

Nov. 9, 1954

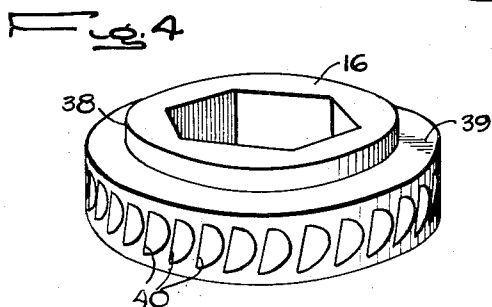
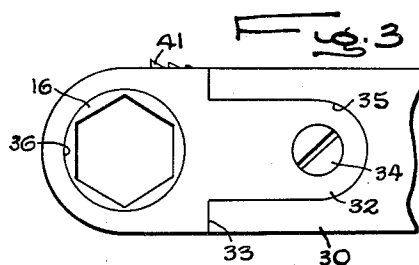
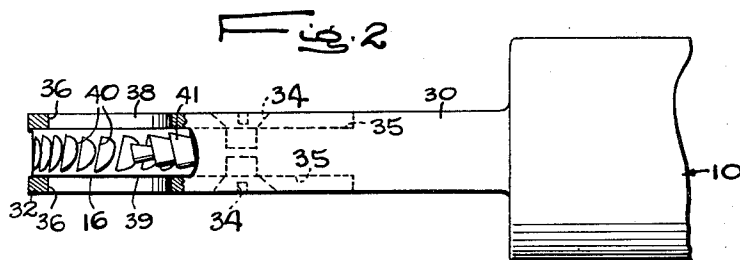
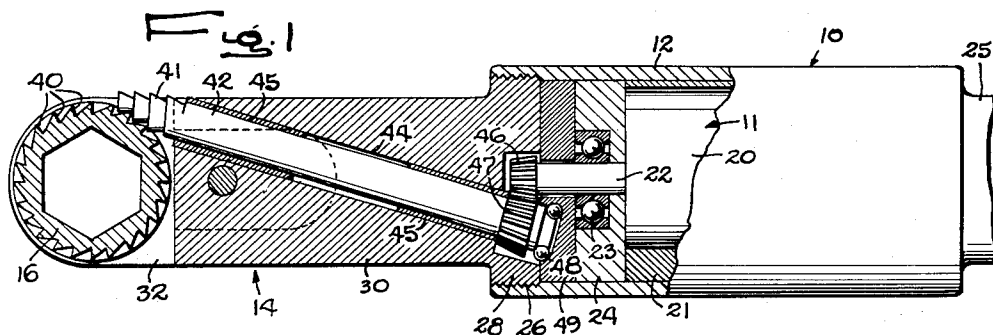
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2,693,728

POWER-OPERATED GEAR CONTROLLED SOCKET WRENCH

Filed Aug. 16, 1949

2 Sheets-Sheet 1



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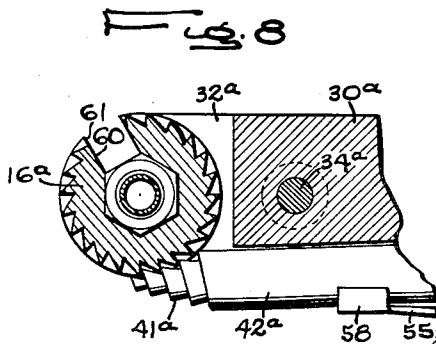
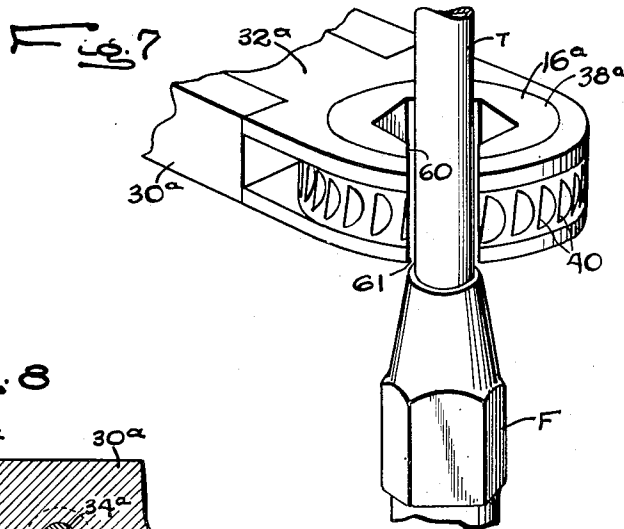
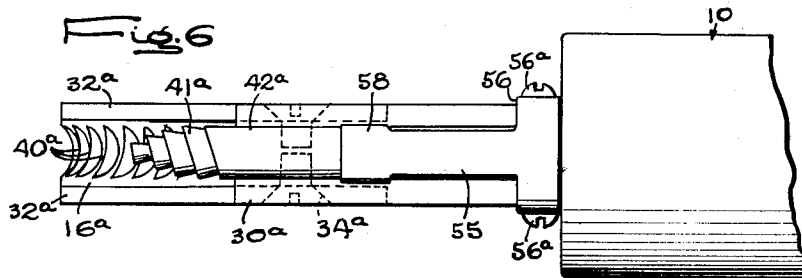
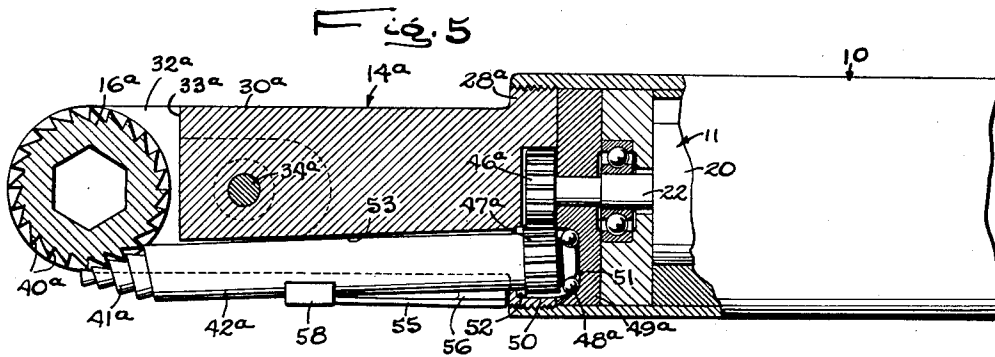
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POWER-OPERATED GEAR CONTROLLED SOCKET WRENCH

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2 Sheets-Sheet 2



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2,693,728

POWER-OPERATED GEAR CONTROLLED SOCKET WRENCH

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9 Claims. (Cl. 81-57)

The present invention relates to power driven wrenches and has for its primary object the provision of a modified form of worm drive for the socket element, so as to achieve a substantial increase in efficiency as compared to conventional worm drives, while minimizing lateral or side pressure on the worm shaft, and in addition, providing a more positive lock between the tool spindle, worm and socket for manual application of force in the tightening or final setting action.

Still another object is to provide an improved drive for a tool member having a socket of the open end type by so correlating the pitch of the socket teeth and the worm thread that the drive is continuous notwithstanding the presence of a radial slot in the socket.

A further object is to provide a drive means of the character set forth in which the drive shaft is advantageously arranged to minimize the dimensions of the nose portion of the tool.

Still another object is to provide a combined radial and thrust bearing for the worm shaft permitting yielding thereof for ratchet action in the operation of setting a nut.

The objects of the invention thus generally set forth, together with other objects and ancillary advantages, are obtained by the construction and arrangement shown by way of illustration in the accompanying drawings, in which:

Figure 1 is a fragmentary plan view partly in section, of a power wrench embodying the features of the present invention.

Fig. 2 is a fragmentary side elevation of the tool shown in Fig. 1.

Fig. 3 is a fragmentary plan view of the head of the tool shown in Fig. 1.

Fig. 4 is a perspective view of the socket element of the tool.

Fig. 5 is a fragmentary plan view, partly in section, of another form of power wrench incorporating the features of the present invention.

Fig. 6 is a fragmentary side elevation of the tool shown in Fig. 5.

Fig. 7 is a fragmentary perspective view of still another modified form of the instant invention.

Fig. 8 is a fragmentary sectional view of the form of the wrench illustrated in Fig. 7.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawings and will herein describe in detail the preferred embodiments, but it is to be understood that I do not thereby intend to limit the invention to the specific forms disclosed, but do intend to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

By way of illustration, there is shown in the drawings a portable wrench comprising a power unit 10, embodying a rotary motor 11 enclosed within a casing 12, and a tool head 14 connected with the power unit and extending longitudinally therefrom. As shown, the drive motor 11 is of the non-reversible, rotary, fluid-pressure actuated type and includes a vane rotor 20 eccentrically disposed in a cylinder 21 and fast on a spindle 22. The latter is journaled in a bearing 23 which, in turn, is held in an end plate 24 fixed within the casing 12 in position to close the forward end of the cylinder 21. The rear end of the casing 12 terminates in a handle 25, and at its forward end the casing is provided with internal screw

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threads 26 for the reception of the base portion 28 of the tool head 14.

In the form of the invention shown in Figs. 1 to 4, inclusive, the tool head 14 includes an elongated flat portion or nose 30 which, as shown, is integrally formed with the base portion 28 and which serves as a carrier for a hexagonal socket 16. It will be apparent that other tool elements can be substituted for the socket 16 as may be desired for the accommodation of other forms of threaded fastening elements. On opposite sides of the nose 30 is secured a pair of similar bearing plates 32, the nose and the plates being suitably apertured to receive mounting screws 34. Preferably, the inner ends of the bearing plates 32 are reduced in width to provide outwardly extending shoulders 33, and the nose 30 is suitably channeled as at 35 to receive the reduced end portions of the bearing plates 32 and to permit abutment of the shoulders 33 with the outer ends thereof. This construction prevents loosening of the plates by torsional strains to which they are subjected in the use of the tool.

The outer ends of the plates 32 project beyond the end of the nose 30 and are adapted to receive the socket 16 therebetween. For this purpose these outer ends are provided with coaxially disposed apertures 36, and the socket is fashioned to provide hub portions 38 of a diameter corresponding to that of the apertures 36 for journaling therein. Intermediate its ends the socket 16 is of a diameter somewhat larger than that of the hubs 38 and of a thickness substantially the same as the spacing between the inner faces of the plates 32. Thus are formed bearing surfaces 39 for engagement with the plates 32.

In accordance with my invention, I employ a drive which partakes of the nature of worm gearing, yet is especially constructed to provide a positive, efficient connection between the power source and the socket element. Thus the socket has a circumferentially arranged series of teeth 40 providing flat, angularly disposed rear faces for coaction with a tapered worm 41 having a single buttress thread. While the size of the tool member having a socket therein and the worm may vary and the number of teeth and the pitch of the worm thread may be altered, a drive gearing of the following character has been found to operate satisfactorily: a socket of one and one-fourth inches in major diameter having twenty four teeth thereon with a pitch angle of ten degrees was utilized in conjunction with a tapered worm fashioned with a pitch of eight threads per inch. To provide maximum working surface on each of the socket teeth for engagement by the leading or thrust surface of the worm thread, the rim of the worm is relieved making the tips or crests of the teeth concave when viewed in side elevation (Figs. 2 and 4). It will be observed that the tapered form of the worm serves to minimize axial projection thereof.

In order to minimize lateral projection of the worm 41, as shown in Fig. 1, the shaft 42 extends diagonally, in the plane of the longitudinal axis of the tool, between the power unit 10 and the socket 16 through a passage 44 provided therefor in the nose 30 wherein it is journaled in sleeve bearings 45 disposed adjacent the ends of the passage which serve to maintain engagement between the worm 41 and the gear teeth 40. Thus it is to be noted that only the outermost portion of the worm thread extends beyond the bearing plates 32 (Fig. 3). Furthermore, with the worm and shaft so constructed and arranged practically all of the force exerted thereon by the socket 16 is axially sustained and lateral pressure on the worm and shaft is substantially eliminated.

The shaft 42 is rotated by the motor 11 through the medium of bevel gears 46 and 47 which are preferably formed integral with the forward end of the motor spindle and the rear end of the shaft 42, respectively. Axial thrust on the shaft 42 is taken up by anti-friction bearing elements such as balls 48, the forward race for which is formed by simply providing an arcuate groove about the rear end of the shaft. The rear race for the balls 48 is formed by appropriately recessing a disc-like bearing plate 49 which is interposed between the motor end plates 24 and the base portion 28 of the tool head 14.

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This bearing, therefore, constitutes a combined radial and thrust bearing and is self-aligning as well.

In use, after a nut or other threaded fastening element has been run down to the stall point of the motor, the fastening element is driven home manually by swinging the tool bodily about the axis of the socket. Rotation of the socket relative to the tool is prevented by the engagement of the worm 41 with the socket teeth 40, its form providing a positive lock therebetween. As hereinbefore pointed out, thrust on the worm is sustained axially of the shaft 42. Repositioning of this form of the tool for further tightening without the necessity of removing the socket from the fastening element is effected by momentarily admitting pressure fluid to drive the motor 11. With the fastening element tight and thus stationary, the socket is prevented from rotating, and therefore reverse rotation of the power unit and the tool head relative to the socket and about its rotational axis is produced.

Turning now to the form of the invention illustrated in Figs. 5 and 6 of the drawings, the power unit 10 of the device is identical with that of the preceding embodiment and thus the same reference characters have been applied. In the instant form, however, certain modifications have been made in the tool head, comparable elements being denoted for similar reference numerals with the addition of suffix "a." Thus the tool head 14a includes a disc-like base portion 28a which is suitably secured to the power unit casing 12 and has integrally formed therewith a nose 30a serving as a carrier for a socket 16a. As shown, the outer end of the nose 30a is of reduced thickness so as to provide shoulders 33a against which the inner ends of a pair of similar bearing plates 32a squarely abut. The nose and plates are of the same width and are suitably apertured for the reception of fastening means such as mounting screws 34a.

The outer ends of the bearing plates 32a are again coaxially apertured for the reception of the socket 16a therebetween in the same manner as previously set forth, and the latter is identical in form with the socket 16 of the first embodiment illustrated including a circumferentially arranged series of teeth 40a.

To rotate the socket 16a, driving force from the motor 11 is transmitted by means of a shaft 42a having a tapered, buttress-thread worm 41a formed on the outer end thereof and adapted to mesh with the teeth 40a of the socket 16a. Rotation of the shaft 42a by the motor 11 is accomplished by means of gears 46a and 47a which are rigid with the ends of the motor spindle 22 and the shaft 42a, respectively. To provide a gear chamber for the accommodation of these gears the base portion 28a of the tool head 14a is suitably recessed as at 50. The rear end of the shaft 42a is rotatably supported in a bearing of the self-aligning, thrust type which includes balls 48a. The forward race for the balls 48a is provided by an arcuate circumferential groove in the rear end of the shaft 42a, and the rear race is provided by an appropriately formed recess 51 in a bearing disc 49a. Interposed between the bottom of the recess 50 and the front face of the gear 47a is a hardened bearing washer 52.

In this form of the invention quick return movement for repositioning the wrench is accomplished by ratchet action. To this end the shaft 42a and the worm 41a are utilized to perform the function of a pawl, and the socket 16a functions as a ratchet wheel. Thus the shaft 18a extends substantially longitudinally at one side of the nose 30a in a channel 53 defined by the bearing plates 32a and the nose 30a, the latter being cut away for the purpose, and is supported for limited outward movement.

To normally maintain the worm 41a in mesh with the socket teeth 40a, a leaf spring 55 is utilized. The latter is secured to the nose 30a at its rear end in any suitable manner as by tabs 56 which, as shown, are suitably apertured to receive mounting screws 56a. At its forward end, the spring 55 is provided with an arcuate portion 58 which bears directly against the shaft 42a. Upon manual application of a torque to the power unit 10, in order to reposition it relative to the socket, the socket teeth 40a engage the rear inclined faces of the worm threads and force the worm 41a and the shaft 42a outwardly against the action of the spring 55 and slip by until the desired position of the wrench is attained.

An important feature of the invention resides in the correlation of the pitch of the socket teeth, the worm thread and the taper of the worm so that there is simul-

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taneous engagement of the worm with several of the socket teeth to the end that a uniform, continuous drive obtains. It will be observed that in the embodiments illustrated the correlation is such that the worm normally engages three of the socket teeth. Thus the tool lends itself readily to formation as an open end wrench. For purposes of illustration, the form just described, and shown in Figs. 5 and 6, is shown in Figs. 7 and 8 modified for use as an open end wrench. To this end the socket 16a is cut away to form a parallel-sided, radial slot 60 of a width equal to two of the teeth 40a. The bearing plates 32a are, of course, similarly slotted as at 61. Since, as noted above, the worm normally engages three of the socket teeth there will always be at least one of the teeth engaged by the worm and consequently there will be no interruption of socket drive upon actuation of the tool even when the socket slot 60 is rotated into position opposite the worm.

This form of wrench is particularly well suited for the application of threaded fittings that are commonly employed in tubing installations as utilized, for example, in fuel and lubricant supply systems. For the running and setting of a fitting F which is carried by a length of tubing (Fig. 7) the wrench with the slots 60 and 61 in register is slipped over the tubing and then down onto the fitting. It will be noted that the slot width is insufficient to permit passage of the hexagonal portion of the fitting F, and thus there is no danger of the wrench slipping from the work. When the fitting has been finally set, the wrench is slipped off the hexagonal fitting portion and onto the tubing T where a slight pull on the wrench in the direction of the bearing plate slots 61 together with a momentary application of power to rotate the socket 16a permits the wrench to be removed when the slot 60 comes into register with the slots 61.

Still another valuable feature of the present invention resides in the fact that in addition to its use for running and setting conventionally threaded fastening elements, the tool can also be used for running and setting reversely threaded elements and for the removal of either form. In the latter application manual operation is employed for initially loosening the fastening element. To accomplish these ends, the tool need only be inverted or turned over from the positions illustrated in the drawings. This feature is especially advantageous for it permits the use of a non-reversible motor to drive the tool, such being inherently less complicated and of greater relative power output than a comparable size reversible motor.

From the foregoing, therefore, it will be apparent that the present invention provides an improved worm-type drive for power wrenches which is almost completely unexposed, which because of the correlation between the worm thread and socket teeth permits power actuation of wrenches of the open end type and which because of its high operating efficiency permits rapid application, including both running and setting, of threaded fastening elements. Moreover, the present tool embodies advantages such as reversibility for either setting or removing a threaded element though it is powered by any suitable rotary motor of the non-reversible type.

I claim as my invention:

1. In a power wrench having a nose portion with a tool member journaled therein, drive means for said tool member comprising an annular gear element rigid with the tool member and having a circumferentially arranged series of teeth thereon, a driven shaft having a worm rigid therewith meshing with said teeth to drive the tool member, and bearing means journaling the inner end of said shaft, said bearing means including a plurality of balls and a plate providing a recess having an annular wall of arcuate contour forming the one race for said bearing elements, said shaft having a groove of arcuate cross-section forming the other race for said elements, whereby the bearing means is self-aligning and operative to sustain thrust exerted axially of said shaft.

2. In a power wrench for running and setting fastening elements including an elongated nose portion with a tool member journaled therein and having a diagonally disposed passage therethrough, drive means for said tool member comprising a circumferentially disposed series of teeth on the tool member, a driven shaft journaled in said passage, and a tapered worm rigid with the outer end of the shaft and meshing with said teeth to drive the tool element upon application of power for running

a fastening element and to prevent rotation of the tool element upon interruption of power to permit setting of the fastening element by manually swinging the wrench.

3. In a power wrench for running and setting fastening elements, the combination comprising a socket journaled for rotation about an axis transverse to that of the wrench and having a circumferentially arranged series of teeth thereon, a driven shaft supported for limited lateral movement but constrained against axial movement, a tapered buttress thread worm rigid with the outer end of the shaft, and a resilient member normally urging said worm into engagement with said socket teeth, said worm and shaft serving to prevent rotation of the socket upon manually swinging the wrench bodily about the socket axis in setting the fastening element, and said member allowing outward lateral movement of the shaft and worm to permit ratchet action between the latter and the socket for repositioning the wrench.

4. In a power wrench for running and setting fastening elements, the combination comprising a socket journaled for rotation about an axis transverse to that of the wrench and having a circumferentially arranged series of teeth thereon, a driven shaft having a worm rigid with the outer end of the shaft, bearing means including inner and outer race members one of which is rigid with said shaft and a plurality of anti-friction bearing elements for supporting said shaft for limited lateral movement and constraining the same against axial movement, and a resilient member normally urging said worm into engagement with said socket teeth, said worm and shaft serving to prevent rotation of the socket upon manually swinging the wrench bodily about the socket axis in setting the fastening element, and said member allowing outward lateral movement of the shaft and worm to permit ratchet action between the latter and the socket for repositioning the wrench.

5. In a power wrench for running and setting fastening elements having an elongated nose portion with a tool member journaled therein, drive means for the tool member comprising an annular gear element rigid with the tool member and having a circumferentially arranged series of teeth thereon, a shaft supported for limited lateral movement but constrained against axial movement, a tapered worm having a single buttress thread rigid with the outer end of said shaft and arranged to mesh with said teeth, and a leaf spring having one end fixed to said nose portion and the other end bearing against said shaft and normally urging said worm into engagement with said teeth, said spring allowing limited lateral movement of said shaft and worm to permit ratchet action between the worm and socket for repositioning the wrench.

6. In a power wrench for running and setting fastening elements having a nose portion with a socket member journaled therein, drive means for the socket member comprising an annular gear element rigid with the socket member and having a circumferentially arranged series of teeth thereon, and a tapered worm having a

single buttress thread normally engaging a plurality of said teeth, said socket member and gear element having a slot therein of a width less than that of the number of teeth engaged by the worm whereby a continuous drive for the socket obtains notwithstanding the presence of said slot.

7. In a power wrench for running and setting fastening elements the combination comprising a socket journaled for rotation about an axis transverse to that of the wrench and having a circumferentially arranged series of teeth thereon and further having a radial slot therein of a width equal to two of said teeth, a driven shaft, and a worm rigid with the end of said shaft and having its thread so correlated with said socket teeth that it normally engages at least three of them whereby a continuous drive for the socket obtains notwithstanding the presence of said slot.

8. In a power operated tool for running and setting fastening elements, the combination comprising a tool member supported for rotation, said member being formed with a socket for engaging a fastening element to be driven, drive means for the tool member including a circumferentially arranged series of teeth on the tool member, a driven tapered worm having its axis and the longitudinal axis of the tool defining an acute included angle therebetween in a plane disposed at right angles to the rotational axis of said tool member, said worm having a single buttress thread simultaneously engaging a plurality of said teeth so as to provide a continuous drive for the tool member, and means for retaining said worm thread in engagement with said teeth.

9. In a power wrench for running and setting fastening elements having a nose portion with a tool member journaled therein, said member being formed with a socket for engaging a fastening element to be driven, drive means for the tool member comprising an annular gear element rigid with the tool member and having a circumferentially arranged series of teeth thereon, a tapered worm having a single buttress thread worm adapted to extend over a plurality of said teeth, and means for retaining said worm in engagement with said teeth, said socket extending laterally through the tool member and gear element and having a width less than that of the number of teeth engaged by the worm, whereby a continuous drive for the tool member is maintained notwithstanding the interruption of the gear teeth by the extension of the socket.

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