Nov. 15, 1955 A. J. BRAME 2,723,580

POWER DRIVEN WRENCH

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Fig. 1.

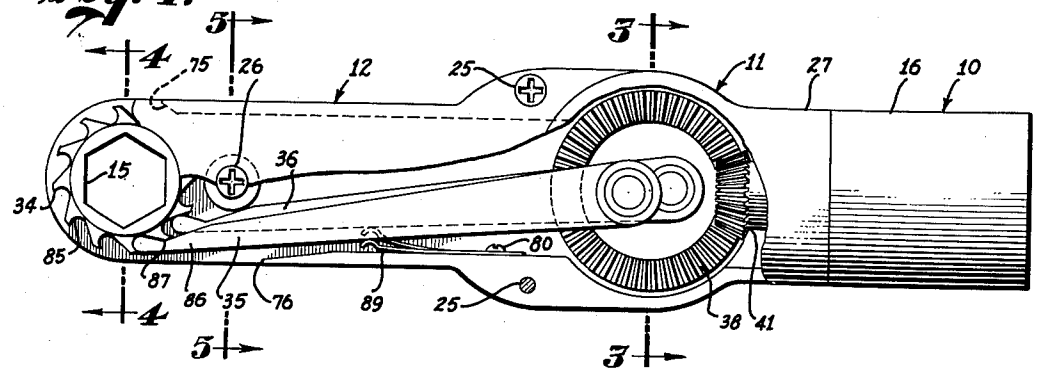


Fig. 2.

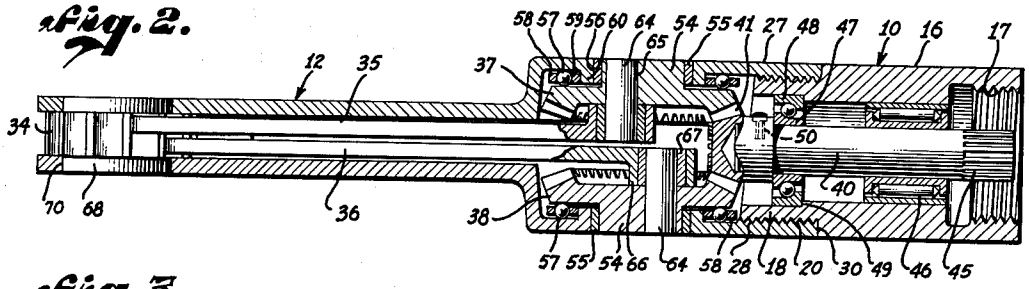


Fig. 3.

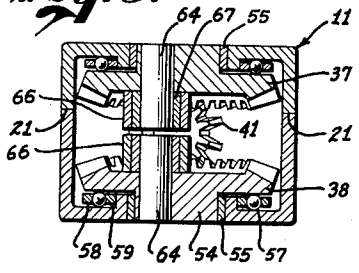


Fig. 4.

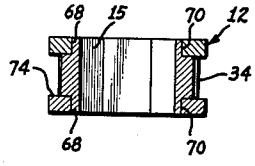
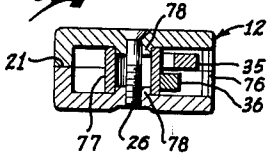


Fig. 5.



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POWER DRIVEN WRENCH

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10 Claims. (Cl. 81—57)

This invention relates to power-actuated wrenches of the type that incorporate a pawl-actuated rotary socket member. The inventien is directed to the problem of making such a wrench of simple, compact construction, and at the same time providing a rugged, efficient and smoothly operating wrench mechanism.

A tool of this type has a handle with a drive-shaft journalled longitudinally therein for operative connection to a power source and has a rotary socket member mounted in a shank structure that extends forward longitudinally from the handle. The problem is to provide within desirable space limitations a rugged force-multiplying transmission for converting rotation of the driveshaft about the longitudinal axis of the tool into slower actuation of the socket member about its transverse axis.

It is not too difficult to achieve simplicity alone, or ruggedness alone, or compactness alone, or even to achieve all three in a heavy bulky tool that is awkward to use. It is a problem, however, to achieve all these ends in a relatively light tool that is of a desirable compact configuration.

The invention meets this problem, in part, by incorporating a gear box in the tool handle adjacent the shank structure. The grip portion of the handle houses the driveshaft and the gear box provides a flat surface appropriately located for thumb pressure by the operator in the normal use of the wrench. Thus the tool is given a configuration that provides maximum convenience for the operator and that is conducive to skillful and time-saving utilization of the tool.

Two beveled gears positioned in spaced face-to-face relationship on a transverse axis in the gear box are actuated by a third beveled gear on the driveshaft and serve, in turn, to actuate a pair of pawl arms in the adjacent shank structure for rotation of the socket member by ratchet action. The two beveled gears are provided with crank pins for the purpose of reciprocating the two pawl arms. Such a mechanism has a minimum number of separately moving operating parts for smooth actuation of the rotary socket member and these parts not only conform to an optimum tool configuration but also completely utilize the available space within the optimum configuration.

The desired speed reduction with corresponding force multiplication is accomplished accumulatively in this chain of actuating parts. The speed reduction resides first in the fact that the two beveled gears are substantially larger in diameter than the co-acting third beveled gear on the driveshaft, second, in the fact that the throw of the crank arm is substantially less than the diameter of the pair of beveled gears on which they are mounted, and, third, in the fact that the pair of pawl arms advance the rotary socket member only a fraction of a rotation in response to a complete rotation of the pair of beveled gears.

The preferred practice of the invention is further characterized by the concept of operating both pawl arms on the same quadrant of the toothed rotary socket member. With such a pair of pawl arms operating at 180° phase relationship to one another, substantially continuous operating force is applied to the rotary socket member. Preferably, but not necessarily, the two pawl arms operate as pusher arms rather than as puller arms. In this regard, a feature of the preferred practice of the invention is the provision of circularly curved recesses between the ratchet teeth of the rotary socket member with the ends of the pusher arms correspondingly curved for pivotal bearing against the recess surfaces.

The features and advantages of the invention may be readily understood from the following detailed description considered with the accompanying drawing.

In the drawing, which is to be considered illustrative:

Figure 1 is a plan view of the presently preferred embodiment of the tool, with one gear and a portion of the housing removed to reveal concealed parts;

Figure 2 is a longitudinal sectional view of the tool;

Figure 3 is a transverse section through the gear box taken on line 3—3 of Figure 1;

Figure 4 is a transverse section taken on line 4—4 of Figure 1, showing the construction of the rotary socket member; and

Figure 5 is a transverse section taken on the line 5—5 of Figure 1.

The housing of the illustrated embodiment of the invention may be considered as comprising, first, a base or grip portion **10** that is connected to the power source, second, the gear box **11** that cooperates with the grip portion **10** to form a handle with a convenient thumb rest, and, third, a forwardly extending longitudinal shank portion **12** in the end of which is mounted a suitable rotary socket member **15**. The shank portion **12** is of relatively narrow flat configuration to permit the tool to enter narrow spaces and to minimize interference with visibility in the manipulation of the tool.

The base portion **10** of the tool housing includes a cylindrical body **16** that has internal threads **17** at the butt end of the tool for connection with a suitable power source such as a pneumatic motor (not shown). The cylindrical body **16** has a reduced portion **18** at its other end formed with external threads **20**. In the construction shown, the gear box **11** and the shank portion **12** are unitary or integral with each other but are divided into two longitudinal sections which mate at parting lines shown at **21** in Figures 3 and 5. These two mating housing sections are held together by a pair of laterally spaced screws **25** in the gear box **11** and by a single central screw **26**, in the shank portion **12** near the rotary socket member **15**.

The two mating longitudinal housing sections form a cylinder **27** at one end which, in the assembled tool, is a part of the base or grip portion **10** of the housing. The cylinder **27** has internal threads **28** that normally engage the previously mentioned external threads **20** of the cylindrical body **16** with the end of the cylinder **27** in abutment against a circumferential shoulder **30** of the cylindrical body.

The actuating mechanism employed in this embodiment of the invention consists essentially of only six separately movable parts, namely: the previously mentioned rotary socket member **15** having peripheral ratchet teeth **34**; a pair of reciprocative pawl arms **35** and **36** for driving engagement with the ratchet teeth **34**; a pair of beveled gears **37** and **38** adapted to reciprocate the two pawl arms respectively; and a driveshaft **40** carrying a third beveled gear **41** in mesh with the pair of beveled gears **37** and **38**. It is to be understood, however, that the invention in its broader aspects is not restricted to these specific working parts.

The driveshaft **40**, which has a splined end **45** for connection to a power source, is rotatably mounted in

the cylindrical body **16** by means of a roller bearing **46** and by means of a ball bearing having an inner race **47** and an outer race **48**. The inner race **47** of the ball bearing abuts the back of the third beveled gear **41** on the end of the driveshaft and the outer race **48** fits against an inner circumferential shoulder **49** of the cylindrical body **16**. It is apparent that the beveled gear **41** which is fixed to the end of the driveshaft **40** by a suitable set screw **50** cooperates with the pair of gears **37** and **38** to hold the driveshaft **40** against forward axial movement and cooperates with the ball bearing and the inner shoulder **49** to prevent rearward axial movement of the driveshaft.

Each of the two beveled gears **37** and **38** is formed with an outwardly extending hub **54** that is journalled in a bearing sleeve **55** in a circular aperture **56** in the wall of the gear box **11**. Each of the two beveled gears **37** and **38** also backs against a circular series of balls **57** confined between an outer race **58** and an inner race **59**. The inner race **59** embraces an inner cylindrical flange **60** formed in the gear box **11** around the corresponding aperture **56**. It can be seen that the two beveled gears **37** and **38** are held apart and in engagement with the two corresponding series of balls **57** by virtue of their engagement with the intervening driving beveled gear **41**.

The two beveled gears **37** and **38** may be adapted in any suitable manner for reciprocating the two pawl arms **35** and **36**. For this purpose, each of the beveled gears may be provided with an eccentric crank pin **64** that is mounted with a press fit in a bore **65** in the beveled gear. For cooperation with the two crank pins **64**, respectively, the two pawl arms **35** and **36** may each be formed with an integral collar **66** that is lined with a bearing sleeve **67**, the bearing sleeve rotatably embracing the corresponding crank pin **64**. Preferably, as shown on the drawing, the eccentric positions of the two crank pins **64** are approximately 180 degrees out of phase with each other.

The socket member **15**, which has the usual hexagonal opening, as shown in Figure 1, is formed with two opposite hub portions **68** (Figure 4) which are journalled in corresponding circular apertures **70** in the opposite walls of the shank portion **12** of the housing. Preferably, the housing is cut away to provide a window **74**, the two opposite ends of which are indicated at **75** and **76**, respectively, in Figure 1. Thus the window **74** extends around the nose of the shank portion **12** and exposes the peripheral teeth **34** of the rotary socket member **15**, as may be seen in Figure 4. This open arrangement makes the interior of the housing accessible for inspection and oiling.

Both of the two pawl arms **35** and **36** lie to one side of the central housing screw **26** for operation on the same quadrant of the rotary socket member **15**. Thus the two pawl arms are confined between the screw **26** and one side wall of the shank portion of the housing. Preferably a sleeve **77** encircles the housing screw **26**. As shown in Figure 5, the sleeve **77** may be held in place by a pair of opposite bosses **78** on the inner wall of the housing. The two pawl arms **35** and **36** are normally urged laterally towards the sleeve **77** in a yielding manner, for example, by means of a leaf spring **89**. The leaf spring **89** is mounted inside the housing by a suitable screw **80** and has two arms pressing against the two pawl arms **35** and **36** respectively.

As heretofore indicated, a feature of the preferred practice of the invention is that the peripheral recesses in the rotary socket member **15** that are formed by the series of ratchet teeth **34** have bottom walls of circular curvature, and the ends of the two pawl arms **35** and **36** are of corresponding configuration to fit snugly therein for cooperative pivotal action through a small angular range. For this purpose, the inner surfaces **85** of the recesses between the ratchet teeth may be spherically

curved and the operating ends of the pawl arms may be correspondingly spherically curved. Preferably, however, the inner surfaces **85** of the recesses are cylindrically curved as indicated in Figure 1 and the operating end of each of the two pawl arms **35** and **36** is formed with a nose or lobe of similar external cylindrical curvature.

In the construction shown, each of the pawl arms is also cut away or slightly recessed on its inner longitudinal edge to permit the desired cooperation with the rotary socket member **15**. The desired configuration of the two pawl arms **35** and **36** may be seen in Figure 1 where the pawl arm **35** is shown at its extreme advanced position. It will be noted that the outer longitudinal edge **86** of the pawl arm is at this time substantially tangential to the circle defined by the tips of the ratchet teeth **34**, and that the inner longitudinal side of the pawl arm is formed with a shallow V-shaped recess with its vortex at **87** so that the nose or lobe at the end of the pawl arm conforms at this moment with the slope of the back of the next successive ratchet tooth **34**.

Figure 1 shows the second pawl arm **36** just as it begins its approach into operative contact with the rotary socket member **15**. As the end of the pawl arm makes initial seating contact with the cylindrically curved bottom surface **85** of the recess between two of the ratchet teeth **34**, the side of the pawl arm diverges at a slight angle from the sloping back of the next successive ratchet tooth. As the pawl arm makes its longitudinal thrust, it pivots cylindrically in the bottom of the recess and the angle between the surface of the pawl and the back of the next successive ratchet tooth progressively closes as the pawl arm reaches its outer limit position.

It is apparent that the two pawl arms **35** and **36** will operate alternately for intermittent rotary advancement of the socket member **15** with only a slight pause between each advance. Since each thrust of a pawl arm involves a transmission of force by the seating of a curved surface of a pawl arm in a similarly curved recess of the ratchet member, the wearing action is distributed rather than concentrated, and, moreover, the desired complementary curvatures of the surfaces of the pawl arms and of the ratchet recesses tends to be maintained by the wearing action.

My description of the selected embodiment of the invention, by way of example and to illustrate the principles involved, will suggest various changes, substitutions and other departures from my disclosure that properly lie within the spirit and scope of the appended claims.

I claim:

1. In a power wrench of the character described, the combination of: a housing; a socket member rotatably mounted in said housing, said socket member having peripheral ratchet teeth; a pair of pawl arms positioned and adapted for engagement with said ratchet teeth in the same quadrant of the socket member; and power-actuated means to reciprocate said pawl arms for driving said socket member, said power actuated means including two rotary eccentric members substantially 180 degrees out of phase with each other for alternate operation of said two pawl arms.

2. In a power wrench of the character described, the combination of: a housing; a socket member rotatably mounted in said housing, said socket member having peripheral ratchet teeth; a pair of pawl arms positioned and adapted for engagement with said ratchet teeth in the same quadrant of the socket member and power-actuated means to reciprocate said pawl arms for driving said socket member, said power actuated means including two beveled gears having eccentric elements in operating engagement with said pair of pawl arms respectively.

3. A power wrench as set forth in claim 2 in which said power-actuated means includes a driveshaft having a beveled gear thereon in engagement with said pair of beveled gears.

4. A power wrench of the type described, comprising: a housing; a driven member rotatably mounted in said housing, said driven member having peripherially arranged ratchet teeth; a pair of pawl arms positioned and adapted for thrust engagement with said ratchet teeth in the same quadrant of the driven member; and power-actuated means to alternately reciprocate said pawl arms, each arm applying a pushing thrust to said ratchet teeth engaged thereby at each reciprocation of the arm, whereby said driven member is rotatably driven.

5. A power wrench of the type described, comprising: a housing; a driven member rotatably mounted in said housing; an annular series of ratchet teeth peripherally formed about said driven member; a pair of pawl arms positioned and adapted for engagement with said ratchet teeth in the same quadrant of the driven member; power-actuated means operatively connected to each of said pawl arms and operable to alternately reciprocate said arms; and power means for actuating said last named means, whereby said power-actuated means alternately reciprocate said arms to urge the same into driving engagement with said ratchet teeth to rotatably drive said driven member.

6. A power wrench of the type described, comprising: a housing; a driven member rotatably mounted in said housing, said driven member having peripherally arranged ratchet teeth; a pair of pawl arms positioned and adapted for thrust engagement with said ratchet teeth in the same quadrant of the driven member; power-actuated means operatively connected to each arm at one end thereof for alternately reciprocating said arms to alternately thrust the free ends of said arms into engagement with said ratchet teeth in a path substantially tangential thereto; and resilient means mounted on said housing and engaged with said arms for yieldably holding the free ends of said arms in engagement with said teeth.

7. A power wrench of the type described, comprising: a housing; a driven member; support means for rotatably mounting said member on said housing; an annular series of ratchet teeth peripherally formed about said driven member; a pair of pawl arms; eccentric means operatively connected to an end of each arm for reciprocatively driving each of said pawl arms; means for guiding said pawl arms and yieldably holding the free ends thereof in engagement with said ratchet teeth in the same quadrant of said driven member; and power means for operating said eccentric means so that said eccentric means alternately reciprocates said pawl arms to alternately thrust the free ends of said arms into driving engagement with said ratchet teeth to rotatably drive said driven member.

8. A power wrench of the type described, comprising: a housing; a driven member rotatably mounted in said housing, said driven member having peripherally arranged ratchet teeth; a pair of pawl arms positioned and adapted for thrust engagement with said ratchet teeth in the same quadrant of the driven member; eccentric means operatively connected to each arm and adapted, when actuated, to alternately reciprocate said arms; and power-actuated means including a rotatable drive element operatively connected to said eccentric means for actuating the same, said eccentric means completing a reciprocation of each pawl arm for each revolution of said rotatable drive element whereby said pawl arms thrustingly engage with said teeth twice for each revolution of said drive element to rotatably drive said driven member.

9. In a power wrench of the character described, the combination of: a housing having a grip portion, a gear box portion adjacent said grip portion, and a shank portion extending from said gear box portion; a socket member having ratchet teeth and mounted rotatably in the outer end of said shank portion of the housing; a pair of pawl arms extending from said gear box portion of the housing through said shank portion for operative engagement with said ratchet teeth; a pair of beveled gears positioned face-to-face in said gear box portion of the housing, each of said beveled gears having an eccentric element thereon in operative engagement with said pawl arms respectively; a drive shaft extending longitudinally through said grip portion of the housing; a beveled gear on said driveshaft in mesh with said pair of beveled gears; and yielding means exerting force against said pawl arms laterally thereof to urge the pawl arms into engagement with said ratchet teeth of the rotary socket member.

10. A power wrench as set forth in claim 9 in which both of said pawl arms are pusher arms extending to one side of the longitudinal axis of said housing to act on the same quadrant of said rotary socket member.

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