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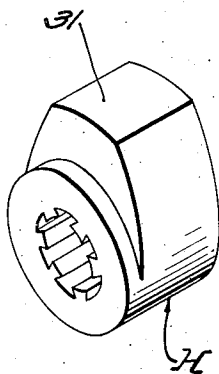
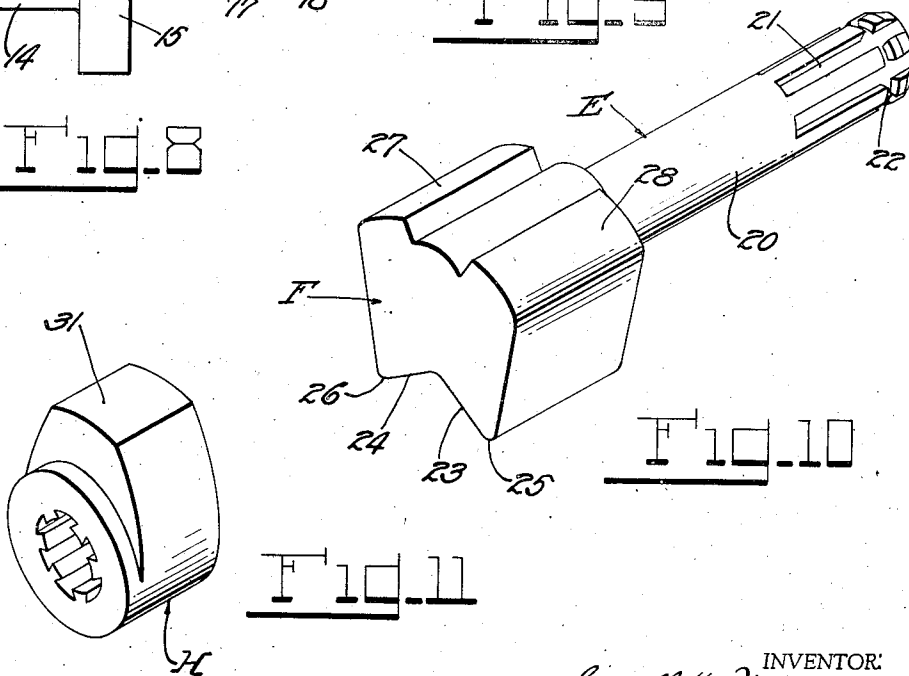
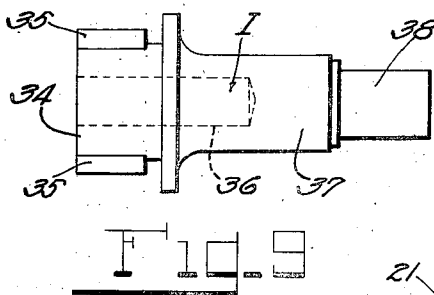
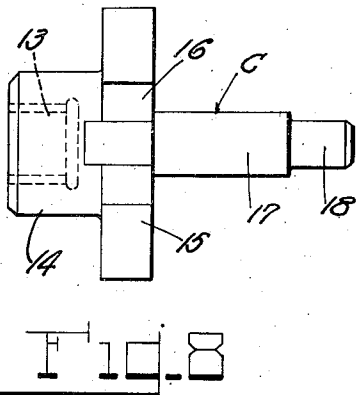
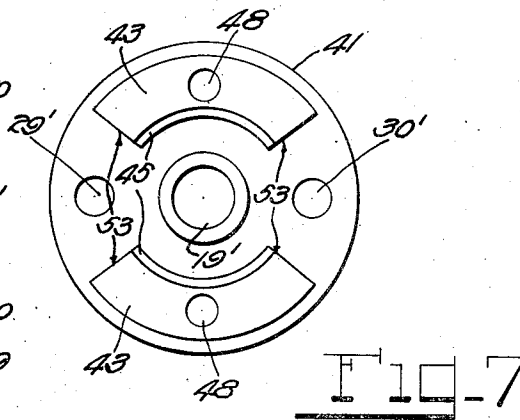
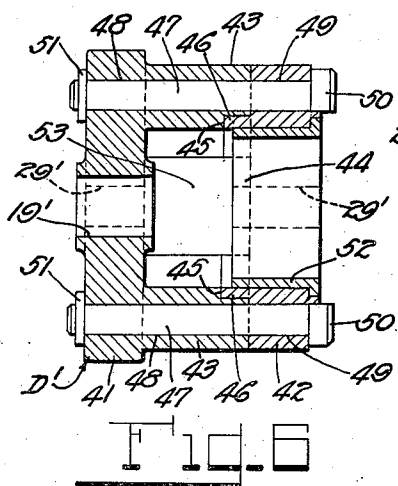
C. H. RICHARDS

2,408,228

IMPACT TOOL MECHANISM

Filed Feb. 24, 1944

3 Sheets-Sheet 2



INVENTOR:
Carroll H. Richards
BY
Dike, Colver + Porter
ATTYS-

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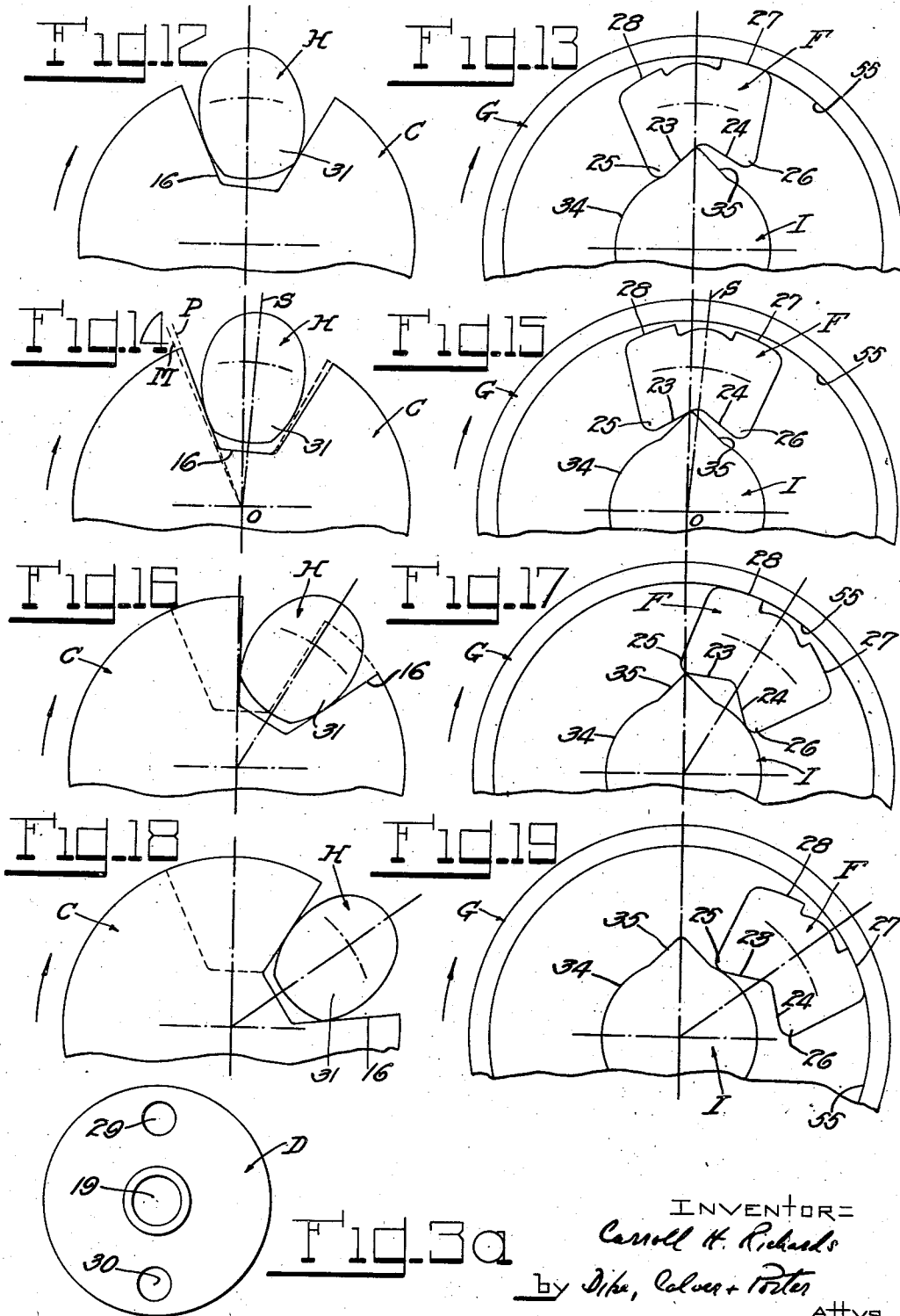
C. H. RICHARDS

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3 Sheets-Sheet 3



INVENTOR=

Carroll H. Richards

by Dike, Colver + Porter

Attys.

UNITED STATES PATENT OFFICE

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IMPACT TOOL MECHANISM

Carroll H. Richards, Boston, Mass.

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6 Claims. (Cl. 192—30.5)

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This invention relates to impact tool mechanisms, such as impact wrenches.

In previous impact mechanisms with which I have been familiar, the hammer is decelerated on impact with the driven element. In the mechanism of the invention, a rotating hammer is accelerated and is capable of delivering a greater driving force to the driven member. This is a great advantage because it provides greater force when needed most.

The deceleration of the impact hammer in previous impact tool mechanisms necessarily causes the motor driving the mechanism to slow down, or stop, between impacts, and heretofore the only motor that would perform satisfactorily under these conditions has been a pneumatic or compressed-air motor. An impact tool embodying the present invention, however, is capable of being driven by an electric motor, as well as by compressed air. This is a great advantage in operations where compressed air is not readily available.

Furthermore, in prior impact tool mechanisms the hammer surface becomes quickly distorted and deformed through constant hammering, and the same angle of contact between the hammer and anvil faces at all times is impossible. These machines vary in performance, quickly lose their efficiency, and parts must be frequently replaced. In my mechanism, however, positive means are provided for maintaining the same angle of impact at all times for greatest efficiency and constant performance, despite wear.

A further important object of the present invention is to provide an impact tool mechanism which will absorb the reaction of the impact within itself.

Another advantage of the present tool lies in the provision of auxiliary means to dampen or smooth out the revolutions of the mechanism to reduce vibration and jerkiness in operation.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation, and it is not intended to limit the invention claimed herein beyond the requirements of the prior art.

In the drawings:

Fig. 1 is a sectional view of an impact wrench,

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with parts of the motor and housing broken away. Fig. 2 is a sectional view taken on line 2—2 of Fig. 1.

Fig. 3 is a sectional view taken on line 3—3 of Fig. 1.

Fig. 3a is a detail end view, of the rotatable torque receiving member D, shown in Figs. 1, 2 and 3.

Fig. 4 is a sectional view of another form of construction of the rotatable torque receiving member with part of its housing and other parts broken away.

Fig. 5 is an end view of the rotatable torque receiving member shown in Fig. 4.

Fig. 6 is a section of the rotatable torque receiving member taken on line 6—6 of Fig. 4.

Fig. 7 is a plan view of one of the parts of the rotatable torque receiving member shown in Fig. 4.

Fig. 8 is a side elevation of the driving element.

Fig. 9 is a side elevation of the driven element.

Fig. 10 is a perspective view of the driving connection between the rotatable torque receiving member and the driven element.

Fig. 11 is a perspective view of a special gear constituting the driving connection between the rotatable torque receiving member and the driving element.

Figs. 12 to 19 inclusive are diagrams showing the relation of certain of the parts at different periods in the operation of the device, taken from the point of view of the operator using the device, or from the left of Fig. 1, and opposite to that of Fig. 3.

A conventional housing or case, shown here as adapted to an impact wrench, houses the mechanism of the invention which housing is made in two parts, upper part B and lower part K, conventionally fitted together and held in place by bolts and nuts 40 (Fig. 1). Spindle A of the driving power unit is journaled in ball bearing 10 conventionally held in partition 11 located in the upper portion B of the housing. It is understood that a suitable motor, pneumatic, electric, or otherwise (not shown), provides power for driving spindle A. The splined end 12 of spindle A fits into splined hole 13 of the driving element C, and the driving force is transmitted by spindle A through these splines to the driving element C. The end 14 of driving element C abuts one end of ball bearing 10 and aids in locating the ball bearing.

Driving element C (Figs. 1, 2 and 8) includes the flanged portions 15, having two gear teeth spaces 16 therein and extending from the center of the flanged portion 15 and integral with it, is

shaft portion 17, at the extreme end of which is another shaft portion 18, smaller in diameter than portion 17.

A rotatable torque receiving member D (Figs. 1, 3 and 3a) is rotatably mounted on driving element C about shaft portion 17, having a central hole 19 into which shaft portion 17 fits.

Two driving connections E (Figs. 1, 2 and 10) having shaft portions 20 are rotatably mounted in holes or bearings 29 and 30 of the rotatable torque receiving member D (Figs. 1 and 3a), said holes 29 and 30 being located a suitable distance out from the center of the rotatable torque receiving member D. Shaft portion 20 has splines 21 at one end, and an annular groove 22 adjacent the splines 21 adapted to receive a conventional spring fastening ring 32 (Fig. 1). Splined on the splined ends 21 of driving connection E are specially designed acceleration control parts H (Figs. 1, 2 and 11), each having one tooth 31. Gear teeth 31 operate in gear spaces 16 of driving element C and receive the driving force therefrom. The contacting surfaces of these gear teeth 31 are arcuate surfaces and their radius R (Fig. 2) may be changed to suit different operating conditions. The spring rings 32 fitting in the annular grooves 22 on splined ends 21 of driving connection E aid in locating parts H on the splined end 21 of shaft portion 20 and prevent longitudinal movement of the parts H in one direction along shaft portion 20.

At the opposite end of shaft portion 20 of driving connection E, and integral with it, is hammer head F (Figs. 1, 3 and 10), having hammer faces 23 and 24 forming a V, the open ends of the V terminating in rounded noses 25 and 26 adapted to contact a cylindrical surface guide 34. The V-shaped hammer faces facilitate the transmission of the drive in either direction. Cylindrical surface portions 27 and 28, opposite rounded noses 25 and 26 respectively, on hammer head F slidably contact inner cylindrical surface 55 of guide ring G (Figs. 1 and 3), and maintain the proper angle of impact for hammer faces 23 and 24 at all times. Guide ring G is suitably located and fastened in the lower portion K of the housing.

Driven element I (Figs. 1, 3 and 9) is rotatably mounted in bearing 33 located and held in lower portion K of the housing. Cylindrical end portion 34 of driven element I, having central cavity 36 therein, receives the smaller shaft portion 18 of the driving element C, and serves as a bearing for shaft portion 18, and as a lubricant reservoir. Cylindrical end portion 34 has two anvil faces 35, of inverted V-shape, oppositely located thereon, adapted to receive the impact of hammer faces 23 and 24 of hammer head F (Fig. 3), and to drive driven element I in either direction around shaft portion 18 of driving element C. Rounded noses 25 and 26 of the hammer heads F on the driving connections E, ride the cylindrical surface 34 of driven element I when not contacting the anvil faces 35 and aid in guiding hammer heads F of driving connections E, to insure the correct angle of impact at the exact instant of impact of hammer faces 23 and 24, with the cooperating anvil faces 35 of driven element I.

The shank 37 of driven element I revolves in bearing 33 which serves as both a radial and thrust bearing. At the extreme end of shank 37 of driven element I is a non-circular, preferably square portion 39 that receives the conventional socket or wrench 39, rigidly mounted thereon in any suitable manner. End portion 38, of course,

transmits the drive to the socket or wrench 39 which is adapted to receive bolt heads, nuts, studs, or other resisting element to be turned.

The operation of my device is as follows: After fitting the socket or wrench 39 over the bolt or other head to be tightened, the motor is started and this rotates in a clockwise direction, as viewed from the left, the position of the operator using the wrench (Fig. 1). Spindle A of the motor which has splined driving connection with driving element C, imparts the drive to driving element C. The surfaces of gear teeth spaces 16 of driving element C in driving contact with gear teeth 31 of parts H in turn transmit the drive to the parts H, which being splined to end 21 of the driving connections E, transmit the drive thereto, and thence to hammer heads F, which are integral parts of driving connections E.

Assuming that the parts are in the positions shown in Figs. 18 and 19, the hammer heads F and the torque balancer D rotate as a whole with the driving element C and at the speed of the drive, until the hammer faces 23 of hammer heads F contact the cooperating anvil faces 35 of the driven element I.

After the hammer faces 23 have made contact with the cooperative anvil faces 35, if the ratio of the driving torque transmitted through the hammer faces 23 to the anvil faces 35, to the resisting torque transmitted at the anvil faces 35 from driven element I, is substantially the same, then the driving element C, the rotatable torque receiving member D, parts H, driving connections E, and the driven element I, will all rotate as a whole at the same speed as the driving element C, with substantially no relative movement between the parts moving as a whole (Figs. 12 and 13).

However, if after the hammer faces 23 have made contact with the anvil faces 35 and driving torque transmitted through the hammer faces 23 to the anvil faces 35 is less than the resisting torque transmitted to the anvil faces 35 from the driven element I, the operation then is as follows: The rotatable torque receiving member D responds to this torque ratio by being accelerated faster than the drive, causing hammer heads F to be turned or rocked in a clockwise direction (from the position of the operator using the wrench) and thus disrupting the driving contact between hammer faces 23 of hammer heads F and the cooperating anvil faces 35 of the driven element I, and the driven element remains at rest (Figs. 14 and 15).

After the disruption of the drive, driving element C, parts H, driving connections E, and rotatable torque receiving member D, all rotate about central shaft 17 for an interval, during which, through the cooperative functions of the guides, (cylindrical surface 34 of driven element I, and the inner cylindrical surface 55 of ring G acting on the rounded noses 25 or arcuate surface portion 28, respectively, of the hammer heads F), the driving connections are forced by the drive into potential driving relations (Figs. 12, 13, 18 and 19). The said interval of driving required to force the driving connections into potential driving relations depends on the design, application and type of driving power, and usually never exceeds 65° (sixty-five degrees) of a revolution. After the driving connections have been forced by the drive into potential driving relations, the driving element C, torque balancer D and hammer heads F all rotate as a unit until the hammer faces 23 of the hammer heads F, contact the anvil

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faces 35 of the driven element I, and substantially at this instant, an impact is delivered and the torque balancer D is accelerated and the driving connection between the hammer faces 23 and the anvil faces 35 then is disrupted as previously described.

The driven element I transmits the drive through its end portion 38 to the conventional socket or wrench 39, which drives the head of the nut, bolt, or other resisting element being turned, and impacts occur at successive intervals until the bolt is sufficiently tightened, or otherwise turned, or the operator terminates the operation at any time. It is obvious from the foregoing that the driven element I is driven at the same speed as the driving element C when the ratio of the driving torque to the resisting torque is substantially the same, and that when the resisting torque is greater than the driving torque, because of the resistance encountered, the driven element I is driven at intervals by successive impacts and forces due to the acceleration of the rotatable torque receiving member D.

Fig. 12 shows the relative positions of the gear teeth 31 of parts H, to the contacting surfaces 16 of the tooth spaces of the driving element C, at the time of impact, or when the entire mechanism is being driven as a whole with substantially no relative movement between the component parts of the mechanism. Fig. 13 shows the corresponding relative positions of the hammer faces 23 of driving connections E to the anvil faces 35 of the driven element I, and inner cylindrical surface 55 of guide ring G at the same period as in Fig. 12. Here hammer faces 23 are in driving contact with the cooperating anvil faces 35 of the driven element I, being forced into this position by the driving force imparted through driving element C to gear teeth 31 of parts H.

Fig. 14 shows the relative position of gear teeth 31 of parts H to their cooperative contacting surfaces 16 of the driving element C, just after impact, or at, or near the beginning of the full disruption of the drive.

Fig. 15 shows the relative position between hammer head F and driven element I at the same period as in Fig. 14, with hammer surfaces 23 of hammer head F in contact with the cooperating anvil surfaces 35 at practically one point. The angle made by the broken line OM in Fig. 14 and full line OP represents the angle through which the driving element C could have rotated from its impact position or driving position shown in Fig. 12. And the angle made by the vertical center line passing through center of rotation O and the dot and dash line OS represents the minimum angle the rotatable torque receiving member D could travel since the time of impact. It is obvious from the magnitude of these two angles, that the rotatable torque receiving member D has rotated more than twice as fast as the driving element C, during the time that was required for the driving element to rotate through the small angle MOP. But the comparison of the magnitude of these angles does not disclose the maximum acceleration of the rotatable torque receiving member D, since member D had begun to slow down before it reached its point of travel disclosed in Figs. 14 and 15 and its acceleration was greater at the instant of contact disclosed in Figures 12 and

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13. This slowing down of the rotatable torque receiving member D will be more apparent in the next step of the operation disclosed in Figs. 16 and 17.

Fig. 16 shows the positions of the gear teeth 31 of parts H relative to contacting surfaces 16 of the driving element C, at practically the point of total disruption of the drive. Fig. 17 shows the positions of the hammer heads F relative to the driven element C at the same period as in Fig. 16. In the position shown in Fig. 16 the driving element C has the maximum mechanical advantage to cause parts H to turn or rock the driving connections E in their bearings 29 and 30 in rotatable torque receiving member D, since the contacting surfaces 16 of driving element C, contact the teeth 31 of parts H at the farthest possible points from the centers of parts H. The purpose of designing the tooth to secure this condition is, that at this point in the operation, the drive begins to force the driving connection E into potential driving relations which is accomplished by the turning or rocking parts H about their own axis, which in turn rotate driving connections E and their hammer heads F, such that the rounded noses 26 of hammer heads F are moved to contact guiding surface 34 of the driven element I, or the arcuate surfaces 28 of the hammer heads F are moved to contact inner cylindrical surface 55 of the guide ring G.

Fig. 17 discloses the hammer head F of the driving connection E tilted or rocked at its greatest possible angle about its own axis and in a clockwise direction, or at the point in its operation where it changes its direction of rotation or rocking and thereafter can rotate only in a counterclockwise direction about its own axis. At this point in the operation, guide of hammer heads F may be obtained from any one of three surfaces, from rounded noses 25 of hammer heads F contacting the rounded apex of anvil surfaces 35 of driven element I, rounded noses 26 of hammer heads F contacting cylindrical surface 34 of driven element I, and arcuate surface 28 of hammer heads F by contacting inner cylindrical surfaces 55 of guide ring G.

Fig. 16 shows the relative positions of gear teeth 31 of parts H to the contacting surfaces 16 of the driving element C. It is obvious by comparison of the relation of the parts disclosed in Figs. 16, 12 and 14 relative to their rotation about the center of rotation of the driving element C, that the average speed of the rotatable torque receiving member D (on which parts H and driving connection E are mounted) and the driving element C have been almost the same between the two points of operation represented by Figs. 14 and 16 and that the rotatable torque receiving member D has slowed down to almost the speed of the driving element C.

Fig. 18 shows the relative position of gear teeth 31 of parts H and contacting surfaces 16 of driving element C after the total disruption of the drive, and the driving connections are in normal potential driving positions. Fig. 19 shows hammer heads F at the same period as in Fig. 18. Rounded noses 25 of hammer heads F are now riding the cylindrical guiding surface 34 of driven element I, and arcuate surfaces 27 of the hammer heads F are in sliding contact, or close to proximity of sliding contact, with the inner cylindrical surface 55 of guide ring G. It is obvious from the relation of the parts disclosed in Figs. 18 and 19 that at this point in the operation that the driving element C and the rotatable torque re-

ceiving member D are rotating at the same speed. The relative positions of the gear teeth 31 of parts H to the contacting surfaces 16 of the driving elements C are the same in both Figs. 12 and 18.

From the drawings, it will be seen that the device is readily reversible, by reversing the direction of the power drive. When a reversal of the drive is required, to secure smoothness of operation, hammer heads F should start to rotate first about their own axis, before the actual driving or rotation of the rotatable torque receiving member D starts to rotate about the center of rotation of the driving element C. This is accomplished by designing the teeth 31 of parts H such that the maximum mechanical advantage is had by the contacting surfaces of the tooth spaces 16 of the driving element C, with contact of the gear teeth 31 as far from the center of rotation of the parts H as possible. As stated before, the advantage of starting the rotation of parts H about their own axis, is to force as quickly as possible the driving connections into potential driving relation, and this is accomplished primarily by the rotation of parts H.

It should also be apparent from the foregoing description that the rotatable torque receiving member D absorbs the reaction to the impact by its acceleration and this reaction is not transmitted to the housing or case of the impact wrench and thence to the operator's hands. For instance, if the rotatable torque receiving member D were given a push applied at its periphery manually, or otherwise, to cause its rotation before driving contact with the driven element I was had, and the driving connections E could turn in their bearings 29 and 30 in the rotatable torque receiving member, that when the hammer faces 23 or 24 of the hammer heads F contacted the cooperating anvil faces 35 of the driven element I, (assuming that the hammer heads F would be in potential driving relation at the time of contact), rotatable torque receiving member D would have to rotate faster than it was rotating at the time of impact or contact to cause a disruption of the drive.

The angle made at the apex of the intersecting surfaces of the anvil portion 35, is a factor in determining the acceleration of the rotatable torque receiving member D. If a constant speed of the driving element is had, the smaller the said angle, the greater the acceleration and the greater the impact.

In the slowing down of the rotatable torque receiving member D and generally stabilizing its rotation, the arcuate surfaces 27 and 28 of the hammer heads F, which are adapted to slidably contact the inner surface 55 of guide ring G, function similarly to the damper mechanism used in gasoline motor constructions to produce smooth performance. These arcuate surfaces 27 and 28 operate as a mild brake, until the instant of impact, when their contact with the inner cylindrical surface 55 of guide ring G, is instantaneously broken. The rounded noses 25 and 26 of the hammer heads F, contacting the cylindrical surface 34 of the driven element I, function to some extent like the arcuate surfaces 27 and 28 of the hammer heads F, sliding over the inner cylindrical surface of guide ring G.

Since the speed of the motor, the mass of the rotatable torque receiving member, and the angle made by the surfaces of the anvil faces 35 in great part determine the magnitude of the impact, and since all these can be varied to suit conditions, and since the rotatable torque receiv-

ing member D is accelerated and there is no mass to be accelerated again to the motor's speed after each impact, it will be apparent that a correct relative proportioning can readily be had of the vital parts, and hence that the impact wrench disclosed can be made for almost any type of driving power, and satisfactory performance can be obtained therefrom.

Figs. 4, 5, 6 and 7 disclose a modification of the invention, in which the rotatable torque receiving member D' is made in two parts 41 and 42. The object of this construction is to secure two bearings in the rotatable torque receiving member D', for each driving connection E', such that the hammer heads F', integral with the driving connections E' have a bearing contiguous to each of their sides longitudinally along the shaft portions 20', hammer heads F' being located between the shaft ends 20', of the driving connections E'. This construction is particularly desirable for heavy duty wrenches.

Part 41 of rotatable torque receiving member D' (Figs. 6 and 7) has an extending arcuate segment 43, portions of which function similarly to the jaws of a jaw clutch and abut similar portions 44 of part 42 of member D'. Arcuate lips 45 of portions 43 fit tight over arcuate projections 46 of part 42 and locate the parts centrally. The parts 41 and 42 are press-fitted together and are further held in place by rods 47 which extend through holes 48 of part 41 and holes 49 of part 42. Heads 50 of rods 47 (Figs. 5 and 6) contact part 42, and the other ends of rods 47 each have an annular groove, into which fits a conventional spring fastening ring 51 contacting part 41. The parts 41 and 42 are thus held together as practically one solid part.

The driven element I' is elongated comparably to driven element I of Fig. 1 in order that part 42 of rotatable torque receiving member D' may revolve about it. A bushing 52 (Figs. 4 and 6) is conventionally located in part 42 of rotatable torque receiving member D' and functions as a bearing between a portion of the driven element I' and rotatable member D'.

Shaft portion 17' of driving element C', fits in hole 19' of part 41 of the rotatable torque receiving member D', and the member D' is free to rotate about shaft portion 17'.

Smaller shaft portion 18' in turn fits into cavity 36' of driven element I' which acts as a bearing for shaft portion 18'. Shaft portions 20' of driving connections E' fit into bearings 29' and 30', formed in rotatable torque receiving member D', and are free to rotate thereon.

Hammer heads F' are integral with driving connections E' and are free to operate in apertures 53 of the rotatable torque receiving member D', and the hammer faces 23' and 24' (not shown) of the contacting heads F' are adapted to contact anvil faces 35' of the driven element I' through these apertures 53.

Parts H' are splined to shaft portions 20' and teeth 31', operate in gear teeth spaces 16' of driving element C' exactly as in the form shown in Fig. 1.

I claim:

1. In an impact tool in combination, a rotatable driving member, a rotatable driven member having an impact receiving surface, a driving connection between said driving and driven members including a force receiving member rotatably mounted to rotate relative to said members, a hammer rotatably carried by said force receiving member and having an impact applying

surface adapted to impact said receiving surface, said impact applying and impact receiving surfaces at the time of impact being positioned with respect to the axis of rotation of said hammer so that a line normal to their engaging surfaces at any point of the entire portion thereof passes in back of said axis with respect to the direction of rotation of the driving member whereby, when the force resisting movement of the driven member exceeds the force tending to drive said driven member said force receiving member is moved faster than said driving member in the direction of rotation of the driving member and the hammer is rotated in one direction about its axis to disrupt its driving connection with said impact receiving surface, said driving connection also including means for causing said hammer to rotate in the opposite direction when said driving connection has been disrupted, said last mentioned means including a member operatively connected with said hammer and contacting a driving surface on said driving member, and guide means for controlling the extent of rotation of said hammer in said opposite direction to locate the impact applying surface thereon in a predetermined position relative to said impact receiving surface.

2. In an impact tool, in combination, a rotatable driving member, a rotatable driven member having an impact receiving surface, a driving connection between said driving and driven members including a rotatably mounted hammer having an impact applying surface adapted to impact said impact receiving surface, said driving connection also including means for causing said hammer to rotate in the direction of rotation of the driving member to disrupt said driving connection in response to the resultant component of force applied to said force applying surface at the time of impact of said surfaces, when the force resisting movement of the driven member exceeds the force tending to drive said driven member, all lines normal to said impact applying surface, at the time of impact being positioned behind the axis of rotation of said hammer with respect to the direction of rotation of said driving member.

3. In an impact tool, in combination, a rotatable driving member, a rotatable driven member having an impact receiving surface, a driving connection between said driving and driven members including a rotatably mounted hammer having an impact applying surface adapted to impact said impact receiving surface, said driving connection also including means for causing said hammer to rotate in the direction of rotation of the driving member to disrupt said driving connection in response to the resultant component of force applied to said force applying surface at the time of impact of said surfaces, when the force resisting movement of the driven member exceeds the force tending to drive said driven member, all lines normal to said impact applying surface, at the time of impact being positioned behind the axis of rotation of said hammer with respect to the direction of rotation of said driving member, said driving connection also including means for causing said hammer to rotate in the opposite direction to that of the driving member, when said driving connection has been disrupted, and guide means for controlling the extent of rotation of said hammer in said opposite direction to locate the impact applying surface thereon in a predetermined

position relative to said impact receiving surface.

4. In an impact tool, in combination, a rotatable driving member, a rotatable driven member having an impact receiving surface, a driving connection between said driving and driven members comprising a rotatably mounted hammer having an impact applying surface adapted to impact said impact receiving surface, said driving connection also including means for causing said hammer to rotate in the direction of rotation of the driving member to disrupt said driving connection in response to the resultant component of the force applied to said force applying surface at the time of impact of said surfaces, when the force resisting movement of the driven member exceeds the force tending to drive said driven member, said driving connection also including means for causing said hammer to rotate in the opposite direction to that of the driving member when said driving connection has been disrupted and guide means including inner and outer cylindrical surfaces and in which the inner end of said impact applying surface is provided with a rounded nose adapted to engage the inner guide surface and in which the hammer is provided with a cylindrical surface adapted to engage the outer guide surface.

5. In an impact tool, in combination, a rotatable driving member, a rotatable driven member having an impact receiving surface, a driving connection between said driving and driven members comprising a force receiving member rotatably mounted to move relatively to said driving and driven members, a shaft mounted in said force receiving member for rotation about an axis spaced radially outward from the axis of rotation of said force receiving member, a hammer secured to said shaft to rotate therewith and having an impact applying surface adapted to impact said impact receiving surface, all lines normal to said impact applying surface at the time of impact being positioned behind the axis of rotation of said hammer with respect to the direction of rotation of said driving member whereby the resultant component of the force resisting movement of said driven member applied to said impact applying surface at the time of impact, causes said force receiving member to be moved faster than the driving member and in the same direction and said hammer is rotated in the same direction to disrupt said driving connection when the force resisting movement of the driven member is greater than the driving force applied to the driven member.

6. In an impact tool, in combination, a rotatable driving member, a rotatable driven member having an impact receiving surface, a driving connection between said driving and driven members comprising a force receiving member rotatably mounted to move relatively to said driving and driven members, a shaft mounted in said force receiving member for rotation about an axis spaced radially outward from the axis of rotation of said force receiving member, a hammer secured to said shaft to rotate therewith and having an impact applying surface adapted to impact said impact receiving surface, all lines normal to said impact applying surface at the time of impact being positioned behind the axis of rotation of said hammer with respect to the direction of rotation of said driving member, whereby the resultant component of the force resisting movement of said driven member applied to said impact applying surface at the time of impact,

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causes said force receiving member to be moved faster than the driving member and in the same direction and said hammer is rotated in the same direction to disrupt said driving connection when the force resisting movement of the driving member is greater than the driving force applied to the driven member, said driving connection also including a member secured to said shaft and having a curved surface adapted to slidably en-

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gage a radially extending surface on said driving member whereby said hammer is rotated in the opposite direction when said driving connection is disrupted and guide means for controlling the extent of rotation of said hammer in said opposite direction to locate the impact applying surface thereon in a predetermined position relative to said impact receiving surface.

CARROLL H. RICHARDS.