POWER-OPERATED, ROTARY IMPACT-TYPE
HAND TOOL

Willy Schwend, Ludwigshurg, Erich Bayer, Stuttgart-Vaihingen, Carl Hagemann, Stuttgart-Heidelberg, and Ernst Haberer, Stuttgart-Vaihingen, Germany, assignors to Robert Bosch G.m.b.H., Stuttgart, Germany

Application January 20, 1958, Serial No. 710,039

Claims priority, application Germany January 31, 1957
8 Claims. (Cl. 81—52.3)

The present invention relates to power tools.

More particularly, the present invention relates to rotary hand power tools which provide impact forces.

With rotary power tools of this type, it does not infrequently happen that relatively severe forces resulting from the repeated impact blows cause parts of the tool to break, such as, for example, parts of an electric driving motor of the tool.

One of the objects of the present invention is to provide a power tool which is capable of shielding its driving motor from the full force of the impact blows provided by the tool.

A further object of the present invention is to provide, in a power tool of the above type, an arrangement which prevents the impact force from being transmitted back to a driving motor of the tool at the instant when impact occurs.

A further object of the present invention is to provide a simple, reliable structure which is capable of accomplishing the above objects.

With the above objects in view, the present invention includes, in a power tool, a rotary driven means and a rotary impact means coaxial with the driven means for driving the latter and for imparting rotary impact blows thereto when the driven means encounters more than a predetermined resistance.

The rotary impact means is formed with an axial bore defined by an annular surface which is formed with a recess directed toward the axis of the bore. A drive shaft extends slidably through this bore, and, in accordance with the present invention, this drive shaft is formed in its outer surface with a groove, part of which is directed toward the recess.

The first groove portion has a first direction directed toward the recess when the rotary impact means is in an operating position, and this impact means is shiftable axially away from the driven means to an inoperative position. The groove of the drive shaft having a second portion directed toward the recess when the rotary impact means is in its inoperative position.

These first and second groove portions are inclined one with respect to the other when developed onto a common plane onto which the axis of the drive shaft is also projected, the first and second groove portions make different angles with this axis, the angle which the first groove portion makes with the latter axis being closer to 90° than the angle which the second groove portion makes with this axis.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

Fig. 1 is a sectional elevational view of a power tool according to the present invention;

Fig. 2 is a developed view of one form of a drive shaft groove according to the present invention; and

Fig. 3 is a developed view of another form of a drive shaft groove according to the present invention.

Referring to the drawings, there is shown in Fig. 1 a driving motor located within a housing 10 made of a light metal such as aluminum and connected with a handle 11. The motor housing portion 12 is closed by a cover 13 whose periphery is clamped between another housing portion 13 and the housing portion 10, the parts 10—13 forming a support means for the structure housed therein. An electric motor within the housing 10 has an armature shaft 14 extending through a suitable bearing beyond the cover 12 of the housing 10 and formed at its free end with a pinion 15 which meshes with a gear 16 carried by a suitable transmission shaft 17. Part of the shaft 17 has the form of a pinion 18 which meshes with a gear 20 which has an elongated hollow tubular hub portion 23. The gear 20 has an annular portion 21 which cooperates with a bearing of a member 22 to support the gear 20 for rotation, and the tubular portion 23 extends into the housing 13.

Arranged in the housing 23 coaxially with the gear 20 is a rotary impact means 26 having a bottom end 40, as viewed in Fig. 1, which takes the form of the driving half of a dog clutch having a pair of axially projecting clutch dogs 27 and 28. The housing 13 supports at its lower end, as viewed in Fig. 1, a rotary driven means 29, the upper end of which, as viewed in Fig. 1, forms the driven half of the dog clutch and has the axially projecting dogs 30 and 31. The portion 40 of the rotary impact means 26 is formed with an axial bore 41 through which a drive shaft 32 axially extends in slidable engagement with the rotary impact means, and the annular surface which defines the bore 41 is formed with recess 45 directed toward the axis of the drive shaft 32.

An outer surface of the drive shaft 32 is formed with a groove 35, part of which is directed toward the recess 45, and a motion transmitting element in the form of a spherical ball member 34 is located partly in the recess 45 and partly in the recess 35. The recess 45 is in the form of an axially grooved. The drive shaft 32 is fitted with an elongated axial bore 36 which slidably receives the tubular hub portion 23 of the gear 20, so that this portion 23 serves as one bearing for the drive shaft 32, and this shaft 32 has a reduced end portion 39 extending slidably into a bore 38 of the driven means 29 so that the latter serves as a second bearing for the drive shaft.

A spring means in the form of a coil spring 33 is coiled about the drive shaft 32 and located within the upper hollow tubular portion of the rotary impact means 26. The upper end of the spring 33, as viewed in Fig. 1, bears against a ring 42 freely shaftable along the drive shaft and limited in its upward movement, as viewed in Fig. 1, by a collar portion 43 of the drive shaft. The ring 42 has an annular peripheral portion 44 slidably engaging the inner surface of the rotary impact means 26.

The opposite end of the spring 33 bears against the end portion 40 of the rotary means so as to urge the latter to the illustrated operating position where element 34 is at the lowest part of the groove 35, as viewed in Fig. 1.

Fig. 2 shows one form which the groove 35 may take in accordance with the present invention, with this groove developed onto a plane. In the operating position of the rotary impact means shown in Fig. 1, the element 34 is located in the lower portion 69 of the groove shown in Fig. 2, and the axis 59 of this portion 69 is perpendicular to the axis of the drive shaft when the latter axis is projected onto the plane of Fig. 2. The portion 69 of the groove interconnects the lateral portions 61 and 62 of the groove, each of which, when developed onto the plane of Fig. 2, makes an angle of 45° with the portion 60 of the groove. The square end portion 47 of the
3 driven means 29 is adapted to cooperate through a suitable socket wrench or the like with a screw or bolt which is to be turned by the tool. The inclined portion 61 of the groove comes into operation during turning of the drive shaft in the direction I shown in Figs. 1 and 2 when the tool is used for turning a bolt or the like having a right hand thread, and the direction of rotation of the drive shaft is reversed so as to call the groove portion 62 into play when working with a workpiece having a left hand thread. Also, the groove portion 62 comes into play when loosening a screw having a right hand thread, for example.

The coil spring 48 is located within the bore of the end portion 39 of the drive shaft as well as within the bore 38 of the driven means 29 for urging the latter to the rest position shown in Fig. 1 where the clutch halves are out of engagement with each other.

The transmission means from the driving motor to the drive shaft includes a cogwheel assembly 22 which is in meshing engagement with the end 47 of the driven means 29, and the switch 51 is actuated by the operator to energize the motor and rotate the shaft 32 in the direction I. The spherical member 34 will be located in the position A shown in Fig. 2 and while in this position, will transmit the rotation of the shaft 32 to the rotary impact member 26. The compressed spring 33 prevents movement of the impact means 26 in an upward direction, as viewed in Fig. 1.

The operator presses the housing of the tool downwardly so as to urge the driven means 29 inwardly into the housing 13 against the force of spring 48 and this results in meshing with the clutch halves so that the driven means 29 now rotates with the rotary impact means 26. This turning of the driven means 29 continues until its resistance to turning is so great that the spring 33 is no longer capable of maintaining the rotary impact means 26 in the operating position shown in Fig. 1. At this time, the shaft 32 continues to turn without turning the rotary impact means 26 and, as a result, the transmission element 34 moves upwardly along the portion 61 of groove 35 away from the position A shown in Fig. 2. In this way, the spring 33 is compressed further and the rotary impact means 26 moves away from its operating position until the ball member 34 reaches the position B of Fig. 2. When member 34 is in this latter position, the clutch halves are out of engagement with each other and, therefore, the spring 33 is now free to expand so as to shift the rotary impact means 26 back to its operating position. This movement during which the ball member returns from position B toward position A provides a strong rotary acceleration on the drive shaft, and the rotary impact means overtake the shaft 32 and then provides between its clutch dogs and those of the driven means 29 a strong rotary impact blow. At the instant when impact occurs, the ball member 34 is in the solid line position indicated in Fig. 2, so that at the instant of impact, the shaft 32 is free to turn without resistance through an angular distance determined by the angular length of the groove portion 60 without being in driving engagement with the rotary impact means 26 which is sharply braked by the impact. Only when the ball member 34 has again reached the position A of Fig. 2 does the ball member 34 together with the rotary impact means again shift along the shaft 32 while compressing the spring 33 to repeat the sequence of operations. Thus, the groove portion 60 serves to prevent the severe forces which occur at impact from being transmitted back through the transmission means to the driving member.

The embodiment of the groove 35 which is illustrated in Fig. 3 is of advantage in that there is no sharp junction of the groove portions of different inclinations, respectively. Thus, the inclined portions 66 and 67 of the groove of Fig. 3 merge smoothly and gradually with the portion 65 which corresponds to the portion 60 and which extends along an arc which is tangent to a line perpendicular to the axis of shaft 32 when the latter axis is projected to the plane of Fig. 3. Thus, with the groove of Fig. 3, there will be, directly after the moment of impact, an extremely small degree of shifting of the rotary impact means 26 away from the driven means 29, and this shifting will gradually accelerate until the ball member 34 reaches the groove portion 66, for example. Thus, the tool runs quietly and is rendered much easier to handle.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of power tools differing from the types described above.

While the structure thus described and illustrated is embodied in rotary power tools, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully describe the invention that others may, by examining the drawings and the accompanying specification, be enabled to see that the various features and incidents are set forth and arranged so as to provide a new and distinctive invention.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a power tool, in combination, rotary driven means adapted to at least indirectly turn a workpiece; rotary impact means cooperating with said rotary driven means for turning the latter and for driving the latter with rotary impact blows when said driven means encounters more than a predetermined resistance to turning, said rotary impact means and rotary driven means having a common axis of rotation and said rotary impact means being formed with an axial bore extending along said axis and defined by an annular surface surrounding said axis and forming with a recess directed toward said axis; a drive shaft coaxial with said rotary impact means and extending radially through said axial bore thereof, said drive shaft having an outer surface portion formed with a groove part of which is directed toward said recess, said rotary impact means being axially slidable along said shaft away from said driven means from an operating position to an inoperative position and said groove having a first portion directed toward said recess when said rotary impact means is in its operating position and a second portion forming an extension of said first portion and directed toward said recess when said impact means is in said inoperative position, said first and second groove portions being inclined one with respect to the other and said first groove portion when said groove is developed onto a plane onto which the axis of said drive shaft is projected making with said axis an angle greater than 45° and in a range between 45° and 90° and said second groove portion when projected on said plane extending along a straight line which makes with said axis an acute angle substantially less than the angle between said axis and said first groove portion; and a motion transmitting element located partly in said recess and partly in said groove for movement along said groove and for transmitting the rotation of said shaft to said tool.

2. In a power tool as recited in claim 1, said motion transmitting element being in the form of a spherical ball member and said first and second groove portions each having a radius of curvature greater than the diameter of said ball member.

3. In a power tool as recited in claim 1, said first
groove portion when developed onto said plane making a right angle with said axis of said drive shaft when said axis is projected onto said plane.

4. In a power tool as recited in claim 1, said first groove portion when projected onto said plane extending along an axis which is tangent to a straight line which is perpendicular to the axis of said drive shaft when said drive shaft axis is projected onto said plane.

5. In a power tool as recited in claim 1, said first and second groove portions merging smoothly into each other.

6. In a power tool as recited in claim 1, said first and second groove portions when projected onto said plane respectively making angles of 90° and 45° with the axis of said drive shaft when said drive shaft axis is projected onto said plane.

7. A power tool comprising, in combination, support means; a rotary driven member having an axis of rotation and supported by said support means for rotational and axial movement with respect to said axis, said driven member having an outer end adapted to cooperate at least indirectly with a workpiece which is to be turned by the tool and said driven member having an inner end in the form of the driven half of a dog clutch; first spring means cooperating with said driven member for urging the latter downwardly to a rest position; a rotary impact member coaxial with said driven member and having an end in the form of the driving half of a dog clutch directed toward and located adjacent said driven half of said clutch, said driven member being axially movable against the force of said first spring means from said rest position inwardly toward an operating position where said clutch halves mesh, said clutch halves having with respect to each other an angular clearance giving said driving half of said clutch a free angular turning movement before said driving clutch half strikes against said driven clutch half, and said rotary impact member being formed with an axial bore defined by an annular surface formed with a recess directed toward the axis of said rotary impact member; second spring means cooperating with said rotary impact member for urging the latter toward said driven member; a drive shaft extending slidably through said bore of said impact member coaxially with the latter and having an outer surface formed with a groove, part of which is directed toward said recess, said impact member being axially shiftable along said drive shaft against the force of said second spring means from an operative position where a first portion of said groove is directed toward said recess to an inoperative position where a second portion of said groove is directed toward said recess, said first and second groove portions being inclined one with respect to the other and making different angles with the axis of said drive shaft when said groove and axis are projected onto a common plane, the angle which said first groove portion makes with said axis being nearer to 90° than the angle which said second groove portion makes with said axis; a driving motor; and yieldable transmission means interconnecting said driving motor with said drive shaft for rotating the latter, said yieldable transmission means yielding to prevent relatively severe forces from being transmitted back to said driving motor.

8. A power tool as recited in claim 7, wherein said yieldable transmission means includes a torsion bar which twists to absorb said severe forces.

References Cited in the file of this patent

UNITED STATES PATENTS

2,261,204 Amtsberg Nov. 4, 1941
2,533,703 Wilhide et al. Dec. 12, 1950
2,662,434 Burkhardt Dec. 15, 1953
2,691,434 Jimerson Oct. 12, 1954
2,784,625 Maurer Mar. 12, 1957
2,821,276 Reynolds Jan. 28, 1958
2,822,677 Reynolds Feb. 11, 1958