

April 28, 1953

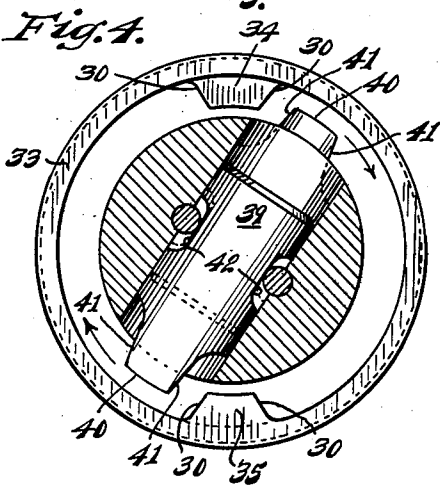
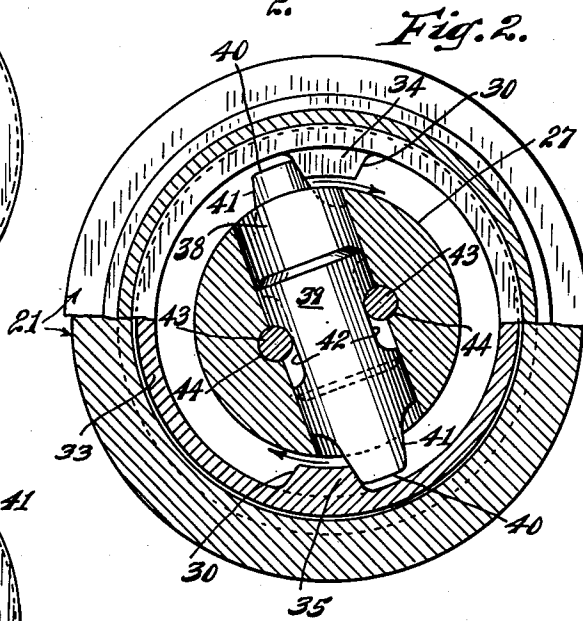
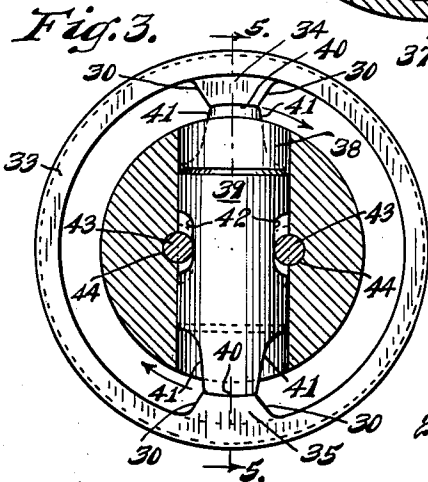
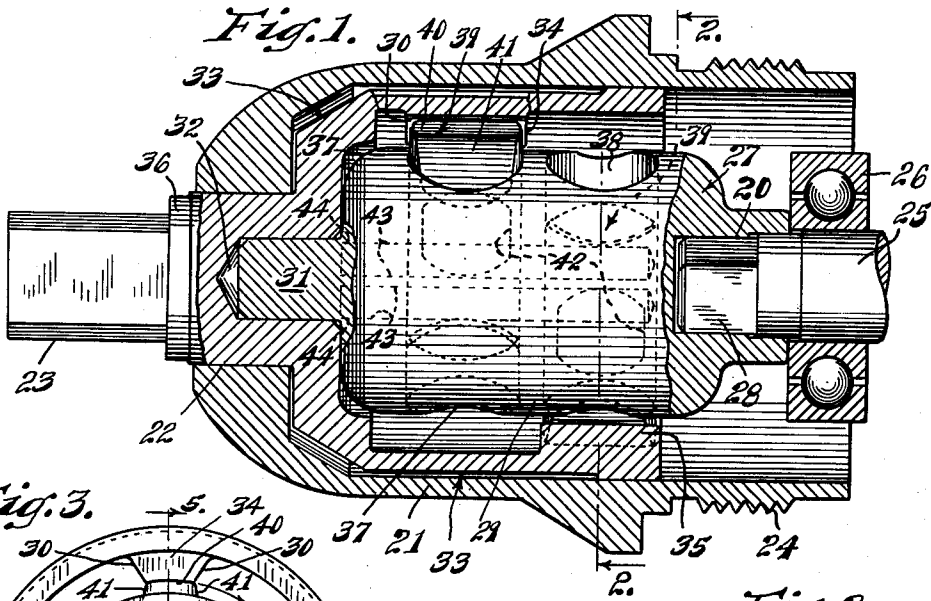
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2,636,583

IMPACT WRENCH

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4 Sheets-Sheet 1



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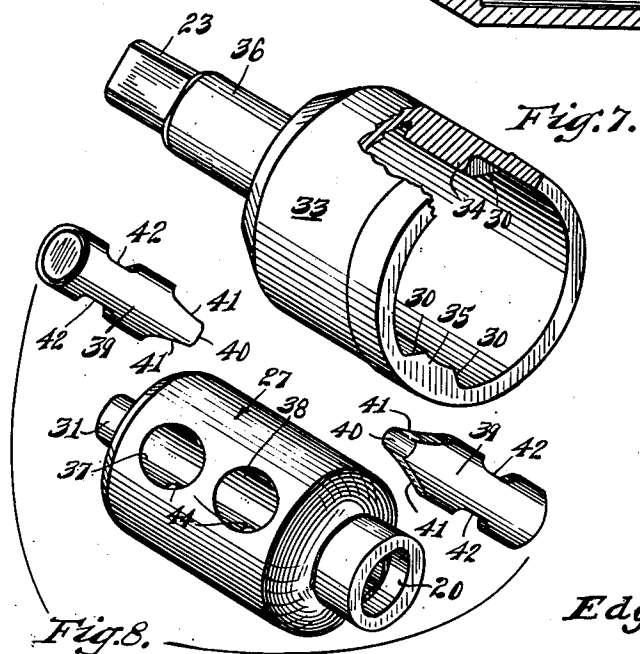
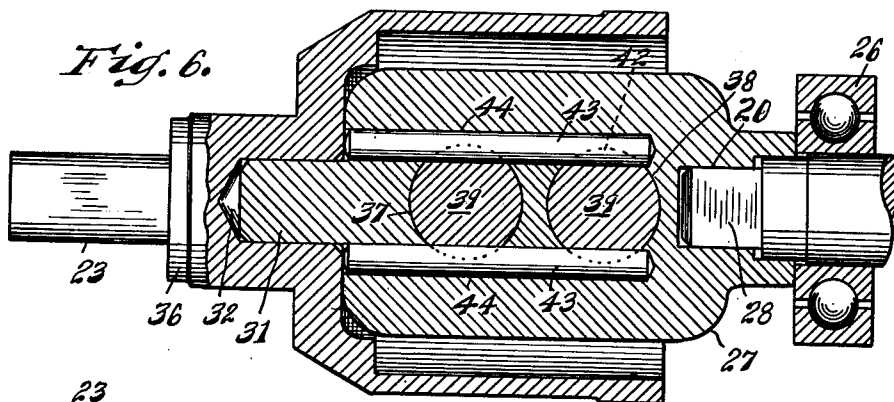
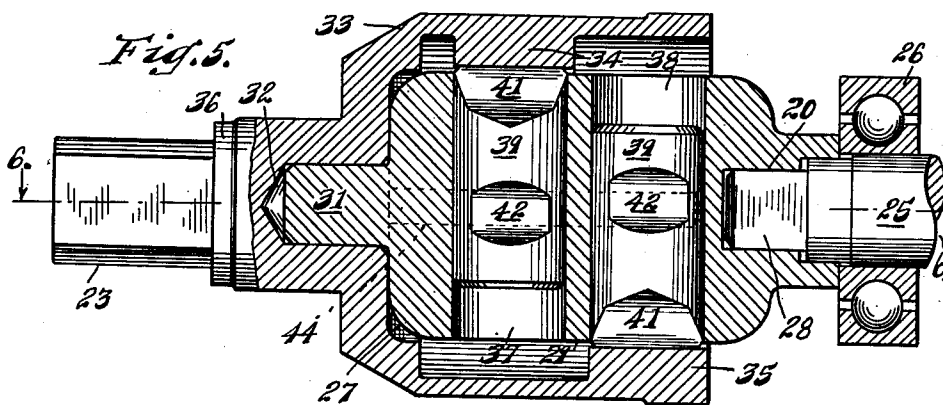
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4 Sheets-Sheet 2



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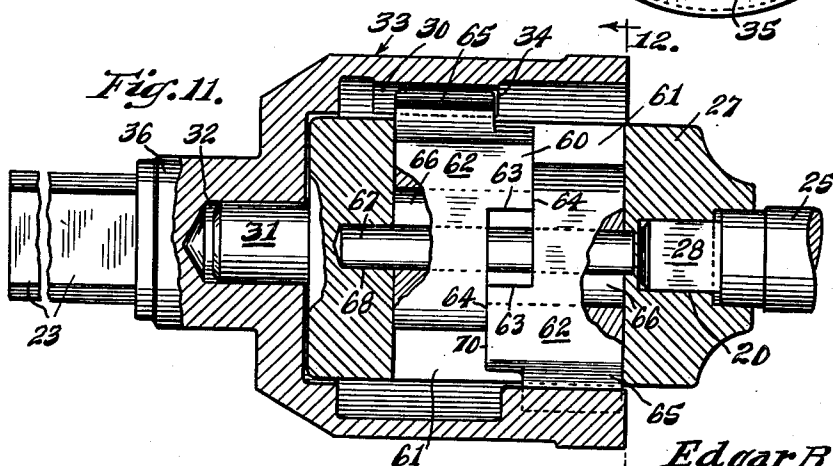
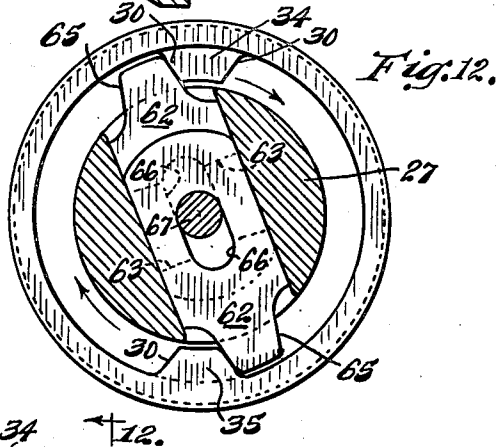
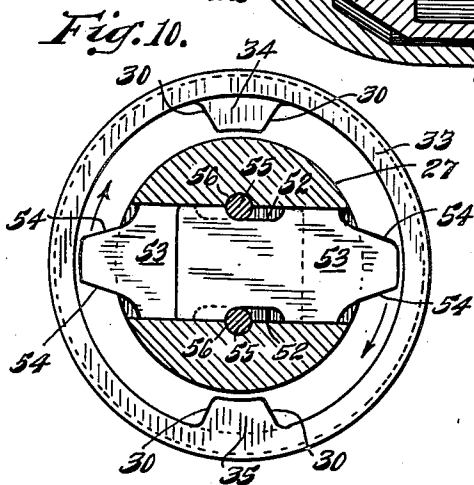
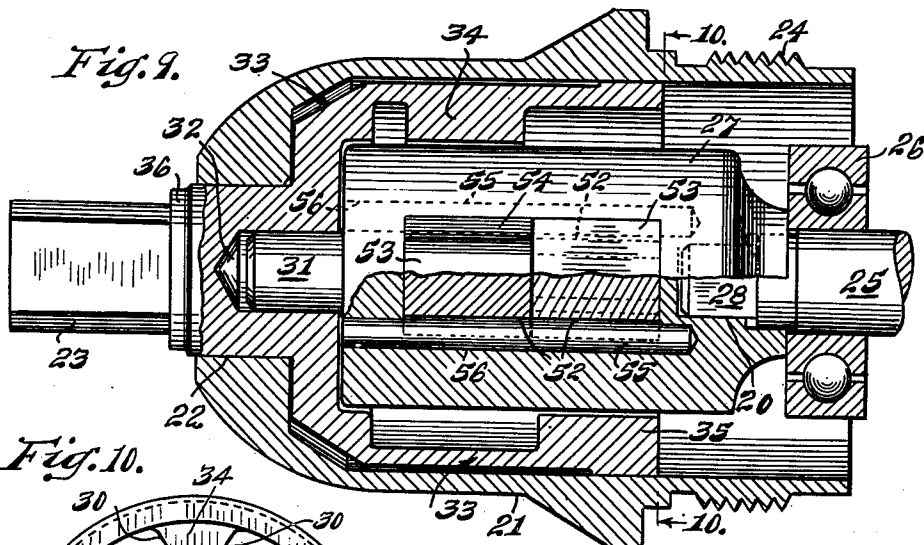
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IMPACT WRENCH

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4 Sheets-Sheet 3



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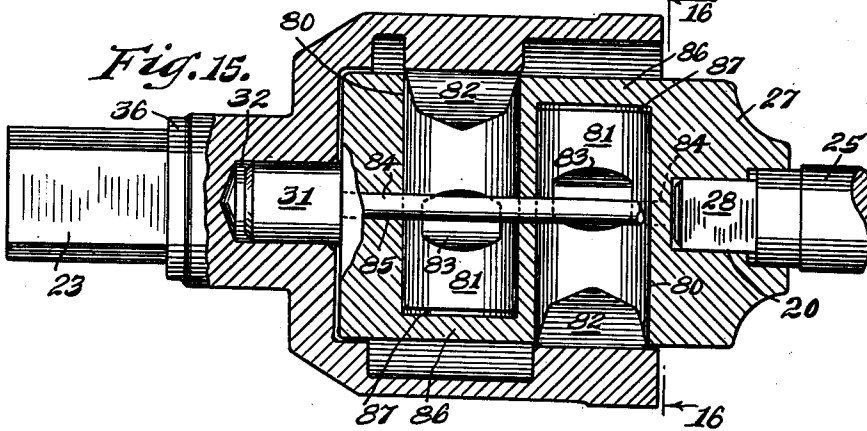
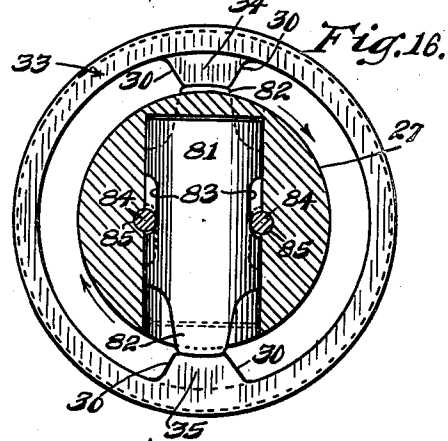
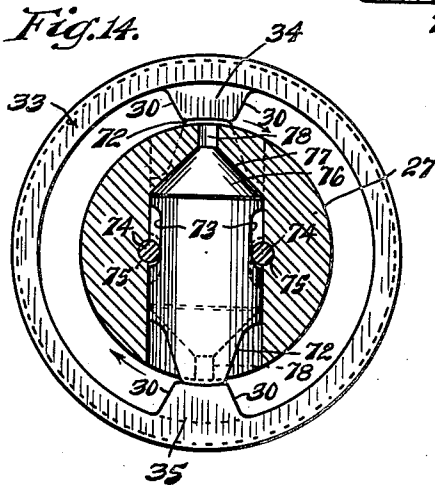
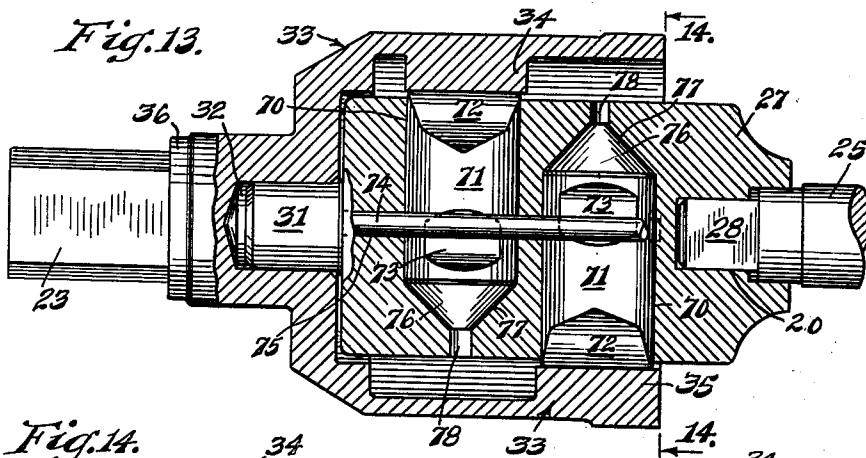
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,636,583

IMPACT WRENCH

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7 Claims. (Cl. 192—30.5)

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This invention relates to an impact tool or wrench. The tool is particularly adapted for use as a nut runner and tightener, although the principles involved are not limited thereto.

It is an object of the invention to provide a light, portable impact tool which delivers exceptional power.

It is also an object of the invention to provide an impact tool which is extremely rugged and not subject to breakage.

It is a further object of the invention to provide an impact tool which has a small number of parts.

It is an additional object of the invention to provide an impact wrench which will smoothly turn nuts and the like below a predetermined resistance to torque, and which delivers strong impact blows when a higher resistance to torque is encountered.

It is also an object of the invention to provide an impact tool which delivers an impact blow each time the hammer, or carrier therefor, rotates 360°—also, to provide two hammers and impact surfaces which simultaneously engage and disengage after each 360° of rotation.

It is an important object of the invention to dispense with any positive declutching means in an impact tool, such as springs, cams and the like, and to depend entirely on the coaction and shape of the hammer and the impact receiving surfaces to effect declutching.

It is a further object of the invention to provide an impact tool in which the hammers, when rotated, never come to a full stop in an orbital direction, even when an impact blow is delivered.

It is an additional object of the invention to dispense with trackways which have heretofore been provided and over which the hammers roll or slide during rotation, thus reducing friction.

It is another object of the invention to provide an impact tool in which the hammers may be of a variety of easily manufactured shapes.

It is also an object of the invention to provide cushioning for the hammers of an impact tool during the inward movement of the hammers in their carrier.

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

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one preferred embodiment of the impact tool;

Figure 2 is a sectional view of the impact tool taken on line 2—2 of Figure 1 and showing the position of the parts at the moment of impact;

Figure 3 is a sectional view similar to Figure 2 showing the position of the parts just after impact;

Figure 4 is a sectional view similar to Figure 2 showing the position of the parts after the hammers have passed the impact abutments;

Figure 5 is a vertical sectional view taken on line 5—5 of Figure 3;

Figure 6 is a horizontal sectional view of the impact tool taken on line 6—6 of Figure 5;

Figure 7 is a perspective view of the anvil member;

Figure 8 is an exploded perspective view of the hammer carrier and hammers;

Figure 9 is a vertical sectional view of an impact tool illustrating a second embodiment of the invention;

Figure 10 is a sectional view of the impact tool shown in Figure 9, taken on line 10—10 thereof;

Figure 11 is a vertical sectional view of an impact tool illustrating a third embodiment of the invention;

Figure 12 is a sectional view of the impact tool shown in Figure 11 taken on line 12—12 thereof;

Figure 13 is a vertical sectional view of a fourth embodiment of the invention;

Figure 14 is a sectional view taken on line 14—14 of Figure 13;

Figure 15 is a vertical sectional view of a fifth embodiment of the invention; and

Figure 16 is a sectional view taken on line 16—16 of Figure 15.

Referring specifically to Figures 1 to 8, inclusive, of the drawings for a detailed description of the first embodiment of the invention, numeral 21 designates generally a cup-shaped casing having an opening 22 in the bottom thereof, through which a socket wrench member 23 extends. The other end of the cup-shaped casing is provided with threads 24 for attachment to a suitable motor (not shown) for driving the impact tool. The motor drives a shaft 25, which is provided with bearings 26. The shaft 25 enters a recess 20 in a generally cylindrical hammer carrier member indicated at 27. A driving connection in the form of a square or hexagonal stud is provided on the end of the shaft 25 and engages in the recess 20. The other end of the carrier member 27 is provided with a stud or projection 31 which

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extends into a recess 32 of an anvil member generally indicated at 33.

The anvil member 33 is of cup shape, and the socket wrench member 23 is either integral therewith, as shown at 36, or is secured thereto by any well known detachable connection. The anvil member is provided with two abutments 34 and 35, each having two impact receiving surfaces 30. The angle of the impact receiving surfaces 30, with respect to a line drawn through the center of abutments 34 and 35, is, for example, 40°, although other angles of plus or minus 1° may be utilized. Abutments 34 and 35 are diametrically 180° apart and are offset coaxially of the anvil member 33, as best shown in Figures 1 and 5.

Two circular holes or passages 37 and 38 are provided in the hammer carrier member, as shown, for example, in Figure 8. The holes are coaxial with each other and extend completely through the carrier member. Disposed within the holes 37 and 38 are generally cylindrical hammers, indicated by the numeral 39. The hammers are provided at one end thereof with a slightly curved top 40 and oppositely inclined impact surfaces 41. The angle of the inclined surfaces 41, with respect to the center line of the hammers 39, is 16.5° in the preferred form. This angle may vary plus 3.5° and minus 1°. The hammers 39 are also provided with undercut portions 42, which are in the shape of one-half an ellipse.

Two pins 43 extend coaxially of the hammer carrier 27 and are inserted in bores 44, as best shown in Figure 6. The bores 44 extend from the end of the hammer carrier 27 adjacent the projection 31, but do not extend completely through the hammer carrier 27.

The unit is assembled by first placing the hammers 39 within the holes 37 and 38 in the hammer carrier 27 with the ends provided with the impacting surfaces 41 extending in opposite directions. The hammers 39 are, therefore, coaxially aligned. The undercuts 42 in the hammers 39 are then aligned and axially spaced from each other so that the pins 43 may be inserted in the bores 44 and be positioned in the undercuts, as best shown in Figures 2, 3 and 4. The hammer carrier 27, with the hammer 29 therein, is then inserted into the anvil 33 with the pilot pin 31 entering the recess 32. This entire assembly is then inserted into the casing 21, and the end of the shaft 25, which is connected to a motor (not shown), is then disposed in recess 20. Preferably, the motor utilized is a pneumatic motor, although the invention is not limited thereto.

Operation of Figures 1 to 8

When a nut is to be tightened, the socket 33 is placed over the nut and the motor for driving the shaft 25 is rotated. The centrifugal force, due to rotation of the shaft 25 and hammer carrier 27, will almost immediately throw the hammers 39 outwardly and, as the hammer carrier 27 rotates, the impact surfaces 41 on one side of each of the hammers 39 will engage with the impact surfaces 30 on one side of each of the abutments 34 and 35 of the anvil 33. It is to be noted that the slightly curved extremities 40 of the hammers 39 do not engage with or slide in the walls of the anvil 33, but are always spaced slightly therefrom. The outward movement of the hammers 39 is limited by the pins 33, which engage with one of the curved extremities 40 of the undercuts 42. This, obviously, limits the outward movement of the hammers 39.

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The aforesaid impacting surfaces remain in engagement, in a manner shown in Figure 2, until the nut is run down and the torque resistance to further rotation of the nut increases above a predetermined amount. When this occurs, the inclined surfaces 41 of the hammers 39 slide along similarly inclined surfaces 30 of the abutments 34 and 35 on the anvil 33. The hammer members 39, therefore, move inwardly to a position such as that shown in Figure 3. Obviously, the pins 43 limit the inward movement of the hammers 39 and prevent them from sliding through the holes 37 and 38. Shortly after the hammers 39 pass the abutments 34 and 35, they are again thrown outwardly by centrifugal force and continue in that position until they strike the next abutment during their rotational travel. This striking of the impact surfaces 30 and 41 delivers an impact blow to the anvil 33, which is transmitted through the extension 36 to the socket wrench 23. This imparts a strong impact blow to the nut and tightens it. As soon as the impact blow is struck, however, the hammers 39 will again be retracted, due to the shape of the impact surfaces 30 and 41, the hammers 39 will slide past the abutments 34 and 35, centrifugal force will again throw the hammers outwardly and another impact blow will be delivered when the hammers 39 again strike the next abutments 34 and 35.

It will be apparent that, due to the offset position of the abutments 34 and 35 coaxially of the anvil 33, and because of the fact that the hammers 39 only extend outwardly of the carrier 27 in one direction thereof, the carrier 27 will rotate a full 360° after each impact, before the next impact is delivered. The impact is then delivered simultaneously by the two hammers 39 striking the abutments 34 and 35 on the anvil 33. A rapid series of impact blows are, therefore, delivered to the nut, and it is thereby tightened.

The impact tool is adapted to be reversed, and for this reason, the impact surfaces 30 and 41 are provided on both sides of the abutments 34 and 35 and the hammers 39, respectively. Rotating the impact tool in the opposite direction makes it possible to loosen nuts which have already been tightened or to tighten nuts with left hand threads, as is well known in the art.

In operation, during the delivery of impact blows, the carrier 27 and the hammers 39 do not come to a full stop at any time. This is because of the fact that as soon as the impact surfaces 30 and 41 strike, the angle thereof immediately forces the hammers 39 inwardly and forward rotation continues.

Furthermore, it will be noted that there are no separate declutching means, such as springs or cams, for the hammers 39 and the abutments 34 and 35 on the anvil. Declutching of these parts is effected solely by the shape of the impact surfaces on the hammers and on the abutments on the anvil.

Description of Figures 9 and 10

Referring to Figures 9 and 10 for a detailed description of the second embodiment of the invention, like reference numerals have been given to like parts described in Figures 1 to 8, inclusive. The parts are substantially the same, except that a rectangular bore 52 is provided in the carrier member 27 instead of round holes 37 and 38. Obviously, therefore, parallelepiped hammer members 53 are provided for insertion in the bore 52 instead of cylindrical hammer members.

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Vertical surfaces of adjacent hammer members 53 slide on each other, as is apparent from Figure 9. The hammer members are provided with inclined impact surfaces 54, which are adapted to engage with the impact surfaces 30 on the anvil 33. The anvil 33 is exactly as shown in Figures 1 to 8, inclusive, and the angles of the impact surfaces on both hammers and the anvil are the same. The hammer members 53 are provided with semi-elliptical undercuts 52 for the reception of two pins 55 which are inserted in bores 56 in the anvil member.

The operation of the impact tool shown in Figures 9 and 10 is the same as that described with respect to Figures 1 to 8, inclusive. Obviously, instead of rectangular blocks or parallelepipeds 53, hexagonal blocks may be utilized.

Description of Figures 11 and 12

Referring to Figures 11 and 12 for a detailed description of a third embodiment of the invention, again like numerals are given to like parts as utilized in the description of Figures 1 to 8, inclusive. In this embodiment of the invention, the carrier 27 is provided with a single rectangular bore 61, in which hammers 62 are disposed. The hammers 62 are again rectangular blocks or parallelepipeds, but each of the hammers 62 has a projection 60 formed thereon adjacent the end of the hammer having impact surfaces 65 thereon adapted to engage with the impact receiving surfaces 30. The angles of the impact surfaces are the same as set forth with respect to Figures 1 to 8, inclusive. The projection 60 provides a flat surface 63 and a flat surface 64 at right angles to each other. The surfaces 63, when the hammers 62 are assembled, face each other, as best shown in Figure 11. The surfaces 64 slide on the flat vertical surface of the main portion of the parallelepiped hammers 62.

The hammers 62 are provided with an elliptical bore 66 centrally thereof, as best shown in Figure 12. A single pin 67 is inserted in a bore 68 in the hammer carrier 27 and extends through the elliptical bores 66 of the hammer 62.

The operation of the device shown in Figures 11 and 12 is the same as that described with respect to Figures 1 to 8, inclusive, except that the outward movement of the hammers 62 is limited by the pins 67 and elliptical bore 66 in each of the hammers 62. When the hammers are forced inwardly after an impact blow, the surfaces 63 thereof will engage and prevent further inward movement of the hammers. The elliptical bores 66 and the surfaces 63 are so proportioned that the bores 66 and pins 67 do not prevent or limit the inward movement of the hammers, but the surfaces 63 perform this function.

Description of Figures 13 and 14

Referring now to Figures 13 and 14 for a detailed description of the fourth embodiment of the invention, again like numerals are given to like parts. In this embodiment of the invention, two cylindrical bores 70 are provided in the carrier 27, but the bores are not cylindrical completely through the carrier 27. Each of the bores extends in cylindrical form part way through the carrier 27 and then is provided with an inwardly tapered surface 77 and a reduced cylindrical bore 78. A pair of generally cylindrical hammers 71, having impacting surfaces 72 thereon, are positioned within the bores 70. The impacting surfaces 72 are adapted to engage with

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the impact receiving surfaces 30. The angles of the impact surfaces are the same as set forth with respect to Figures 1 to 8, inclusive. The inner ends of the hammers 71 are provided with tapered ends 76 which conform with the configuration of the tapered portion 77 of the bores 70. Each of the hammers 71 is provided with semi-elliptical undercuts 73 similar in shape to those shown in Figure 3. A pair of pins 74 is inserted in coaxially extending bores 75 and is disposed in the recess 73 when the tool is assembled, as shown in Figure 14. The operation of the tool shown in Figures 13 and 14 is the same as that described with respect to Figures 1 to 8, inclusive, except that the inward movement of the hammers 71, after an impact blow, is limited by the tapered portion 76 of the hammer striking or engaging with the tapered portion 77 of the bores 70. In other words, the pins 74 perform no function in limiting the inward movement of the hammers. The recess 73, the tapered portions 76 of the hammers and the tapered portions 77 of the bores 70 are so proportioned, however, that the pins 74 limit outward movement of the hammers 71 in the same manner as described with respect to Figures 1 to 8, inclusive. As stated above, however, the pins 74 have nothing to do with preventing inward movement of the hammers. The reduced bores 78 provide for release of air below the hammers 71, so that in this embodiment of the invention, very little, if any, cushioning effect, because of entrapped air, is present.

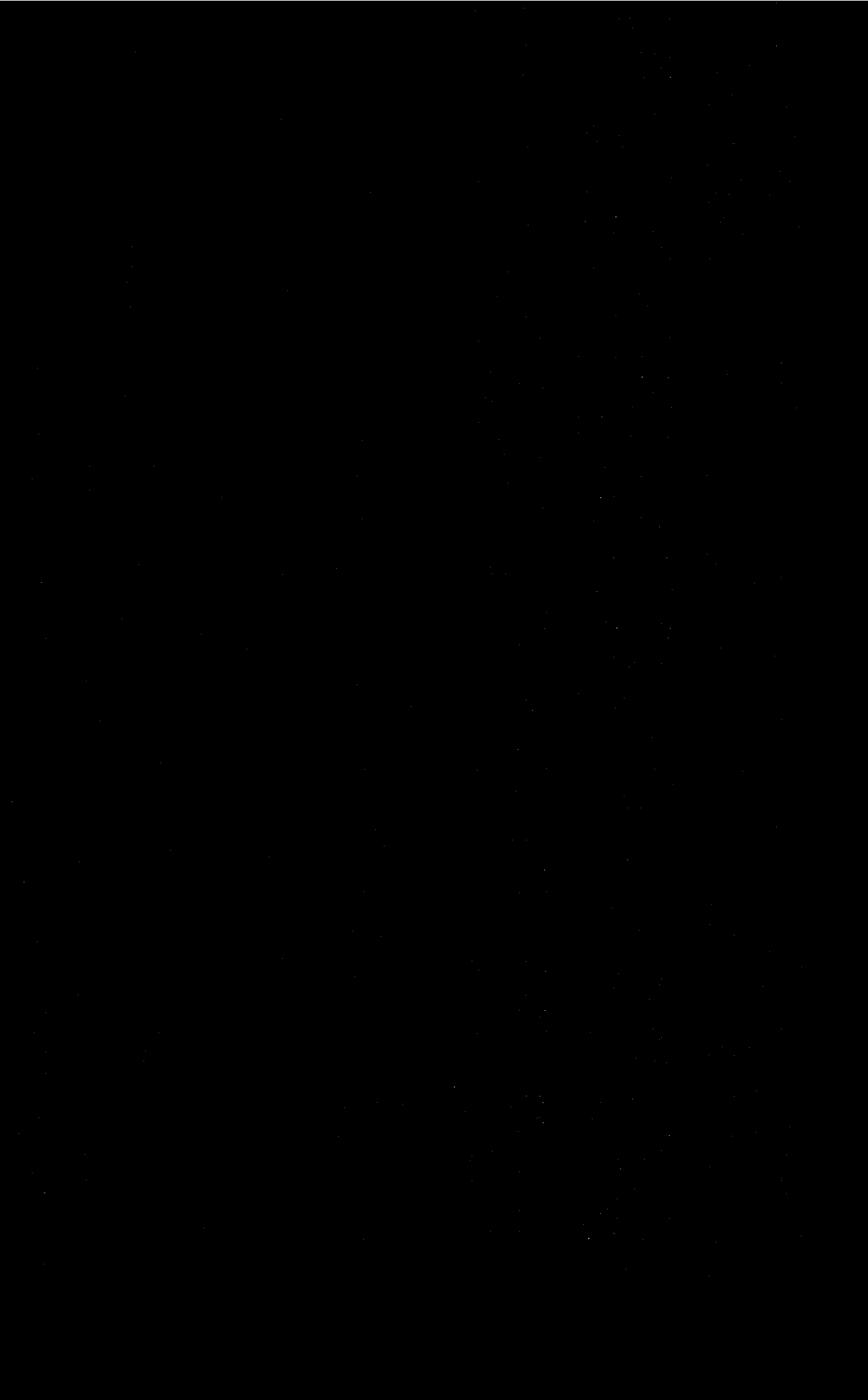
Description of Figures 15 and 16

Referring now to Figures 15 and 16 for a detailed description of a fifth embodiment of the invention, again like reference numerals are given to similar parts. The tool illustrated differs from the tool shown in Figures 13 and 14 mainly in that a pair of cylindrical bores 80 are provided in the hammer carrier 27, but the bores 80 are closed at one end, as shown at 86. Cylindrical hammer members 81, having impact surfaces 82, are provided, which cylindrical hammers 81 are formed with semi-elliptical undercuts 83 similar in shape to those disclosed, for example, in Figure 3. The impact surfaces 82 are adapted to engage with the impact surfaces 30, and the angle of the impact surfaces is the same as set forth with respect to Figures 1 to 8, inclusive. Two pins 84 are inserted in coaxially extending bores 85 in the hammer member 27, which pins are received in the semi-elliptical recess 83, in a manner shown in Figure 16.

The ends of the hammers 81 opposite to the impact surfaces 82 are preferably flat and are adapted to engage or strike against the flat surface of the abutment of the bores 80. The operation of the device is exactly the same as described with respect to the device shown in Figures 13 and 14, except that air may escape from below the hammers 81 only along the sides thereof and, therefore, a slight cushioning effect is provided.

Obviously, the shape of the hammer elements and the bores for receiving them may be varied considerably, depending on the type of machining operation desired. I have provided an efficient impact tool which is reversible and which will either tighten or loosen nuts, bolts or the like. In addition, I have dispensed with separate declutching mechanisms such as springs or cams.

Some changes may be made in the construction and arrangement of the parts of my device without departing from the real spirit and pur-



directions to force said hammers inwardly of said carrier upon a predetermined increase in the resistance to torque of said tool, and means independent of the anvil for limiting both the inward and outward movement of said hammers.

6. An impact tool comprising a driven member adapted to be rotated continuously, a hammer carrier, means for rotating said hammer carrier with said driven member, a pair of axially aligned and axially spaced non-rotatable hammers movable transversely to the axis of said hammer carrier and carried thereby, impact surfaces adjacent the outer end of each of said hammers, said impact surfaces being the same surfaces at all times due to the non-rotating nature of the hammers, said hammers being positioned in said carrier with said impact surface ends extending in different directions, said hammers moving outwardly with respect to said hammer carrier in response to centrifugal force when said hammer carrier is rotated, an anvil member encompassing a portion of said hammer carrier and having substantially flat impact receiving surfaces thereon disposed in the path of the impact surfaces of said hammers when said hammers are moved outwardly by centrifugal force and a tool secured to said anvil and driven thereby, said impact surfaces on said anvil being axially spaced and so arranged that an impact blow is delivered thereto every 360° rotation of said individual hammers.

7. An impact tool comprising a driven member adapted to be rotated continuously, a hammer carrier, means for rotating said hammer carrier with said driven member, a pair of axially spaced non-rotatable hammers movable transversely to the axis of said hammer carrier and carried thereby, impact surfaces adjacent the outer end

of each of said hammers, said impact surfaces being the same surfaces at all times due to the non-rotating nature of the hammers, said hammers being positioned in said carrier with said impact surface ends extending in different directions, said hammers moving outwardly with respect to said hammer carrier in response to centrifugal force when said hammer carrier is rotated, an anvil encompassing a portion of said hammer carrier and having substantially flat impact receiving surfaces thereon disposed in the path of the impact surfaces of said hammers when said hammers are moved outwardly by centrifugal force, a tool secured to said anvil and driven thereby, said impact surfaces on the hammers and impact receiving surfaces on the anvil being tapered in opposite directions to force said hammers inwardly of said carrier upon a predetermined increase in the resistance to torque of said tool and means independent of the anvil for limiting the outward movement of said hammers, said impact surfaces on said anvil being axially spaced and so arranged that an impact blow is delivered thereto every 360° rotation of said individual hammers.

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