**Sept. 1, 1970** J. P. NEWMAN **3,526,282**

IMPACT WRENCH

Filed Nov. 1, 1968

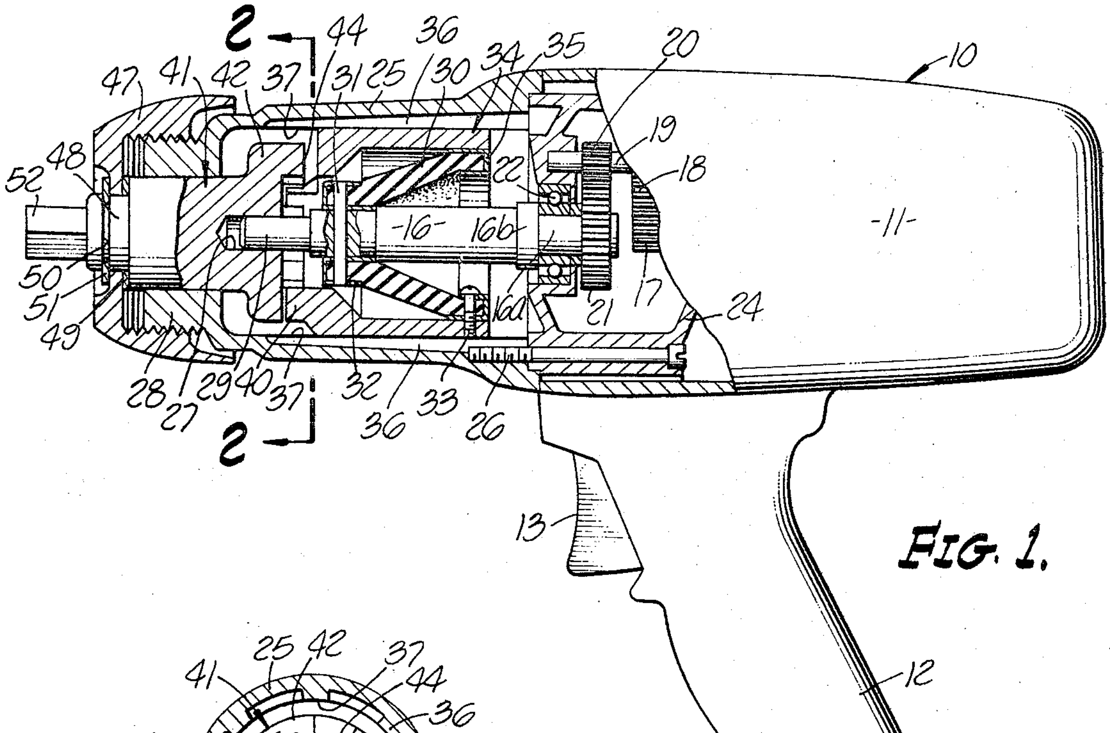


FIG. 1.

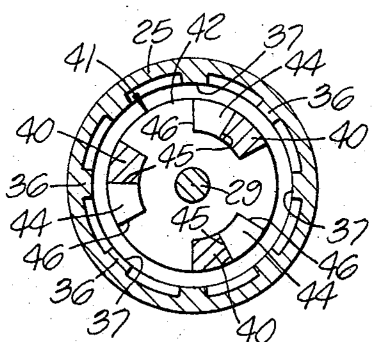


FIG. 2.

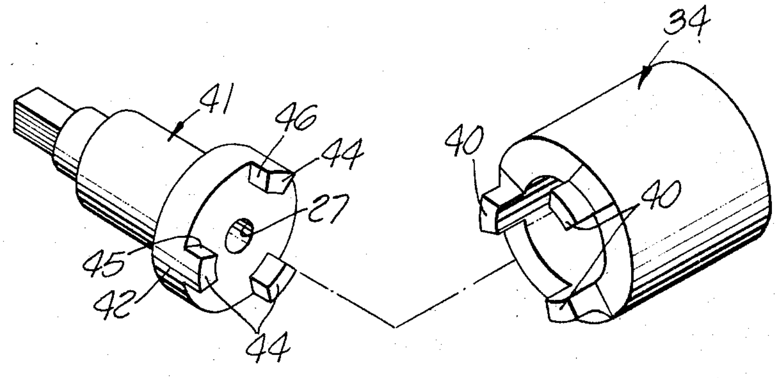


FIG. 3.

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## ABSTRACT OF THE DISCLOSURE

An improved power driven impact wrench having a hammer and an anvil member, tightens a threaded member by a series of impacts between the hammer and anvil member. A resilient rubber-like sleeve connects the hammer to a drive shaft and the hammer is accelerated between impacts by the resilient sleeve and the drive shaft.

This invention relates to a new and improved form of impact wrench.

Impact wrenches of the types shown in my U.S. Pats. Nos. 2,733,621 and 3,203,283 are useful for rapidly tightening a threaded member such as a nut or bolt to a desired degree or rapidly loosening a threaded member. The wrenches of the above referred to U.S. patents both disclose a rotary impact wrench utilizing a resilient sleeve of rubber or rubber-like material which performs the dual function of storage of energy for the repeated blows or impacts and actuation of the mechanism for intermittently connecting and disconnecting the drive member or anvil from the power driven shaft. These wrenches have proven to be of great utility because they tighten without causing an overload condition and loosen without damaging the threaded member. However, there have been problems in connection with the resilient sleeve. During operation of the impact wrenches, this resilient sleeve is subjected to continual twisting which causes an overheated condition and eventual failure of the sleeve. My U.S. Pat. 3,203,283 was also concerned with eliminating problems relating to the resilient sleeve, but is was primarily concerned with the problems caused by the rubbing of the inner surface of the resilient sleeve against the drive shaft under heavy use conditions. That problem was substantially cured by that invention, however, the fatigue problem due to the great amount of twisting still exists.

Therefore, an important object of this invention is to provide a power driven impact wrench having novel and improved means for intermittently connecting and disconnecting the driven member from the power driven drive shaft and in accordance with this object, to provide an improved structure for purposes of resisting sleeve failure due to torsion.

Other objects and advantages of this invention will be apparent from the following description and accompanying drawings.

## IN THE DRAWINGS

FIG. 1 is a side elevation, partly in section of an impact wrench embodying the invention.

FIG. 2 is a sectional view taken substantially on the line 2—2 of FIG. 1.

FIG. 3 is a perspective view of both the hammer and anvil member of the invention.

Briefly, this invention comprises a power driven impact wrench which includes a driven hammer and an anvil member operated upon by the hammer, the hammer being connected to a drive shaft by means of a rubber-like sleeve which encircles the shaft and which is subject to a limited degree of twisting to store energy.

Referring now to the drawings, the impact wrench,



generally designated **10**, is provided with an electric motor (not shown) suitably mounted in a housing **11**. A downwardly extending handle portion **12** on the housing **11** is porportioned to be received within the palm of the hand by the user, and a trigger element **13** pivotally mounted on the handle portion is adapted to operate a control switch (not shown) for regulating the operation of the electric motor. Electrical current for the motor is transmitted through the cable **14** which depends from the underside of the handle portion **12**. A switch lever **15** may also be mounted on the handle **12** for reversing the direction of rotation of the shaft of the motor when desired. It is to be understood that an air driven motor may be substituted for the electric motor if desired, since the particular type of power means employed for turning the drive shaft does not constitute an important part of the invention.

Reduction gearing may be provided for driving the drive shaft **16** from the motor shaft drive gear **17**, and as shown in the drawings this gearing may include the pinion gear **18** on the counter shaft **19**. A pinion **20** also fixed on the counter shaft **19** engages the larger drive gear **21** which is carried on the reduced end **16*a*** of the drive shaft **16**. A motor mount and bearing support casting **24** is provided in the housing **11**, a suitable bearing assembly **22** for the end **16*a*** of the drive shaft **16** being provided thereon. As shown, the drive shaft is provided with a shoulder member **16*b*** which abuts against the face plate of the bearing **22**, preventing rearward thrust of the drive shaft.

A housing extension or nose casting **25** is secured to housing **11** by means of bolts **26**. The forward projecting end of the housing extension **25** carries a bearing sleeve **28**. The drive shaft **16** extends axially through the housing extension **25** and its outer end **29** extends into a bore **27** provided in the driver member **41**, which member is supported in the bearing sleeve **28**.

A resilient rubber-like driving member or sleeve **30**, generally conical in shape, encircles the drive shaft **16** for a portion of the length thereof and is connected at its smaller diameter, forward end in driven relationship with the drive shaft **16** by means of the pin connection **31**. The outer ends of the pin **31** extend through a cylindrical reinforcement element or ferrule **32**. The rearward, larger diameter end of the sleeve **30** is connected by screws **33** to the rearward end of a hammer member **34** which is rotatably mounted within the housing extension **25**. The screws **33** extend through a cylindrical reinforcement element or ferrule **35**. A plurality of longitudinal lands **36** are formed, preferably integrally with the housing extension **25** and are provided with cylindrical surfaces **37** so as to function as bearings for the hammer member **34**. It will be noted that since the sleeve **30** is constructed of rubber or rubber-like material, the rearward end of the sleeve and hence also the hammer **34** may be driven by the shaft **16** but are capable of relative angular movement with respect thereto.

The hammer **34** is provided at its forward end with three protruding dogs **40** disposed 120 degrees apart. The driver member **41** is rotatably mounted within the bearing sleeve **28** and is provided with a flange portion **42** received within the housing extension **25** and forming an anvil member having three oppositely disposed projections **44**, each having radial driving jaw surfaces **45** and **46**. From an inspection of FIG. 2 it will be apparent that in the normal driving relationship, the dogs **40** contact respective jaw surfaces **45** of the projections **44**.

An adjustment nut **47** is threadedly engaged with the bearing sleeve **28** and is provided with a central opening through which extends the reduced portion **48** of the driver member **41**, a washer **49** being interposed between the nut **47** and the driver member **41**. Means are provided for preventing rearward longitudinal movement of the driver member with respect to the nut 47 while permitting rotational movement of the driver member with respect thereto, such means comprising a circumferential groove 50 on the portion 48 in which is received a spring retaining washer 51.

The forward end of the driver member 41 is provided with a non-circular portion 52, which ordinarily is formed with a square cross section. A conventional socket member (not shown) provided with a square opening for the reception of the non-circular portion 52, and also provided with the usual socket for the reception of a nut or bolt head, is adapted to be retained on the non-circular portion 52.

In operation of the device embodying this invention, the drive shaft 16 is turned by the motor through the reduction gearing described above. So long as no resistance to rotation is imposed by the socket member (not shown), th drive shaft 16, drive sleeve 30, hammer member 34, and drive member 41 all rotates as a unit with respect to the housing extension 25 and bearing sleeve 28. When resistance to rotation of the socket member (not shown) is encountered, such as for example, by the tightening of the nut or bolt, (not shown) which is being operated upon, the driver 41 slows down relative to the drive shaft 16. The angular velocity of the hammer 34, it being in driving engagement with the projections 44 of the driver 41, will likewise be reduced. In turn, the speed of rotation of the rearward end of the drive sleeve 30 will be reduced, since it is connected to the rearward end of the hammer 34. However, the forward end of the drive sleeve 30 is rigidly connected to the drive shaft 16 and hence this portion of the sleeve 30 will be rotated at a faster rate of speed than the rearward end thereof. The drive sleeve 30 will accordingly be twisted or placed in torsion an amount dependent upon the degree of relative movement between the hammer 34 and the drive shaft 16.

As the sleeve 30 is twisted, the longitudinal dimension thereof increases, causing the rearward end of the sleeve to move relative to the drive shaft 16 and housing extension 24 in a rearward direction, thus also moving the hammer 34 in the same direction. This movement continues until the three dogs 40 have been moved out of engagement with the three jaw surfaces 45. At this point, the sleeve 30 is freed of any forces tending to maintain it in torsion, and the energy thereby restored in the resilient sleeve is released, causing the rearward portion of the sleeve and accordingly the hammer to be rotated rapidly at a speed greater than the speed of the driving shaft 16. The release of this energy also reduces the longitudinal dimension of the resilient sleeve 30 to its original magnitude thereby extending the dogs 40 between the anvil projections 44. The hammer 34 continues to rotate rapidly until the three dogs 40 are again engaged with the three jaw surfaces 45 of the anvil member. Because the hammer 34 has a relatively large mass, the dogs 40 strike the anvil projections 44 with a first sharp blow or impact followed by a series of blows of lesser magnitude in a vibrating fashion. Continued resistance to rotation of the socket member (not shown) causes a repetition of the above described cycle of energy in the sleeve 30, disengagement of the hammer from the anvil, release of the energy stored in the sleeve and subsequent engagement of the hammer with the anvil together with the series of impacts therebetween. When the nut reaches its final tightened position, the socket member and driver 41 cease to rotate at all with the result that the hammer 34 comes to a stop, the dogs 40 move out of engagement with the jaw surfaces 45, the hammer then accelerates rapidly until the dogs 40 impact the jaw surfaces 45. This sequence occurs thrice during each revolution of the drive shaft 16.

If it is desired to remove a tightened nut from a bolt, or if it is desired to tighten a nut having left-hand threads, the direction of rotation of the motor shaft is reversed by means of the switch 15, and in such cases the jaw surfaces



46 on the driver 41 becomes operative. The action of the rubber-like 30 is the same, however, with the exception that the sleeve is twisted in the opposite direction.

The magnitude of the individual impacts transmitted to the driver 41 may be varied by adjusting the position of the adjustment nut 47 relative to the housing extension 25. This in turn causes a change in the longitudinal position of the driver 41 and the anvil portion 42 relative to the hammer 34. It will thus be understood that by turning the nut 47 to move it forwardly or rearwardly with respect to the housing extension 25, the longitudinal amount of surface contact between the dogs 40 and the jaw surfaces 45 (or jaw surfaces 46, as the case may be) may be respectively increased or reduced. If a greater magnitude of impact is desired, the nut 47 in its related parts are moved in a rearward direction relative to the housing extension 25, thus providing a greater longitudinal surface contact between the dogs 40 and the jaw surfaces 45. Accordingly, a greater amount of twisting of the sleeve is required in order to cause an elongation of the sleeve sufficient to move the dogs out of contact with the jaw surfaces. Therefore, a greater amount of energy is stored in the sleeve 30 causing a greater impact. If, on the other hand, a lesser impact is desired, the nut 47 is moved forwardly with respect to the housing extension 25 and a smaller longitudinal surface contact between the dogs 40 and jaw surfaces 45 is provided, ultimately resulting in a lesser impact.

It has been found that increasing the number of dogs on the hammer and the corresponding projections on the anvil member decreases the amount of twisting of the resilient sleeve necessary in order to accumulate sufficient energy to cause the dogs to reach and impact with a sharp blow the projections on the anvil. In a three dog and three projection arrangement as shown in the present invention, the resilient sleeve need only be twisted before disengagement of the hammer with the anvil enough to accumulate sufficient energy to cause rotation of the hammer at a faster speed than the speed of the drive shaft 16 for a maximum angular distance of 120 degrees. Moreover, the three dog and three projection configuration results in greater adjustability of the magnitude of impact between the hammer and anvil.

However, there is a limitation on the number of dogs which can be employed, because sufficient space is required between the anvil projection to allow the dogs time enough to be extended and impact the projections with proper longitudinal surface contact therebetween.

The present invention provides the necessary impact required with less twist of the resilient sleeve thereby preventing wear and subsequent failure of the sleeve.

I claim:

1. In an impact wrench, the combination of a drive shaft, a driver member mounted co-axially of the drive shaft, power means for rotating the drive shaft, a hammer member adapted to impact said driver member and rotatably mounted co-axially of the drive shaft, a cylindrical resilient driving member adapted to rotate the hammer member and driven from the drive shaft, cooperating means on said hammer member and said driver member for releasably engagement therebetween, said cooperating means limiting relative angular movement between said hammer member and said driver member to 120 degrees between each impact of said hammer member and said driver member, means for connecting to the hammer member the end of the resilient driving member most remote from the cooperating means, and other means for connecting the other end of the resilient driving member to the drive shaft so that upon relative rotational movement between the hammer member and the drive shaft the resilient driving member is twisted and thereby elongatd to move the hammer member out of engagement with the driver member.

2. The combination of claim 1, wherein the cooperating means includes a plurality of radial jaw faces on said hammer member and on said driver member.

3. The combination of claim 2, wherein said radial jaw faces on said hammer member are angularly spaced not more than 120 degrees apart and said radial jaw faces on said driver member are angularly spaced not more than 120 degrees apart.

4. The combination of claim 2, wherein said hammer member and said driver member each include six radial jaw faces.

5. In an impact wrench, the combination of a drive shaft, a driver member mounted co-axially of the drive shaft, power means for rotating the drive shaft, a hammer member adapted to impact said driver member and rotatably mounted co-axially of the drive shaft, a conical shaped resilient driving member co-axial with said drive shaft, said driving member having conical inner and outer surfaces and a small diameter and a large diameter end, said driving member being operatively connected to the hammer for rotation therewith and driven from the drive shaft, cooperating means on said hammer member and said driver member for releasable engagement therebetween, said cooperating means comprising radial jaw faces on said hammer member and on said driver member, said radial jaw faces limiting relative angular movement between said hammer member and said driver member to 120 degrees between each impact of said hammer member and said driver member means for connecting to the hammer member the large diameter end of the resilient driving member, said large diameter end being most remote from the



cooperating means as compared to said small diameter end, and other means for connecting the small diameter end of the resilient driving member to the drive shaft so that upon relative rotational movement between the hammer member and the drive shaft the resilient driving member is twisted and thereby elongated to move the hammer member out of engagement with the driver member.

6. In a power driven impact wrench having a resilient sleeve connected at one end to the drive shaft and connected at the other end to a hammer member which releasably engages an anvil member so that upon relative movement between the hammer member and the drive shaft the resilient sleeve is twisted and thereby elongated to move the hammer member out of engagement with the driver member, wherein the improvement comprises; cooperating means on said hammer member and on said anvil member to prevent relative angular movement between said hammer member and said anvil member in excess of 120 degrees between each impact of said hammer member and said anvil member.

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