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ROTARY IMPACT WRENCH

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2 Sheets-Sheet 1

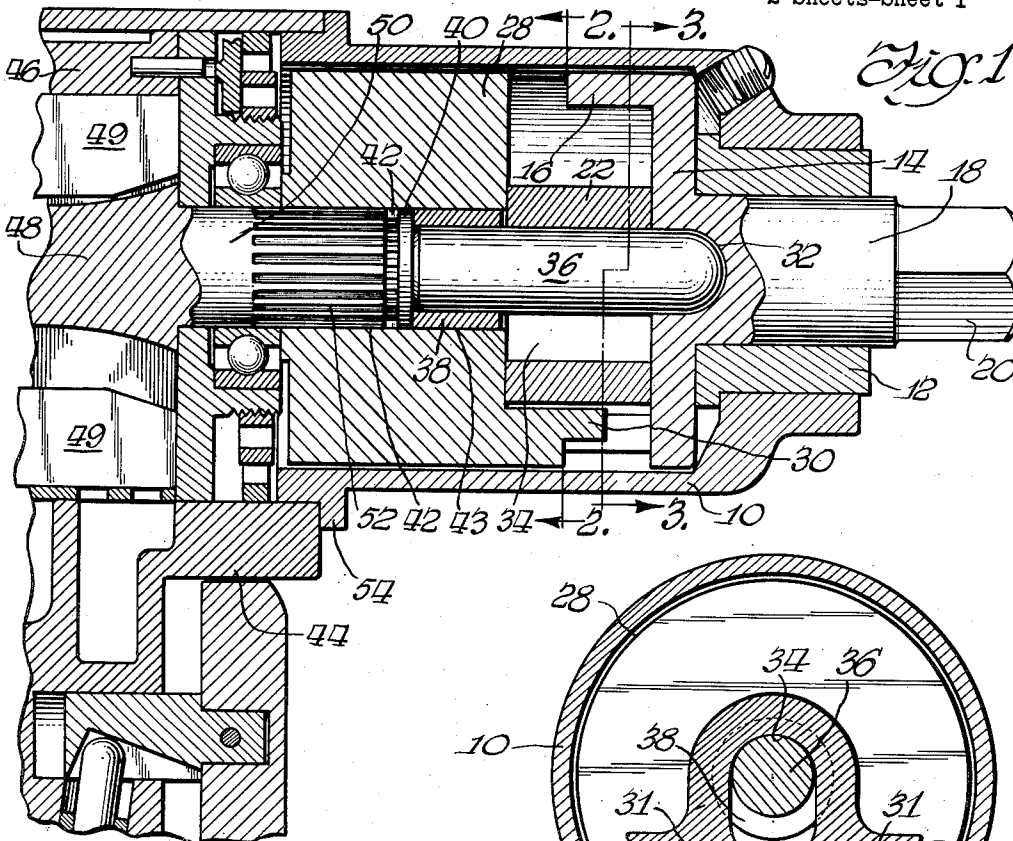


Fig. 1

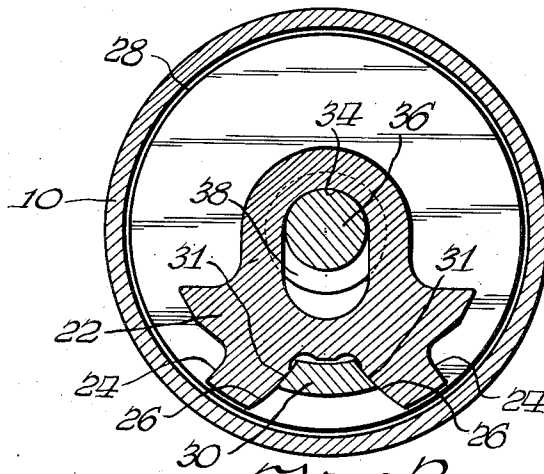


Fig. 2

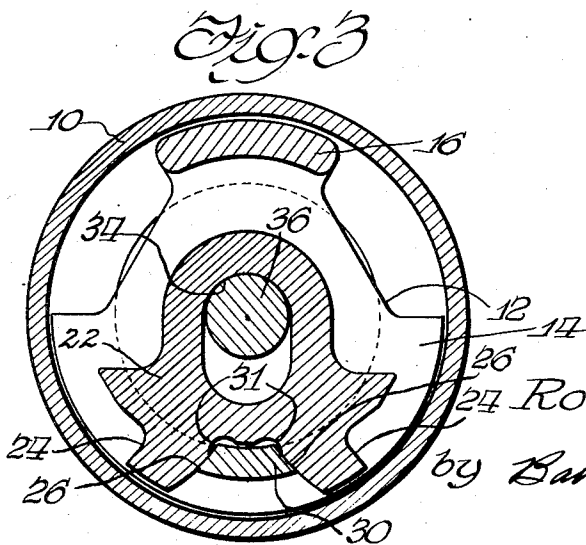


Fig. 3

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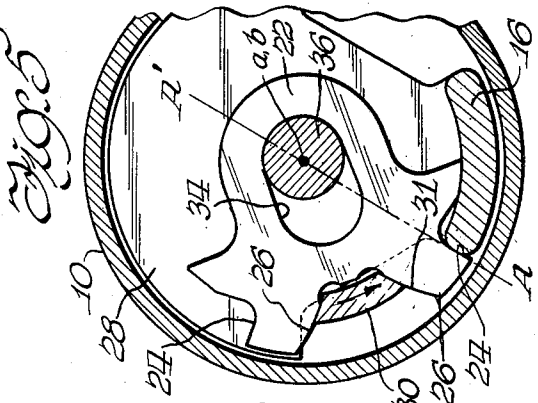
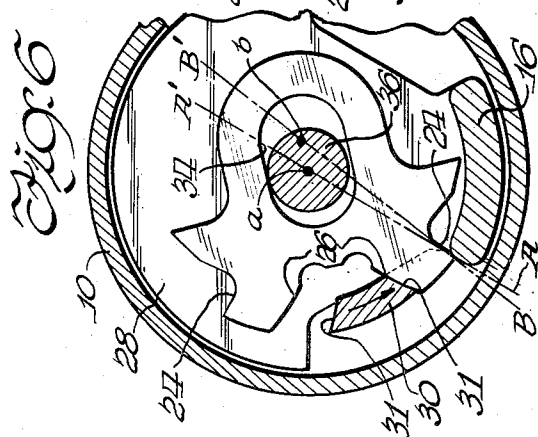
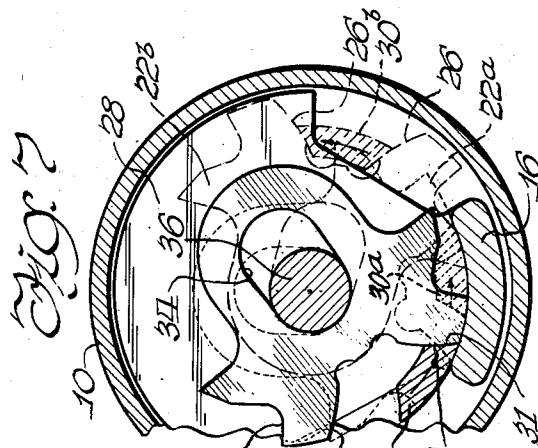
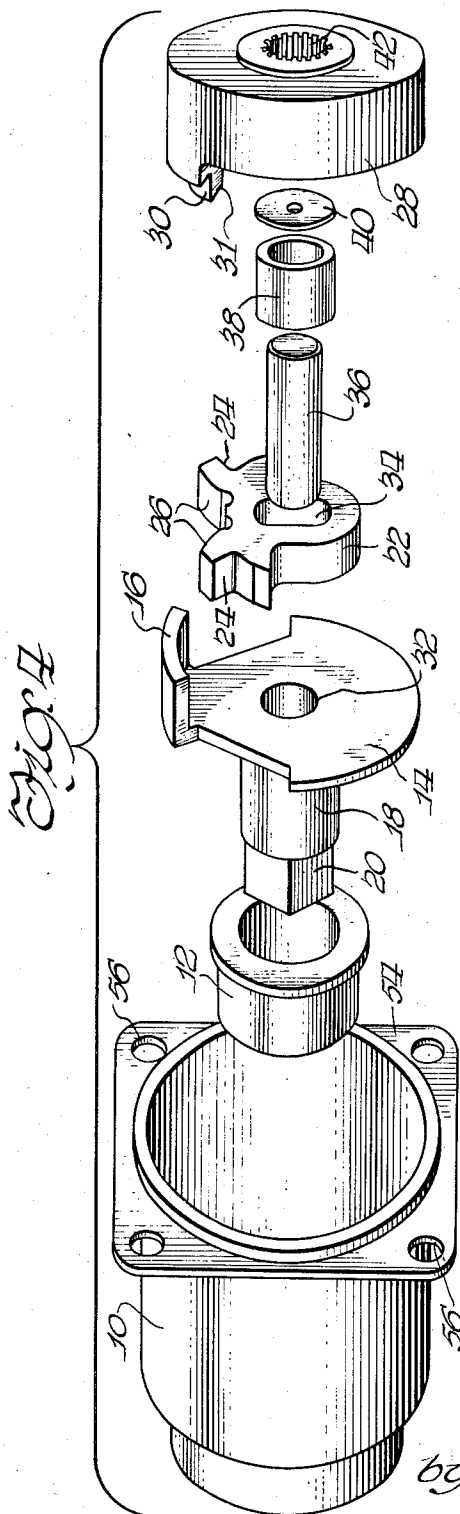
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2 Sheets-Sheet 2



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ROTARY IMPACT WRENCH

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12 Claims. (Cl. 81—52.3)

This invention relates to a rotary impact wrench particularly adapted for operation from a pneumatic motor wherein an assemblage of driver, hammer member and anvil member are interposed between the motor shaft and the work, such as threading a nut on a bolt, for initially, rapidly rotating the work until a predetermined resistance to torque has been built up, whereupon the mechanism operates to deliver a series of rotary impact blows to the work as long as the motor continues to operate. Conversely, as when loosening a nut, impact blows are first delivered to the nut until it is loose, and then the nut is automatically, quickly rotated off the bolt when the resistance to torque reduces because of the nut having loosened.

One object of the invention is to provide the foregoing referred to mechanism of comparatively simple and inexpensive construction and involving a minimum number of parts, a condition conducive to long life and so designed as to require a minimum of time and parts in replacement when the wear advances to a stage requiring replacement.

Another object is to provide an impacting mechanism comprising a driver having a driver lug which is a section of a cylinder, and an anvil having a driven lug which is also a section of a cylinder, one being rotatable inside the other, and a hammer member for interposition between the two, the hammer member being substantially radially movable relative to the axis of rotation and cammingly cooperative with the driver to cam the hammer out of engagement with the anvil upon predetermined resistance to torque being offered by the work, the camming action and centrifugal force then cooperating to move the hammer back into the path of the anvil so that another hammer blow is delivered after about 270° of rotation.

Still another object is to provide the hammer member and the anvil member with substantially radial faces for greatest efficiency in delivering impact blows and coacting cam faces at such angles as to cam the hammer member out of an interposed position between the driver and the anvil when the desired resistance to torque is reached.

A further object is to provide camming action which, when the anvil stops rotation of the hammer, drives the hammer out of engagement with the anvil, and in so doing the hammer rotates slightly in a retrograde direction relative to the driver. Upon release of the hammer from the anvil, the hammer rotates slightly in the original direction relative to the driver under the action of centrifugal force to resume the anvil engaging position.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my impact wrench, whereby the objects above contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in detail on the accompanying drawings, wherein:

Fig. 1 is a cross-sectional view through an impact wrench embodying my invention and showing adjacent

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portions of a pneumatic motor, also in cross-section, for driving the wrench;

Figs. 2 and 3 are vertical sectional views on the lines 2—2 and 3—3, respectively of Fig. 1 showing the parts in positions they assume at one time between impact blows;

Fig. 4 is an exploded perspective view of the parts of my impact wrench; and

Figs. 5, 6 and 7 are sectional views similar to Fig. 3 showing successive operating positions of the parts of the wrench.

On the accompanying drawings I have used the reference numeral 10 to indicate a housing for the impact wrench mechanism. A bearing 12 is mounted in one end of the housing and journals a shaft 18 of an anvil member 14. The anvil member 14 is somewhat disc-like in character and is provided with an anvil 16 in the form of a projecting lug. The shaft 18 is provided with a driving shank 20 which may be square or other suitable shape to fit into an interchangeable wrench socket, or a similarly shaped socket in the head of a cap screw or the like.

My impact wrench mechanism further includes a hammer 22 having hammer faces 24 and cam faces 26. A driver 28 is provided having a driver lug 30 projecting from one side thereof. Its opposite ends constitute cam faces 31 for a purpose which will hereinafter appear.

The anvil member 14 has a socket 32 to receive one end of a pin 36. This pin extends through a lateral slot 34 of the hammer 22 and a sleeve 38 is located thereon to receive the other end of the pin 36 and journal it. A washer 40 is located at said other end and at the corresponding end of the sleeve 38 as shown in Fig. 1.

The driver 28 is provided with a splined bore 42 and a smooth bore 43. The splined bore 42 coacts with a spline 52 on a motor shaft 50, and the smooth bore 43 receives the sleeve 38. In Fig. 1, I illustrate a motor housing 44 of a pneumatic vane type motor or the like, 46 being a stator thereof and 48 a rotor thereof from which the motor shaft 50 extends.

The housing 10 for my impact wrench is provided with a flange 54 having openings 56 therein through which cap screws may extend to be threaded into the end of the pneumatic motor housing 44 in an obvious manner so that the impact wrench housing 10 and the mechanism therein are suitably supported with respect to the motor.

The driver 28 is supported for rotation on the motor shaft 50 by means of the splining 42—52 and is aligned with the anvil member 14 by means of the pin 36 and the sleeve 38. The intermediate portion of the pin serves as a support for the hammer 22, the slot 34 of the hammer encircling the pin and thereby permitting some radial movement of the hammer relative to the pin. Also for a purpose which will hereinafter appear, the driver 28 preferably has considerable mass so as to act as a fly wheel for the pneumatic motor.

Practical operation

In the operation of my impact wrench, considering the parts as starting at rest as illustrated in Fig. 3, operation of the motor results in rotation of the driver 28 and its lug 30. Assuming rotation in the counterclockwise direction, the lug 30 will move the hammer 22 likewise in the counterclockwise direction and the forward facing hammer face 24 will engage the anvil 16 and rotate the anvil member 14 as long as no substantial resistance to torque is offered by the work. Referring to Fig. 5, counterclockwise rotation of the anvil 16 imparts counterclockwise rotation to the anvil member 14 and through the shaft 18 and the shank 20 to the work. Such rotation will continue until a predetermined torque is reached

whereupon impacting will commence, as will now be described.

Referring to Fig. 6 and assuming that the predetermined torque referred to was reached at the Fig. 5 position, the camming action of the forward cam face 31 of the driver lug 30 on the adjacent cam face 26 of the hammer 22 will cam the hammer inwardly from the position of Fig. 5 to the position of Fig. 6 because the camming moment is greater than that produced by centrifugal force. At the same time, the hammer face 24 which is in contact with the anvil 16 will start tilting slightly and thus produce additional camming action after once started which augments the camming action of the cam face 31 against the cam face 26.

This is illustrated in Fig. 5 where the hammer face 24 and the end of the anvil 16 are coincident on a line A—A' passing through a center indicated *a*, *b*. The center *a* is the center of the pin 36 or, in other words, the axis of rotation and is also the center or focus of the radial impact receiving faces of the anvil 16. The center *b* is the center for the inner end of the slot 34 and is also the center of the radial striking faces 24 of the hammer 22. In Fig. 6 the center *b* has been displaced so that a line B—B' indicating the face 24 now slants in relation to the line A—A' for the face 26 of the anvil 16.

The tilting action above referred to actually produces slight retrograde rotation of the hammer relative to the driver, the anvil 16 being stationary in Figs. 5 and 6 and the cam 30 having advanced from the Fig. 5 position to the Fig. 6 position.

From the description just made, it will be obvious that upon driving the impact wrench before impact takes place, the line A—A' in Fig. 5 shows that the engaging faces of the hammer and anvil are radial so that there is neither an engaging nor a disengaging moment. By providing the proper angle for the camming faces 31 and 26, and proper weight in the hammer, the predetermined torque desired can be regulated.

Fig. 7 illustrates a further position after the Fig. 6 position in which the hammer face 24 has been cammed sufficiently inward relative to the anvil 16 to start bypassing it and is now riding the inner surface of the anvil as shown in solid lines. When the hammer reaches the dotted position shown as 22*a* both lugs defined by the faces 24 and 26 are riding the inner surface of the anvil. When the dash-line position 22*b* is reached, the hammer has moved outwardly again under the action of centrifugal force so that after about 270° of rotation, it resumes the anvil engaging position of Fig. 5. Thereupon, the impact cycle will be repeated as long as the motor remains in operation.

It is obvious from an inspection of Figs. 6 and 7 in relation to Fig. 5 that the camming action permits the hammer to have some retrograde movement relative to the driver 28 and the driver lug 30 during the camming action. After the camming action has been completed, centrifugal force acting on the hammer will speed up its rotation relative to the driver lug by reason of the camming action at 31—26 where these two surfaces are shown in contact in Fig. 7, position 22*b*. This brings the hammer into position so that it can deliver the next blow when the position of Fig. 5 is again reached.

It is obvious from the foregoing specification that I have provided a mechanism consisting of but few parts and essentially a driver and an anvil with a hammer intermediate the two for initially continuously rotating the work and upon predetermined torque imparting rotary impacts thereto. The parts are relatively inexpensive and sufficiently rugged to resist wear to a considerable extent and the assembly is such that worn parts can be readily replaced in a minimum of time.

The parts, it will be noted, are symmetrical so that the impact wrench will operate in either direction for tightening or loosening nuts and the like. The motor, 75

of course, is reversible so as to select clockwise or counterclockwise rotation as desired, and in either direction the operation is substantially the same.

Some changes may be made in the construction and arrangement of the parts of my impact wrench without departing from the real spirit and purpose of my invention. It is accordingly my invention to cover by any claims any modified forms of structure or use of mechanical equivalents which may reasonably be included within their scope.

I claim as my invention:

1. In a tool of the character described, a rotatable driven shaft, a rotatable driver, releasable hammer mechanism interposed between said driver and said shaft, said hammer mechanism being confined to substantially radial movement relative to the axis of rotation of said driver and anvil and having the major portion of its mass on one side of said axis, said hammer mechanism comprising an element having cam faces and substantially radial hammer faces adjacent the outer end of said major portion, said shaft having an anvil provided with substantially radial anvil faces to be engaged by said hammer faces, and said driver having cam faces coacting with the cam faces of said hammer and operable to rotate said hammer, said coacting cam faces being shaped for propelling said hammer substantially radially inward from said driver and anvil faces against the action of centrifugal force upon predetermined resistance to torque.

2. In a tool of the character described, a rotatable driven shaft, a pilot shaft coaxial therewith, a rotatable driver, a releasable hammer interposed between said driver and said shaft and comprising an element having a slot receiving said pilot shaft to permit limited radial movement of said element relative to said pilot shaft, said element having cam faces and hammer faces, said shaft having anvil faces to be engaged by said hammer faces, and said driver having cam faces coacting with the cam faces of said hammer and operable to rotate said hammer, said coacting cam faces being shaped for propelling said hammer substantially radially inward against the action of centrifugal force upon predetermined resistance to torque.

3. In a tool of the character described, a rotatable driven shaft, a rotatable driver, releasable hammer mechanism interposed between said driver and said driven shaft, said hammer mechanism comprising an element having separate cam faces and substantially radial hammer faces, said shaft having an anvil provided with substantially radial anvil faces to be engaged by said hammer faces, and said driver having cam faces coacting with the cam faces of said hammer which are operable to rotate said hammer, said coacting cam faces being shaped for propelling said hammer substantially radially against the action of centrifugal force upon predetermined resistance to torque, and said hammer being provided with only a slot and pin connection to permit of such substantially radial movement of said hammer.

4. In a tool of the character described, a rotatable driven shaft, a rotatable driver, releasable hammer mechanism interposed between said driver and said shaft, said hammer mechanism comprising an element having separate cam faces and hammer faces, said shaft having anvil faces to be engaged by said hammer faces, said driver having cam faces coacting with the cam faces of said hammer which are operable to rotate said hammer, said coacting cam faces being shaped for propelling said hammer substantially radially against the action of centrifugal force upon predetermined resistance to torque, and said hammer having a slotted connection only with said driver to permit of such substantially radial movement.

5. In an impact mechanism, relatively rotatable driver, hammer and anvil members, and means for driving said hammer member from said driver member and said anvil member from said hammer member comprising an anvil on said anvil member comprising a section of a cylinder,

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a driver lug on said driver member comprising another section of a cylinder rotatable inside said anvil cylinder section, said hammer having a projection for interposition between one circumferential edge of said anvil cylinder section and one circumferential edge of said driver lug, said section of a cylinder of said anvil and said projection of said hammer having engageable faces, and said section of a cylinder of said driver and said projection of said hammer also having engageable faces, said first faces being substantially radial and said last faces being at an angle relative to the radial to act as camming means for camming said hammer member from a position with its lug interposed between said driver lug and said anvil to a position inside said anvil cylinder section against the action of centrifugal force, and a pin extending between said driver and said anvil for supporting said hammer, said hammer having a slot receiving said pin to permit of such radial movement of the hammer.

6. In an impact mechanism, relatively rotatable driver, hammer and anvil members, and means for driving said hammer member from said driver member and said anvil member from said hammer member comprising an anvil on said anvil member comprising a section of a cylinder, a driver lug on said driver member comprising another section of a cylinder rotatable inside said anvil cylinder section, said hammer having a projection for interposition between one circumferential edge of said anvil cylinder section and one circumferential edge of said driver lug, said section of a cylinder of said anvil and said projection of said hammer having engageable faces, and said section of a cylinder of said driver and said projection of said hammer also having engageable faces, said first faces being substantially radial and said last faces being at an angle relative to the radial to act as camming means for camming said hammer member from a position with its lug interposed between said driver lug and said anvil to a position inside said anvil cylinder section against the action of centrifugal force.

7. In an impact wrench relatively rotatable driver, hammer and anvil members, and means for driving said hammer member from said driver member and said anvil member from said hammer member comprising an anvil on said anvil member comprising a section of a cylinder, a driver lug on said driver member comprising another section of a cylinder rotatable inside said first cylinder section, said hammer having a projection for interposition between one circumferential edge of said first cylinder section and one circumferential edge of said driver lug, said section of a cylinder of said anvil and said projection of said hammer having engageable faces, and said section of a cylinder of said driver and said projection of said hammer also having engageable faces, said first faces being substantially radial and said last faces being a shallow V to act as camming means for camming said hammer member from a position with its lug interposed between said driver lug and said anvil to a position inside said first cylinder section against the action of centrifugal force.

8. An impact mechanism comprising relatively rotatable driver, hammer and anvil members, and means for driving said hammer member from said driver member and said anvil member from said hammer member comprising an anvil on said anvil member, a driver lug on said driver member rotatable inside said anvil, said hammer having a projection for interposition between one circumferential edge of said anvil and one circumferential edge of said driver lug, said anvil and said projection having engageable faces, and said driver lug and said projection also having engageable faces, said first faces being substantially radial and said last faces being at an angle relative to the radial to act as camming means for camming said hammer member against the action of centrifugal force from a position interposed between said driver lug and said anvil to a position inside said anvil, and means extending between said driver and said anvil

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for supporting said hammer, said hammer having a slot receiving said means to permit radial movement of said hammer.

9. In a tool of the character described, a rotatable driven shaft, a rotatable driver, releasable hammer mechanism interposed between said driver and said shaft, said hammer comprising an element having cam faces forming a shallow V which opens radially outward and having substantially radial hammer faces independent of said cam faces, said shaft having an anvil provided with substantially radial faces to be engaged by said hammer faces, said driver having cam faces complementary to said cam faces of said hammer, said driver cam faces propelling said hammer radially inward against the action of centrifugal force upon predetermined resistance to torque, and said hammer being provided with a slotted connection only to said driver to permit of such radial movement.

10. In a device of the character described, the combination of a driver having rotation imparted thereto in either direction, a rotatable anvil having means to connect with work to be rotated, a hammer rotatable with said driver and having limited rotation relative to said driver and means to permit radial movement of said hammer relative to the axis in addition to rotation therearound into and out of rotation transmitting engagement with said anvil, said hammer having a pair of opposite hammer faces for engaging opposite circumferential ends of said anvil and a cam face, and said driver having a complementary cam face coacting with said cam face of said hammer and being inclined relative to the radial for camming the hammer inwardly against the action of centrifugal force upon predetermined resistance to rotation being offered by the work through the anvil to said hammer.

11. In an impact wrench, a driver having rotation imparted thereto in either direction, a rotatable anvil having means to connect with work to be rotated, a hammer rotatable with said driver and having limited rotation relative thereto and means to permit radial movement relative to the axis in addition to rotation therearound into and out of rotation transmitting engagement with said anvil, said hammer having a pair of opposite hammer faces for engaging opposite circumferential ends of said anvil and a pair of cam faces, and said driver having complementary cam faces coacting with said cam faces of said hammer, said faces being inclined relative to the radial for camming said hammer inwardly against the action of centrifugal force upon predetermined resistance to rotation being offered by the work.

12. In a tool of the character disclosed, a rotatable driven shaft, a rotatable driver, releasable hammer mechanism interposed between said driver and said shaft, said hammer comprising an element having cam faces forming a shallow V and having substantially radial hammer faces, said shaft having an anvil provided with substantially radial faces to be engaged by said hammer faces, said driver having cam faces complementary to said cam faces of said hammer, said driver cam faces propelling said hammer substantially radially against the action of centrifugal force upon predetermined resistance to torque, and said hammer being provided with a slot-like connection to permit of such substantially radial movement.

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