A device for exerting impact force to a fastener such as a nut to tighten or loosen the nut with respect to an associated bolt. The device has an axially movable and rotatable cylindrical drive member normally in engagement with an output shaft of the device having an outer end for engagement with a fastener. An electrically actuated drive shaft extends into the drive member for relative rotational movement with respect to the drive member. A formation comprising a plurality of balls is disposed between the drive member and shaft. The arrangement is such that the formation is depressed circumferentially of the drive member to expand axially thereof in response to the relative rotational movement between the drive member and the shaft whereby the drive member is disengaged from the output shaft.
The device according to the present invention comprises a housing, a motor in said housing, means in driving connection with said motor for reducing the speed of the rotation of said motor, an impact force producing means within said housing and in operative connection with said speed reducing means, an output shaft rotatably extending outwardly from said housing and having a tool portion outside thereof for engagement with a fastener element, said output shaft having a portion within said housing having teeth formed thereon, said impact force producing means including a drive shaft in operative connection with said speed reducing means, a tubular hollow drive member loosely received on said drive shaft for rotation and axial movement with respect to said drive shaft and having teeth normally in engagement with said teeth on said output shaft, means within said housing for biasing said drive member axially toward said output shaft to cause said teeth on said drive member to be engaged with said teeth on said output shaft, means between said drive shaft and said drive member for momentarily disengaging said teeth on said drive member from said teeth on said output shaft, said disengaging means being operative to axially shift said drive member away from said output shaft against said biasing means in response to the relative rotation of said drive shaft with respect to said drive member.

In the preferred embodiment of the invention, the tubular hollow drive member has at least one axial bead extending radially inwardly therefrom. The end of the drive member remote from the output shaft is preferably substantially closed by a radial wall through which the drive shaft extends rotatably and slidably. The ridge of the drive shaft, the bead and radial wall of the drive member cooperate with the inner end face of the output shaft to define at least one radially, axially and circumferentially confined space in which the disengaging means is operatively received.

The disengaging means may preferably comprise a formation of a plurality of balls so arranged within the space that the formation is circumferentially depressed by the ridge and bead to axially expand thereby urging the drive member away from the output shaft against the biasing means when the drive shaft is rotated with respect to the drive member. The disengaging means may alternatively be a resilient ring-like element disposed in the space.

The drive member may preferably have a pair of circumferentially spaced flanges extending circumferentially of the drive member and projecting radially inwardly therefrom into the space. The above-mentioned formation may include two balls which are aligned substantially circumferentially of the drive member. The flanges are operative to limit the axial movement of the circumferentially aligned balls.

The device may preferably include a spring retainer mounted rotatably on the drive shaft. The biasing means may preferably be a compression spring extending between the drive member and the spring retainer for normally urging the drive member against the output shaft.

According to another feature of the invention, there is also provided an electrically powered device for exerting an intermittent rotational impact force to a fastener element to tighten or loosen the same with respect to another fastener element associated therewith, said device comprising a housing, a motor in said hous-
ing, means in driving connection with said motor for reducing the speed of the rotation of said motor, an impact force producing means within said housing and in operative connection with said speed reducing means, an output shaft rotatably extending outwardly from said housing and having a tool portion outside thereof for engagement with a fastener element, said output shaft being adapted for interrupted driving connection with said impact force producing means so that the latter exerts a rotational impact force to said tool portion when said output shaft is in engagement with said impact force producing means, said housing including at least a pair of generally cylindrical hollow cover members coupled together at their adjacent ends against relative axial movement with respect to one another and for relative rotational movement with respect to one another, one of said cover members having a portion rotatably extending into the adjacent end of other cover member, said portion of said one cover member having a plurality of circumferentially aligned and spaced radial holes formed in the peripheral surface of said portion, said housing having a handle at the end thereof remote from said tool portion, an auxiliary handle mounted on said other cover member and extending substantially radially therefrom, said auxiliary handle including a pin member mounted therein for axial sliding movement with respect to said auxiliary handle, said pin member having an end portion extending slidably through the peripheral wall of said other cover member into a selected one of said radial holes in said portion of said one cover member, said pin member being retractable from said selected one radial hole for enabling said other cover member to be rotated together with said auxiliary handle with respect to said one cover member whereby said auxiliary handle has an adjusted angular position with respect to said housing.

The mentioned portion of the one cover member may preferably have an annular groove formed in the peripheral surface of the portion. Coupling means which preferably comprises a pair of semi-circular pieces secured to the inner surface of the other cover member are received in the annular groove for sliding movement therealong together with the other cover member.

The auxiliary handle preferably includes a sleeve member secured at one end to the other cover member and extending around the pin member. A knob member may preferably be mounted on an extension of the pin member which extends out of the sleeve member. The latter is preferably formed, in the peripheral surface thereof, with an L-shaped slot along which a stud on the pin member is slidable therewith axially and circumferentially of the sleeve member when the knob member is rotated or pulled with respect to the sleeve member.

The above and other objects, features and advantages of the present invention will become more apparent from the following description with reference to the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a fragmentary partial axial sectional view of an embodiment of an electrically powered fastener rotating and tightening and loosening device according to the present invention with a part thereof broken away;

FIG. 2 is a cross-sectional view of the device taken substantially along line II — II in FIG. 1;

FIG. 3 is a view similar to FIG. 1 but illustrating another embodiment of the invention;

FIG. 4 is a cross-sectional view of the device shown in FIG. 3 taken substantially along line IV — IV in FIG. 3;

FIG. 5 diagrammatically illustrates in reduced scale the device of the present invention in its entirety;

FIG. 6A—1 is a perspective view of a modification of the means for disengaging the drive member from the output shaft as shown in FIGS. 1 and 3;

FIG. 6A—2 diagrammatically illustrates the function of the modified disengaging means shown in FIG. 6A—1;

FIG. 6B diagrammatically illustrates another modification of the disengaging means;

FIG. 7A is an axial sectional view of the driving member of the embodiment shown in FIGS. 3 and 4 taken along line VII — VII in FIG. 4 and illustrating the disengaging means in its inoperative position;

FIG. 7B is a view similar to FIG. 7A but illustrating the disengaging means in its operative position;

FIG. 8 is a partial axial sectional view of a further embodiment of the device of the invention with a part removed;

FIG. 9 is a perspective view of a part of the device of the further embodiment with some elements shown in disassembled positions;

FIG. 10 is an enlarged axial sectional view of the auxiliary handle shown in FIG. 8; and

FIG. 11 is a fragmentary view of the auxiliary handle taken along line XI — XI in FIG. 10.

Same reference numerals indicate similar or identical parts throughout the drawings.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring first to FIGS. 1, 2 and 5 of the drawings, there is shown an embodiment of an electrically powered fastener rotating and tightening and loosening device which comprises an electric motor 1 housed by a motor cover 5, a speed-reduction section 2 housed by a reduction section cover 6, an impact drive section 3 housed by a drive section cover 7, and an output or tool portion 4. The covers 5, 6 and 7 and a handle portion 28 having a trigger type switch actuator 29 are assembled in an appropriate manner as shown in FIG. 5.

More specifically, the motor 1 has its output shaft connected to a small gear 8 which is drivenly connected to a drive shaft 12 through a series of reduction gears 9, 10 and 11 of the speed reduction section 2. The drive shaft 12 is secured at one end to the first reduction gear 11 for rotation therewith and is rotatably supported at a portion intermediary of the ends thereof by a ball bearing 20 mounted on that portion 51 of the cover 6 which is snugly received in and secured to the rear end of the cover 7. A collar 24 is mounted on the shaft 12 in abutment with one end face of the bearing 20.

The impact drive section 3 includes a cylindrical drive member 13 having a disc-like end wall 13' which is slidable received on the drive shaft 12 so that the drive member 13 is rotatable and axially slidable with respect to the shaft 12. The drive member 13 has a pair of diametrically opposite axially forwardly extending teeth 15 formed on the forward end face of the drive member 13.
The tool portion 4 includes an output shaft 16 rotatably extending through a bushing 25 received in and secured to the inner surface of a bore 7' formed in the forward end of the cover 7. The output shaft 16 is coaxial with the drive shaft 12 and has an inner or rear portion 16a of an increased diameter which loosely extends rearwardly into the drive member 13 and which rotatably receives a forward extension 18 of the drive shaft 12 in an axial bore 19 formed in the rear portion 16a. The output shaft 16 also has formed thereon a flange 16b on which are formed a pair of diametrically opposite axially rearwardly extending teeth 17 adapted to be engaged and disengaged by the teeth 15 on the drive member 13.

A compression coil spring 21 extends around a rear reduced diameter portion of the drive member 13 and an intermediate portion of the drive shaft 12. The coil spring 21 has an end in pressure contact with an annular shoulder 6' provided by a forward portion of the cover 6 received in the cover 7. The other end of the coil spring 21 is in pressure contact with another shoulder provided by the rear reduced diameter portion of the drive member 13. The compression coil spring 21 normally forwardly biases the drive member 13 to urge the teeth 15 thereof into engagement with the teeth 17 of the output shaft 16.

FIG. 3 illustrates another embodiment of the invention which is modified to employ a thrust bearing 23 mounted on the drive shaft 12 adjacent the collar 24. The thrust bearing 24 bears a thrust from a disclike spring retainer 22 which is rotatably mounted partly on the drive shaft 12 and partly on the thrust bearing 24 and which receives the rear end of the compression coil spring 21 at the marginal edge portion. It will be appreciated that the embodiment shown in FIG. 3 is more advantageous than that shown in FIG. 1 in that the spring 21, which is rotated by the drive member 13 which in turn is rotated by the drive shaft 12 as will be described in detail later, is rotatable freely with respect to the housing of the device whereas, in the embodiment in FIG. 1, the spring 21 which is similarly rotated by the drive member 13 is required to rotate with respect to the annular shoulder 6' of the cover 6 against the friction produced therebetween.

In both of the embodiments shown in FIGS. 1 and 3, means are provided for momentarily disengaging the teeth 15 of the drive member 13 from the teeth 17 of the output shaft 16 in response to the rotation of the shaft 12 relative to the drive member 13 and the output shaft 16. In each of the illustrated embodiments, the disengaging means comprises two sets of four balls of a hard material such as steel. In each of the embodiments, the disengaging means are disposed in spaces 14, 14 defined in radial and axial directions by the inner surface 131 of the drive member 13, the rear wall 13' thereof, the outer surface of the shaft 12 and the rear end surface of the rear portion 16a of the output shaft 16.

FIG. 2 is a cross-sectional view of the embodiment shown in FIG. 1 illustrating the spaces 14, 14 as seen in a direction perpendicular to that in which the spaces are seen in FIG. 1. FIG. 4 is a cross-sectional view similar to FIG. 2 but illustrating the spaces 14, 14 in the modified embodiment shown in FIG. 3. From the illustrations in FIGS. 2 and 4, it will be understood that each of the embodiments has a pair of generally arcuate diametrically opposite spaces 14, 14 defined in the circumferential direction by a pair of diametrically opposite beads 27, 27 projecting radially inwardly from the drive member 13 and by a pair of diametrically opposite ridges 26, 26 radially outwardly extending from the drive shaft 12. The side faces of the ridges 26, 26 and beads 27, 27 are formed to provide arcuate concave profiles to accommodate the spherical surfaces of the balls received in the spaces 14, 14.

The embodiment shown in FIG. 4 is substantially identical with the embodiment shown in FIG. 2 except for the provision of a pair of diametrically opposite flanges 132, 132 extending radially inwardly beyond the ridges 27, 27 and extending circumferentially between the spaces 14, 14 at the ends thereof adjacent the rear end face of the output shaft portion 16a as best seen in FIGS. 7A and 7B which are taken substantially along line VII — VII in FIG. 4. It will be seen in FIGS. 7A and 7B that four balls 141, 142, 143 and 144 are received in each space 14.

As shown in FIG. 3, it is preferable that the diameter D1 of the shaft 12, the diameter D2 of a circle of revolution of the inner surfaces 131, 131 of the drive member 13, the diameter D3 of a circle of revolution of the outer surfaces of the ridges 26, 26 and the diameter d of each of the balls 141 through 144 be of the following relationship:

\[ D2 = D1 + 2d \]
\[ D3 = \frac{d}{2} (D1 + D2) \]

As will be seen in FIGS. 7A and 7B, the four balls 141 through 144 are disposed at the four apexes of a diamond. When the device is either in its inoperative position or under no load condition, the axially aligned balls 141 and 144 contact each other while the other circumferentially aligned two balls 142 and 143 are spaced from one another as shown in FIG. 7A. In this position of the device, the drive member 13 is biased forwardly by the coil spring 21 so that the teeth 15 of the drive member 13 are in meshing engagement with the teeth 17 of the output shaft 16. When the shaft 12 is rotated and the output shaft 16 is under loaded condition, the shaft 12 tends to rotate with respect to the drive member 13 so that the ridges 26, 26 on the shaft 12 are moved in a circumferential direction relative to the beads 27, 27 of the drive member 13. For this reason, the two circumferentially aligned spaced balls 142 and 143 are urged or shifted toward each other to positively displace the other axially aligned balls 141 and 144 away from one another in the axial direction as shown in FIG. 7B. This axial displacement of the balls 141 and 144 urges the drive member 13 rearwardly away from the output shaft 16 and against the compression coil spring 21 to cause the teeth 15 of the drive member 13 to be momentarily disengaged from the teeth 17 of the output shaft 16, with a result that the drive member 13 is allowed to have a rotational lost motion for about 180° with respect to the output shaft 16. During this 180° rotation of the drive member 13, the compression spring 21 restores to its initial position to return the drive member 13 to a position in which the teeth 15 thereof are engageable with the teeth 17 of the output shaft 16. The process is repeated to give the tool portion 4 an interrupted rotational impact force of the same magnitude which in turn may be exerted to a fastener such as a nut to tighten the same with respect to a cooperating bolt and against a workpiece through which the bolt extends.
The embodiments shown in FIGS. 2 and 4 are operable substantially in the same manner. It will, however, be appreciated that the embodiment shown in FIG. 4 is more advantageous in that the circumferentially and radially inwardly extending flanges 132, 132 of the embodiment shown in FIG. 4 assure controlled or axially limited operations of the circumferentially aligned balls 142 and 143 for the reliable engagement between the sets of the teeth 15 and 17 and their disengagement from each other. On the contrary with the embodiment shown in FIG. 2 there is a little possibility that either the ball 142 or the ball 143 will be accidentally urged over the ball 141 by the corresponding ridge 26 on the shaft 12 with the resultant trouble that it is difficult for the compression spring 21 to return the drive member 13 to its initial position in which the member 13 is engageable with the output shaft 16 at their teeth 15 and 17.

As discussed in the above, the inner surfaces 131 of the drive member 13 in both embodiments shown in FIGS. 2 and 4 have complex curvatures. In addition, the drive member 13 of the embodiment shown in FIG. 4 has circumferentially and radially inwardly extending flanges 132, 132. In order to facilitate simplified manufacture of the drive member 13, therefore, the rear wall portion 13' thereof is advantageously a disclike member which is fitted into and secured to a cylindrical hollow member to complete the drive member 13.

It will be understood that, while four balls 141 through 144 are employed in the described embodiments of the invention, triangularly arranged three balls 142', 143' and 144' may alternatively be employed, as shown in FIG. 6B, to axially urge the drive member 13 away from the output shaft 16 for disengaging the teeth 15 of the drive member 13 from the teeth 17 of the output shaft 16 in response to the relative rotational movement between the shaft 12 and the drive member 13. In a further modification, a resilient ring-like member such as a coil spring 141' shown in FIG. 6A-1 may be employed for the same purpose. It will be appreciated that the ring-like spring 141' compressed in the X direction will be expanded in the Y direction as diagrammatically illustrated in FIG. 6A-2. This character can be utilized to move the drive member 13 away from the output shaft 16. It will be understood that in the case where sets of the three balls 142' through 144' or sets of ring-like springs 141' are employed in the device, the spaces 14, 14 therefor may also be modified accordingly in configuration and volume.

For convenience, the embodiment shown in FIGS. 3 and 4 is illustrated and has been described employing both of the disc-like spring retainer and thrust bearing assembly 22 and 23 and the radially inwardly and circumferentially extending flanges 132 and 132. It is, however, to be understood that the scope of the present invention includes a device which does not have such a spring retainer and thrust bearing assembly but employs such flanges. It is also to be understood that a device which has such a spring retainer and thrust bearing assembly but does not include such flanges is also included in the scope of the invention.

The above-described device of the invention is operable per se. It is, however, difficult for the device to be supported in position at the handle 28 alone during operation. The device of another embodiment, therefore, may preferably be equipped with accessories which will be described hereunder with reference to FIGS. 8 to 11 of the drawings.

Referring to FIG. 8, the reduction section cover 6 and the handle portion 28 are provided thereon with brackets 30 and 30', respectively. The device is provided with a suspension belt 31 connected at the opposite ends to the brackets 30 and 30' so that the device can be supported from a shoulder of an operator by means of the suspension belt 31.

An auxiliary handle 38 is mounted on the cover 7 at a portion adjacent the rear end thereof. Numerical 52 indicates a socket mounted on the tool portion 4. Numerical 53 denotes an electric lead line connected to the handle portion 28 and electrically connected to a switch (not shown) associated with the actuator 29.

Referring next to FIG. 9, that portion 51 of the reduction section cover 6 which is received in the rear end portion of the cover 7 is formed with an annular groove 33 in the peripheral surface thereof. The groove 33 rotatably receives a split ring comprising a pair of semi-circular pieces 34, 34 having formed therein threaded holes 35, 35. The cover 7 is rotatably coupled to the cover 6 by means of screws 37 extending inwardly through apertures 36 in the cover 7 into the threaded holes 35, 35 in the split ring pieces 34, 34 slideable along the groove 33.

A plurality of spaced holes 39 are formed in the peripheral surface of the portion 51 of the cover 6. The holes 39 are arranged in a radial plane which is parallel to the annular groove 33 and includes the axis of the auxiliary handle 32. The latter has a pin 38 which extends slidable through the wall of the cover 7 into a selected one of the apertures 39 to determine the angular position of the auxiliary handle with respect to the device as will be described later in more detail.

Referring to FIGS. 10 and 11, the auxiliary handle 32 comprises a sleeve 40 in which the above-mentioned pin 38 is received for relative sliding movement with respect to the sleeve 40. A collar 45 is fitted into the bottom end of the sleeve 40 and is secured thereto by means of a set screw 46. At the intermediary portion between the ends of the pin 38 is provided a flange 41 with which a compression coil spring 42 is in pressure contact at one end to hold the pin 38 in engagement with the selected one of the apertures 39 in the cover 6, the other end of the spring 42 being retained by the collar 45.

The pin 38 has mounted on the periphery thereof a stud 43 which is slidable received in an L-shaped slot 44, as shown in FIG. 11, formed in the peripheral wall of the sleeve 40 so that the stud 43 and the slot 44 cooperate together to limit the axial movement of the pin 38 with respect to the sleeve 40.

A knob 47 is secured to the bottom end of the pin 38 by means of a set screw 48. The sleeve 40 and the knob 47 are covered with rugged covers 49 and 50, respectively, to make it easy for an operator to grip the auxiliary handle 32.

The stud 43 is normally positioned at an upper end portion A of the slot 44. When the knob 47 is pulled downwardly with respect to the cover 49 and sleeve 40 therein, the stud 43 is moved along the slot 44 to a central portion B thereof and, when the knob 47 is rotated in a direction, the stud 43 is further moved to the other end portion C of the slot 44. In this position of the stud 43, the pin 38 is removed from the hole 39 in the forward end portion 51 of the cover 6 and is maintained.
in this position by the cooperation of the stud 43 and the circumferential section of the slot 44 even if the pulling force is removed from the knob 47. In this position of the pin 38, the drive section cover 7 is rotatable together with the split ring pieces 34, 34 with respect to the reduction section cover 6. When the cover 7 is rotated to a position in which the upper or inner end of the pin 38 is registered with another selected aperture 39, the knob 47 may be rotated in the other direction to allow the pin 38 to be urged into the selected aperture 39 by the compression spring 42 so that the auxiliary handle 32 is angularly firmly repositioned with respect to the device. The stud 43 is also returned to its initial position A in the slot 44.

It will, therefore, be appreciated that the auxiliary handle 32 can be set at a position most suited for easy operation of the device to facilitate improved working efficiency.

What is claimed is

1. An electrically-powered device for exerting intermittent rotational impact force to a first fastener element to move the same with respect to a second fastener element associated therewith, said device comprising a housing, a motor in said housing, means in driving connection with said motor for reducing the speed of the rotation of said motor, an impact force producing means within said housing and in operative connection with said speed reducing means, an output shaft rotatably extending outwardly from said housing and having a tool portion outside thereof for engagement with said first fastener element, said output shaft having a portion within said housing having teeth formed thereon, said impact force producing means including a drive shaft in operative connection with said speed reducing means, a tubular hollow drive member loosely received on said drive shaft for rotation and axial movement with respect to said drive shaft and having teeth normally in engagement with said teeth on said output shaft, means within said housing for biasing said drive member axially toward said output shaft to cause said teeth on said drive member to be engaged with said teeth on said output shaft, means between said drive shaft and said drive member for momentarily disengaging said teeth on said drive member from said teeth on said output shaft, said disengaging means being deformable circumferentially and axially of said drive member in response to the relative rotation of said drive shaft with respect to said drive member to axially shift said drive member away from said output shaft against said biasing means.

2. A device as claimed in claim 1, in which said drive shaft has formed thereon at least one radially outwardly and axially extending ridge, said tubular hollow drive member having at least one axial bead extending radially inwardly therefrom, the end of said drive member remote from said output shaft being substantially closed by a radial wall through which said drive shaft extends rotatably and slidably, said ridge on said drive shaft, said bead and radial wall of said drive member cooperating with the inner end face of said output shaft to define at least one radially, axially and circumferentially confined space in which said disengaging means are operatively received.

3. A device as claimed in claim 2, in which said disengaging means comprises a formation of a plurality of balls so arranged within said space that the formation is depressed circumferentially of said drive member by said ridge and bead to expand axially of said drive member for thereby urging said drive member away from said output shaft against said biasing means when said drive shaft is rotated with respect to said drive member.

4. A device as claimed in claim 3, in which said formation is formed of four balls disposed at the four apexes of a diamond, the two of said balls being aligned substantially axially of said drive member while the other two balls are aligned substantially circumferentially of said drive member.

5. A device as claimed in claim 3, in which said formation is formed of three triangularly arranged balls two of which are aligned substantially circumferentially of said drive member.

6. A device as claimed in claim 2, in which said disengaging means comprises a resilient ring-like element disposed within said space, said resilient element being adapted to be depressed circumferentially of said drive member by said ridge and bead to expand axially of said drive member for thereby urging said drive member away from said output shaft against said biasing means when said drive shaft is rotated with respect to said drive member.

7. A device as claimed in claim 3, in which said drive member has a pair of circumferentially spaced flanges extending circumferentially of said drive member and projecting radially inwardly therefrom into said space, said formation including two balls aligned substantially circumferentially of said drive member, said flanges limiting the axial movement of said circumferentially aligned balls.

8. A device as claimed in claim 1, characterized by a spring retainer mounted rotatably on said drive shaft, said biasing means comprising a compression spring extending between said drive member and said spring retainer for normally urging said drive member against said output shaft.

9. An electrically powered device for exerting intermittent rotational impact force to a first fastener element to tighten the same with respect to a second fastener element associated therewith, said device comprising a housing, a motor in said housing, means in driving connection with said motor for reducing the speed of the rotation of said motor, an impact force producing means within said housing and in operative connection with said speed reducing means, an output shaft rotatably extending outwardly from said housing and having a tool portion outside thereof for engagement with said first fastener element, said output shaft consisting of a plurality of balls so arranged within said space that the formation is depressed circumferentially of said drive member by said ridge and bead to expand axially of said drive member for thereby urging said drive member away from said output shaft against said biasing means when said drive shaft is rotated with respect to said drive member.

10. A device as claimed in claim 9, in which said formation is formed of four balls disposed at the four apexes of a diamond, the two of said balls being aligned substantially axially of said drive member while the other two balls are aligned substantially circumferentially of said drive member.

11. A device as claimed in claim 9, in which said formation is formed of three triangularly arranged balls two of which are aligned substantially circumferentially of said drive member.

12. A device as claimed in claim 9, in which said disengaging means comprises a resilient ring-like element disposed within said space, said resilient element being adapted to be depressed circumferentially of said drive member by said ridge and bead to expand axially of said drive member for thereby urging said drive member away from said output shaft against said biasing means when said drive shaft is rotated with respect to said drive member.

13. A device as claimed in claim 10, in which said formation is formed of four balls disposed at the four apexes of a diamond, the two of said balls being aligned substantially axially of said drive member while the other two balls are aligned substantially circumferentially of said drive member.

14. A device as claimed in claim 10, in which said formation is formed of three triangularly arranged balls two of which are aligned substantially circumferentially of said drive member.

15. A device as claimed in claim 10, in which said disengaging means comprises a resilient ring-like element disposed within said space, said resilient element being adapted to be depressed circumferentially of said drive member by said ridge and bead to expand axially of said drive member for thereby urging said drive member away from said output shaft against said biasing means when said drive shaft is rotated with respect to said drive member.

16. A device as claimed in claim 11, in which said formation is formed of four balls disposed at the four apexes of a diamond, the two of said balls being aligned substantially axially of said drive member while the other two balls are aligned substantially circumferentially of said drive member.

17. A device as claimed in claim 11, in which said formation is formed of three triangularly arranged balls two of which are aligned substantially circumferentially of said drive member.

18. A device as claimed in claim 11, in which said disengaging means comprises a resilient ring-like element disposed within said space, said resilient element being adapted to be depressed circumferentially of said drive member by said ridge and bead to expand axially of said drive member for thereby urging said drive member away from said output shaft against said biasing means when said drive shaft is rotated with respect to said drive member.

19. A device as claimed in claim 12, in which said formation is formed of four balls disposed at the four apexes of a diamond, the two of said balls being aligned substantially axially of said drive member while the other two balls are aligned substantially circumferentially of said drive member.

20. A device as claimed in claim 12, in which said formation is formed of three triangularly arranged balls two of which are aligned substantially circumferentially of said drive member.

21. A device as claimed in claim 12, in which said disengaging means comprises a resilient ring-like element disposed within said space, said resilient element being adapted to be depressed circumferentially of said drive member by said ridge and bead to expand axially of said drive member for thereby urging said drive member away from said output shaft against said biasing means when said drive shaft is rotated with respect to said drive member.
11. A device as claimed in claim 10, in which said coupling means comprise a pair of semi-circular pieces assembled into a split ring, said semi-circular pieces being secured to the inner surface of said other cover member by means of screws.

12. A device as claimed in claim 10, in which said auxiliary handle includes a sleeve member secured at one end to said other cover member and extending around said pin member, the latter having an extension projecting out of the other end of said sleeve member, a knob member mounted on said extension of said pin member, said sleeve member having an L-shaped slot formed in the peripheral wall thereof, said pin member having a stud radially projecting therefrom and extending into said slot for movement therealong, said slot having a portion extending axially of said sleeve member and another portion extending circumferentially thereof.

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