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(54) Reversible ratcheting tool with a smaller head

(57) A ratcheting tool includes a handle (11) and a head (12) with a compartment (13). A drive member (20) includes a first end (22), a second end, and a gear wheel (21) formed between the first end and the second end. The gear wheel is rotatably mounted in the compartment and includes a toothed outer periphery. A pawl (30) is mounted in the compartment and includes a toothed side facing the gear wheel teeth (211). A reversing plate (50) is mounted to the first end (22) of the drive member and pivotable about the rotational axis of the gear wheel (21) between a first position and a second position. The reversing plate (50) is operably connected to the pawl (30) for moving the pawl between a first ratcheting position and a second ratcheting position.

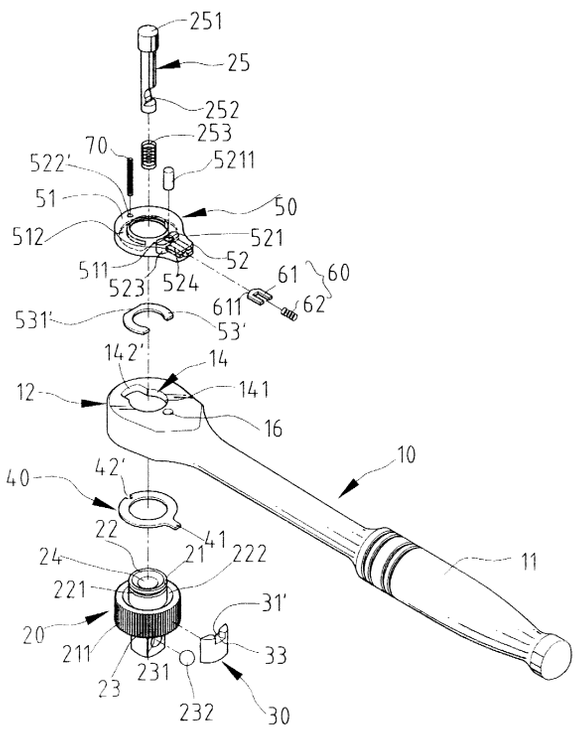

Fig. 10

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Description

[0001] The present invention relates to a reversible ratcheting tool having a smaller head for convenient use in a limited space.

[0002] U.S. Patent No. 1,957,462 to Kress issued on May. 8, 1934 discloses a ratchet wrench including a ratchet wheel 24 housed in a cylindrical recess 23 in the head 22. A pawl 25 is mounted in a second cylindrical recess 26 in the head 22 for controlling movement of the ratchet wheel 24. The pawl 25 is retained in place by a spring-biased plunger 41. Upon rotation of a thumbpiece 58 connected to the pawl 25, the pawl 25 is movable between two positions and thus provides driving and ratcheting of a socket in opposite directions. The pawl 25 is pivoted through a relatively long distance in the head 22, i.e., the head 22 must be relatively large to allow pivotal movement of the pawl 25. Furthermore, the pawl 25 engages with the teeth of the ratchet wheel 24 by only two teeth, i.e., the wrench is not capable of bearing high torque.

[0003] U.S. Patent No. 4,328,720 to Shiel issued on May. 11, 1982 discloses a socket wrench including a drive ring 30, a pawl 50 mounted in a recess 52 in the head 21 of the socket wrench and having two toothed portions 56 and 57, and an external latch handle 53 for controlling position of the pawl 50, thereby optionally causing a desired one of the toothed portions 56 and 57 to engage with a ratcheted outer peripheral portion 48 of the drive ring 30 and thus changing the ratcheting direction. Nevertheless, there are too many components in this socket wrench, and the head 21 is relatively large, as it has to receive the components. Processing and assembly for the components are both troublesome and time-consuming. In addition, transmission between the elements for changing the ratcheting direction is not reliable, as the latch handle 53 does not directly actuate the pawl 50. Furthermore, each toothed portion 56, 57 has only two teeth, i.e., the socket wrench is not capable of bearing high torque.

[0004] U.S. Patent No. 5,626,062 to Colvin issued on May. 6, 1997 discloses a ratchet wrench including a drive gear 48 mounted in a head 44 thereof. A reversing pawl 60 is mounted in the head 44 and has teeth 62 for engaging the drive teeth 50 of the drive gear 48 to provide driving and ratcheting of the socket 22 in opposite directions that are reversible by movement of the reversing pawl between two positions under control of a reversing lever 102. The reversing pawl 60 is pivoted through a relatively long distance in the head 44, i.e., the head must be large enough to allow pivotal movement of the reversing pawl 60. Furthermore, the pawl 60 engages with the teeth 50 of the drive gear 48 by only two teeth, i.e., the wrench is not capable of bearing high torque.

[0005] U.S. Patent No. 4,762,033 to Chow issued on Aug. 9, 1988 discloses a ratchet wrench including a drive head 30 with inner ratchet teeth 42. A core assembly 34 is rotatably mounted in the drive head 30 and has a tool-coupling stud 56. Mounted in the core assembly 34 is a pawl 46 that engages with the teeth 42. Upon rotation of a control plate 60, the pawl 46 is movable between two positions and thus provides driving and ratcheting of a socket in opposite directions via transmission of an intercoupling, resilient, spring-like wire 104 that is mounted in the core assembly. The pawl 46 engages with the teeth 42 by about five teeth and thus may bear higher torque. Nevertheless, the user must use both hands to switch the ratcheting direction. In addition, there are too many components in this wrench, and the head must be relatively large for receiving the components and allowing movement of the pawl 46. Processing and assembly for these components are both troublesome and time-consuming. Furthermore, the wire 104 tends to malfunction as a result of fatigue and thus fails to provide the required switching direction.

[0006] U.S. Patent No. 4,520,697 to Moetteli issued on Jun. 4, 1985 discloses a ratchet wrench including a holed head 22' having inner ratchet teeth 30'. Mounted in the head 22' is a drive member 32' with a hexagonal drive portion 36'. Also mounted in the head 22' is a pawl 54' having a first set of ratchet teeth 58' and a second set of ratchet teeth 60' for selectively engaging with the teeth 30'. A reverser plate 70' is mounted on top of the drive member 32' and includes two reverser pins 74' for connection with the pawl 54'. The ratcheting action is reversible by merely moving the reverser pins 74'. Nevertheless, there are too many components in this wrench, and the head is large, as it has to receive the components. In addition, processing and assembly are both troublesome and time-consuming. Furthermore, the pawl 54' engages with the teeth 30' by only two teeth, i.e., the wrench is not capable of bearing high torque.

[0007] U.S. Patent No. 3,337,014 to Sandrick issued on Aug. 22, 1967 discloses a ratchet wrench including a head 10 provided with internal periphery ratchet teeth 15. Mounted in the head 10 is a double-ended pawl 26 that is pivotable by a spring pressed plunger 38. Upon rotation of a finger piece 36, the pawl 26 is movable between two positions and thus provides driving and ratcheting of a socket in opposite directions. Nevertheless, there are too many components in this wrench, and the head is large, as it has to receive the components. In addition, processing and assembly are both troublesome and time-consuming. The pawl 26 engages with the teeth 15 by only three teeth, i.e., the wrench is not capable of bearing high torque. Furthermore, the user must use both hands to switch the ratcheting direction.

[0008] U.S. Patent No. 5,144,869 to Chow issued on Sep. 8, 1992 discloses a ratchet wrench including a handle with two box ends each having a ratchet wheel 12 mounted therein. A pawl 20 is engaged with each ratchet wheel 12. A knob 30 is mounted in a middle of the handle and receives a disc 40 that is connected to each pawl 20 by two resilient members 26. When the knob 30 and the disc 40 are rotated, the first toothed section 22

and the second toothed section 23 of each pawl 20 are caused to engage with the associated ratchet wheel 12 via transmission by the resilient members 26, thereby controlling the torque transmission direction of the ratchet wheel 12. Nevertheless, the resilient plates 26 tend to malfunction as a result of fatigue. In addition, position of each pawl 25 cannot be precisely controlled. The handle structure is weak, as it must be machined to provide a space for receiving the knob 30, the resilient members 26, and the pawls 25. Furthermore, each pawl 25 engages with the ratchet wheel 12 by only two teeth, i.e., the wrench is not capable of bearing high torque.

[0009] Fig. 18 of the drawings illustrates a conventional ratcheting tool including a head 11' having a first compartment 121' for receiving a drive member 20' with a ratchet wheel 21', a second compartment 122' for receiving a pawl 30', and a third compartment 123' for receiving a switch block 40'. The pawl 30' includes teeth 31' formed on a first side thereof' for engaging with teeth of the ratchet wheel 21'. The switch block 40' includes a first side having two operative sections 416' for selectively bearing against a second side of the pawl 30'. A second side of the switch block 40' includes two arcuate grooves 414'. A thumb piece 42' includes a stem 421' that extends through a hole 13' in the head 11', a vertical hole 413' in the switch block 40', and a hole 71' of a cover 70'. A spring 61' is mounted in a cavity 14' in the web area of the tool for urging a ball 62' to engage with one of the grooves 414'. An elastic ring 50' is wound around a stub 411' on the switch block 40' and includes an engaging end 51' engaged in a hole 32' of the pawl 30'. Upon rotation of the thumb piece 42', the pawl 30' is movable between two positions and thus provides driving and ratcheting of a socket in opposite directions via transmission of the switch block 40' and the elastic ring 50'. The pawl 30' engages with the ratchet wheel teeth by more teeth and thus may bear higher torque. Nevertheless, the pawl 30' has a long travel in the head 11', and the head 11' must be relatively large for receiving the ratchet wheel 21', the pawl 30', and the switch block 40' and allowing pivotal movement of the pawl 30' and the switch block 40'. In addition, the elastic ring 50' is required for transmitting the force from the switch block 40' to the pawl 30' so as to change the ratcheting direction. More specifically, position of the pawl 30' cannot be precisely controlled. In addition, the elastic ring 50' tends to malfunction as a result of fatigue.

[0010] In conclusion, the above-mentioned conventional ratcheting tools fail to provide high torque operation, as most of the pawls merely engage with the ratchet wheel by at best three or five teeth. The head of the ratcheting tool has to be relatively large for accommodating those components and thus is difficult to be used in a limited space. In addition, the pawl is directly driven by the switch button or reverser plate or like element such that the pawl tends to be disengaged from the ratchet wheel or like element if the switch block is inadvertently impinged. Generally, a skilled user uses a combination wrench, a spanner with two open ends, or a ring spanner for tightening or loosening a fastener in a limited space. Yet, it is found that free rotation of the ratcheting tool during ratcheting is too large (larger than the theoretic value of 5°), as the pawl has a long travel.

[0011] Figs. 19 and 20 illustrate another conventional ratcheting tool 100' including a head having a compartment 101' for receiving a drive member with a ratchet wheel 108'. The pawl 102' includes teeth 103' formed on a side thereof' for engaging with teeth of the ratchet wheel 108'. A switch block 104' is attached to the pawl 102' via an elastic member 106' and includes a thumb piece 105'. Upon pivotal movement of the thumb piece 105', the pawl 102' is movable between two positions and thus provides driving and ratcheting for a socket in opposite directions via transmission of the pawl 102' and the ratchet wheel 108'. The pawl 102' engages with the ratchet wheel teeth by more teeth and thus may bear higher torque. Nevertheless, pivotal axis for the switch block 104' is not coincident with rotational axis of the ratchet wheel 108'. Namely, the head of the ratcheting tool must be machined to form additional grooves or compartments 107' and 109' (Fig. 19) for accommodating the pawl 102' and the switch block 104'. As a result, the head of the ratcheting tool is relatively large. In addition, the pawl 102' tends to be disengaged from the ratchet wheel if the thumb piece 105' is inadvertently impinged. Thus, the engagement between the pawl 102' and the ratchet wheel 108' is adversely affected.

[0012] Fig. 28 illustrates engagement between a gear wheel 80 and a pawl 81 of another conventional ratcheting tool. The pawl 81 has a plurality of teeth engaged with teeth 83 of the gear wheel 80 at faces 82 so as to provide high torque operation. The faces 82 have a center of curvature at "B", which is coincident with the center of the gear wheel 80. Referring to Fig. 29, when the handle (not shown) is rotated clockwise, the gear wheel 80 exerts a force F on each tooth on the pawl 81. The force F is imparted into a downward vertical force F1 and a leftward horizontal force F2. The leftward horizontal force F2 make the pawl 81 bear against point A on a wall in a cavity in a web area of the handle. The downward vertical force F1 moves the pawl 81 away from the gear wheel 80. As a result, the right portion of the pawl 81 is disengaged from the gear wheel 80. The reactive force by the wall at point A is imparted into an upward vertical force FN1 and a rightward horizontal force FN2. The upward vertical force FN1 makes the pawl 81 toward the gear wheel 80 and the rightward horizontal force FN2 moves the pawl 81 rightward. As a result, the pawl 81 and the gear wheel 80 have a firm engagement with each associated tooth of the gear wheel at point D.

[0013] Referring to Fig. 30, when the handle is further rotated clockwise, a higher torque is applied such that the magnitudes of the forces F1 and F2 increase. The right portion of the pawl teeth that is slightly disengaged from the gear wheel teeth 83 can still be in contact with the gear wheel teeth 83 when the gear wheel 80 is ro-

tated. The right portion of the pawl 81 is moved downward farther. As a result, more teeth on the pawl 81 are disengaged from the gear wheel 80 (see the pawl teeth on the right side of point A). The forces FN1 and FN2 are also increased in magnitude, yet fewer pawl teeth have firm engagement with the gear wheel teeth. This problem is aggravated when the handle is further rotated clockwise. Accordingly, the gear wheel/pawl arrangement fails to provide the required high torque operation, as all of the pawl teeth have the same center of curvature. In addition, the pawl and the gear wheel will be damaged quickly.

Summary of the Invention

[0014] It is a primary object of the present invention to provide a reversible ratcheting tool with a small head while providing improved driving torque for convenient use in a limited space.

[0015] In accordance with a first aspect of the invention, a ratcheting tool comprises:

a handle;
a head extended from the handle and having a compartment therein;
a drive member including a first end, a second end, and a gear wheel formed between the first end and the second end, the gear wheel being rotatably mounted in the compartment and including an outer periphery with a plurality of first teeth;
a pawl mounted in the compartment and including a first side with a plurality of second teeth facing the first teeth of the gear wheel and a second side facing away from the gear wheel;
a reversing plate mounted to the first end of the drive member and pivotable about the rotational axis of the gear wheel between a first position and a second position, the reversing plate being operably connected to the pawl for moving the pawl between a first ratcheting position and a second ratcheting position, wherein the second teeth of the pawl is engaged with the first teeth of the gear wheel for ratcheting in a first direction when the pawl is in the first ratcheting position, and wherein the second teeth of the pawl is engaged with the first teeth of the gear wheel for ratcheting in a second direction opposite to the first ratcheting direction when the pawl is in the second ratcheting position; and
means for retaining the reversing plate in one of the first position and the second position.

[0016] In accordance with a second aspect of the invention, a ratcheting tool comprises:

a handle;
a head extended from the handle and having a compartment therein;
a drive member including a first end extended beyond the compartment, a second end extended beyond the compartment, and a gear wheel formed between the first end and the second end, the gear wheel being rotatably mounted in the compartment and including an outer periphery with a plurality of first teeth;
a pawl mounted in the compartment and including a first side with a plurality of second teeth facing the first teeth of the gear wheel and a second side facing away from the gear wheel;
a ring mounted in the compartment and around the first end of the drive member, the ring being operably connected to the pawl such that the ring and the pawl are pivotable about a rotational axis of the gear wheel and that the pawl is movable in a radial direction relative to the ring;
a reversing plate mounted to the first end of the drive member and pivotable about the rotational axis of the gear wheel between a first position and a second position, the reversing plate being operably connected to the ring for moving the pawl between a first ratcheting position and a second ratcheting position, wherein the second teeth of the pawl is engaged with the first teeth of the gear wheel for ratcheting in a first direction when the pawl is in the first ratcheting position, and wherein the second teeth of the pawl is engaged with the first teeth of the gear wheel for ratcheting in a second direction opposite to the first ratcheting direction when the pawl is in the second ratcheting position; and
means for retaining the reversing plate in position.

[0017] In accordance with a third aspect of the invention, a ratcheting tool comprises:

a handle;
a head extended from the handle and having a compartment therein;
a drive member including a first end, a second end, and a gear wheel formed between the first end and the second end, the gear wheel being rotatably mounted in the compartment and including an outer periphery with a plurality of first teeth;
a pawl mounted in the compartment and including a first side with a plurality of second teeth facing the first teeth of the gear wheel and a second side facing away the gear wheel, the second teeth of the pawl including a first teeth portion having a first center of curvature and a second teeth portion having a second center of curvature located at a position different from the first center of the curvature;
a reversing plate mounted to the first end of the drive member and pivotable about the rotational axis of the gear wheel between a first position and a second position, the reversing plate being operably connected to the pawl for moving the pawl between a first ratcheting position and a second ratcheting position, wherein the second teeth of the pawl is en-

gaged with the first teeth of the gear wheel for ratcheting in a first direction when the pawl is in the first ratcheting position, and wherein the second teeth of the pawl is engaged with the first teeth of the gear wheel for ratcheting in a second direction opposite to the first ratcheting direction when the pawl is in the second ratcheting position; and

means for retaining the reversing plate in position.

[0018] Transmission means is provided for providing transmission between the reversing plate and the pawl for moving the pawl between the first ratcheting position and the second ratcheting position. A ring is mounted in the compartment and around the first end of the drive member. The ring is operably connected to the pawl such that the ring and the pawl are pivotable about a rotational axis of the gear wheel and that the pawl is movable in a radial direction relative to the ring.

[0019] The head further includes a top face with an opening, and the first end of the drive member is extended beyond the opening. The second end of the drive member is a drive column for releasably engaging with a socket. The pawl has a recess in a top thereof and the ring has a tip piece engaged in the recess of the pawl in a manner that the ring and the pawl are pivotable about the rotational axis of the gear wheel and that the pawl is movable in the radial direction relative to the ring without disengaging from the ring. The reversing plate includes a hole so as to be pivotally mounted around the first end of the drive member. The first end of the drive member includes an engaging groove. A C-clip is engaged in the engaging groove for retaining the drive member in place. A positioning piece projects radially inward from an inner periphery of the hole of the reversing plate and is engaged in the engaging groove for positioning the reversing plate.

[0020] The reversing plate has a thumb piece projected therefrom for manual operation. The thumb piece of the reversing plate includes a receptacle. The reversing plate includes an arcuate groove communicated with the receptacle. A pin is securely mounted in the arcuate groove in a manner allowing pivotable movement of the reversing plate about the rotating axis of the gear wheel. The retaining means includes a U-shape slide piece with two limbs and an elastic member mounted between the limbs of the slide piece. The slide piece includes a tapered push-face consisting of two faces separated by a tip. The push-face of the slide piece is extended into the arcuate groove of the reversing plate. One of the faces bears against the pin when the reversing plate is in its first position to thereby retain the pawl in its first ratcheting position. The other face of the slide piece bears against the pin when the reversing plate in its second position to thereby retain the pawl in its second ratcheting position. The slide piece is slidable relative to the elastic member and biased toward the pin by the elastic member. The reversing plate includes a through-hole. The head includes a top face with a hole. The ring includes a notch. The gear wheel of the drive member includes an annular groove. The means for providing transmission between the reversing plate and the pawl includes a spring having a small pitch. The spring is extended through the through-hole of the reversing plate, the hole in the top face of the head , and the notch in the ring and retained in the annular groove of the drive member. The notch of the ring is defined in an inner periphery of the ring and includes an enlarged section. The reversing plate includes a retainer block having a portion pivotally movable in the enlarged section of the notch of the ring. The retainer block is in contact with a portion of the transmitting means for preventing over-distortion of the transmitting means. In an alternative embodiment of the invention, the notch of the ring is defined in an outer periphery of the ring.

[0021] The reversing plate has a recessed portion in an upper side thereof for receiving the C-clip. The recessed portion of the reversing plate has a protrusion and the C-clip has a bulge with a cavity for engaging with the protrusion.

[0022] In a modified embodiment, the pawl includes a recess in a top thereof and the reversing plate includes an engaging member that is engaged in the recess of the pawl for driving the pawl upon manual rotational movement of the reversing plate. In another modified embodiment, the ring includes a notch and the reversing plate includes an engaging member that is engaged in the notch of the ring for driving the pawl upon manual rotational movement of the reversing plate.

[0023] The first center of curvature of the pawl is coincident with a center of the gear wheel when the pawl is in the first ratcheting position. The second center of curvature of the pawl is coincident with a center of the gear wheel when the pawl is in the second ratcheting position. The first teeth portion and the second teeth portion of the pawl are arranged in a continuous or uncontinuous manner.

[0024] In accordance with a fourth aspect of the invention, a pawl is provided for a reversible ratcheting tool. The pawl comprises a side with a plurality of teeth. The teeth of the pawl including a first teeth portion having a first center of curvature and a second teeth portion having a second center of curvature located at a position different from the first center of the curvature.

[0025] Other objects, advantages, and novel features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

Brief Description of the Drawings

[0026]

Fig. 1 is a perspective view of a first embodiment of a reversible ratcheting tool in accordance with the present invention.

Fig. 2 is an exploded perspective view of the re-

versible ratcheting tool in Fig. 1.

Fig. 3 is a top sectional view, in an enlarged scale, of an end portion of the reversible ratcheting tool in Fig. 1, wherein the ratcheting tool is a status allowing counterclockwise ratcheting.

Fig. 4 is a sectional view similar to Fig. 3, wherein the reversible ratcheting tool is in a status allowing free rotation.

Fig. 5 is a sectional view similar to Fig. 3, wherein the reversible ratcheting tool is in a status allowing clockwise ratcheting.

Fig. 6 is a sectional view taken along line 6-6 in Fig. 3.

Fig. 7 is a sectional view taken along line 7-7 in Fig. 3.

Fig. 8 is a sectional view taken along line 8-8 in Fig. 4.

Fig. 9 a perspective view of a second embodiment of the reversible ratcheting tool in accordance with the present invention.

Fig. 10 is an exploded perspective view of the reversible ratcheting tool in Fig. 9.

Fig. 11 is a sectional view, similar to Fig. 6, of an end portion of the reversible ratcheting tool in Fig. 9.

Fig. 12 is a perspective view of a third embodiment of the reversible ratcheting tool in accordance with the present invention.

Fig. 13 is an exploded perspective view of the reversible ratcheting tool in Fig. 12.

Fig. 14 is a sectional view, similar to Fig. 6, of an end portion of the reversible ratcheting tool in Fig. 12.

Fig. 15 is a perspective view of a fourth embodiment of the reversible ratcheting tool in accordance with the present invention.

Fig. 16 is an exploded perspective view of the reversible ratcheting tool in Fig. 15.

Fig. 17 is a sectional view, similar to Fig. 6, of an end portion of the reversible ratcheting tool in Fig. 15.

Fig. 18 is an exploded perspective view of a conventional ratcheting tool.

Fig. 19 is an exploded perspective view of another conventional ratcheting tool.

Fig. 20 is a sectional view of an end portion of the conventional ratcheting tool in Fig. 19.

Fig. 21 is an exploded perspective view of a fifth embodiment of the reversible ratcheting tool in accordance with the present invention.

Fig. 22A is a schematic view, in an enlarged scale, illustrating a pawl of the fifth embodiment of the reversible ratcheting tool in accordance with the present invention.

Fig. 22B is an enlarged perspective view illustrating a reversing plate of the fifth embodiment of the reversible ratcheting tool in accordance with the present invention.

Fig. 22C is an enlarged perspective view illustrating a ring of the fifth embodiment of the reversible ratcheting tool in accordance with the present invention.

Fig. 23 is a top sectional view, in an enlarged scale, of an end portion of the reversible ratcheting tool in Fig. 21, wherein the ratcheting tool is a status allowing free rotation.

Fig. 23A is a schematic view, in an enlarged scale, illustrating engagement between a gear wheel and the pawl of the reversible ratcheting tool in Fig. 21, wherein the ratcheting tool is a status allowing free rotation.

Fig. 24 is a sectional view similar to Fig. 23, wherein the reversible ratcheting tool is in a status allowing clockwise ratcheting.

Fig. 24A is a view similar to Fig. 23A, wherein the ratcheting tool is a status allowing clockwise ratcheting.

Fig. 25 is a sectional view similar to Fig. 23, wherein the reversible ratcheting tool is in a status allowing counterclockwise ratcheting.

Fig. 25A is a view similar to Fig. 23A, wherein the ratcheting tool is a status allowing counterclockwise ratcheting.

Fig. 26 is a sectional view taken along line 26-26 in Fig. 24.

Fig. 27 is a sectional view taken along line 27-27 in Fig. 24.

Fig. 28 is a schematic view illustrating engagement between a gear wheel and a pawl of another conventional ratcheting tool.

Fig. 29 is a view similar to Fig. 28, wherein a handle of the conventional ratcheting tool is rotated clockwise.

Fig. 30 is a view similar to Fig. 29, wherein the handle is further rotated clockwise.

Fig. 31 is an exploded perspective view illustrating a sixth embodiment of the ratcheting tool in accordance with the present invention.

Fig. 32 is a sectional view of the sixth embodiment of the ratcheting tool in accordance with the present invention.

Fig. 33 is an exploded perspective view illustrating a seventh embodiment of the ratcheting tool in accordance with the present invention.

Fig. 34 is a sectional view of the seventh embodiment of the ratcheting tool in accordance with the present invention.

Detailed Description of the Preferred Embodiments

[0027] Referring to Figs. 1 through 17 and initially to Figs. 1, 2, and 6, a first embodiment of a ratcheting tool in accordance with the present invention is designated

by 10 and has a handle 11 and a head 12 extended from the handle 11. The head 12 is substantially circular and has a minimized volume. The head 12 includes a compartment 13 consisting of a relatively larger first compartment section 131 and a relatively smaller second compartment section 132. A top face (not labeled) of the head 12 includes an opening 14 consisting of a circular opening section 141 that is concentric with the first compartment section 131 and a rectangular opening section 142. The top face of the head 12 further includes a hole 16 adjacent to the opening section 142. Defined in a lower end of the head 12 is a circular hole 15 that is concentric with the first compartment section 131 and has a diameter the same as that of the first compartment section 131. The lower end of the head 12 is formed with a ledge 18 (Fig. 6) that defines a portion of the second compartment section 132.

[0028] Rotatably mounted in the head 12 is a drive member 20 having an upper end 22, a drive column 23 on a lower end thereof, and a gear wheel 21 formed in an intermediate portion thereof. The gear wheel 21 is rotatably received in the first compartment 131 of the head 12 and includes teeth 211 formed on an outer periphery thereof. The upper end 22 of the drive member 20 includes an engaging groove 221, and an annular groove 222 is defined in a side of the gear wheel 21. The drive column 23 includes a hole 231 for receiving a ball 232. The drive member 20 further includes a central through-hole 24 with a shoulder portion 241, which will be described later.

[0029] Still referring to Figs. 1, 2, and 6, a pushpin 25 is mounted in the through-hole 24 of the drive member 20 and includes an enlarged upper end 251 for manual pressing. A lower end of the pushpin 25 includes a stepped groove 252 for receiving a portion of the ball 232 when the pushpin 25 is pushed, thereby allowing disengagement of the drive column 23 from a socket (not shown). An elastic member 253 is mounted around the pushpin 25 and attached between the shoulder portion 241 of the through-hole 241 and the enlarged end 251 of the pushpin 25. The elastic member 253 biases the pushpin 25 upward for moving the ball 232 outward to an engaging position for engaging with a socket, which is conventional and therefore not further described. The ball 232 in the engaging position is engaged with the stepped groove 252 to thereby prevent disengagement of the pushpin 25.

[0030] A pawl 30 is mounted in the second compartment section 132 and includes an arcuate surface 31' facing the gear wheel teeth 211. The arcuate surface 31' has a plurality of teeth (preferably more than ten teeth) for engaging with the gearwheel teeth 211, thereby providing reliable mesh therebetween. Thus, the pawl/gear wheel arrangement of the ratcheting tool of the invention may bear higher torque. The pawl 30 includes a recess 33 on a top thereof.

[0031] Still referring to Figs. 1, 2, and 6, a ring 40 is pivotally mounted around the upper end 22 of the drive member 20. A tip piece 41 projects outward from the ring 40 and is engaged in the recess 32 of the pawl 30 to move therewith. A notch 42 is defined in an inner periphery of the ring 40 and aligned with the annular groove 222 of the drive member 20.

[0032] A reversing plate 50 is mounted around the upper end 22 of the drive member 20 and includes a hole 51 and a thumb piece 52. As illustrated in Fig. 6, the enlarged head 251 of the pushpin 25 extends through the circular opening section 141 of the head 12 and beyond the hole 51 of the reversing plate 50 for manual operation. A positioning piece 511 projects radially inward from an inner periphery of the hole 51 of the reversing plate 50 in a portion adjacent to the thumb piece 52. The inner periphery of the hole 51 of the reversing plate 50 further includes a cavity 53 facing the positioning piece 511. A C-clip 53 is mounted around a portion of the engaging groove 221 of the upper end 22 of the drive member 20, thereby retaining the upper end 22 of the drive member 20 to the top face of the head 12. The C-clip 53 is partially accommodated in the cavity 512 of the ring 50. In addition, the positioning piece 511 is extended into the remaining portion of the engaging groove 221 of the drive member 20, Thus, the reversing plate 50 is pivotally mounted to the upper end 22 of the drive member 20. The thumb piece 52 of the reversing plate 50 further includes two through-holes 521 and 522. An arcuate groove 523 is defined in an underside of the thumb piece 52 and communicated with through-hole 521. The thumb piece 52 includes a receptacle 524 that is communicated with the arcuate groove 523.

[0033] A retaining means 60 is mounted in the receptacle 524 of the thumb piece 52 and includes a substantially U-shape slide piece 61 and an elastic member 62. The slide piece 61 includes a tapered push-face 611 consisting of two faces (not labeled) separated by a tip (not labeled, see Fig. 2). The elastic member 62 is received between two limbs (not labeled) of the U-shape slide piece 61. In practice, an end face of the receptacle 524 is pressed to form a configuration for preventing disengagement of the elastic member 62 from the receptacle 524 yet allowing movement of the slider piece 61 relative to the elastic member 62.

[0034] A pin 5211 is inserted through the through-hole 521 of the thumb piece 52 with a lower end of the pin 5211 extended through the arcuate groove 523 and into the hole 16 of the head 12. Thus, the pin 5211 is retained in the hole 16. As a result, the arcuate groove 523 is movable relative to the pin 5211 during pivotal movement of the reversing plate 50. The push-face 611 of the slide piece 61 may retain the pin 5211 in place. In addition, as the pin 5211 is retained in place and the positioning piece 511 of the reversing plate 50 is engaged in the engaging groove 221 of the drive member 20, the reversing plate 50 is securely yet pivotally engaged with the upper end 22 of the drive member 20.

[0035] A transmission member 70 is provided to convert manual pivotal movement of the reversing plate 50

into pivotal movement of the pawl 30 about rotational axis of the gear wheel 21. In this embodiment, the transmission member 70 is in the form of a spring having a relatively small pitch. The transmission member 70 is extended in the through-hole 522 of the reversing plate 50, the rectangular opening section 142 of the head 12 of the handle 10, and the notch 42 of the ring 40 and then into the annular groove 222 of the drive member 20.

[0036] When the reversing plate 50 is in a position shown in Fig. 3, a face (upper one in Fig. 3) of the push-face 611 of the slide piece 61 bears against the pin 5211 under the action of the elastic member 62. The other side of the pawl 30 facing away from the teeth 31 bears against a wall portion defining the second compartment section 132. Thus, the teeth 31 of the pawl 30 is forced to engage with the teeth 211 of the gear wheel 21 of the drive member 20, best shown in Fig. 6. The ratcheting tool is now in a status for driving a socket (not shown) or the like counterclockwise. The handle of the ratcheting tool may be moved clockwise without disengaging the drive member 20 from the socket. Thus, the ratcheting tool may be used in a relatively small space, as the head 12 of the ratcheting tool is relatively small due to provision of the concentric design of the gear wheel 21 and the reversing plate 50. As illustrated in Fig. 7, the through-hole 522 of the thumb piece 52 is slightly offset from the notch 42 of the ring 40. The transmission member 70 is thus in a zigzag status to provide excellent resiliency in the transverse direction for providing the required transmission.

[0037] When the reversing plate 50 is moved to a position shown in Fig. 4, the tip of the push-face 611 of the slide piece 61 bears against the pin 521 under the action of the elastic member 62. The ring 40 is also pivoted via transmission of the transmission member 70. The pawl 30 is moved away from the gear wheel 21, as the tip piece 41 of the ring 40 is engaged in the recess 32 on top face of the pawl 30. Thus, the pawl 30 is moved to a middle portion of the second compartment section 132 and thus disengaged from the teeth 211 of the gear wheel 21, as shown in Fig. 8. As a result, the ratcheting tool is incapable of driving the socket.

[0038] When the reversing plate 50 is moved to a position shown in Fig. 5 by manually pushing the thumb piece 52, the slide piece 61 is moved away from the gear wheel 20 and compresses the elastic member 62. Thus, the pin 5211 may slide over the push-face 611 of the slide piece 61 to the other face of the push-face 611. The other side of the pawl 30 facing away from the teeth 31 bears against another portion defining the second compartment section 132. Thus, the teeth 31 of the pawl 30 are forced to reengage with the teeth 211 of the gear wheel 21 of the drive member 20 (see Fig. 6). The ratcheting tool is now in a status for driving the socket clockwise. It is appreciated that the pawl 30 is pivoted during pivotal movement of the thumb piece 52 via transmission of the transmission member 70 and the ring 40 that engages with the pawl 30.

[0039] It is appreciated that the pawl 30 engages with the gear wheel 21 by at least ten (10) teeth and thus may bear higher torque during ratcheting. It is noted that the push-face 611 of the slide piece 61, under the action of the elastic member 62, retains the ring 40 as well as the pawl 30 in place to provide reliable ratcheting. Yet, the tip piece 41 of the ring 40 and the recess 32 of the pawl 30 are configured to allow the pawl 30 to be moved away from the gear wheel 21 in a radial direction during non-driving rotation of the handle. Accordingly, the user must apply a relatively larger force to switch the reversing plate 50, yet this also prevents inadvertent impingement to the thumb piece 52 that may cause undesired movement of the pawl 30.

[0040] Figs. 9 through 11 illustrate a modified embodiment of the ratcheting tool in accordance with the present invention, in which the transmission member 70 is arranged in a different location. In this embodiment, the rectangular opening section 142' is near peripheral edge of the head 12. The notch 42' of the ring 40 is defined in an outer periphery of the ring 40. The through-hole 522' of the reversing plate 50 is located opposite to the other through-hole 521. The transmission member 70 is extended through the through-hole 522', the rectangular opening section 142', and the notch 42' and into the annular groove 222 of the drive member 20 to provide a transmission medium between the reversing plate 50 and the reversing plate 30. The C-clip 53' has a rectilinear face 531'for not interfering with movement of the transmission member 70.

[0041] Figs. 12 through 14 illustrate another modified embodiment of the ratcheting tool in accordance with the present invention. In this embodiment, a periphery defining the hole 51 of the reversing plate 50 has a recessed portion 51' in an upper side thereof for mounting the C-clip 53. Namely, the C-clip 53 in this embodiment is mounted on top of the reversing plate 50 rather than the underside of the reversing plate 50 in the above two embodiments.

[0042] Figs. 15 through 17 illustrate a further modified embodiment of the ratcheting tool in accordance with the present invention modified from the embodiment illustrated in Figs. 12 through 14. In this embodiment, the recessed portion (now designated by 51") of the reversing plate 50 has a protrusion 513". In addition, the C-Clip (now designated by 53") has a bulge 532" with a cavity (not labeled) for receiving the protrusion 513", thereby providing secure engagement between the C-clip 53" and the reversing plate 50. The transmission member 70 is also arranged in a location similar to that disclosed in the embodiment illustrated in Figs. 9 through 11. Namely, the rectangular opening section 142' is near peripheral edge of the head 12. The notch 42' of the ring 40 is defined in an outer periphery of the ring 40. The through-hole 522" of the reversing plate 50 is defined in the protrusion 513". The transmission member 70 is extended through the through-hole 522", the rectangular opening section 142', and the notch 42' and

into the annular groove 222 of the drive member 20 to provide a transmission medium between the reversing plate 50 and the reversing plate 30.

[0043] According to the above description, it is appreciated that the ratcheting tool in accordance with the present invention may bear much higher torque and has minimized head size that is very useful when operating in a limited space. In addition, the ratcheting direction can be changed by easy operation of the reversing plate. The arrangement for achieving the ratcheting direction switching is simple yet requires a relatively larger force to prevent inadvertent switching.

[0044] Referring to Figs. 21 and 26, a fifth embodiment of the ratcheting tool in accordance with the present invention is designated by 10 and has a handle 11 and a head 12 extended from the handle 11. The head 12 is substantially circular and has a minimized volume. The head 12 includes a compartment 13 consisting of a relatively larger first compartment section 131 and a relatively smaller second compartment section 132. A top face (not labeled) of the head 12 includes an opening 14 consisting of a circular opening section 141 that is concentric with the first compartment section 131 and a rectangular opening section 142. The top face of the head 12 further includes a hole 16 adjacent to the opening section 142. Defined in a lower end of the head 12 is a circular hole 15 that is concentric with the first compartment section 131 and has a diameter the same as that of the first compartment section 131. The lower end of the head 12 is formed with a ledge 18 (Fig. 26) that defines a portion of the second compartment section 132.

[0045] Rotatably mounted in the head 12 is a drive member 20 having an upper end 22, a drive column 23 on a lower end thereof, and a gear wheel 21 formed in an intermediate portion thereof. The gear wheel 21 is rotatably received in the first compartment 131 of the head 12 and includes teeth 211 formed on an outer periphery thereof. The upper end 22 of the drive member 20 includes an engaging groove 221, and an annular groove 222 is defined in a side of the gear wheel 21. The drive column 23 includes a hole 231 for receiving a ball 232. The drive member 20 further includes a central through-hole 24 with a shoulder portion 241, which will be described later.

[0046] Still referring to Figs. 22 and 26, a pushpin 25 is mounted in the through-hole 24 of the drive member 20 and includes an enlarged upper end 251 for manual pressing. A lower end of the pushpin 25 includes a stepped groove 252 for receiving a portion of the ball 232 when the pushpin 25 is pushed, thereby allowing disengagement of the drive column 23 from a socket (not shown). An elastic member 253 is mounted around the pushpin 25 and attached between the shoulder portion 241 of the through-hole 241 and the enlarged end 251 of the pushpin 25. The elastic member 253 biases the pushpin 25 upward for moving the ball 232 outward to an engaging position for engaging with a socket, which is conventional and therefore not further described. The ball 232 in the engaging position is engaged with the stepped groove 252 to thereby prevent disengagement of the pushpin 25.

[0047] A pawl 30 is mounted in the second compartment section 132 and includes a side facing the gear wheel teeth 211. Referring to Fig. 22A, the side of the pawl 30 has a plurality of teeth (ten teeth in this embodiment) for engaging with the gear wheel teeth 211, thereby providing reliable mesh therebetween. The pawl 30 includes a recess 33 on a top thereof. Of more importance, as illustrated in Fig. 22A, the teeth on the side of the pawl 30 includes a first teeth portion 31 having a center of curvature at "E" and a second teeth portion 32 having a center of curvature at "F". Namely, the centers of curvatures for the teeth portions 31 and 32 are located at different positions "E" and "F", the purpose of which will be described later. The first teeth portion 31 and the second teeth portion 32 may be arranged in a continuous or uncontinuous manner.

[0048] Still referring to Figs. 22 and 26, a ring 40 is pivotally mounted around the upper end 22 of the drive member 20. As illustrated in Fig. 22C, a tip piece 41 projects outward from the ring 40 and is engaged in the recess 33 of the pawl 30 to move therewith. A notch 42 is defined in an inner periphery of the ring 40 and aligned with the annular groove 222 of the drive member 20. The notch 42 of the ring 40 further includes an enlarged section 43, which will be described later.

[0049] A reversing plate 50 is mounted around the upper end 22 of the drive member 20 and includes a hole 51 and a thumb piece 52. As illustrated in Fig. 26, the enlarged head 251 of the pushpin 25 extends through the circular opening section 141 of the head 12 and beyond the hole 51 of the reversing plate 50 for manual operation. Referring to Fig. 22B, a positioning piece 511 projects radially inward from an inner periphery of the hole 51 of the reversing plate 50 in a portion adjacent to the thumb piece 52. The inner periphery of the hole 51 of the reversing plate 50 further includes a cavity 53 facing the positioning piece 511. A C-clip 53 is mounted around a portion of the engaging groove 221 of the upper end 22 of the drive member 20, thereby retaining the upper end 22 of the drive member 20 to the top face of the head 12. The C-clip 53 is partially accommodated in the cavity 512 of the ring 50. In addition, the positioning piece 511 is extended into the remaining portion of the engaging groove 221 of the drive member 20, Thus, the reversing plate 50 is pivotally mounted to the upper end 22 of the drive member 20. The thumb piece 52 of the reversing plate 50 further includes two through-holes 521 and 522. An arcuate groove 523 is defined in an underside of the thumb piece 52 and communicated with through-hole 521. The thumb piece 52 includes a receptacle 524 that is communicated with the arcuate groove 523. A retainer block 54 is formed on a bottom of the reversing plate 50 and projects downward from a position between the through-hole 522 and the hole 51.

The retainer block 54 includes a lower end 541 that is pivotally movable in the enlarged section 43 of the ring 40, which will be described later.

[0050] A retaining means 60 is mounted in the receptacle 524 of the thumb piece 52 and includes a substantially U-shape slide piece 61 and an elastic member 62. The slide piece 61 includes a tapered push-face 611 consisting of two faces (not labeled) separated by a tip (not labeled, see Fig. 22). The elastic member 62 is received between two limbs (not labeled) of the U-shape slide piece 61. In practice, an end face of the receptacle 524 is pressed to form a configuration for preventing disengagement of the elastic member 62 from the receptacle 524 yet allowing movement of the slider piece 61 relative to the elastic member 62.

[0051] A pin 5211 is inserted through the through-hole 521 of the thumb piece 52 with a lower end of the pin 5211 extended through the arcuate groove 523 and into the hole 16 of the head 12. Thus, the pin 5211 is retained in the hole 16. As a result, the arcuate groove 523 is movable relative to the pin 5211 during pivotal movement of the reversing plate 50. The push-face 611 of the slide piece 61 may retain the pin 5211 in place. In addition, as the pin 5211 is retained place and the positioning piece 511 of the reversing plate 50 is engaged in the engaging groove 221 of the drive member 20, the reversing plate 50 is securely yet pivotally engaged with the upper end 22 of the drive member 20.

[0052] A transmission member 70 is provided to convert manual pivotal movement of the reversing plate 50 into pivotal movement of the pawl 30 about rotational axis of the gear wheel 21. In this embodiment, the transmission member 70 is in the form of a spring having a relatively small pitch. The transmission member 70 is extended in the through-hole 522 of the reversing plate 50, the rectangular opening section 142 of the head 12 of the handle 10, and the notch 42 of the ring 40 and then into the annular groove 222 of the drive member 20.

[0053] When the reversing plate 50 is in a position shown in Fig. 24, a face (upper one in Fig. 24) of the push-face 611 of the slide piece 61 bears against the pin 5211 under the action of the elastic member 62. The other side of the pawl 30 facing away from the teeth 31 bears against a wall portion defining the second compartment section 132. Thus, the teeth 31 of the pawl 30 is forced to engage with the teeth 211 of the gear wheel 21 of the drive member 20, best shown in Fig. 26. The ratcheting tool is now in a status for driving a socket (not shown) or the like clockwise. The handle of the ratcheting tool may be moved counterclockwise without disengaging the drive member 20 from the socket. Thus, the ratcheting tool may be used in a relatively small space, as the head 12 of the ratcheting tool is relatively small due to provision of the concentric design of the gear wheel 21 and the reversing plate 50. As illustrated in Fig. 27, the through-hole 522 of the thumb piece 52 is slightly offset from the notch 42 of the ring 40. The transmission member 70 is thus in a zigzag status to provide excellent resiliency in the transverse direction for providing the required transmission.

[0054] Referring to Fig. 24A, the pawl 30 bears against a point "G" of a left wall portion defining the second compartment section 132. It is noted that the center of curvature E of the first teeth portion 31 of the pawl 30 is coincident with a center of the gear wheel 21. Thus, all teeth of the first teeth portion 31 are completely engaged with the gear wheel teeth 211 and the second teeth portion 32 is disengaged from the gear wheel teeth 211, as the center of curvature F of the second teeth portion 32 of the pawl 30 locates at a different location. When the handle 11 of the ratcheting tool 10 is rotated clockwise, no force is applied to the second teeth portion 32 of the pawl 30 and there is no reactive force accordingly. Thus, it is the first teeth portion 31 of the pawl 30 that reliably engage with the gear wheel teeth 211 during the clockwise rotation of the handle 11, thereby providing reliable high-torque operation. It is noted that force transmitted from the gear wheel 21 is uniformly distributed to all of the teeth of the first teeth portion 31. The total number of pawl teeth actually and reliably engaged with the gear wheel in accordance with the present invention is greater than that in conventional design.

[0055] When the reversing plate 50 is moved to a position shown in Fig. 23, the tip of the push-face 611 of the slide piece 61 bears against the pin 521 under the action of the elastic member 62. The ring 40 is also pivoted via transmission of the transmission member 70. The pawl 30 is moved away from the gear wheel 21, as the tip piece 41 of the ring 40 is engaged in the recess 33 on top face of the pawl 30. Thus, the pawl 30 is moved to a middle portion of the second compartment section 132 and thus disengaged from the teeth 211 of the gear wheel 21. As a result, the ratcheting tool is incapable of driving the socket. Referring to Fig. 23A, only one or two of each pawl teeth portion 31, 32 are engaged with the gear wheel teeth 211, the remaining pawl teeth are disengaged from the gear wheel teeth 211.

[0056] When the reversing plate 50 is moved to a position shown in Fig. 25 by manually pushing the thumb piece 52, the slide piece 61 is moved away from the gear wheel 20 and compresses the elastic member 62. Thus, the pin 5211 may slide over the push-face 611 of the slide piece 61 to the other face of the push-face 611. The other side of the pawl 30 facing away from the teeth 31 and 32 bears against another portion defining the second compartment section 132. Thus, the teeth of the pawl 30 are forced to reengage with the teeth 211 of the gear wheel 21 of the drive member 20 (see Fig. 26). The ratcheting tool is now in a status for driving the socket counterclockwise. It is appreciated that the pawl 30 is pivoted during pivotal movement of the thumb piece 52 via transmission of the transmission member 70 and the ring 40 that engages with the pawl 30.

[0057] Referring to Fig. 25A, the pawl 30 bears against a point "H" of a right wall portion defining the second compartment section 132. Now the center of

curvature F of the second teeth portion 32 of the pawl 30 is coincident with the center of the gear wheel 21. Thus, all teeth of the second teeth portion 32 are completely engaged with the gear wheel teeth 211 and the first teeth portion 31 is disengaged from the gear wheel teeth 211, as the center of curvature E of the first teeth portion 31 of the pawl 30 locates at a different location. When the handle 11 of the ratcheting tool 10 is rotated counterclockwise, no force is applied to the first teeth portion 31 of the pawl 30 and there is no reactive force accordingly. Thus, it is the second teeth portion 32 of the pawl 30 that reliably engage with the gear wheel teeth 211 during the clockwise rotation of the handle 11, thereby providing reliable high-torque operation. It is noted that force transmitted from the gear wheel 21 is uniformly distributed to all of the teeth of the second teeth portion 32. The total number of pawl teeth actually and reliably engaged with the gear wheel in accordance with the present invention is greater than that in conventional design.

[0058] Referring to Fig. 26, it is noted that the retainer block 54 of the reversing plate 50 is in contact with a portion of the transmission member 70 to prevent disengagement and over-distortion of the transmission member 70. The lower portion 541 of the retainer block 54 is pivotally received in the enlarged section 43 of the notch 42 such that the retainer block 54 can be pivoted when the reversing plate 50 is pivoted.

[0059] It is appreciated that the pawl 30 engages with the gear wheel 21 by at least ten (10) teeth and thus may bear higher torque during ratcheting. It is noted that the push-face 611 of the slide piece 61, under the action of the elastic member 62, retains the ring 40 as well as the pawl 30 in place to provide reliable ratcheting. Yet, the tip piece 41 of the ring 40 and the recess 33 of the pawl 30 are configured to allow the pawl 30 to be moved away from the gear wheel 21 in a radial direction during non-driving rotation of the handle. Accordingly, the user must apply a relatively larger force to switch the reversing plate 50, yet this also prevents inadvertent impingement to the thumb piece 52 that may cause undesired movement of the pawl 30.

[0060] Figs. 31 and 32 illustrate a sixth embodiment of the ratcheting tool in accordance with the present invention that is modified from the first embodiment shown in Figs. 1 through 8. More particularly, the transmission member 70, the rectangular opening section 142 of the head 12 of the handle 10, and the ring 40 have been omitted. Instead, a through-hole 17 is defined in the head 12 and adjacent to the hole 16. In addition, the reversing plate 50 has an engaging member 54 projected therefrom and extended through the through-hole 17 into the recess 33 of the pawl 30. Thus, when the reversing plate 50 is manually moved, the pawl 30 is moved to thereby change the ratcheting direction of the ratcheting tool.

[0061] Figs. 33 and 34 illustrate a seventh embodiment of the ratcheting tool in accordance with the present invention that is modified from the first embodiment shown in Figs. 1 through 8. More particularly, the transmission member 70 has been omitted. Instead, the reversing plate 50 has an engaging member 54 projected therefrom and extended through the rectangular opening section 142 of the head 12 of the handle 10 and engaged with the notch 42 of the ring 40. Thus, when the reversing plate 50 is manually moved, the pawl 30 is moved to thereby change the ratcheting direction of the ratcheting tool.

[0062] According to the above description, it is appreciated that the ratcheting tool in accordance with the present invention may bear much higher torque and has minimized head size that is very useful when operating in a limited space. In addition, the ratcheting direction can be changed by easy operation of the reversing plate. The arrangement for achieving the ratcheting direction switching is simple yet requires a relatively larger force to prevent inadvertent switching. Of more importance, the total number of pawl teeth actually and reliably engaged with the gear wheel in accordance with the present invention during ratcheting is greater than that in conventional design, and such advantage thanks to the novel design in the first and second teeth portions 31 and 32 of the pawl 30.

[0063] Although the invention has been explained in relation to its preferred embodiment, it is to be understood that many other possible modifications and variations can be made without departing from the scope of the invention as hereinafter claimed.

Claims

1. A ratcheting tool comprising:

a handle (11);
a head (12) extended from the handle (11) and having a compartment (13) therein;
a drive member (20) including a first end (22), a second end, and a gear wheel (21) formed between the first end and the second end, the gear wheel being rotatably mounted in the compartment and including an outer periphery with a plurality of first teeth (211);
a pawl (30) mounted in the compartment (13) and including a first side with a plurality of second teeth facing the first teeth of the gear wheel and a second side facing away from the gear wheel;
a reversing plate (50) mounted to the first end (22) of the drive member and pivotable about the rotational axis of the gear wheel (21) between a first position and a second position, the reversing plate (50) being operably connected to the pawl (30) for moving the pawl between a first ratcheting position and a second ratcheting position, wherein the second teeth of the pawl

is engaged with the first teeth of the gear wheel for ratcheting in a first direction when the pawl is in the first ratcheting position, and wherein the second teeth of the pawl is engaged with the first teeth of the gear wheel for ratcheting in a second direction opposite to the first ratcheting direction when the pawl is in the second ratcheting position; and
means (60) for retaining the reversing plate in one of the first position and the second position.

2. A ratcheting tool comprising:

a handle (11);
a head (12) extended from the handle (11) and having a compartment (13) therein;
a drive member (20) including a first end (22) extended beyond the compartment, a second end extended beyond the compartment, and a gear wheel (21) formed between the first end and the second end, the gear wheel being rotatably mounted in the compartment and including an outer periphery with a plurality of first teeth (211);
a pawl (30) mounted in the compartment (13) and including a first side with a plurality of second teeth facing the first teeth of the gear wheel and a second side facing away from the gear wheel;
a ring (40) mounted in the compartment (13) and around the first end (22) of the drive member (20), the ring being operably connected to the pawl (30) such that the ring and the pawl are pivotable about a rotational axis of the gear wheel and that the pawl is movable in a radial direction relative to the ring;
a reversing plate (50) mounted to the first end (22) of the drive member (20) and pivotable about the rotational axis of the gear wheel between a first position and a second position, the reversing plate (50) being operably connected to the ring (40) for moving the pawl between a first ratcheting position and a second ratcheting position, wherein the second teeth of the pawl is engaged with the first teeth of the gear wheel for ratcheting in a first direction when the pawl is in the first ratcheting position, and wherein the second teeth of the pawl is engaged with the first teeth of the gear wheel for ratcheting in a second direction opposite to the first ratcheting direction when the pawl is in the second ratcheting position; and
means (60) for retaining the reversing plate in position.

3. A ratcheting tool comprising:

a handle (11);
a head (12) extended from the handle (11) and having a compartment (13) therein;
a drive member (20) including a first end (22), a second end, and a gear wheel (21) formed between the first end and the second end, the gear wheel being rotatably mounted in the compartment and including an outer periphery with a plurality of first teeth;
a pawl (30) mounted in the compartment (13) and including a first side with a plurality of second teeth facing the first teeth of the gear wheel and a second side facing away the gear wheel, the second teeth of the pawl including a first teeth portion (31) having a first center (E) of curvature and a second teeth portion (32) having a second center (F) of curvature located at a position different from the first center (E) of the curvature;
a reversing plate (50) mounted to the first end (22) of the drive member and pivotable about the rotational axis of the gear wheel between a first position and a second position, the reversing plate (50) being operably connected to the pawl (30) for moving the pawl between a first ratcheting position and a second ratcheting position, wherein the second teeth of the pawl is engaged with the first teeth of the gear wheel for ratcheting in a first direction when the pawl is in the first ratcheting position, and wherein the second teeth of the pawl is engaged with the first teeth of the gear wheel for ratcheting in a second direction opposite to the first ratcheting direction when the pawl is in the second ratcheting position; and
means (60) for retaining the reversing plate in position.

4. The ratcheting tool as claimed in claim 1, 2, or 3, wherein further comprising means (70) for providing transmission between the reversing plate (50) and the pawl (30) for moving the pawl between the first ratcheting position and the second ratcheting position.

5. The ratcheting tool as claimed in claim 1, 3, or 4, further comprising a ring (40) mounted in the compartment (13) and around the first end (22) of the drive member (20), the ring being operably connected to the pawl (30) such that the ring and the pawl are pivotable about a rotational axis of the gear wheel and that the pawl is movable in a radial direction relative to the ring.

6. The ratcheting tool as claimed in claim 1, 2, 3, 4, or 5, wherein the head further includes a top face with an opening (14), and the first end (22) of the drive member (20) is extended beyond the opening.

7. The ratcheting tool as claimed in claim 1, 2, 3, 4, or 5, wherein the second end of the drive member is a drive column (23) for releasably engaging with a socket.

8. The ratcheting tool as claimed in claim 5, wherein the pawl (30) has a recess (33) in a top thereof and the ring (40) has a tip piece (41) engaged in the recess of the pawl in a manner that the ring and the pawl are pivotable about the rotational axis of the gear wheel and that the pawl is movable in the radial direction relative to the ring without disengaging from the ring.

9. The ratcheting tool as claimed in claim 1, 2, 3, 4, or 5, wherein the reversing plate (50) includes a hole (51) so as to be pivotally mounted around the first end (22) of the drive member (20).

10. The ratcheting tool as claimed in claim 9, wherein the first end (22) of the drive member (20) includes an engaging groove (221), further comprising a C-clip (53) engaged in the engaging groove for retaining the drive member in place, and a positioning piece (511) projecting radially inward from an inner periphery of the hole (51) of the reversing plate (50) and being engaged in the engaging groove (221) for positioning the reversing plate (50).

11. The ratcheting tool as claimed in claim 1, 2, 3, 4, 5, or 8, wherein the reversing plate (50) has a thumb piece (52) projected therefrom for manual operation.

12. The ratchet tool as claimed in claim 11, wherein the thumb piece (52) of the reversing plate includes a receptacle (524), the reversing plate including an arcuate groove (523) communicated with the receptacle, a pin (5211) being securely mounted in the arcuate groove in a manner allowing pivotable movement of the reversing plate about the rotating axis of the gear wheel.

13. The ratchet tool as claimed in claim 11, wherein the retaining means (60) includes a U-shape slide piece (61) with two limbs and an elastic member (62) mounted between the limbs of the slide piece, the slide piece (61) including a tapered push-face (611) consisting of two faces separated by a tip, the push-face (611) of the slide piece being extended into the arcuate groove (523) of the reversing plate (50), wherein one of the faces bears against the pin (5211) when the reversing plate is in its first position to thereby retain the pawl in its first ratcheting position, and wherein the other face of the slide piece bears against the pin (5211) when the reversing plate in its second position to thereby retain the pawl in its second ratcheting position, the slide piece (61) being slidable relative to the elastic member (62) and biased toward the pin by the elastic member.

14. The ratchet tool as claimed in claim 13, wherein the reversing plate (50) includes a through-hole (522), the head including a top face with a hole (16), the ring (40) including a notch (42), the gear wheel (21) of the drive member (20) including an annular groove (222), the means for providing transmission between the reversing plate (50) and the pawl (30) including a spring (70) having a small pitch, the spring being extended through the through-hole (522) of the reversing plate (50), the hole (16) in the top face of the head (12), and the notch (42) in the ring (40) and retained in the annular groove (222) of the drive member (20).

15. The ratcheting tool as claimed in claim 12, wherein the notch (42) of the ring (40) is defined in an inner periphery of the ring.

16. The ratcheting tool as claimed in claim 15, wherein the notch (42) includes an enlarged section (43), and wherein the reversing plate (50) includes a retainer block (54) having a portion (541) pivotally movable in the enlarged section (43) of the notch of the ring, the retainer block (54) being in contact with a portion of the transmitting means (70) for preventing over-distortion of the transmitting means.

17. The ratcheting tool as claimed in claim 12, wherein the notch (42) of the ring (40) is defined in an outer periphery of the ring.

18. The ratcheting tool as claimed in claim 10, wherein the reversing plate (50) has a recessed portion (51') in an upper side thereof for receiving the C-clip (53).

19. The ratcheting tool as claimed in claim 18, wherein the recessed portion (51") of the reversing plate (50) has a protrusion (513") and the C-clip (53) has a bulge (532") with a cavity for engaging with the protrusion (513").

20. The ratcheting tool as claimed in claim 3, wherein the first center (E) of curvature of the pawl (30) is coincident with a center of the gear wheel (21) when the pawl is in the first ratcheting position.

21. The ratcheting tool as claimed in claim 3, wherein the second center (F) of curvature of the pawl (30) is coincident with a center of the gear wheel (21) when the pawl is in the second ratcheting position.

22. The ratcheting tool as claimed in claim 3, wherein the first teeth portion (31) and the second teeth portion (32) of the pawl are arranged in a continuous manner.

23. The ratcheting tool as claimed in claim 3, wherein the first teeth portion (31) and the second teeth portion (32) of the pawl are arranged in an uncontinuous manner.

24. The ratcheting tool as claimed in claim 1 or 3, wherein the pawl (30) includes a recess (33) in a top thereof and the reversing plate (50) includes an engaging member (54) that is engaged in the recess (33) of the pawl for driving the pawl upon manual rotational movement of the reversing plate.

25. The ratcheting tool as claimed in claim 5, wherein the ring (40) includes a notch (42) and the reversing plate (50) includes an engaging member (54) that is engaged in the notch (42) of the ring for driving the pawl upon manual rotational movement of the reversing plate.

26. A pawl for a reversible ratcheting tool, the pawl comprising a side with a plurality of teeth, the teeth of the pawl including a first teeth portion (31) having a first center (E) of curvature and a second teeth portion (32) having a second center (F) of curvature located at a position different from the first center of the curvature.

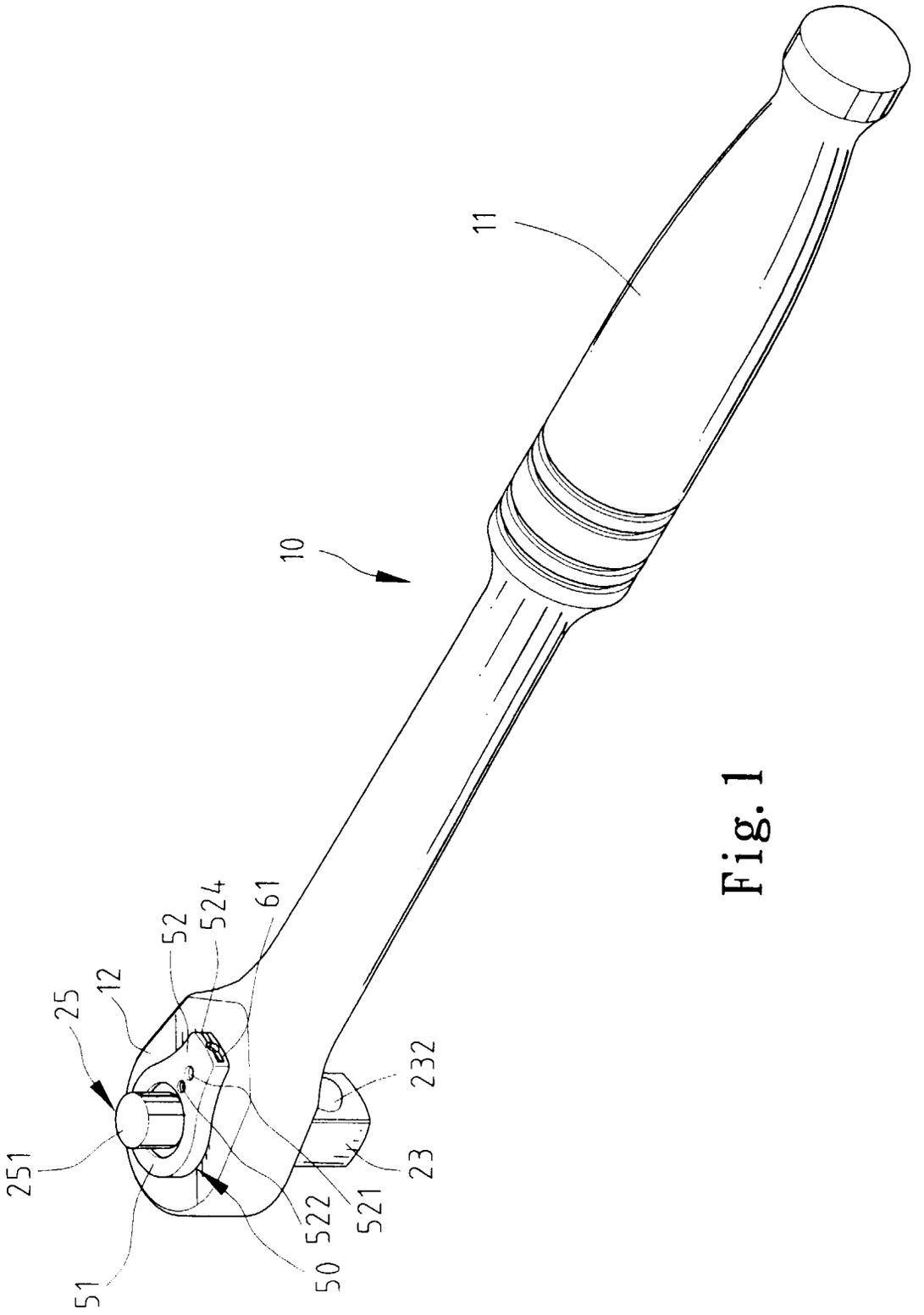
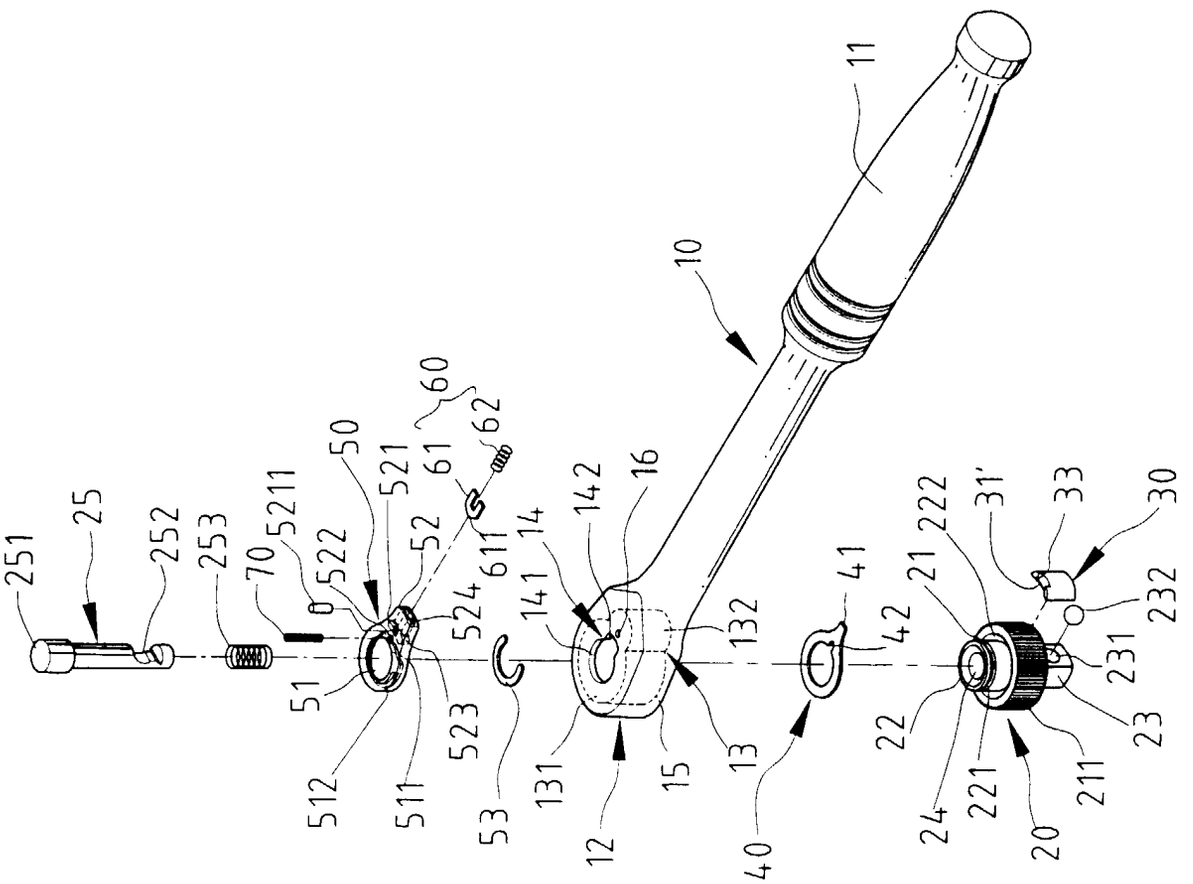


Fig. 1

Fig. 2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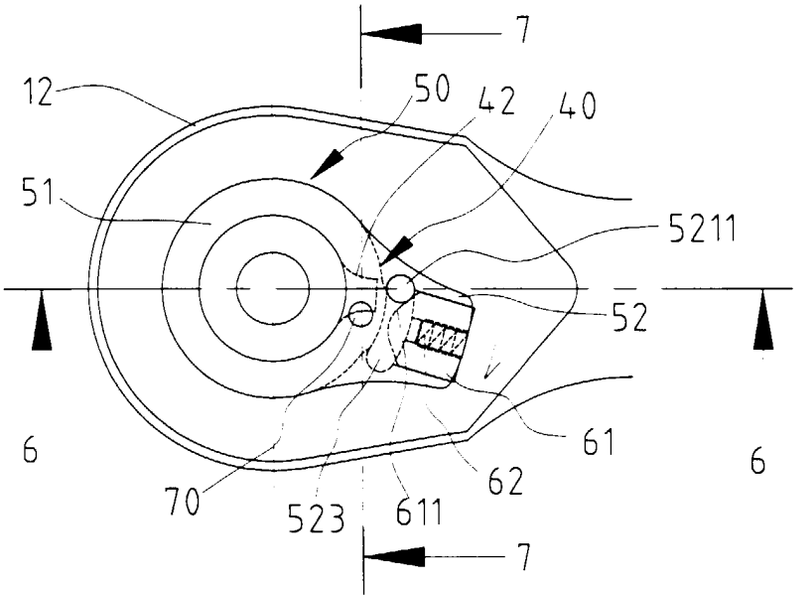


Fig. 3

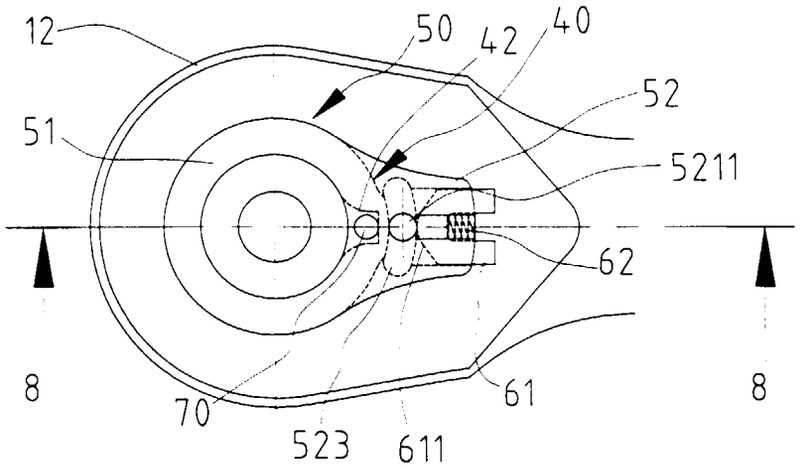
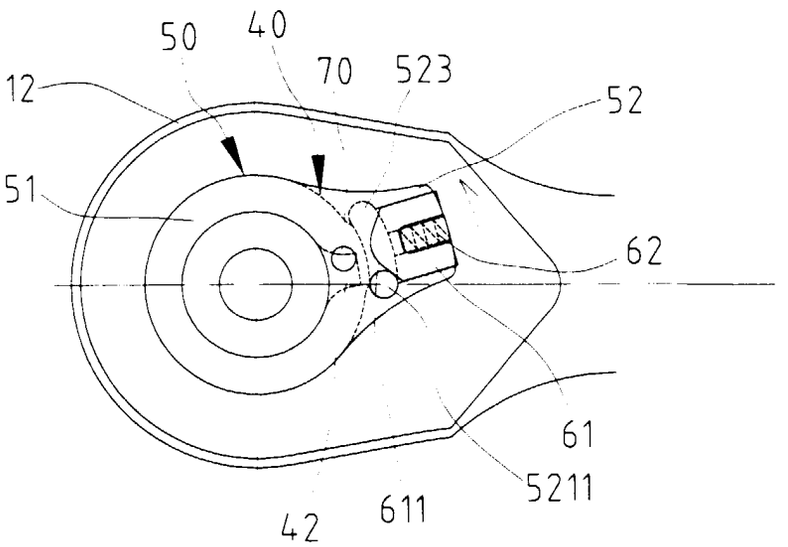


Fig. 4



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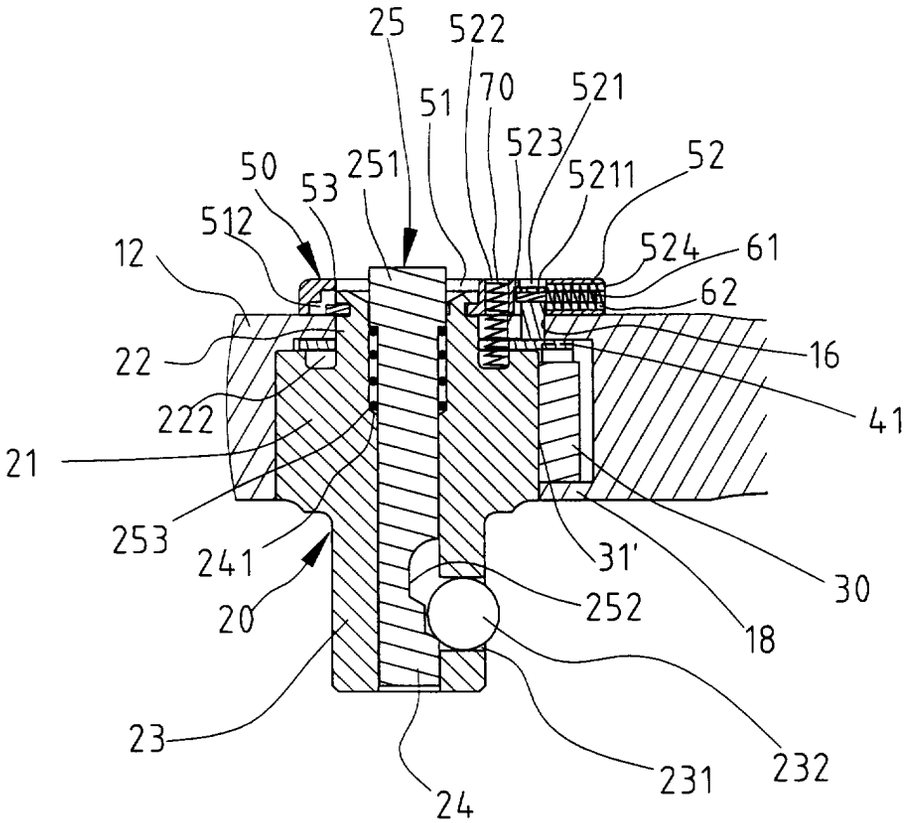
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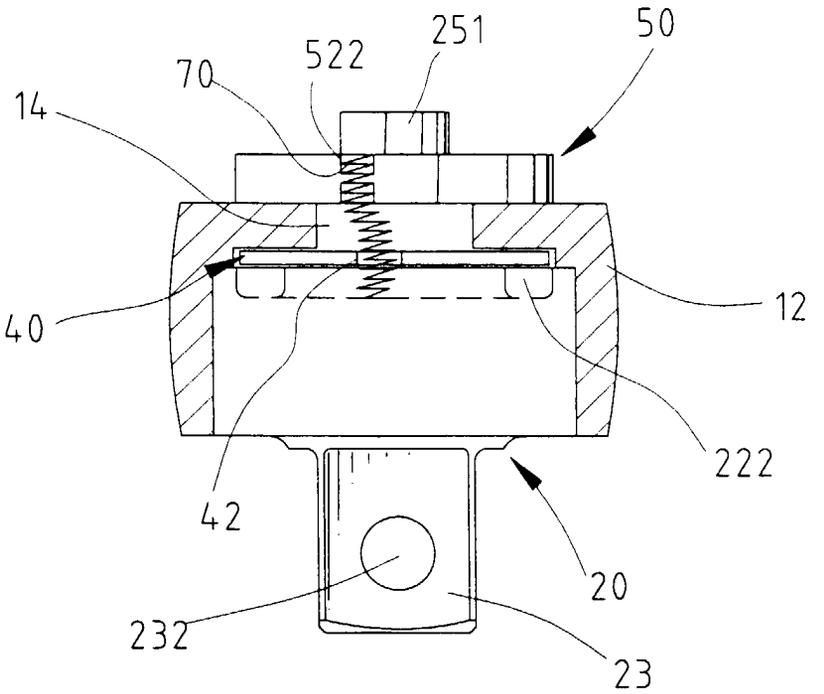
Fig. 6



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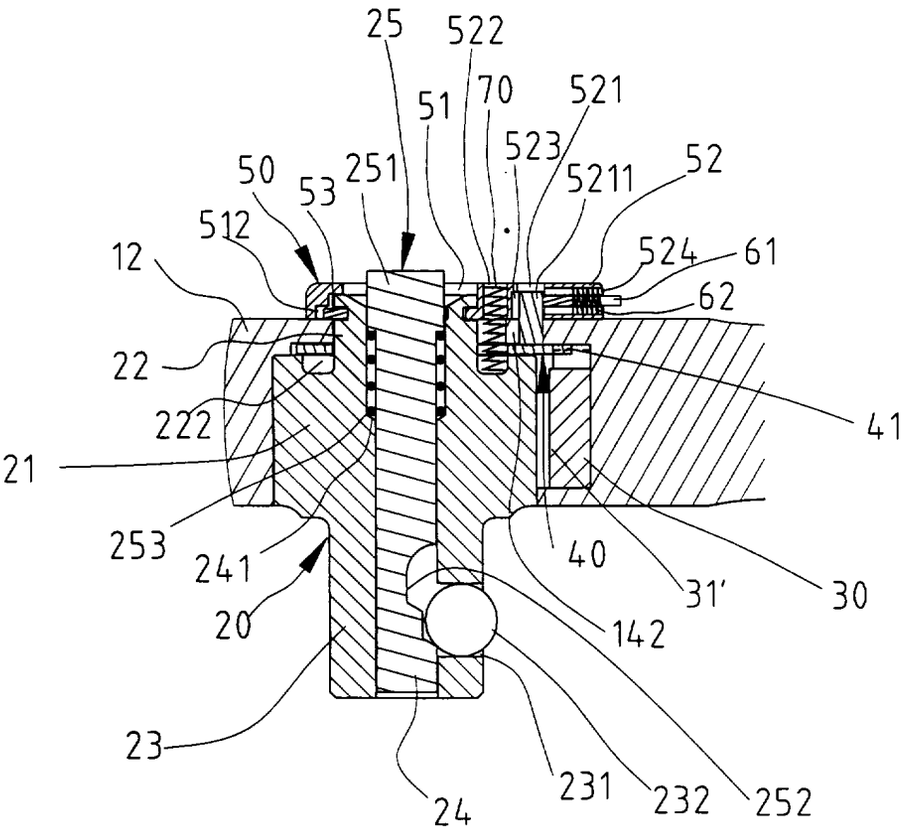
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Fig. 8

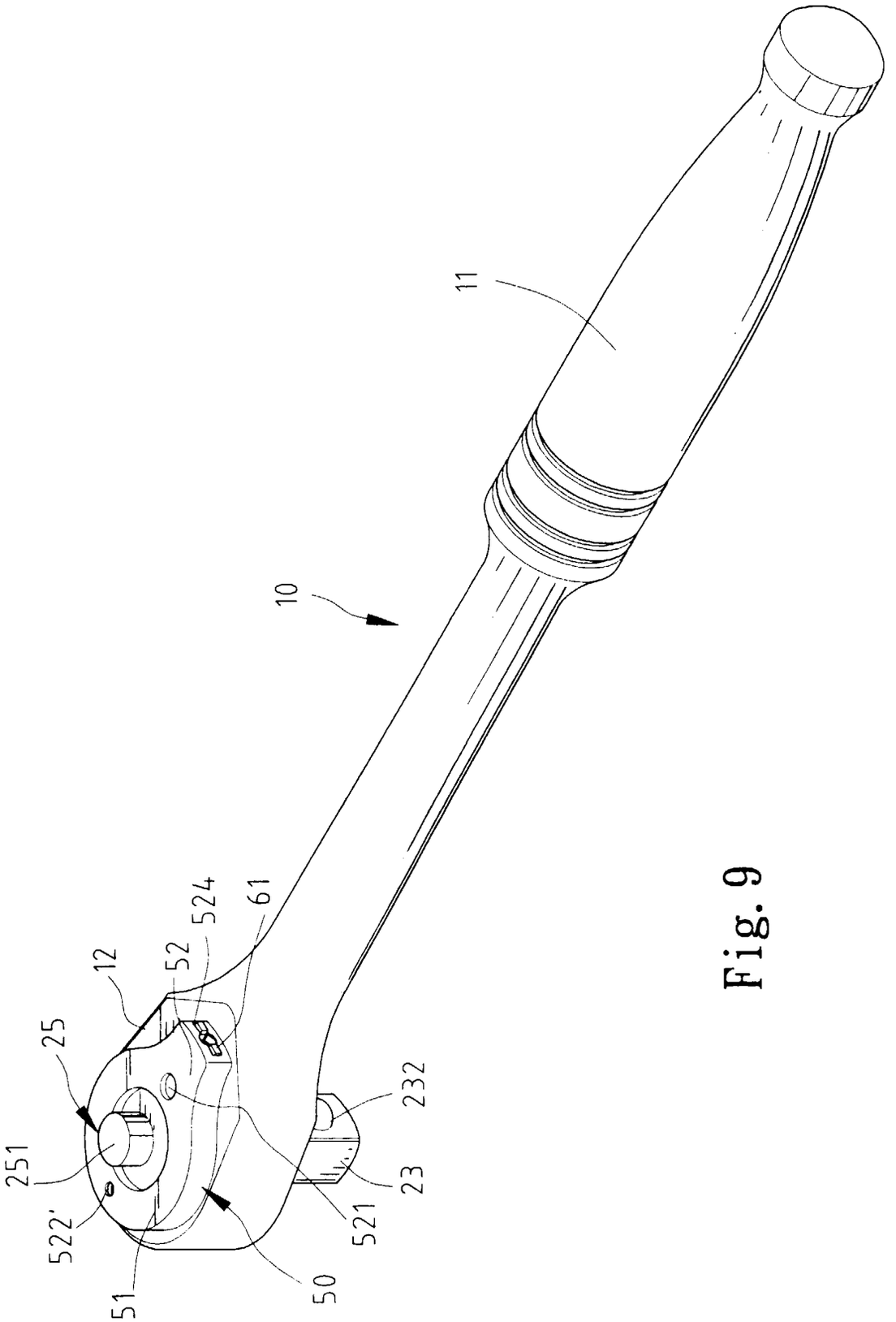
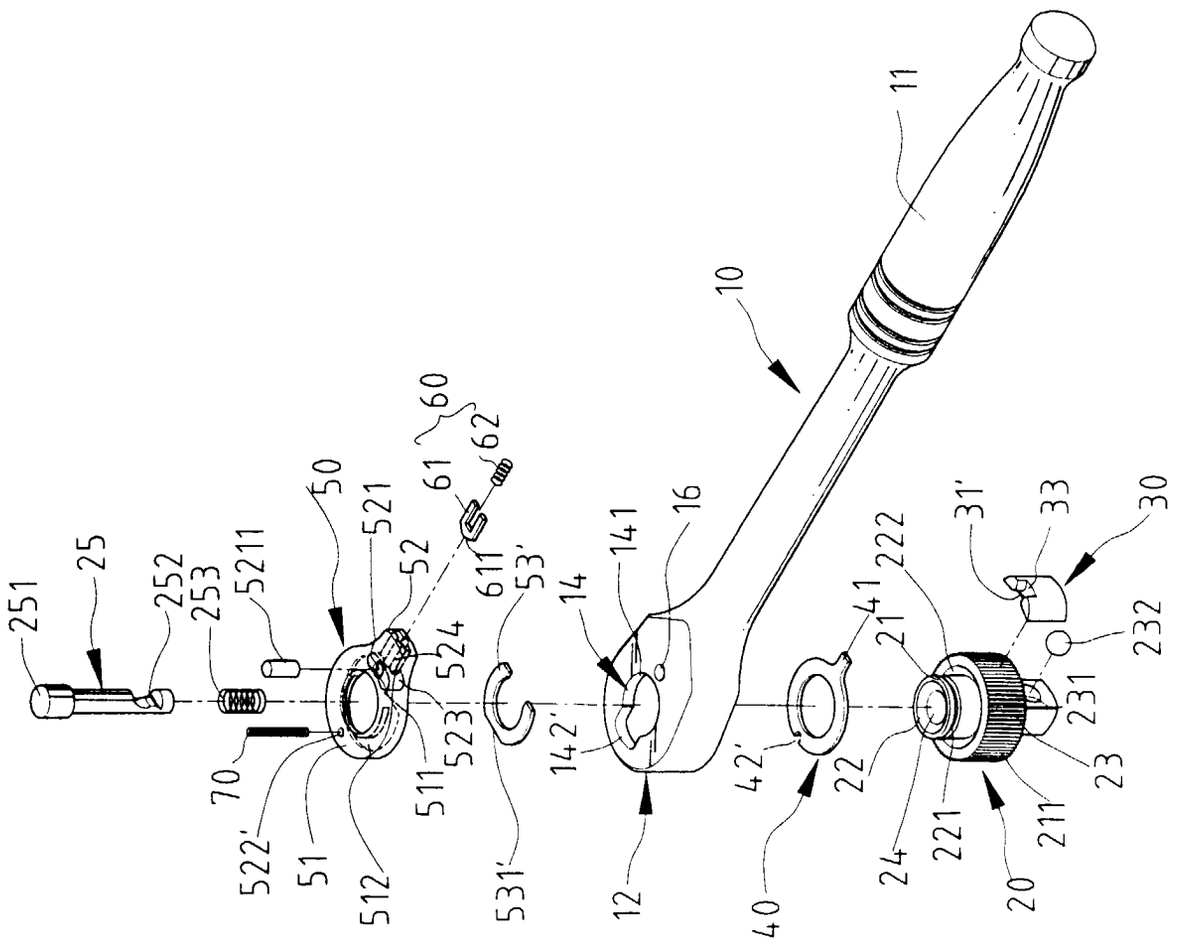


Fig. 9

Fig. 10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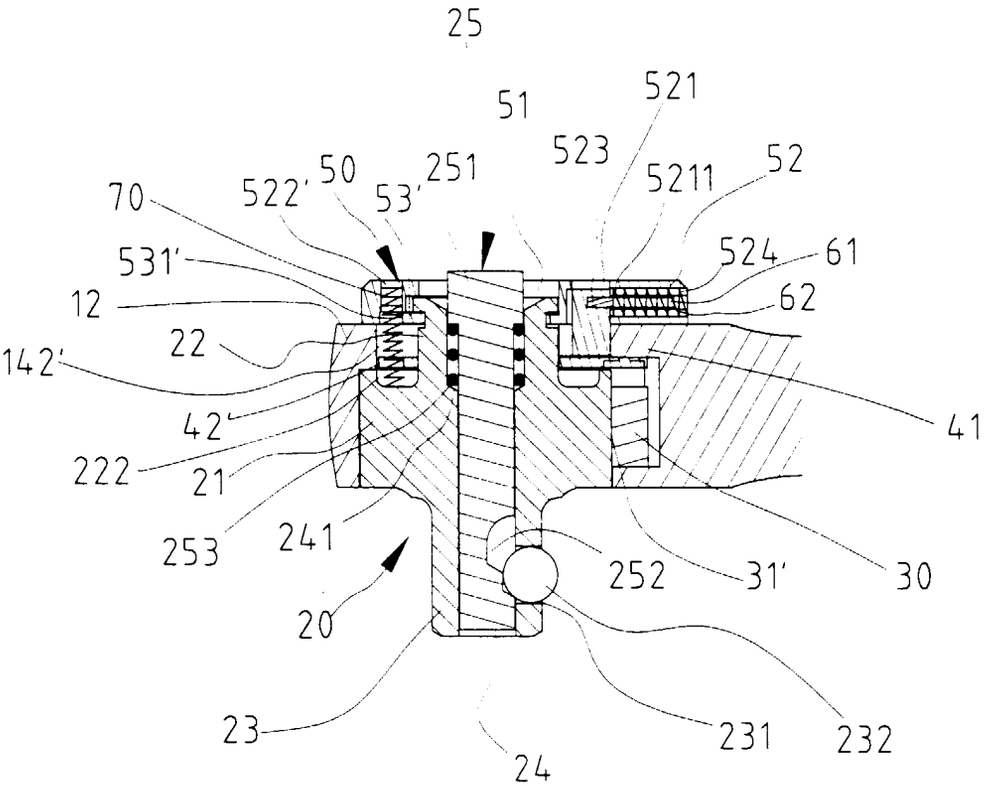
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Fig. 11

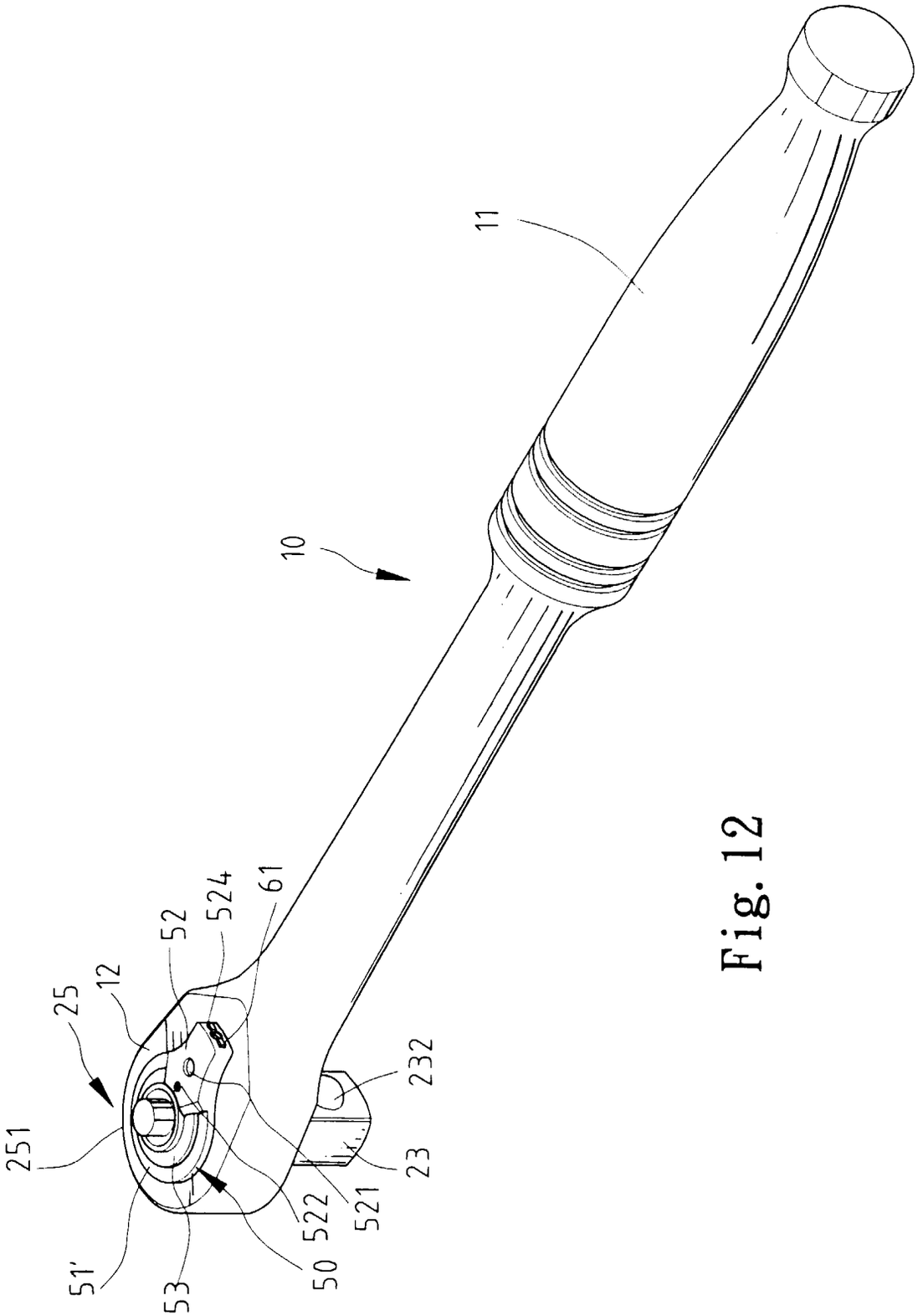
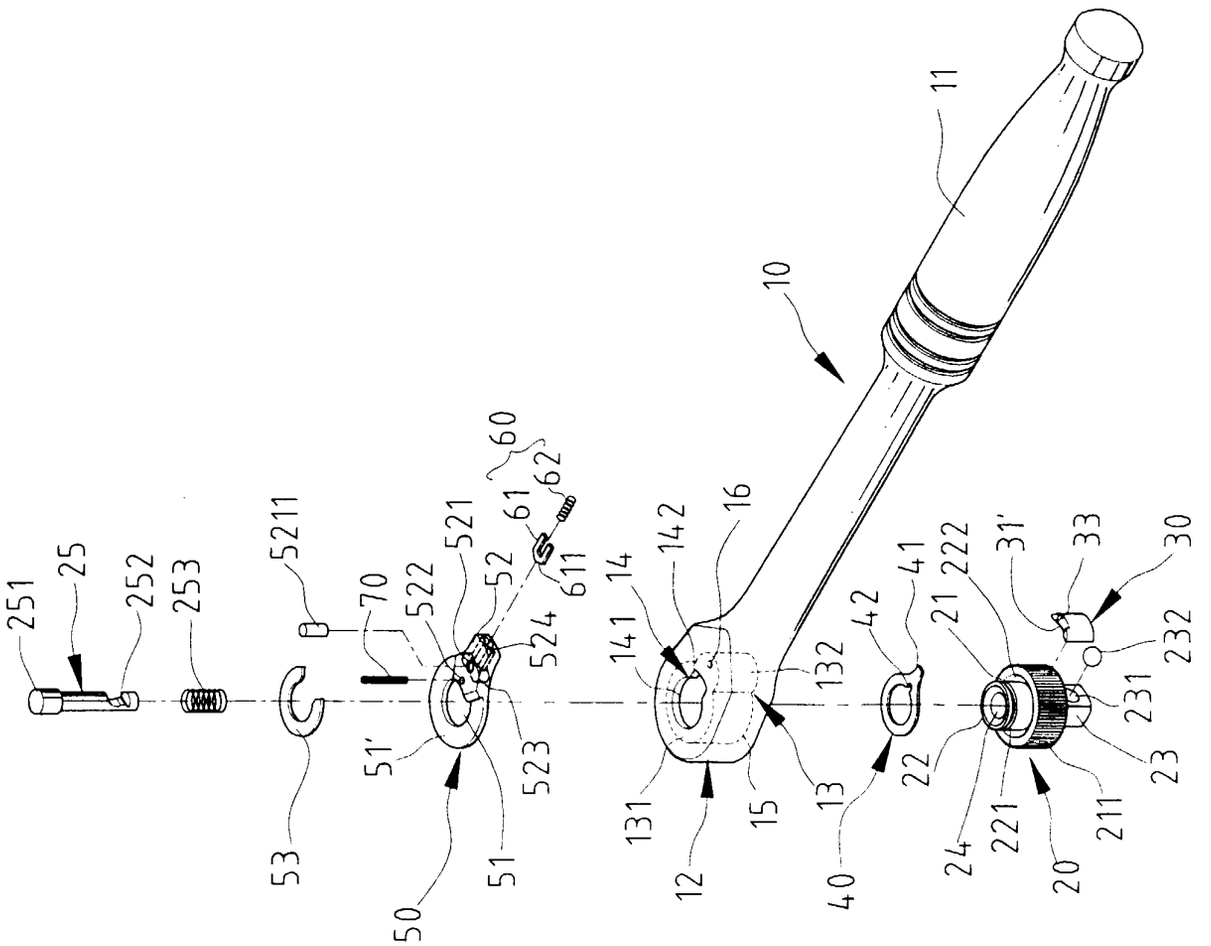


Fig. 12

Fig. 13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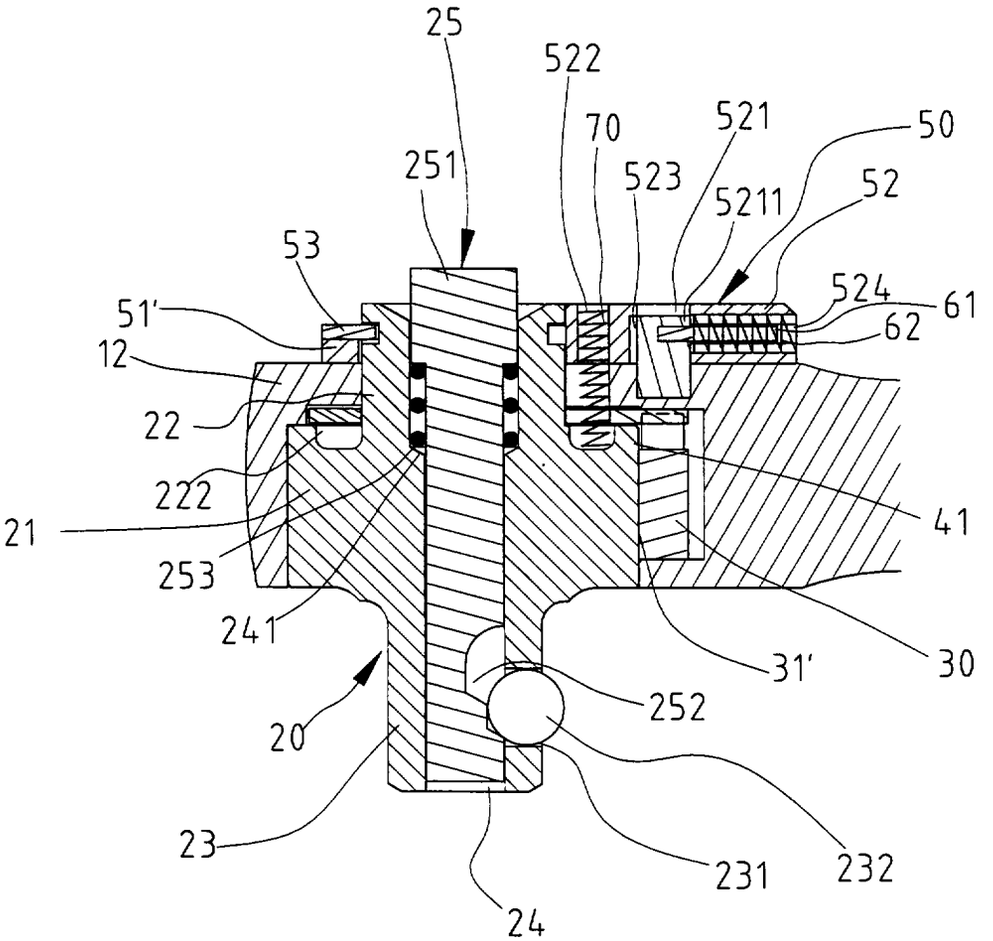
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Fig. 14

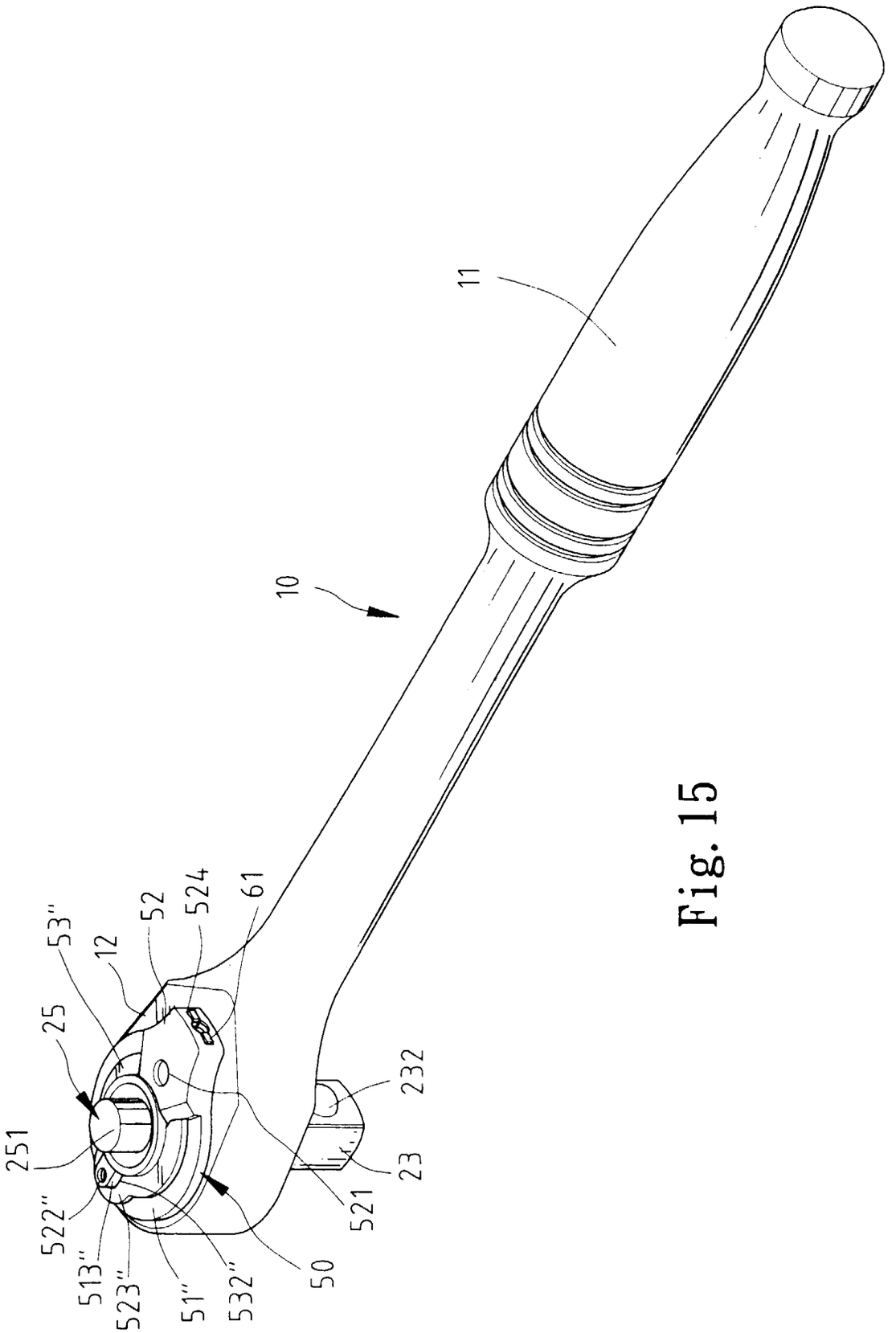
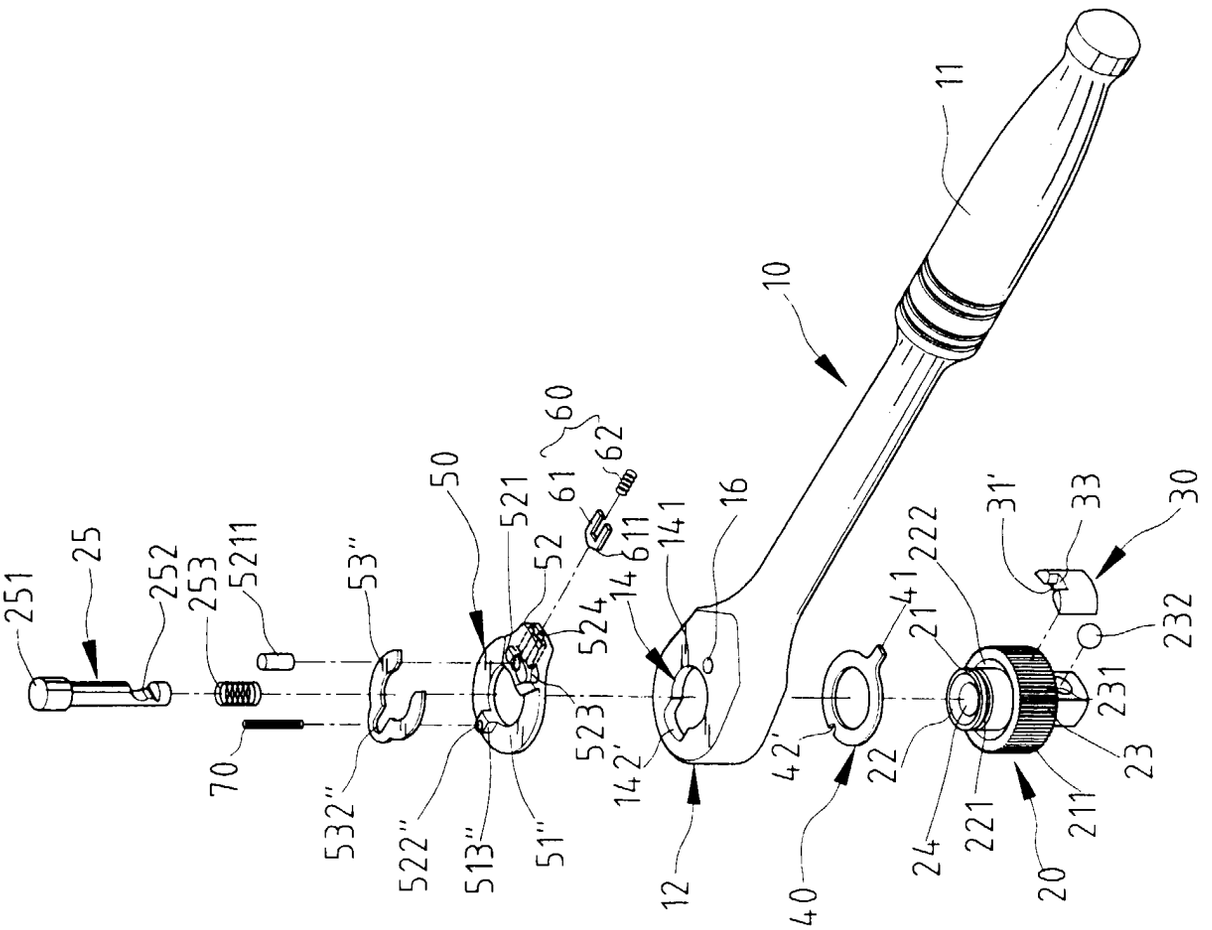


Fig. 15

Fig. 16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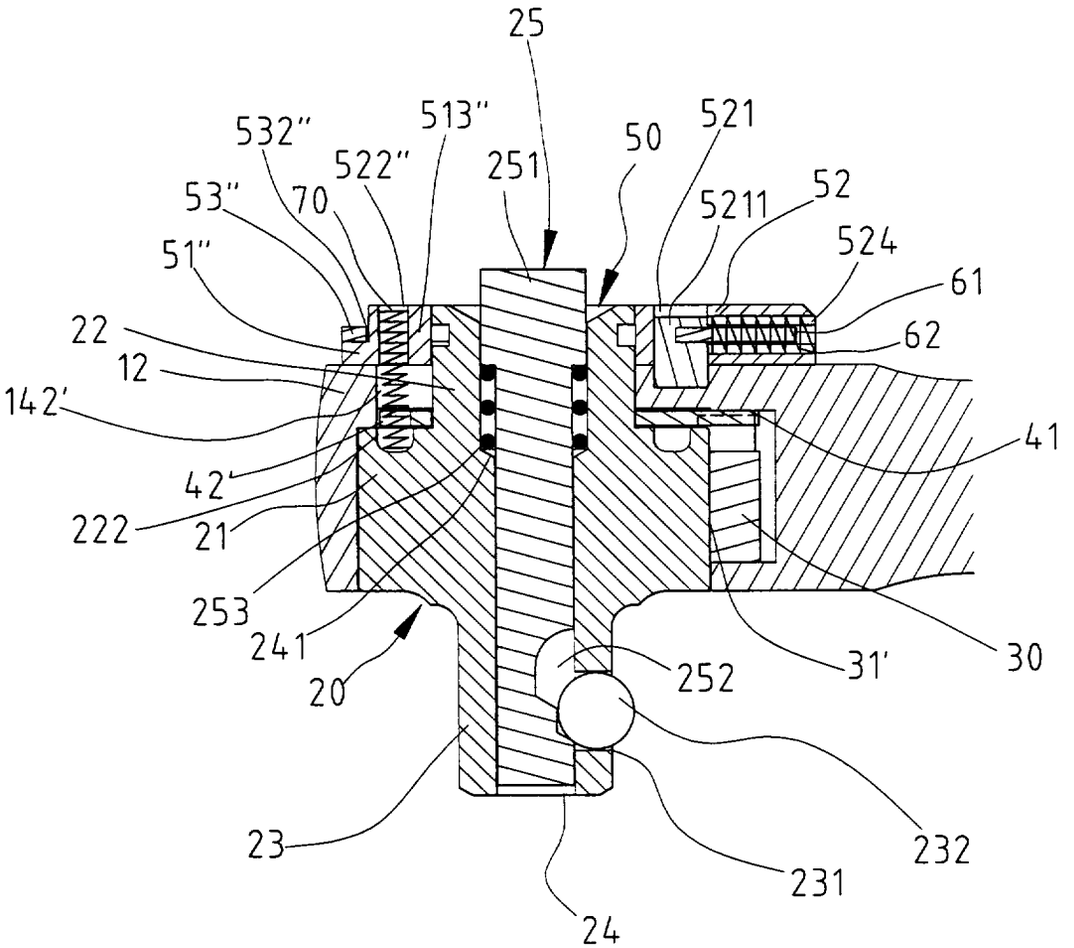
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Fig. 17

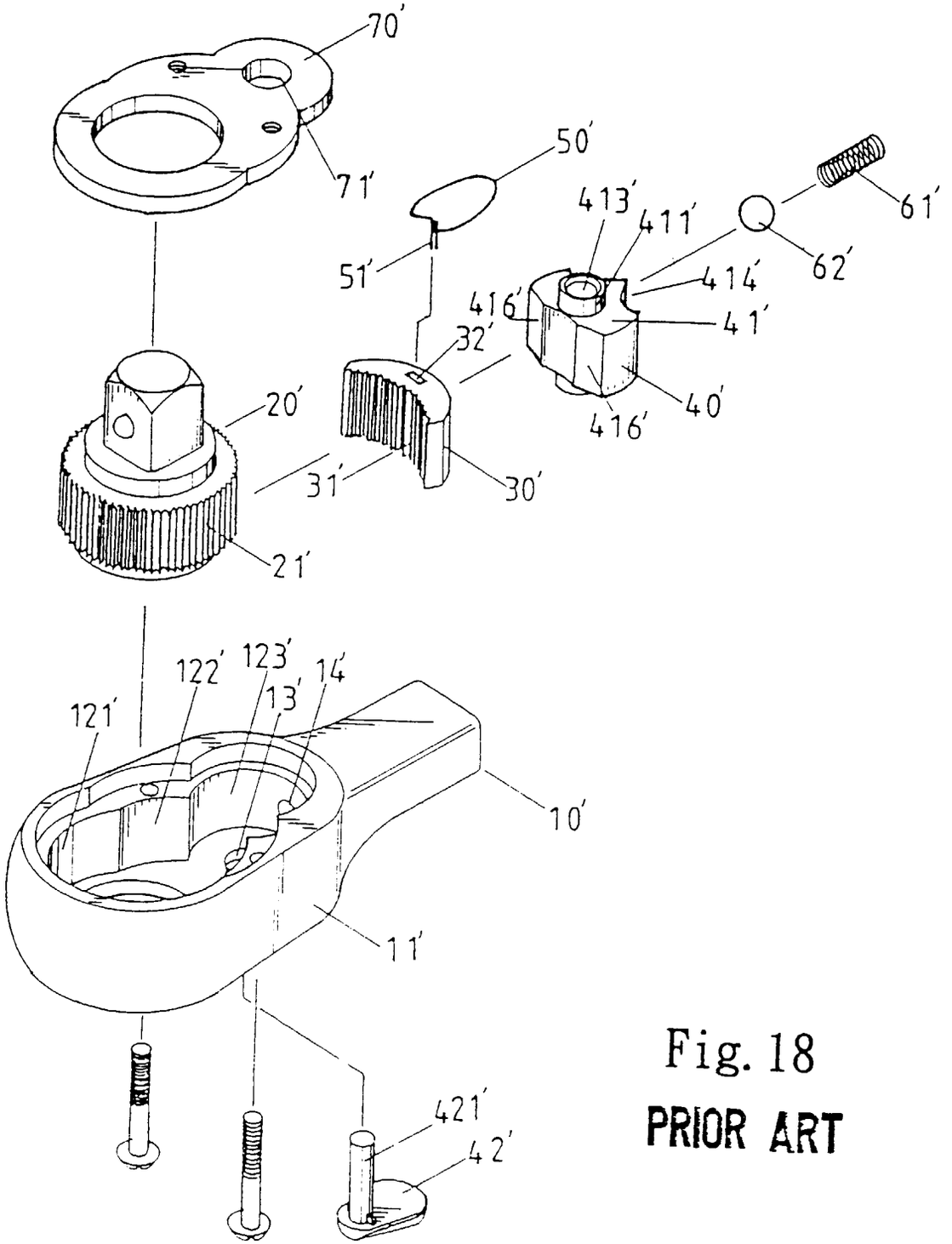

Fig. 18
PRIOR ART

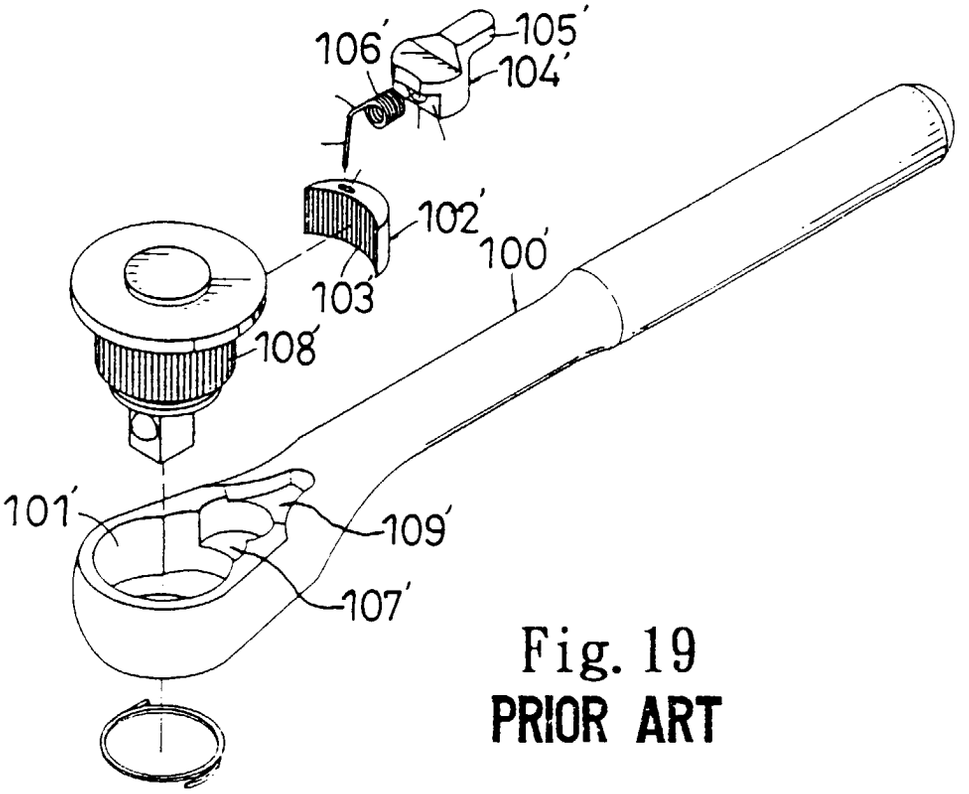

Fig. 19
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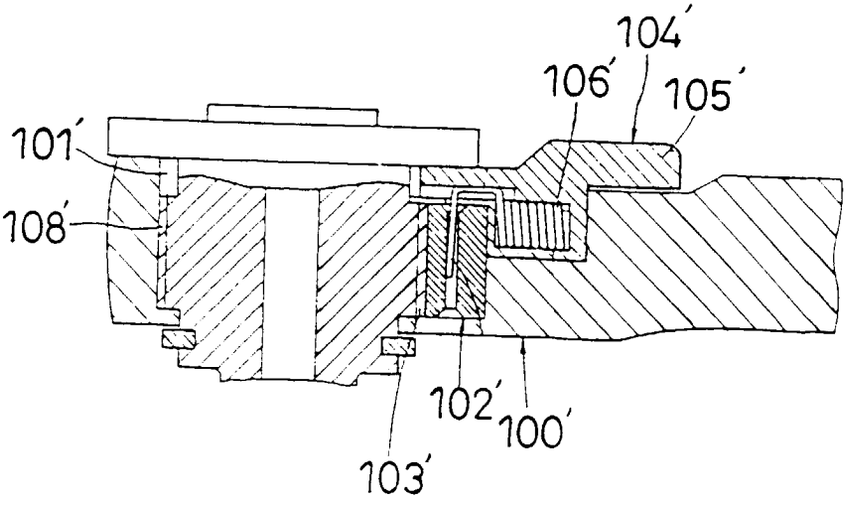
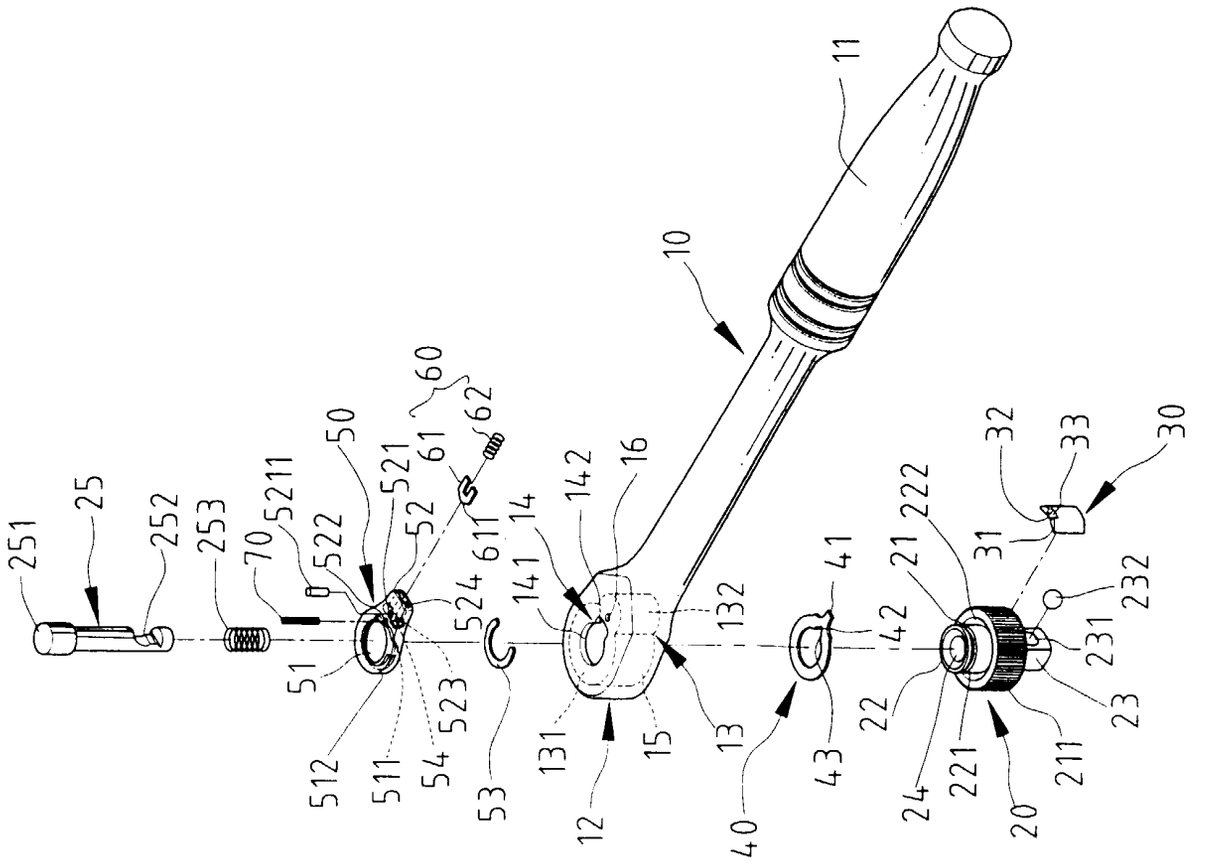


Fig. 20
PRIOR ART

Fig. 21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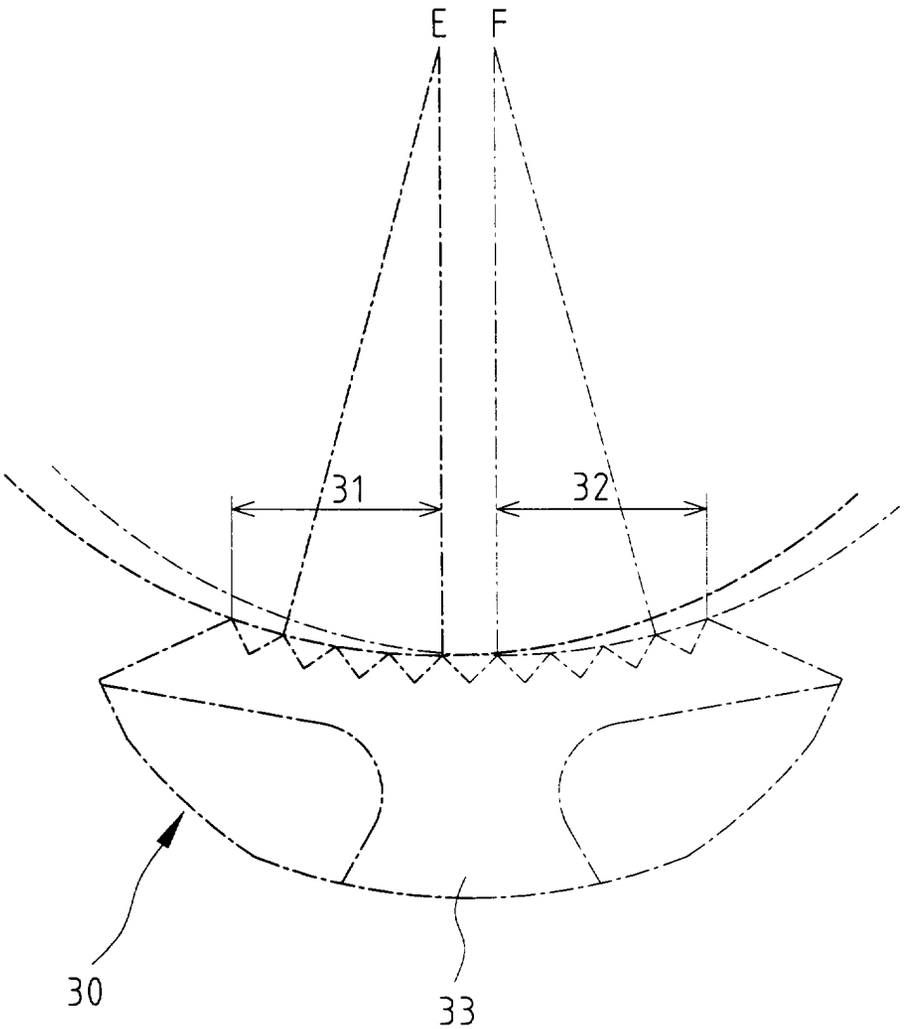


Fig. 22A

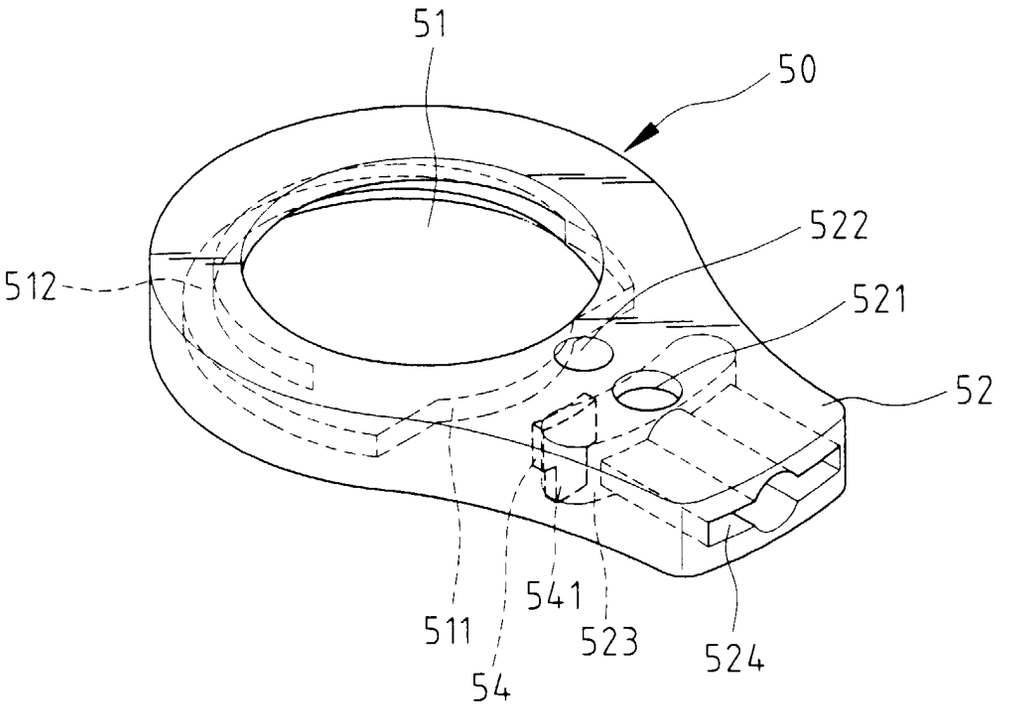


Fig. 22B

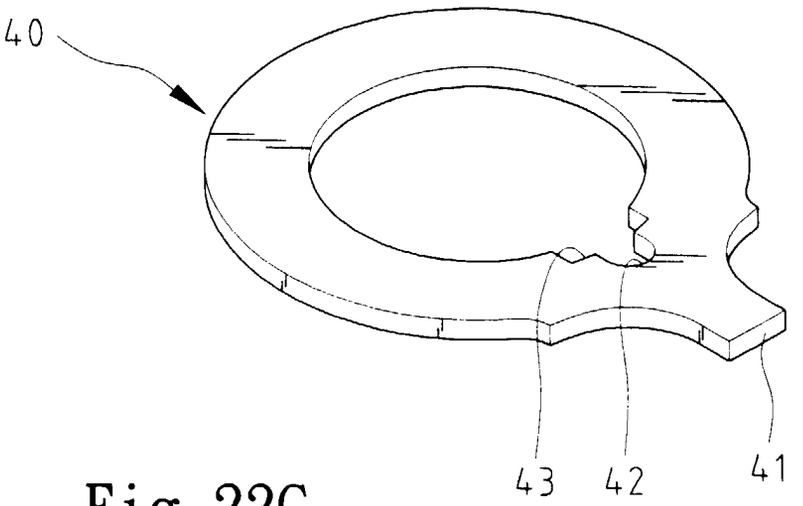


Fig. 22C

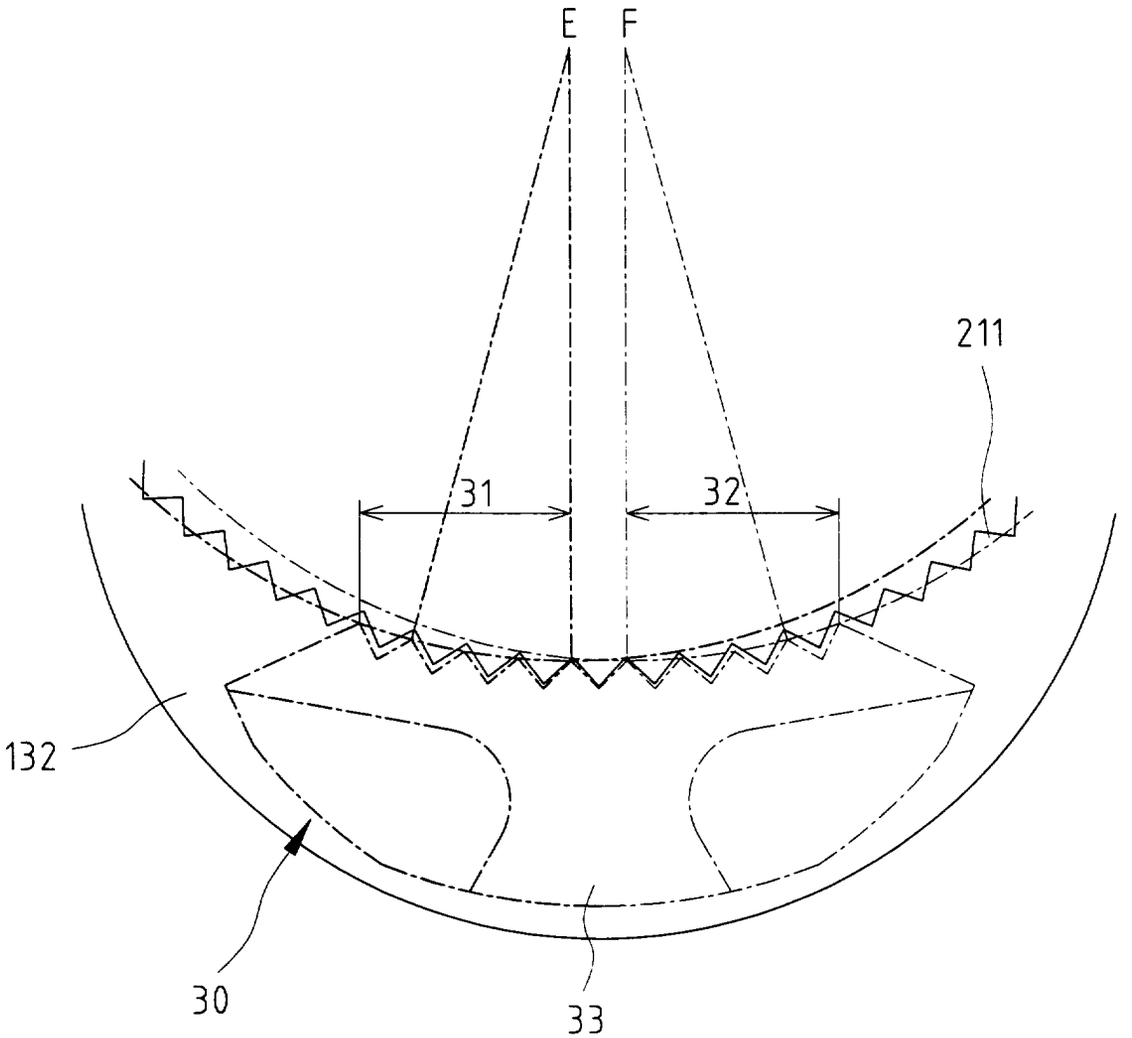


Fig. 23A

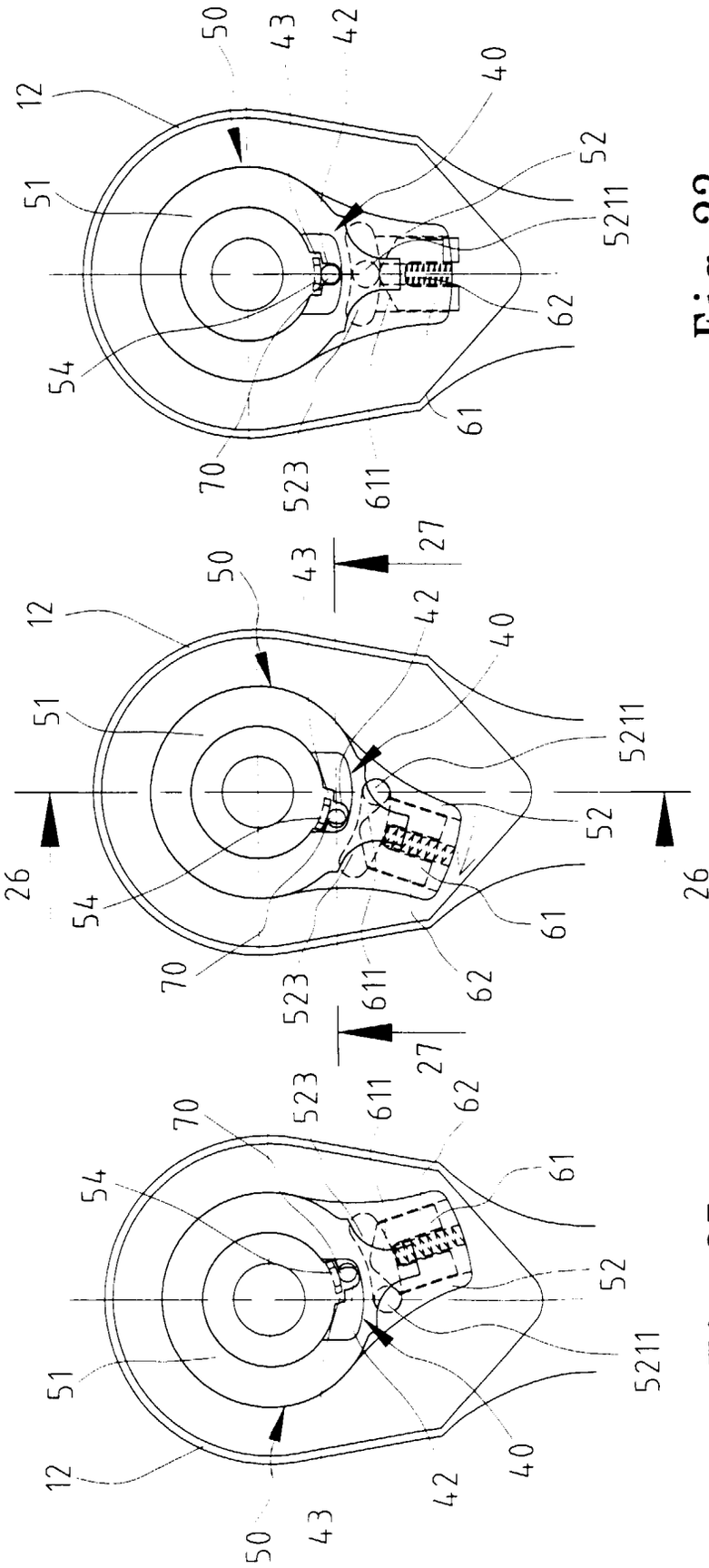
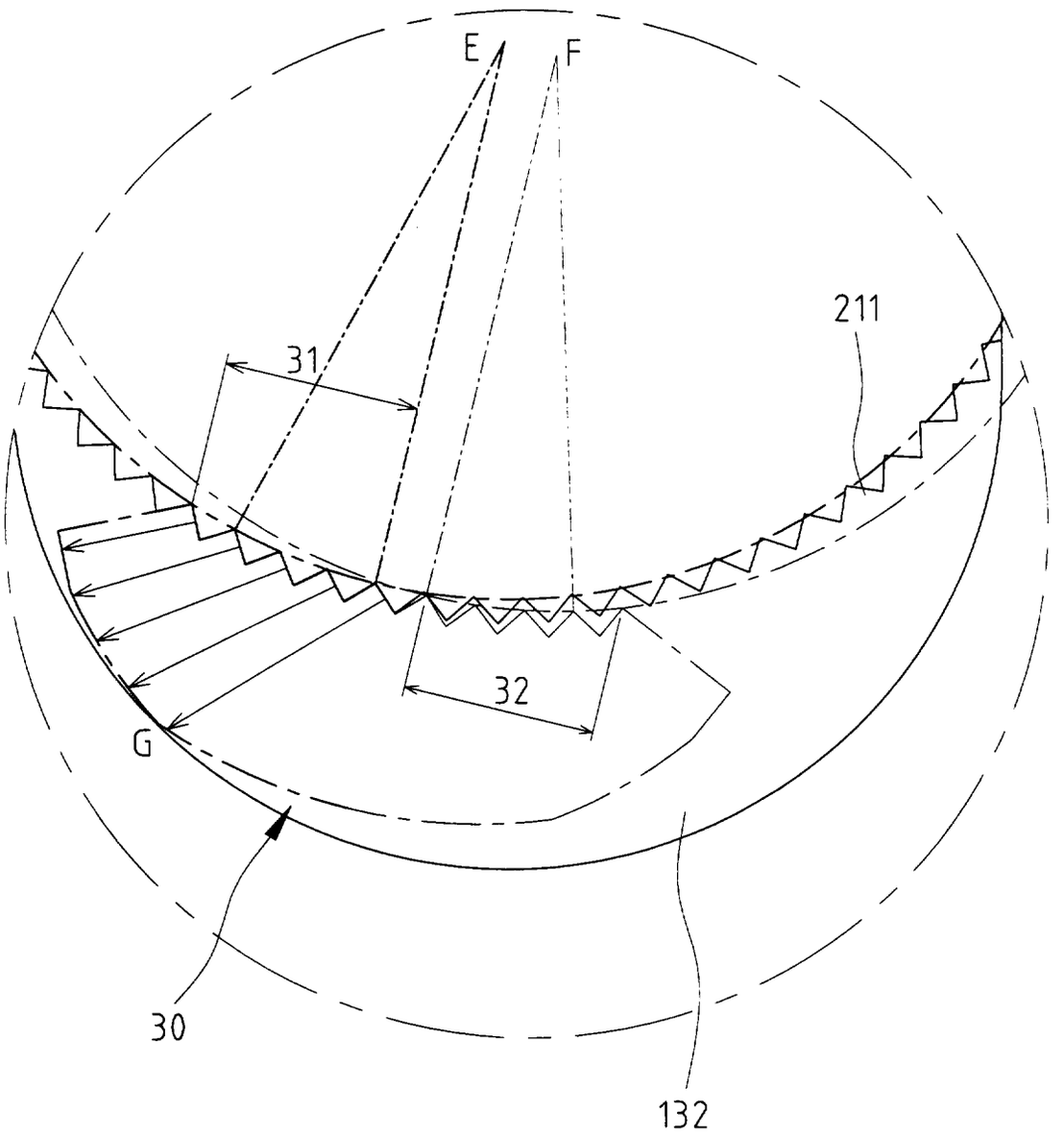


Fig. 23

Fig. 24

Fig. 25



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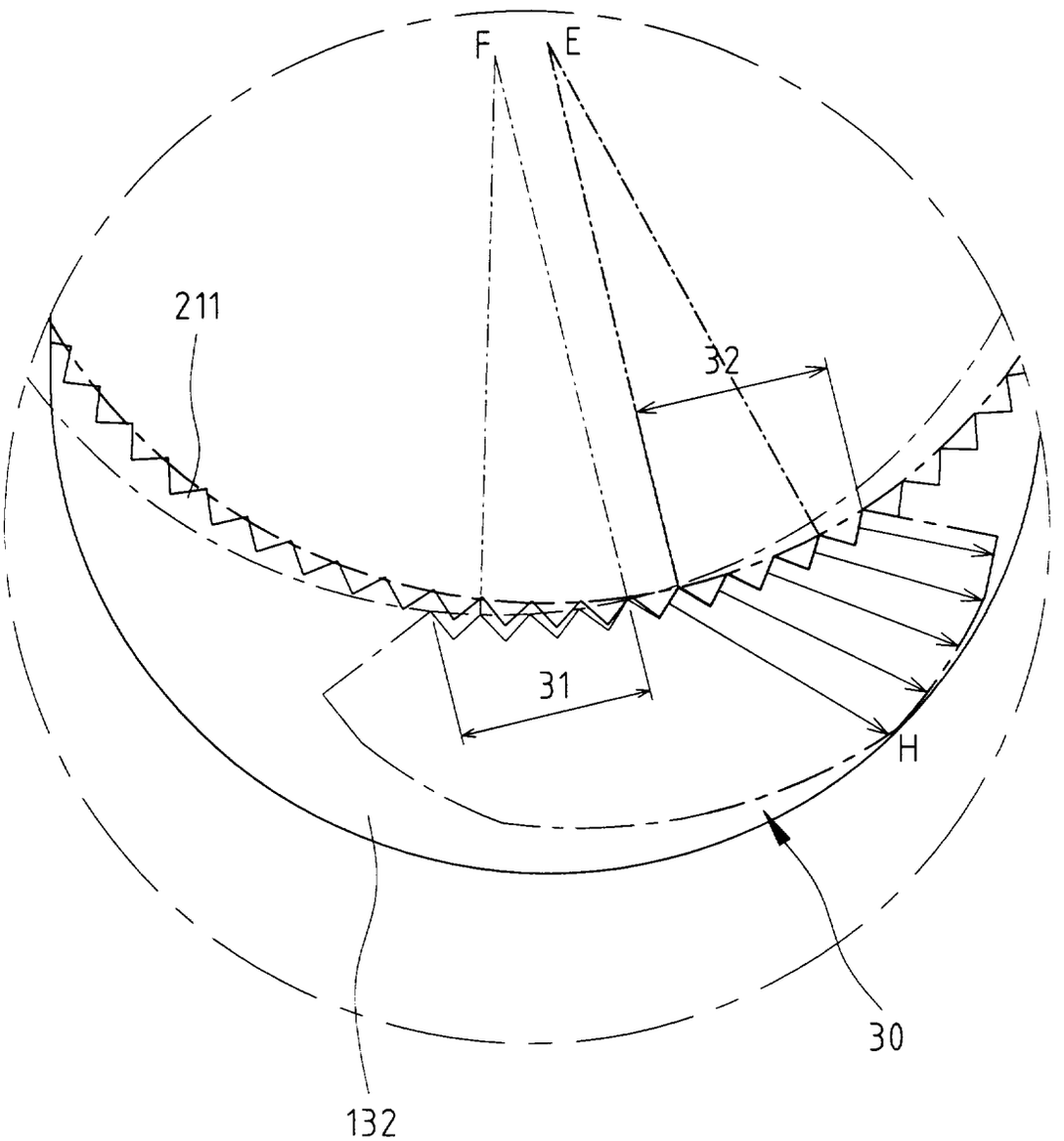

Fig. 25A

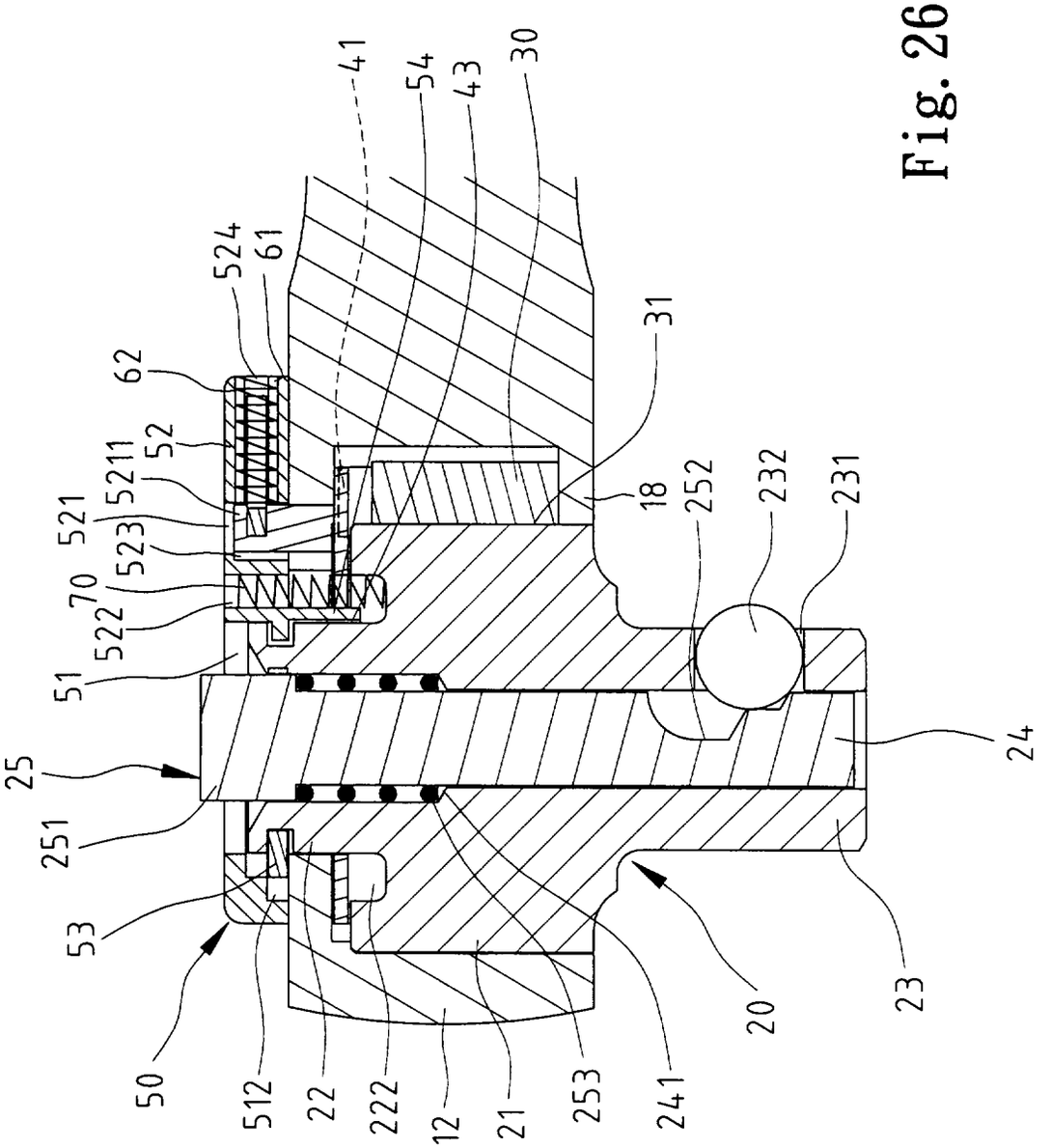
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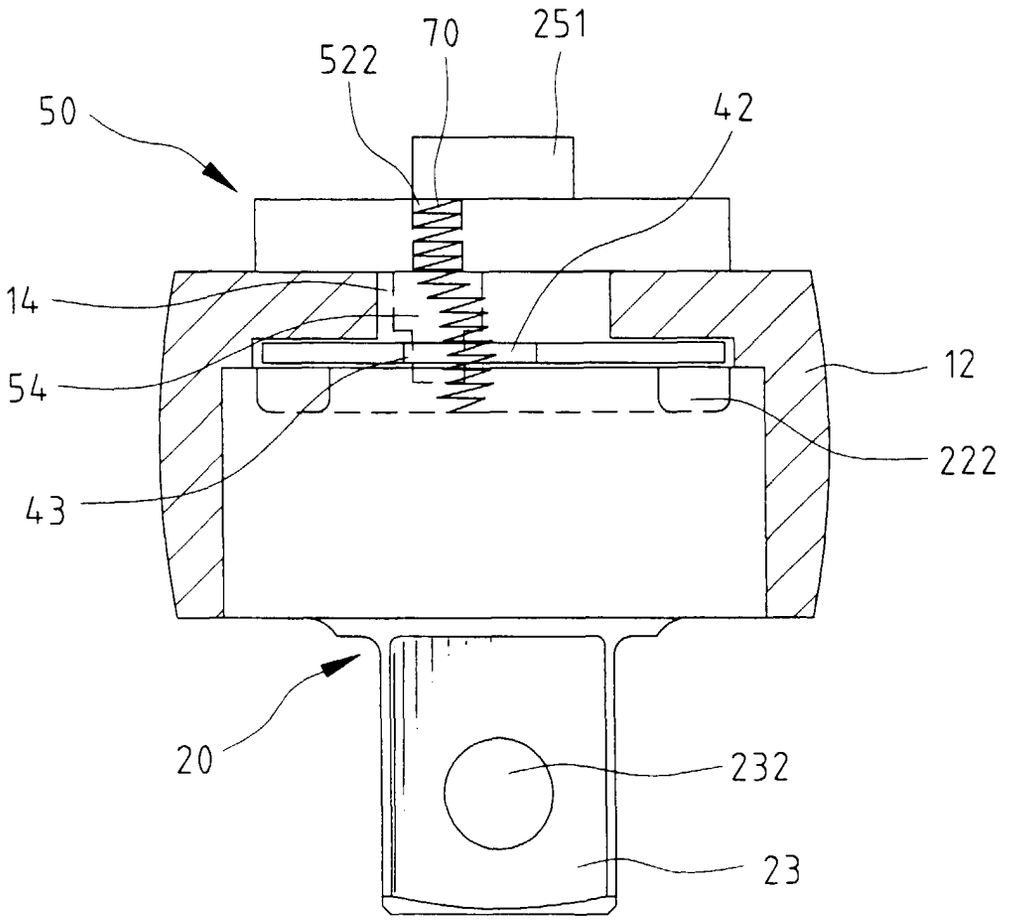
Fig. 26



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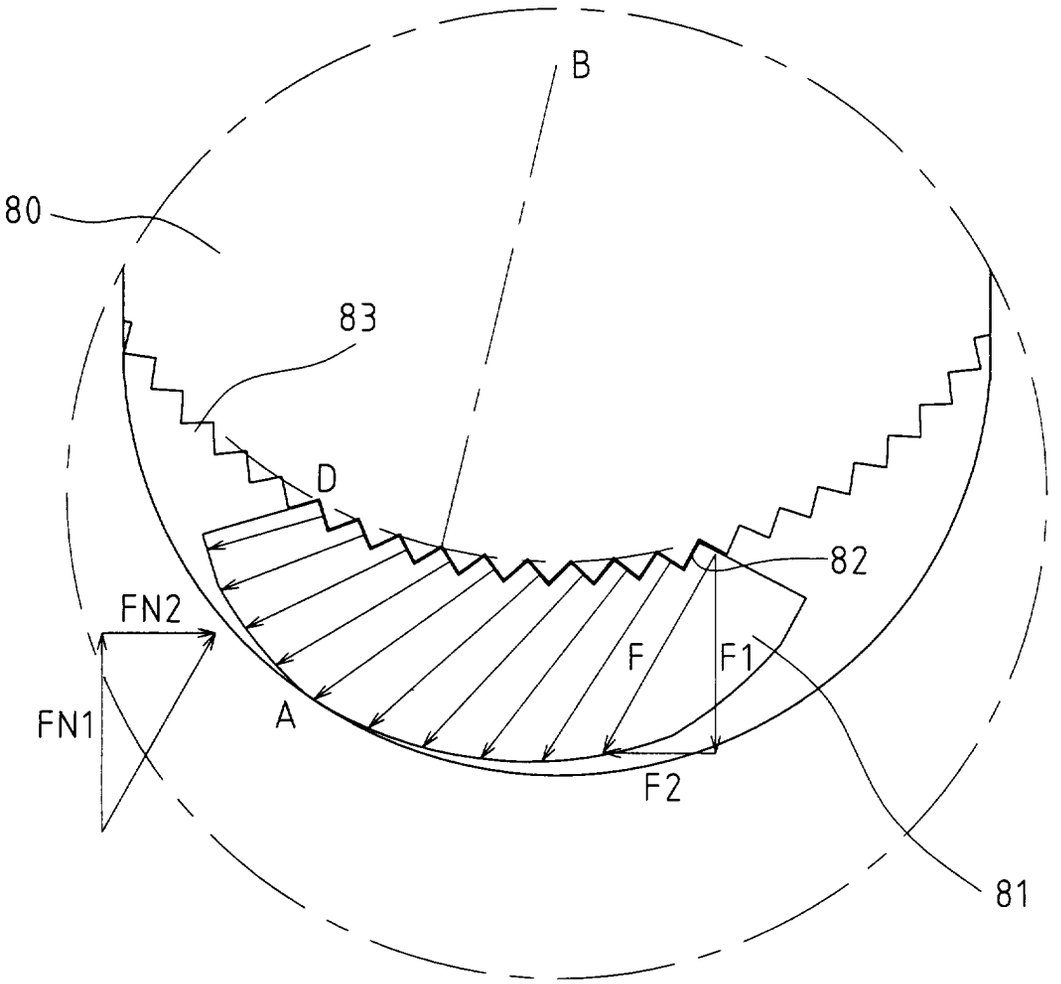

Fig. 28
PRIOR ART

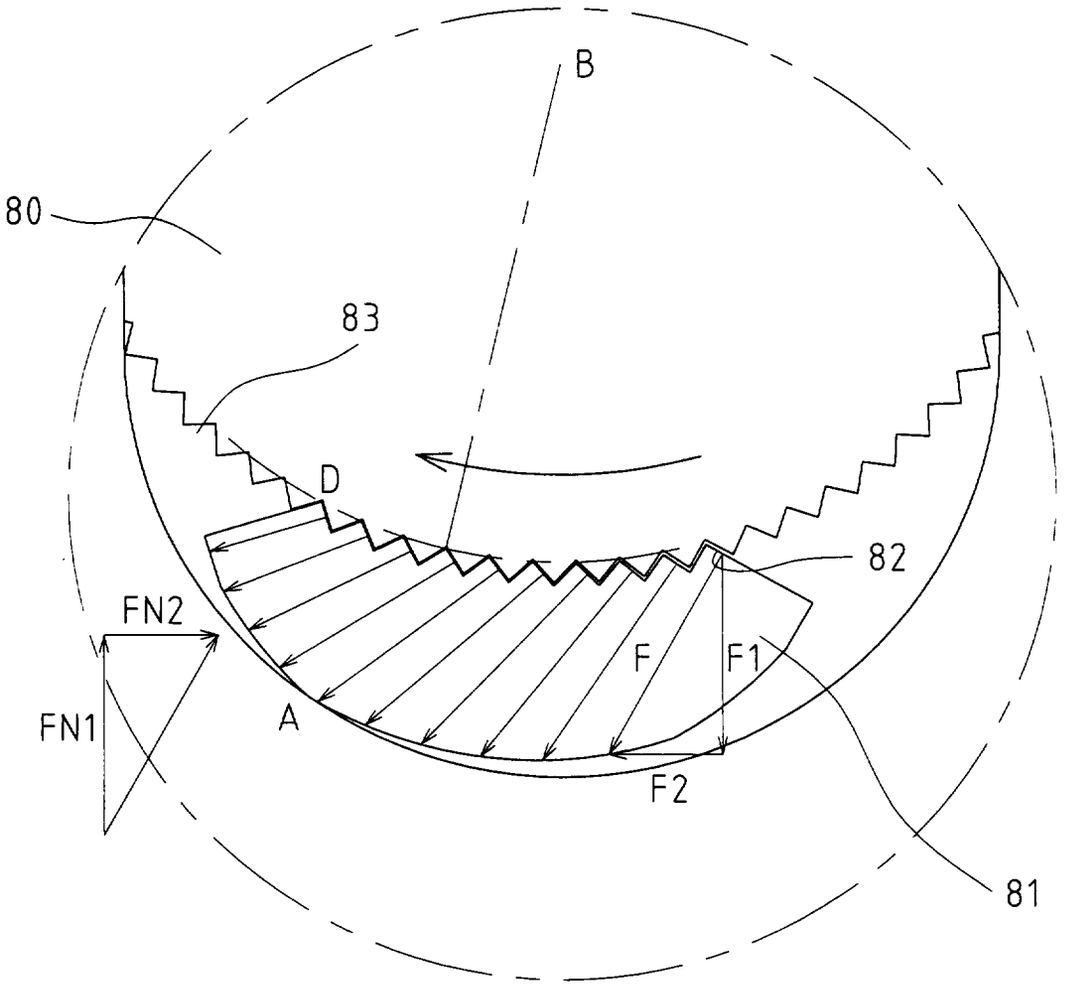

Fig. 29
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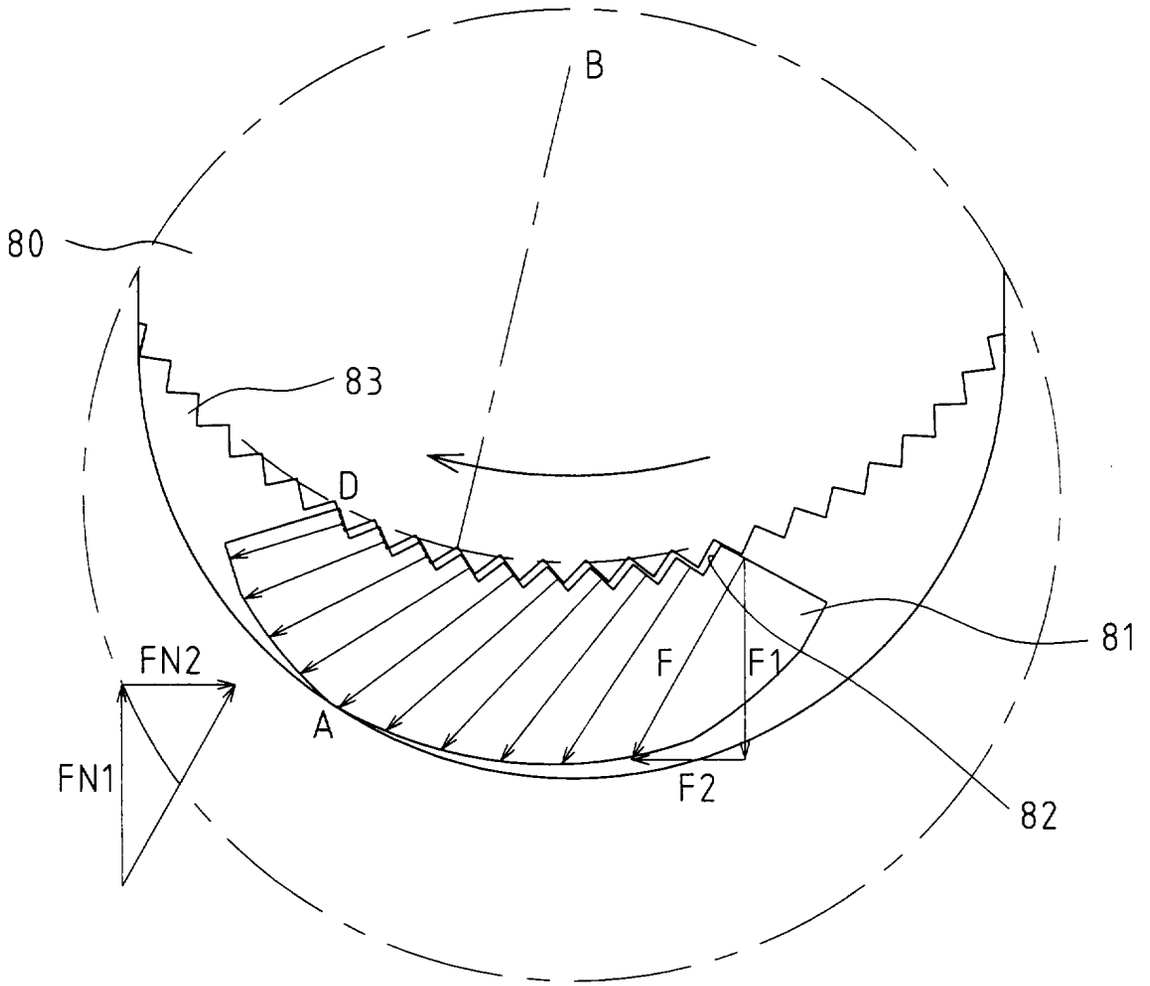

Fig. 30
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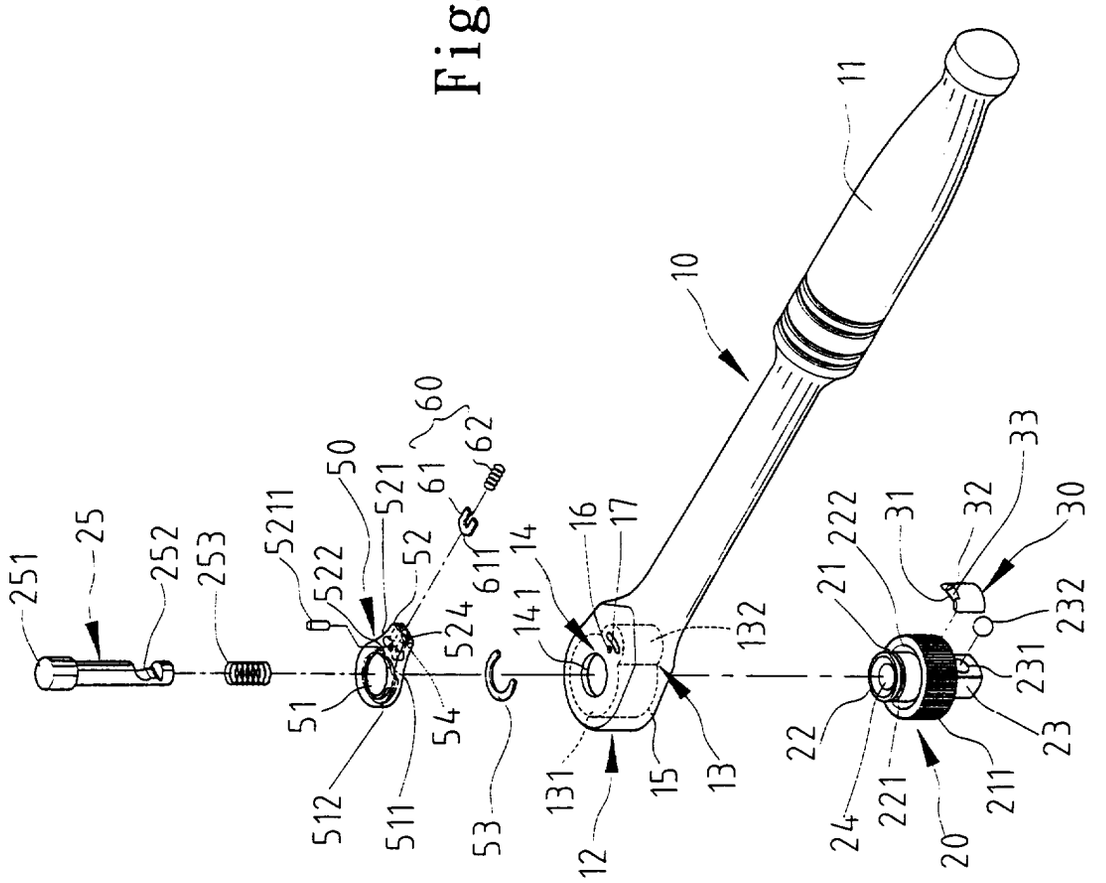
Fig. 31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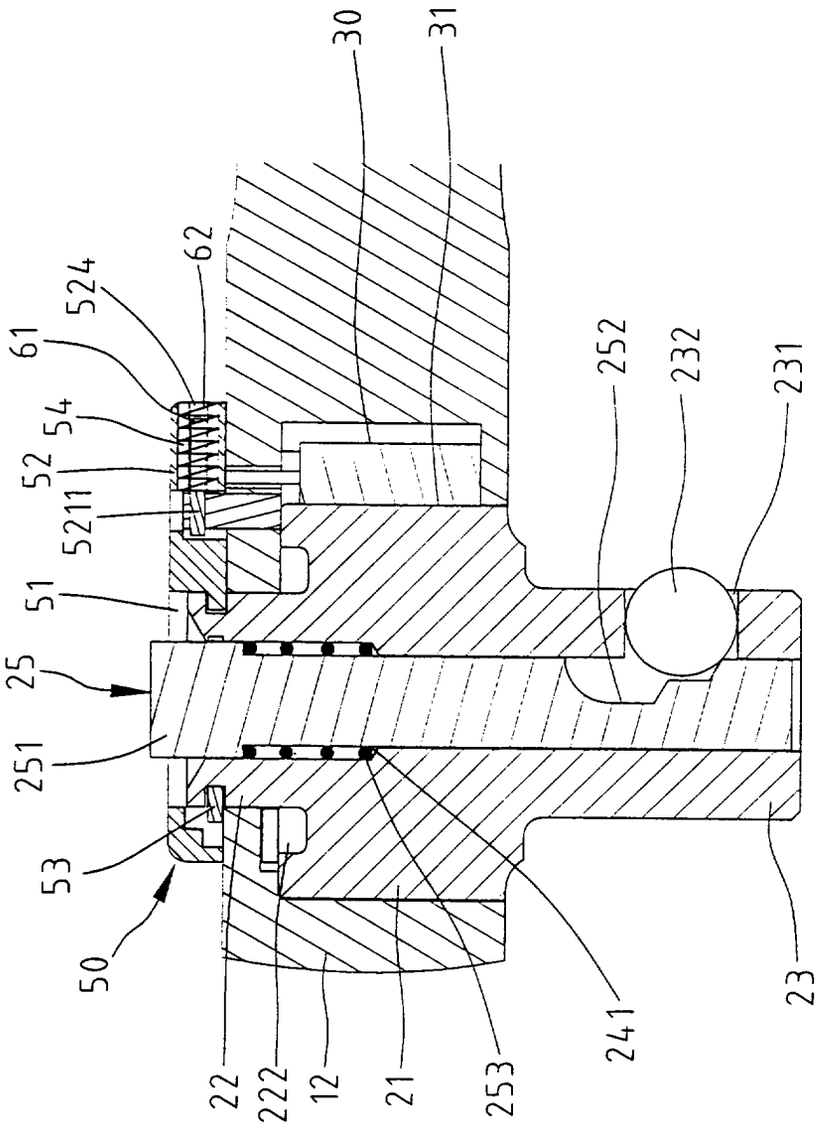
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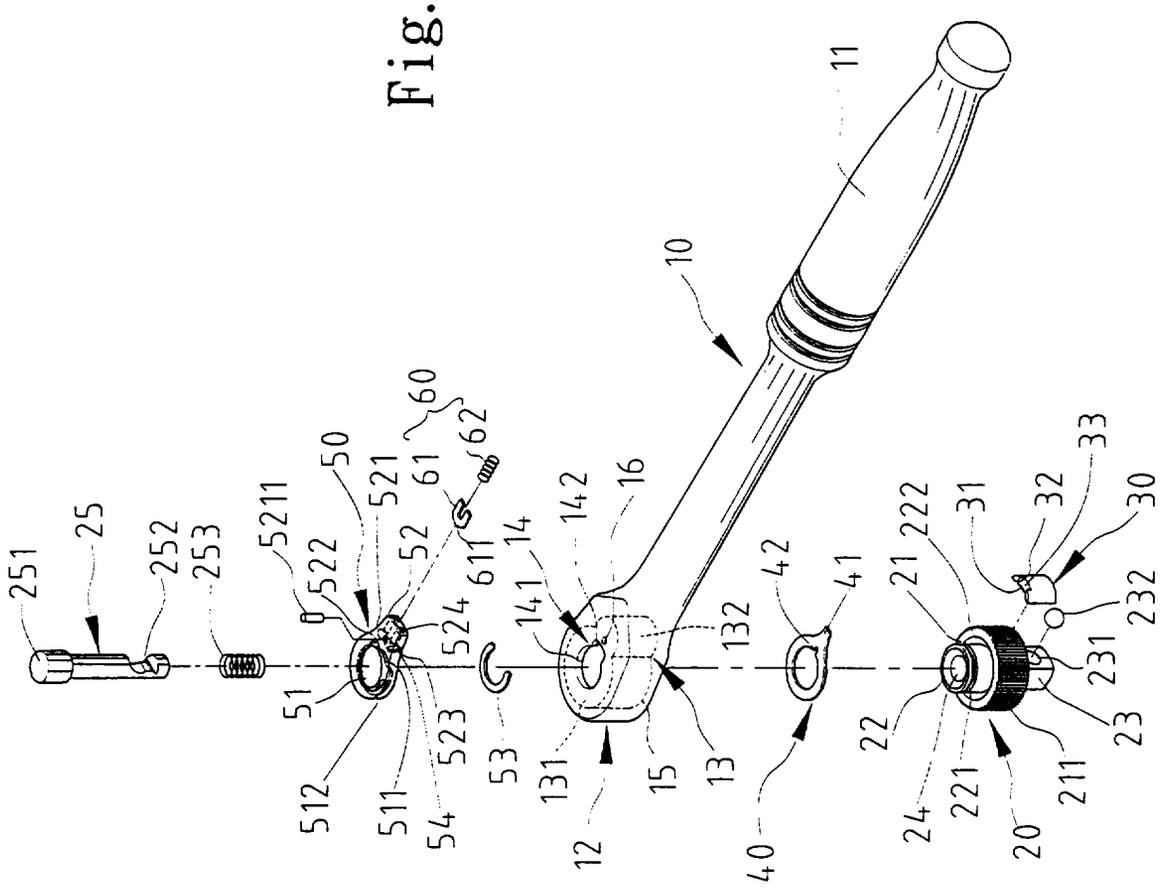
Fig. 32

Fig. 33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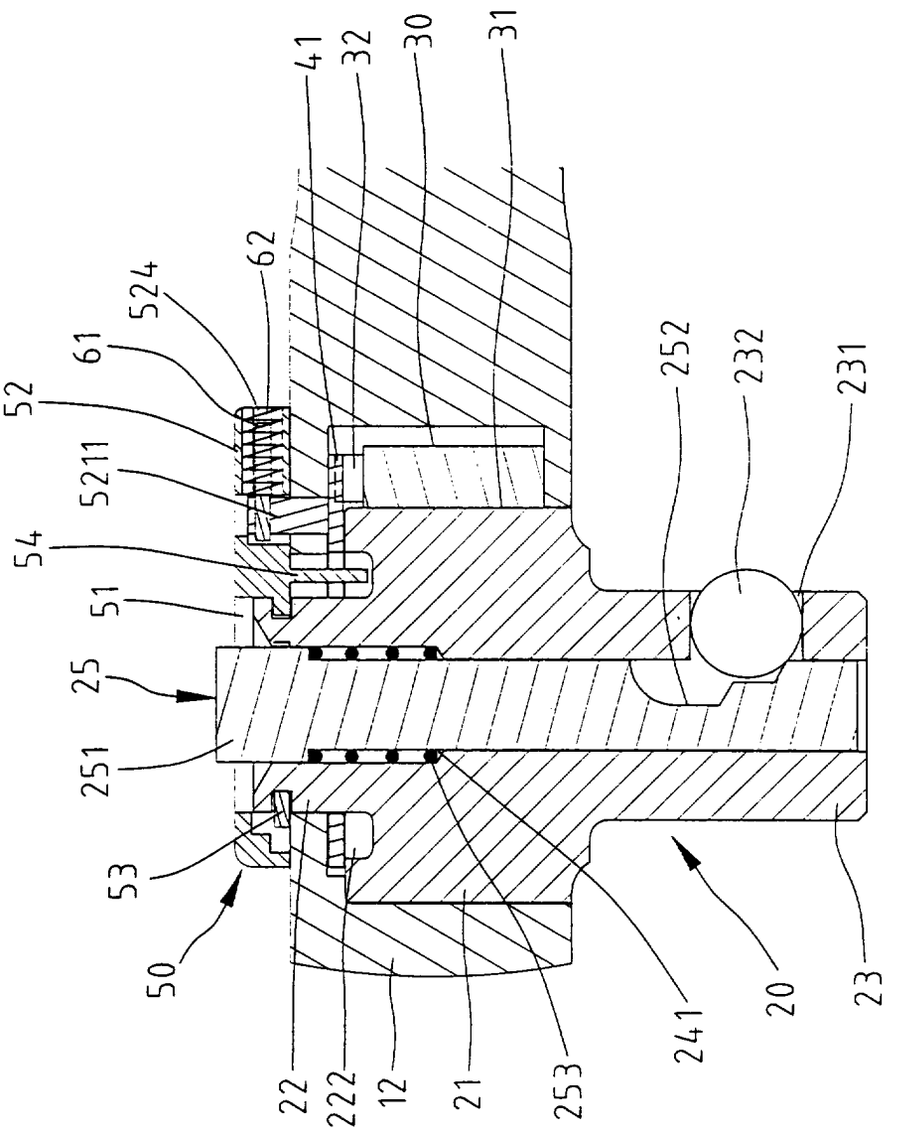
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Fig. 34