear box 2 includes a housing in the form of a pair of essentially identical front and rear plates 15 and 16 having the indicated outline of a large circle and a small circle connected by a pair of tangents. These plates are spaced apart by a short wall member 17 which is integral with front plate 15 and extends transversely therefrom. Plate 16 is a cover plate secured to wall 17 by a number of machine screws 18 extending through openings 19 spaced about the periphery of plate 16 and engaging registering tapped holes in wall 17. This construction makes it possible to keep the operating members within the gear box coated with a lubricant which is free of dust and dirt.

Mounted on plates 15 and 16 for rotation about their individual axes are an upper shaft 30 and a lower or main shaft 4. Upper shaft 30 extends through a boss 20 on the outer surface of front plate 15, being rotatably supported within a flanged bushing 31 fixed in the boss, and extending outside the boss to terminate in a polygonal end 32. The opposite end of shaft 30 extends through a similar bushing 33 and boss 34 in back plate 16. Mounted or formed on shaft 30 for common rotation therewith are a pair of sprockets 37, the teeth 38 of which are of appropriate size and spacing to engage the chains 50 which also engages the teeth of the larger lower sprockets 45. In the particular form illustrated, the small upper sprockets 37 have 10 teeth while lower sprockets 45 have 72 teeth, giving a mechanical advantage of 7.2 when the wrench is driven through upper shaft 30. (Note that in the interest of simplicity only a single chain 50, a single upper sprocket 37 and single lower sprocket 45 have been shown in FIGURES 1 and 6. It will be apparent, of course, that the pairs of such members shown in FIGURES 3 and 4 can be combined into single members of greater width, as necessary to withstand the high stresses involved.)

Similarly mounted on plates 15 and 16 is the lower or main shaft 4 which supports the pair of larger sprockets 45 in common rotational relationship therewith. Shaft 4 extends through both of boss 21 on front plate 15 and boss 22 on rear plate 16, being rotatably supported respectively in bushings 41 and 42 secured in the indicated axially aligned openings through bosses 21 and 22. The

shaft 4 protrudes from both of these bosses, terminating adjacent the front plate 15 of the gear box in a polygonal end 43 but projecting through rear plate 16 into the countertorque member 1 to extend the complete length of sleeve 10, terminating at the end of countertorque finger 3. The large sprockets 45 are secured to shaft 4 by a multiplicity of spaced machine screws 46 extending through openings in the sprocket and engaging registering tapped holes in the flange 47 integrally formed on the shaft.

It will be apparent that the wrench of the invention may be used in either of two ways. The drive member 5 may be connected to either polygonal end 32 of upper shaft 30 or polygonal end 43 of lower shaft 4, the socket member 13 being connected to polygonal end 44 of the lower shaft in either case. When driving through the upper shaft, the small sprockets 37 turn with the upper shaft and drive lower sprocket 45 and lower shaft 4 through chains 50, and the mechanical advantage of the wrench is exploited in "breaking loose" a tightly engaged nut or drawing one up to a maximum tightness. (A torque wrench may, of course, be used in lieu of drive 5 when it is desired to tighten the nut or other threaded member to a predetermined torque.) When driving directly through shaft 4, there is no mechanical advantage but the member being tightened or loosened is rotated at maximum speed, and of course this direct drive is generally adequate until the nut comes face to face with another member of the assembly in which it is used.

The former use is illustrated in FIGURE 6, which shows in vertical section a dual truck wheel assembled on a hub 60 of a truck. An outwardly radially extending annular flange 61 of the hub has formed therein a multiplicity of openings 62, such openings being circumferentially evenly spaced about a circle which is coaxial with hub 60 and the axle (not shown) on the end of which the hub is mounted. Secured in each such opening is a threaded bolt or stud 63, typically splined or otherwise fitted to the flange so that it will not rotate within opening 62. The head 64 of such bolt butts against the inner face flange 61 and the threaded body 65 extends through the opening and protrudes from the opposite end thereof.

A nut 67 having an outwardly facing bevel 68 is then threaded onto the body 65 of the bolt until it is tightened against the outer face of the flange. Inside wheel 70 is then mounted on the set of bolts, this wheel and outside wheel 71 having a set of openings 72 and 73 which register with openings 62 of the flange, each wheel opening being beveled both on the inside and the outside. Sleeve members 75, which are threaded both internally and externally, are then mounted on the bolts with the aid of the wrench of the invention until the inwardly facing beveled surfaces 77 of their heads 76 are seated in the outer beveled surfaces surrounding the corresponding wheel openings 72. Outer wheel 71 is then mounted on the sleeves 75 with the inner bevels of its openings 73 aligned with outer bevels 78 of sleeve head 76. In the final step the wrench of the invention is used to screw nuts 82 up on the outer surfaces of sleeve members 75 until the inwardly facing bevels 83 of the nuts are seated in the outwardly facing beveled surfaces surrounding openings 73 of the outer wheel 71. Disassembly, of course, is the same procedure in reverse.

It will now be apparent that the disclosed invention meets the objects set forth at the beginning of this specification. A tight lug nut which has not been loosened for a long period of time may require as much as 1000 to 2000 foot-pounds of torque to loosen it, and the wrench of the invention will provide this torque by exploiting its mechanical advantage and applying only 140 to 280 ft.-lb. through the hand drive attached to the upper shaft. This is accomplished through the pair of meshing rotary toothed members, the smaller drive member being turned by hand and in turn driving the larger driven member to which an extended shaft is attached in common relationship, the opposite end of the shaft being fitted with a socket or box wrench in engagement with the nut to be loosened or tightened. At the same time, the shaft on which the larger rotary toothed member is mounted for common rotation is provided with a polygonal end which can be used directly with the hand drive to turn the tubular member and run the nut one way or the other on the threaded member it engages without loss of time when no mechanical advantage is needed.

The expression "rotary toothed members" has been used in the foregoing because directly meshing gears could be substituted for the illustrated sprockets and chains, and the quoted expression is used in the claims to indicate sprockets, gears and other members operating in a similar manner to achieve a like purpose. The sprocket and chain drive have the advantage that a large number of teeth on each sprocket are engaged at the same time, and thus the load and resulting stresses are distributed over all such teeth. When gears are used, a small gear may be mounted on shaft 30 and a large gear on shaft 4, while a pair of intermediate size idler gears may be mounted on a pair of additional shafts also journaled in bosses on the front and rear plates of the housing. Each of the idler gears is, of course, disposed to engage and intermesh with both the small driving gear and the large driven gear.

What is claimed is:

1. A gear-driven wrench comprising a countertorque member and a gear box, said gear box including a housing, a small toothed rotary member journaled in said housing on a shaft which extends from one side of the housing and terminates in a polygonal end, and a large toothed rotary member journaled in the housing on a main shaft, one end of said main shaft extending from the opposite side of said housing and terminating at a point spaced from said gear box in an end adapted to receive a socket wrench for loosening a tightened nut, said rotary toothed members being connected in meshing rotational relationship, said countertorque member being securely fixed to said gear box and including a countertorque finger extending longitudinally approximately the same distance from the gear box as said one end of the main shaft, said countertorque finger being a solid member radially offset from said main shaft and adapted to contact a second nut spaced adjacent the nut to be loosened.

2. The improved wrench of claim 1 in which said countertorque member includes a sleeve disposed coaxially with and surrounding said projecting end of the main shaft and serving as a bearing therefor.

3. In a gear-driven wrench which includes a gear box housing, a first rotary toothed member having a smaller number of teeth mounted on a first shaft journaled in said housing and protruding from it and terminating in an end adapted to be turned by a hand crank, and a second rotary toothed member having a larger number of teeth connected in meshing relationship with said first rotary toothed member, said second member being mounted on a main shaft having at least one end projecting from said housing and terminating in an end adapted for connection to a wrench member for loosening a tightened nut, the improvement comprising a counter-torque member fixed to said gear box and extending therefrom in the same direction as the projecting end of the main shaft, said member including a solid countertorque finger extending away from the gear box about the same distance as said end of the main shaft and radially offset therefrom to contact a second nut adjacent the nut being loosened.

4. The improved wrench of claim 3 in which said counter-torque member includes a sleeve supporting the projecting end of the main shaft.

5. A hand operated geared wrench including a gear box housing, a countertorque member including a sleeve fixed at one end to said housing in common rotary relationship therewith and a solid countertorque finger extend-

ing from the other end of said sleeve in radially offset relationship therewith, a train of rotary toothed members journaled on shafts in said housing and disposed in meshing relationship with one another, one of said shafts being a driving member and having an end projecting from said housing and adapted for connection to a hand crank, another of said shafts being a driven main shaft having one of its ends projecting through said housing and the sleeve of said counter-torque member to terminate at about the same distance from the housing as said counter-torque member, said end of the main shaft being adapted to receive a wrench member in common rotary relation-

ship therewith for loosening a tightened nut, said counter-torque finger being adapted to contact a second nut spaced adjacent the nut to be loosened.

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