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F. A. JIMERSON ET AL

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IMPACT WRENCH

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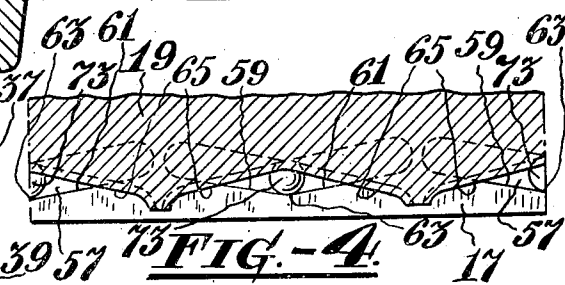
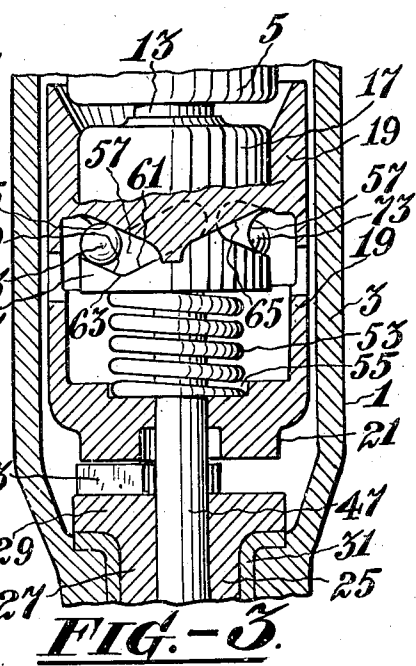
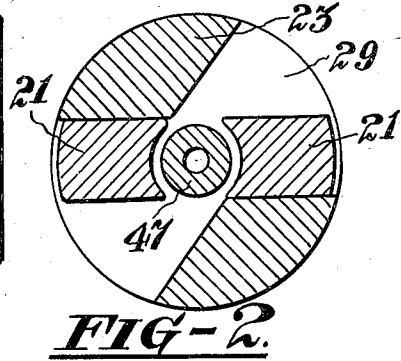
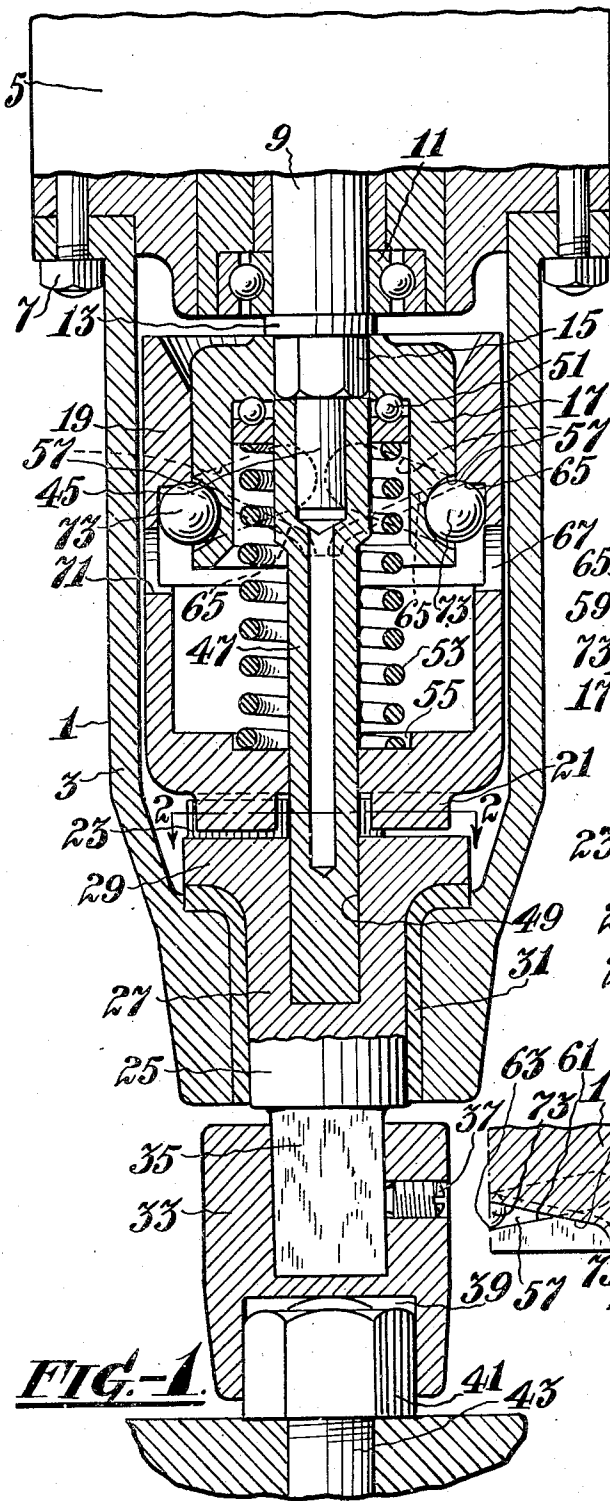


FIG. 1

FIG. 2

FIG. 3

FIG. 4

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IMPACT WRENCH

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The present invention relates to an impact wrench of the rotary type. More specifically, it refers to the type of device adapted to rotate a tool until the work sets up a resistance torque sufficient to prevent further rotation of the tool by the device. When such a torque is set up the device is designed to deliver a series of sharp impact blows to the tool in order that the tool may overcome the work resistance.

Devices of this type are usually provided with an anvil member adapted to engage the work and a hammer member through which the driving force of the motor is transmitted to the anvil. The connecting means between the motor and the hammer is so constructed that the motor will rotate the hammer and anvil so long as the work resistance is insufficient to overcome the driving torque. However, when the torsion set up by the work is greater than the driving torque and sufficient to prevent movement of the anvil by the hammer, this connection is designed to disengage the hammer and the anvil.

While the hammer and the anvil are disengaging, the energy supplied by the motor is stored in a spring or accumulator device, and as soon as these parts are completely disengaged the stored energy is imparted to cause the hammer to re-engage with and impact against the anvil jaws. Thus the stored energy is employed to impart an additional angular velocity to the hammer over that imparted by the motor during the time that the hammer and anvil are re-engaging and the kinetic energy of the hammer is transformed into work delivered to the anvil. A great many forms of such connections have been proposed, but they have all been subject to disadvantages.

It is, therefore, an object of this invention to provide a driving connection which is simple in construction.

It is a further object to provide a driving connection which will permit the hammer to strike the anvil with great force and rapidity.

A still further object is to provide a driving connection which will disengage the clutch member rapidly.

A still further object is to provide a driving connection which will disengage the clutch member completely upon a slight angle of rotation of the motor.

It is still a further object to provide a device which is novel and which will overcome work resistance effectively and efficiently.

A still further object is to provide a driving connection which is of rugged construction and

not subject to excessive wear requiring frequent repairs.

These and further objects will be apparent from the following description of which the drawing is a part.

In the drawing, similar reference numerals refer to similar parts.

Figure 1 is an elevational view in section of a device constructed in accordance with the principles of the present invention,

Figure 2 is a view in section taken along the line 2—2 of Figure 1,

Figure 3 is a view partly in section and partly in elevation of a portion of the device illustrated in Figure 1 showing the hammer and anvil disengaged, and

Figure 4 is a developed view of a portion of the device of Figure 1 illustrating the parts in operating position.

Referring to Fig. 1 the rotary impact device is generally indicated at 1 and consists of a casing 3 secured to the motor 5 by means of the bolts 7. The motor 5 may be any suitably controlled reversible motor having a shaft 9 rotating in the bearing 11. A flange 13 is formed on the shaft 9 to prevent movement of the shaft 9 toward the motor. The hexagonal portion 15 is formed on the shaft 9 in juxtaposition to the flange 13. This hexagonal portion may, of course, be of any other desired construction so long as it will prevent relative rotation of the rotary driving head 17 with respect to the shaft 9 and will permit the shaft 9 to rotate the head 17 which is surrounded by a cup-shaped hammer 19 extending into the casing 3.

On the bottom of the cup-shaped hammer are clutch teeth 21 which are adapted to engage with corresponding clutch teeth 23 mounted on the upper face of the anvil member 25. These clutch teeth 21 and 23 provide a disengageable driving means between the hammer member 19 and the anvil member 25. The anvil 25 consists of a cylindrical portion 27 surmounted by a flange 29 on the upper surface of which are mounted the clutch teeth 23. A bearing 31 situated within the opening at the bottom of casing 3 supports the anvil 25 and permits rotation of the anvil with respect to the casing.

In order that a wrench 33 or any other suitable tool may be secured to the anvil, a shank 35, formed as an integral part of the anvil, extends from the cylindrical portion 27 of the anvil. The wrench 33 is secured by any means, such as the set screw 37 to the shank 35, and is provided with

a socket 39 adapted to engage the nut 41 in order that the nut may be secured to the bolt 43.

It is desirable that the hammer member 19 be maintained in axial alignment with the shaft 9 at all times, and for this reason an extension 45 is formed on the hexagonal portion 15 of the shaft 9. This extension is recessed in a guide rod 47 which passes through the bottom wall of the hammer 19 into a recess 49 formed in the upper part of the anvil member 25. Guide rod 47 acts as a spacer between drive head 17 and anvil 27 to hold the anvil down during disengagement of the clutch teeth 21 and 23. The recess 49 is of sufficient diameter to permit rotation of the guide member therein, and the guide member in turn permits free rotation of the extension 45 formed on the shaft 11.

Within the head 17, and surrounding the guide rod 47, is a thrust bearing 51 which permits the spring 53 to rotate with respect to the head 17. A spring 53 rests against the thrust bearing 51 at one end thereof, and the other end rests in a well 55 formed in the bottom wall of the hammer member 19. The purpose of the spring 53 is normally to hold the hammer clutch jaws 21 in engagement with the anvil clutch jaws 23, and to absorb and impart energy.

The apparatus above described is an impact wrench of a conventional design and the driving connection between the head 17 and the hammer 19 will now be described.

On the side of the driving member 17, channels or races 57 are formed. These channels 57 are formed as shown in Figs. 3 and 4 with inclined surfaces 59 and 61 which meet at their lowermost point 63. Several of these doubly inclined channels are provided, and there is no intercommunication between the separate channels. The hammer member 19 is provided with grooves 65 which are so placed that they cooperate with the channels 57 formed on the driving head. These grooves communicate with openings 67 which extend through the wall of the hammer member 19 and permit the insertion of the balls 73.

The arrangement of grooves 57 and 65 and ball members 73, which are guided in them, is to permit the hammer 19 to disengage the anvil member 29 upon encountering a predetermined resistance thereof to rotation, and to assist in storing in the spring 53 energy which is subsequently expended upon the anvil by the hammer.

Thus, when the torque of the shaft 9, transmitted through the jaws 21 and 23, is insufficient to turn the anvil 29 due to the resistance of nut 41, the jaws 21 and 23 disengage by raising the hammer 19 against the compression of spring 53 during which the balls 73 roll up grooves 57 and the grooves 65 correspondingly rise to lift the hammer 19. As soon as the jaws 21 rise to the height of jaws 23 they slide on top of the latter until rotated to a point of complete disengagement therewith. Jaws 21 are then free of jaws 23 and spring 53 tends to extend itself. In so doing, the hammer 19 is forced to move much faster than the driver 9 and because of this increased velocity, the kinetic energy thereof is increased as the square of the velocity. As the

spring 53 extends, the grooves 65 cause the balls 73 to roll preferably almost down to the bottoms of the grooves 57 before the jaws 21 and 23 re-engage so that the jaws strike each other with the maximum possible impact.

The arrangement above described provides the least possible friction in contacting parts. The bearing of balls 73 with the grooves 57 and 65 is substantially without friction and in addition the balls 73, as they roll, move a very slight distance in the grooves which enables the grooves to be made relatively short. Actually, the grooves may be made only half the length of cam surfaces previously used in similar applications for impact wrenches as is well known in the art. This permits the provision of a plurality of sets of grooves 57 and 65 to give suitable bearing and support for the hammer 19.

The number of jaws 21 or jaws 23 is optional. With two sets of such jaws, two blows are delivered to the anvil 29 at each revolution when the nut 41 is being set.

It is understood that in setting nut 41 the hammering of the hammer 19 upon anvil 29 continues as long as power is applied to shaft 9 and that it is this hammering that causes the nut 41 to be turned to its seat. A very important advantage of this wrench is that the reaction upon the tool itself is negligible so that little effort is required by the operator to prevent the casing 1 from turning. This property is in a large measure due to the frictionless structure provided by this invention.

We claim:

1. In a rotary impact tool having an anvil and a hammer for striking the anvil, clutch members on the hammer and anvil, a spring to normally hold the clutch members in engagement, driving means for the hammer, and means connecting the hammer and driving means comprising V-shaped channels on the driving means having the arms of the V inclined at an angle to the horizontal substantially less than ninety degrees, inverted V-shaped grooves on the hammer member having arms at the same angle to the horizontal as the arms of said channels, and ball members retained in said V-shaped channels by said inverted V-shaped groove.

2. In a rotary impact tool having an anvil and a hammer for striking the anvil, disengageable cooperating clutch members on the hammer and anvil, a spring to normally hold said clutch members in engagement, driving means for the hammer, and means whereby the driving means may drive the hammer member when the clutch members are engaged and to disengage the clutch member when the driving means is incapable of driving the hammer member comprising V-shaped channels on the driving means having the arms of the V inclined at an angle to the horizontal substantially less than ninety degrees, inverted V-shaped grooves on the hammer having the arms of the V at the same angle to the horizontal as the arms of said channels, and means guided by said channels and grooves.

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