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(54) THIN TWO-WAY RATCHET WRENCH

(57) The thickness of the thin bidirectional ratchet wrench of the present invention is less than or equal to 30mm, it can be used in narrow space easily and achieves two working mode and can convert between them conveniently and stably. During the use of the thin bidirectional ratchet wrench of the present invention, the input torque that the operator exerts is a clockwise torque or an anticlockwise torque, the output torque of output end of the thin bidirectional ratchet wrench of the present invention is a clockwise torque or an anticlockwise torque alternatively.

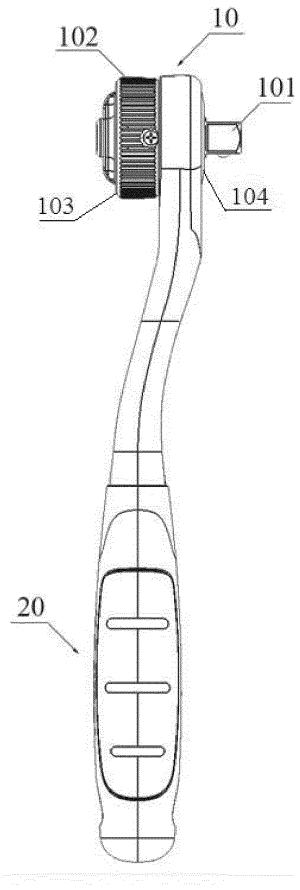

Fig. 1

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Description

Field of the Invention

[0001] The present invention relates to a hand tool, particularly to a thin bidirectional ratchet wrench.

Description of the Prior art

[0002] During the using of common hand tools such as screwdrivers and torque wrenches, there is a movement limitation of the human hand in rotation direction, namely the inability of the human hand to turn continuously in one direction. The operation of such a tool which a rotation axis of the handle is coaxial with the tool's main shaft consists of a repetition of the following cycle: first, the hand rotates the handle in the desirable direction (e.g. tightening or loosening a screw); second, the hand rotates in the opposite direction to reposition the tool for next cycle. During the second portion of the above mentioned cycle, the hand's reversed rotation can be achieved by re-grasping the handle after releasing it, or by the tool which is equipped with an one-way means such as a ratchet surface to keep the main shaft stationary during the reversed rotation of the handle, or by re-inserting the tool bit to the screw after extracting the bit from engagement with the screw. However, in any case, the hand's reversed rotation could not bring any effective advance of the fastener, and therefore it becomes a wasted movement.

[0003] U. S. Pat. No. 5,931,062 discloses a mechanical rectifier, no matter the handle rotates clockwise or anticlockwise, the shaft rotates in the same direction, therefore it can improve the efficiency of the hand motion, and save operation time. However, the converting mechanism of the invention can only make the shaft rotate in on direction, which could not meet the requirement of rotating the shaft in two directions, such as, tightening or loosening a fastener in the application of a torque wrench, the torque wrench equipped with the converting mechanism of the invention could only get the result of tightening a fastener (or loosening a fastener) no matter what operation it executes, either tightening or loosening a fastener, as the conventional wrenches do. If you expect the torque wrench equipped with the converting mechanism of the invention could executes the operation of tightening and loosening a fastener, the considerable solution can only be that the two ends of the shaft of the torque wrench are both mounted with output, and one end is to execute the operation of tightening a fastener, the other to execute the operation of tightening a fastener. But this design is cumbersome, it is inconvenient to choose appropriate output end when using the torque wrench.

[0004] The applicant discloses a bidirectional ratchet wrench in Chinese patent application (CN201320028403.8), which contains a reversing switch and solves the problem of switching the direction of rotation of the main shaft easily. However wrench requires certain torque to tighten fasteners, therefore, in order to provide sufficient torque, the size of the bidirectional wrench need to be thick enough to achieve the desired strength. This requires that the bidirectional wrench needs having large space in main shaft direction to hold the holding device during using. So this bidirectional wrench cannot be applied in narrow space in the main shaft direction, for example, some slit or gap of mechanical components, etc.

[0005] Therefore, it is desired to develop a thin bidirectional ratchet wrench which can be used in narrow space easily.

Summary of the Invention

[0006] In the view of the above, the technical object of the present invention is to provide a thin bidirectional ratchet wrench which can be used in narrow space easily and switch the rotation direction of the main shaft conveniently.

[0007] For the above purpose, the present invention provides a thin bidirectional ratchet wrench, and comprises: a working part and a handle, the working part consisting of a main shaft, the main shaft being used to output torque and its axis being perpendicular to the handle; a capstan gear, a follower gear, an transmission seat and an idle gear, the capstan gear, the follower gear and the transmission seat being all mounted on the main shaft, the axis of the transmission seat being perpendicular to the axis of the main shaft, the idle gear being mounted on the transmission seat and rotating between the capstan gear and the follower gear, wherein the handle entrains the capstan gear to rotate, and the transmission seat is equipped with a holding device, when holding the holding device and rotating the handle to entrain the capstan gear, the capstan gear entraining the follower gear to rotate reversely via the idle gear; a first ratchet surface rotating together with the capstan gear, and a second ratchet surface rotating together with the follower gear; a first pawl element and a second pawl element which are capable of driving the main shaft to rotate; wherein the first pawl element has a first pawl and a second pawl which are matched with the first ratchet selectively, wherein the first pawl skids on the first ratchet surface in the first direction but engages with the first ratchet surface in the second direction, and the second pawl engages with the first ratchet surface in the first direction but skids on the first ratchet surface in the second direction; the second pawl element has a forth pawl and a third pawl which is matched with the second ratchet selectively, wherein the third pawl skids on the first ratchet surface in the first direction but engages with the first ratchet surface in the second direction, and the forth pawl engages with the first ratchet surface in the first direction but skids on the first ratchet surface in the second direction; a reversing switch, which is capable of setting the first pawl element and the second pawl element on a first

condition and a second condition, the first pawl and the third pawl are matched with the first ratchet surface and the second ratchet respectively under the first condition; the second pawl and the forth pawl are matched with the first ratchet surface and the second ratchet respectively under the second condition; the first direction is clockwise or anticlockwise, the second direction is opposite to the first direction; the thickness of the working part is less than or equal to 30mm.

[0008] In a further embodiment, the first pawl element and/or the second pawl element are/is made of high strength material, preferably, the material used is injected powder metallurgy.

[0009] In a further embodiment, thickness of one of the pawl elements is less than or equal to 6.5mm, the other one is less than or equal to it, thickness of the ratchet surface that engages with the pawl element equals to the thickness of the pawl element, thickness of the transmission seat is less than or equal to 8mm, and modulus of the idle gear is less than or equal to 1; preferably, the thickness of the first pawl element is 5mm, the thickness of the second pawl element is less than the first pawl element's, the thickness of the transmission seat is 6mm, the modulus of the idle gear is 0.6, and the thickness of the working part is 25mm.

[0010] In a further embodiment, the handle has a ring-shaped head, and the first ratchet surface is disposed on the inner circumference of the ring-shaped head.

[0011] In a further embodiment, the first ratchet is disposed on the inner circumference of the capstan gear.

[0012] In a further embodiment, the second ratchet is disposed on the inner circumference of the follower gear.

[0013] In a further embodiment, the holding device is a holding ring.

[0014] In a further embodiment, the first pawl element and/or the second pawl element are/is fan-shaped.

[0015] In a further embodiment, the first pawl element and the second pawl element are mounted on the countershaft, the axis of the countershaft is parallel to but not overlap in the main shaft, and the countershaft engages with the main shaft and is capable of entraining the main shaft to rotate.

[0016] In a further embodiment, the countershaft drills through the main shaft.

[0017] In a further embodiment, the reversing switch has spring inside and comprises a newel, a first spring-loaded plunger and a second spring-loaded plunger, the newel is disposed inside the main shaft, the first spring-loaded plunger and the second spring-loaded plunger is fix on the newel in turn, and the first spring-loaded plunger and the second spring-loaded plunger matches with the respectively.

[0018] In a further embodiment, springs are disposed inside the first spring-loaded plunger and the second spring-loaded plunger.

[0019] The thin bidirectional ratchet wrench of the present invention reduces the thickness of all the parts in the working part (along the extending direction of the main shaft 100) on the basis of satisfying the output torque needed, hence reducing the whole thickness of the working part largely, so it can be used in narrow space easily and satisfy the torque needed to tighten fasteners, achieving two working mode and being capable of converting between them conveniently and stably.

[0020] The present invention would be described in detail hereinafter in combination with the attached drawings for better understanding the purpose, features and effects of the present invention.

Brief Description of the Drawings

[0021]

Figure 1 is a front view of the thin bidirectional ratchet wrench of the present invention in the preferred embodiment;

Figure 2 is a sectional view of the working part of the thin bidirectional ratchet wrench in Figure 1;

Figure 3 shows the driving mechanism in the thin bidirectional ratchet wrench of the present invention in the preferred embodiment;

Figure 4 shows the reversing mechanism in the thin bidirectional ratchet wrench of the present invention in the preferred embodiment;

Figure 5 shows the main shaft mounted first pawl element and second pawl element;

Figure 6 is a front view of the first pawl element in Figure 5;

Figure 7 shows cooperation between the first pawl element and the first ratchet surface when the thin bidirectional ratchet wrench of the present invention in the preferred embodiment is on the first working mode;

Figure 8 shows the knob for changing working mode of the thin bidirectional ratchet wrench of the present invention;

Figure 9 shows the blocking device in the thin bidirectional ratchet wrench of the present invention;

Figure 10 is a side view of the blocking device in Figure 9.

Detailed Description of the Preferred Embodiments

[0022] As shown in Figure 1 and 2, the thin bidirectional ratchet wrench, which refers to one detailed embodiment of the present invention, comprises a handle 20 and a working part 10, the handle 20 is socketed to the working

part 10 across the ring-shaped head 21 (see Figure 3) through longitudinal extension. Inside the working part 10 is main shaft 100, outside is a holding ring. One end of the main shaft is an output end 101 which extends beyond the working part 10 and the head 21 of the handle 20. The output end 101 can be a component, which is suitable to operate various fasteners like quoining screw, by mounting different sleeves.

[0023] The thin bidirectional ratchet wrench of the present invention consists of a driving mechanism coupling with a reversing mechanism, the input torque from the handle 20 is transmitted to the main shaft 100 of the working part 10 through the driving mechanism, and make the direction of the output torque from the output end 101 be the first direction or the second direction, wherein the first direction and the second direction are opposite. Such as, when the input torque of the working part 10 is a clockwise torque or an anticlockwise torque, the output torque of the output end 101 is a clockwise torque; or, when the input torque of the working part 10 is a clockwise torque or an anticlockwise torque, the output torque of the output end 101 is an anticlockwise torque.

[0024] The structure of the driving mechanism of the thin bidirectional ratchet wrench of the present invention is shown in Figure. 3, consists of a first ratchet surface 311, a capstan gear 312, a second ratchet surface 321, a follower gear 322, a transmission seat 330, an idle gear 331 and 332. Wherein, the first ratchet surface 311 and the capstan gear 312 connect and be coaxial with each other, in this embodiment, the first ratchet surface 311 is disposed in the inner circumference of the ring-shaped head 21 of the handle 20, the driving engages with the head 21 of the handle 20, thus the head 21 will drive driving gear to rotate when the handle 20 rotates, in other embodiment, the first ratchet surface 311 can be disposed in the inner circumference of capstan gear 312; the second ratchet surface 321 can be disposed in the inner circumference of follower gear 322. The faces of the first ratchet surface 311 and the second ratchet surface 321 connect with the outer face of the main shaft 100; the capstan gear 312 and the follower gear 322 are face-gears, faces of the capstan gear 312 and the follower gear 322 are face to face. The first ratchet 311, the second ratchet 321, the capstan gear 312 and the follower gear 322 are coaxial and the center axes thereof overlap in that of the main shaft 100.

[0025] The transmission seat 330 and the holding ring 102 are fixed together. The idle gear 331, 332 are mounted on the transmission seat 330, which is perpendicular to the main shaft 100. The idle gear 3331, 333 are matched between the capstan gear 312 and the follower gear 322, their tooth engage with the tooth of the capstan gear 312 and the follower gear 322 to drive respectively, when the holding ring 102 is fixed, or the transmission seat 330 is fixed, the capstan gear 312 will drive the follower gear 322 to rotate via the idle gear 331, 331. In this embodiment, the idle gear 331, 332 are angle gears.

[0026] The structure of the reversing mechanism of the thin bidirectional ratchet wrench of the present invention is shown in Figure 4, comprises a newel, a reversing switch consisting of a first spring-loaded plunger 221 and a second spring-loaded plunger 222, a first pawl element 211 and a second pawl element 212. Wherein, the newel 220 is fixed in the main shaft 100, spring 224 is arranged on the newel, which is between the first end 2201 of the newel 220 and the main shaft 100, the first spring-loaded plunger 221 and the second spring-loaded plunger 222 are fixed on the newel 220 in turn, the first spring-loaded plunger 221 and the second spring-loaded plunger 222 are perpendicular to the main shaft 110 along the active direction, preferably, the first spring-loaded plunger 221 and the second spring-loaded plunger 222 have elastic elements such as a spring. The first pawl element 221 and second pawl element 222 are fixed on the main shaft 100 across the countershaft 210, as shown in Figure 5, the countershaft 210 is parallel to the center axis of the main shaft 100 but it does not overlap in it, the pawl element 221 and the second pawl element 222 can rotate round the countershaft 210.

[0027] The first pawl element 211 and the first pawl element 212 have a similar structure, namely a first fan-shaped pawl, a second fan-shaped pawl and a fan-shaped space between them. Take the first pawl element 211 for example, Figure 6 shows the top view of the first pawl element 211 (direction towards the output end 101 along the main shaft 100), as can be seen from Figure 6, the first pawl element 211 consists of the first fan-shaped pawl 2111, the second fan-shaped pawl 2112 and the fan-shaped space between them. The fan-shaped face of the first fan-shaped pawl 2111, the fan-shaped space center section and the fan-shaped face of the second fan-shaped pawl 2112 constitutes the first surface of the first pawl element 211. The first pawl element 211 also has a second surface which is a special shaped surface and contains a concave section 2113, which has a first side wall 2114 and a second side wall 2115, in this embodiment. The first side wall 2114 and the second side wall 2115 extend along the main shaft 100. The first pawl element 211 has a hole 2101 which is matched with the countershaft 210, the countershaft 210 fixes the first pawl element 211 on the main shaft across the hole 2101 (see Figure 5). In this embodiment, the hole 2101 is arranged on the fan-shaped center section of the first pawl element 211, preferably, on the center of gravity of the first pawl element 211. The structure of the second pawl element 212 is similar to the first pawl element 211, no more description, its thickness is less than that of the first pawl element 211 in this embodiment, but in other embodiments, its thickness can be equal to or more than that of the first pawl element 211.

[0028] The first surface of the first pawl element 211 and the second pawl element 212 face to the first ratchet surface 311 and the second ratchet surface 321 respectively, specifically, the tooth of the fan-shaped pawl (which contains the first fan-shaped pawl 2111 and the

second fan-shaped pawl 2112) of the first pawl element 211 face to the tooth of the first ratchet 311, the tooth of the fan-shaped pawl (contains the first fan-shaped pawl and the second fan-shaped pawl) of the second pawl element 212 face to tooth of the second ratchet surface 321. The second surface of the first pawl element 211 and the second pawl element 212 face to the surface of the newel 220, specifically, the second surface of the first pawl element 211 faces to the ball-head section of the first spring-loaded plunger 221, the second surface of the second pawl element 212 faces to the ball-head section of the second spring-loaded plunger 222. Across the newel 220, the ball-head section of the first spring-loaded plunger 221 connects with the first side wall 2114 of the concave section 2113 of the first pawl element 211, the ball-head section of the second spring-loaded plunger 222 connects with the first side wall of the concave section of the second pawl element 212, when the thin bidirectional ratchet wrench of the present invention is on the first working mode; or, the ball-head section of the first spring-loaded plunger 221 connects with the second side wall 2115 of the concave section 2113 of the first pawl element 211, the ball-head section of the second spring-loaded plunger 222 connects with the second side wall of the concave section of the second pawl element 212, when the thin bidirectional ratchet wrench of the present invention is on the second working mode.

[0029] When the thin bidirectional ratchet wrench of the present invention is on the first working mode, see Figure 7, the tooth of the first fan-shaped pawl 2111 of the first pawl element 211 connects with the tooth of the first ratchet surface 311, similarly, the tooth of the first fan-shaped pawl of the second pawl element 212 connects with the tooth of the second ratchet surface 321. When the head 21 of the handle 20 drives the first ratchet surface 311 to rotate, when the moving direction of the first ratchet surface 311 beside the first fan-shaped pawl 2111 is from the first fan-shaped section 2111 to the second fan-shaped section 2112, namely the first ratchet surface 311 rotates clockwise seen in the Figure 7, since the ball-head section of the first spring-loaded plunger 211 connects with the first side wall 2114 of the concave section 2113 of the first pawl element 211, the first ratchet surface 311 can drive the first pawl element 211 to rotate, namely the tooth of the first fan-shaped pawl 2111 engages with the tooth of the first ratchet surface 311, and rotation of the first pawl element 211 is transferred to the countershaft 210 through the main shaft 100, thus driving the main shaft 100 to rotate; but when the moving direction of the first ratchet surface 311 beside the first fan-shaped pawl 2111 is from the second fan-shaped section 2112 to the first fan-shaped section 2111, namely the first ratchet surface 311 rotates anticlockwise seen in the Figure 7, since the ball-head section of the first spring-loaded plunger 211 connects with the first side wall 2114 of the concave section 2113 of the first pawl element 211, the first ratchet surface 311 cannot drive the first pawl element 211 to rotate, namely the tooth of the first fan-shaped pawl 2111 does not engage with the tooth of the first ratchet surface 311.

[0030] Meanwhile, when the moving direction of the second ratchet surface 321 beside the first fan-shaped pawl of the second pawl element 212 is from the first fan-shaped section to the second fan-shaped section in the second pawl element 212, namely the second ratchet surface 321 rotates clockwise, since the ball-head section of the second spring-loaded plunger 222 connects with the first side wall of the concave section of the second pawl element 212, the second ratchet surface 321 can drive the second pawl element 212 to rotate, namely the tooth of the first fan-shaped pawl of the second pawl element 212 engages with the tooth of the second ratchet surface 312, and rotation of the second pawl element 212 is transferred to the countershaft 210 through the main shaft 100, thus driving the main shaft 100 to rotate; but when the moving direction of the second ratchet surface 321 beside the first fan-shaped pawl of the second pawl element 212 is from the second fan-shaped section to the first fan-shaped section in the second pawl element 212, namely the second ratchet surface 321 rotates anticlockwise, since the ball-head section of the second spring-loaded plunger 222 connects with the first side wall of the concave section of the second pawl element 212, the second ratchet surface 321 cannot drive the second pawl element 212 to rotate, namely the tooth of the first fan-shaped pawl of the second ratchet surface 321 does not engage with the tooth of the second ratchet surface 321.

[0031] Since the drive among the idle gear 331, 332, the capstan gear 312 and the follower gear 322, when the holding ring is fixed, the rotation direction of the second ratchet surface 321 is opposite to the first ratchet surface 311. It can be seen from this, when the thin bidirectional ratchet wrench of the present invention is on the first working mode, when the input torque from the working part 10 is a clockwise torque, it makes the first ratchet surface 311 rotate clockwise and the second ratchet surface 321 rotate anticlockwise, the first pawl element 211 engages with the first ratchet surface 311 and the second pawl element 212 does not engage with the second ratchet surface 321 at the moment, thus the first pawl element 211 drives the main shaft 100 to rotate clockwise and the output torque is a clockwise torque; when the input torque from the working part 10 is an anticlockwise torque, it makes the first ratchet 311 rotate anticlockwise and the second ratchet surface 321 rotate clockwise, the first pawl element 211 does not engage with the first ratchet surface 311 and the second pawl element 212 engages with the second ratchet surface 321 at the moment, thus the second pawl element 212 drives the main shaft 100 to rotate clockwise and the output torque is a clockwise torque.

[0032] When the thin bidirectional ratchet wrench of the present invention is on the second working mode, the tooth of the second fan-shaped pawl 2112 of the first pawl element 211 connects with the tooth of the first

ratchet surface 311, similarly, the tooth of the second fan-shaped pawl of the second pawl element 212 connects with the tooth of the second ratchet surface 321. When the head 21 of the handle 20 drives the first ratchet surface 311 to rotate, when the moving direction of the first ratchet surface 311 beside the second fan-shaped pawl 2112 is from the first fan-shaped section 2111 to the second fan-shaped section 2112, namely the first ratchet surface 311 rotates clockwise, since the ball-head section of the first spring-loaded plunger 211 connects with the second side wall 2115 of the concave section 2113 of the first pawl element 211, the first ratchet surface 311 cannot drive the first pawl element 211 to rotate, namely the tooth of the second fan-shaped pawl 2112 does not engage with the tooth of the first ratchet surface 311; but when the moving direction of the first ratchet surface 311 beside the second fan-shaped pawl 2112 is from the second fan-shaped section 2112 to the first fan-shaped section 2111, namely the first ratchet surface 311 rotates anticlockwise, since the ball-head section of the first spring-loaded plunger 211 connects with the second side wall 2115 of the concave section 2113 of the first pawl element 211, the first ratchet surface 311 can drive the first pawl element 211 to rotate, namely the tooth of the second fan-shaped pawl 2112 engages with the tooth of the first ratchet surface 311, and the rotation of the first pawl element 211 is transferred to the main shaft 100 through the countershaft 210, thus driving the main shaft 100 to rotate.

[0033] Meanwhile, when the moving direction of the second ratchet surface 321 beside the second fan-shaped pawl of the second pawl element 212 is from the first fan-shaped section to the second fan-shaped section in the second pawl element 212, namely the second ratchet surface 321 rotates clockwise, since the ball-head section of the second spring-loaded plunger 222 connects with the second side wall of the concave section of the second pawl element 212, the second ratchet surface 321 cannot drive the second pawl element 212 to rotate, namely the tooth of the second fan-shaped pawl of the second pawl element 212 does not engage with the tooth of the second ratchet surface 312; but when the moving direction of the second ratchet surface 321 beside the second fan-shaped pawl of the second pawl element 212 is from the second fan-shaped section to the first fan-shaped section in the second pawl element 212, namely the second ratchet surface 321 rotates anticlockwise, since the ball-head section of the second spring-loaded plunger 222 connects with the second side wall of the concave section of the second pawl element 212, the second ratchet surface 321 can drive the second pawl element 212 to rotate, namely the tooth of the second fan-shaped pawl of the second ratchet surface 321 engages with the tooth of the f second ratchet surface 321, and the rotation of the second pawl element 212 is transferred to the main shaft 100 through the countershaft 210, thus driving the main shaft 100 to rotate.

[0034] Since the drive among the idle gear 331, 332, the driving gear 312 and the driven gear 322, when the holding ring is fixed, the rotation direction of the second ratchet surface 321 is opposite to the first ratchet surface 311. It can be seen from this, when the thin bidirectional ratchet wrench of the present invention is on the second working mode, when the input torque from the working part 10 is a clockwise torque, it makes the first ratchet surface 311 rotate clockwise and the second ratchet surface 321 rotate anticlockwise, the first pawl element 211 does not engage with the first ratchet surface 311 and the second pawl element 212 engages with the second ratchet surface 321 at the moment, thus the first pawl element 211 drives the main shaft 100 to rotate anticlockwise and the output torque is an anticlockwise torque; when the input torque from the working part 10 is an anticlockwise torque, it makes the first ratchet 311 rotate anticlockwise and the second ratchet surface 321 rotate clockwise, the first pawl element 211 engages with the first ratchet surface 311 and the second pawl element 212 does not engage with the second ratchet surface 321 at the moment, thus the second pawl element 212 drives the main shaft 100 to rotate anticlockwise and the output torque is an anticlockwise torque.

[0035] s previously mentioned, the first working mode and the second working of the thin bidirectional ratchet wrench of the present invention can be switched and selected via the newel 220. To be convenient, in this embodiment, as shown in Figure 8, the first end of the newel 220 has a knob 223, which would be matched with the newel 220 by embedding the two ears (ear 2201 in Figure 8) of the newel 220 into the knob 223. In this way, the newel 220 will rotate when turning the knob 223. In this embodiment, two spines protrude out of the surface of the knob 223, such as spine 2231, turning of the knob 223 can be achieved by putting rotating torque on the two spines including the spine 2231.

[0036] The thin bidirectional ratchet wrench of the present invention also contains a blocking device, which keeps the thin bidirectional ratchet wrench of the present invention on the working mode selected until the operator switch it to the other mode artificially. In Figure 9 and 10, the blocking device in this embodiment consists of a spring 224 arranged on the newel 220, a ball 400 disposed between the output end 101 and the second end of the newel 220, a recess matched with the ball 400 on the second end of the newel 220, specifically, the first recess 410 and the second recess 421. The first recess 410 and the second recess 421 are parallel with each other and are separated by the smooth spine; directions between the spine and the newel have an angle.

[0037] The spring 224 keeps a force, which is from the second end 2202 of the newel 220 to the first end 2201, on the newel 220 and the main shaft 100, the ball 400 is in the first recess 410 or in the second recess 421 beside the second end 2202 right now. When turning the knob 223, the spring 224 is compressed, the ball 400 is beside one end of the first recess 410 or in the second recess 421, the ball 400 can move into the second recess 420

from the first recess 410 or vice versa, and reset the ball 400 back to the first recess 410 or the second recess 421 beside the second end 2202.

[0038] When the ball 400 is in the first recess 410, the head working part of the first spring-loaded plunger 221 and the second spring-loaded plunger 222 keeps connecting with the first side wall of the concave section of the first pawl element 211 and the second pawl element 222 respectively, namely the first working mode of the thin bidirectional ratchet wrench of the present invention; when the ball 400 is in the second recess 420, the head working part of the first spring-loaded plunger 221 and the second spring-loaded plunger 222 keeps connecting with the second side wall of the concave section of the first pawl element 211 and the second pawl element 222 respectively, namely the second working mode of the bidirectional wrench of the present invention. When turning the knob 223 to rotate the newel 220 and let the ball 400 move from the first recess 410 to the second recess 420, the thin bidirectional ratchet wrench of the present invention turns from the first working mode to the second working mode; when turning the knob 223 to rotate the newel 220 and let the ball 400 move from the second recess 420 to the first recess 410, the bidirectional wrench of the present invention turns from the second working mode to the first working mode.

[0039] In this embodiment, the transmission seat 330 engages with the holding ring 102 constantly, the transmission seat 330 is fixed with respect to the holding ring 102, thus when the working part 20 rotates with respect to the holding ring 102, the idle gear 331, 332 makes the follower gear 322 and the capstan 312 rotate in the opposite direction. In use, to keep the idle gear 331, 332 working and make sure that the second ratchet surface 321 and the first ratchet surface 311 rotate in the opposite direction, operator can orientate the transmission seat 330 by holding the holding ring 102, thus the capstan gear 312 drives the idle gear 331, 331 to rotate, and then drives the follower gear 322 to rotate, thereby making the second ratchet surface 321 and first ratchet surface 311 rotate in the opposite direction. It should be noted that in other embodiments of the present invention, other methods can also be taken to position the transmission seat 330 and thus drive the idle gear 331, 332 to work.

[0040] In addition, as described previously, the output end 101 of the thin bidirectional ratchet wrench of the present invention can be a component, which is suitable to operate various fasteners such as quoining screw, by mounting various sleeves, and the ball 400 in the blocking device can also be used to block the various sleeves which are mounted on the output end 101 at this moment.

[0041] In this embodiment, the first pawl element 211 is made of high strength material (such as injected powder metallurgy or NO. 45 steel, etc.) whose strength is 30-40% higher than that of the conventional powder metallurgy material. Thickness (along the extended direction of the main shaft 100) of the first pawl element 211 is less than or equals to 6.5mm, thickness of the first ratchet surface 311 that engages with the first pawl element 211 equals to the thickness of the first pawl element 211. Thickness of the second pawl element 212 is less than or equals to that of the first pawl element 211, meanwhile, thickness between the front surface 3301 and the back surface 3302 of the transmission seat is less than or equals to 8mm, modulus of the idle gear is less than or equal to 1. Tooth of the capstan gear 312 and the follower gear 322 engage with the tooth of the idle gear. Therefore, thickness (namely the distance between the front surface 103 of the holding ring and the back surface 3301 of the main shaft 100 along the extended direction of the main shaft 100) of the working part is less than or equals to 30mm.

[0042] This embodiment reduces the thickness of all the parts in the working part (along the extending direction of the main shaft 100) on the basis of satisfying the output torque needed, hence reduces the whole thickness of the working part largely, namely it can be used in narrow space easily and satisfy the torque needed to tighten fasteners.

[0043] In the other embodiment, the first pawl element 211 is made of injected powder metallurgy, thickness of the first pawl element 211 is less than or equals to 5mm, thickness of the second pawl element 212 is less than or equals to that of the first pawl element 211, meanwhile, thickness of the transmission seat is less than or equals to 6mm, modulus of the idle gear is less than or equal to 0.6. Tooth of the capstan gear 312 and the follower gear 322 engage with the tooth of the idle gear. Thickness of the working part is 25mm.

[0044] In other embodiments, materials of pawl elements do not have to be high strength materials, by disposing third and fourth pawl element on the symmetrical position of the first pawl element and the second pawl element related to the main shaft, enough torque can be supplied at the same time reducing the thickness of the pawl element, thus achieving the purpose of reducing the thickness of the wrench.

[0045] What stated above described the preferred embodiment in detail. It should be understood that the ordinary skills in the art can make many modifications and variations according to the present invention without any creative work. Therefore, any modification, equivalent replacement and improvement made to the present invention without going beyond the spirit and principle of the present invention shall be within the scope of the appended claims.

Claims

1. A thin bidirectional ratchet wrench, comprising a working part and a handle, **characterized in that** the working part comprises
   a main shaft, which is used to output torque and whose axis is perpendicular to the handle;
   a capstan gear, a follower gear, an transmission seat

and an idle gear, the capstan gear, the follower gear and the transmission seat being all mounted on the main shaft, the axis of the transmission seat being perpendicular to the axis of the main shaft, and the idle gear being mounted on the transmission seat and rotating between the capstan gear and the follower gear, wherein

the handle entrains the capstan gear to rotate, and the transmission seat is equipped with a holding device, when holding the holding device and rotating the handle to entrain the capstan gear, the capstan gear entraining the follower gear to rotate reversely via the idle gear;

a first ratchet surface rotating together with the capstan gear, and a second ratchet surface rotating together with the follower gear;

a first pawl element and a second pawl element which could drive the main shaft to rotate; wherein

the first pawl element has a first pawl and a second pawl which are matched with the first ratchet selectively, wherein the first pawl skids on the first ratchet surface in the first direction but engages with the first ratchet surface in the second direction, and the second pawl engages with the first ratchet surface in the first direction but skids on the first ratchet surface in the second direction;

the second pawl element has a third pawl and a forth pawl which are matched with the second ratchet selectively, wherein the third pawl skids on the first ratchet surface in the first direction but engages with the first ratchet surface in the second direction, and the forth pawl engages with the first ratchet surface in the first direction but skids on the first ratchet surface in the second direction;

a reversing switch, which is capable of setting the first pawl element and the second pawl element on a first condition and a second condition, the first pawl and the third pawl being matched with the first ratchet surface and the second ratchet respectively under the first condition; the second pawl and the forth pawl being matched with the first ratchet surface and the second ratchet respectively under the second condition;

the first direction being clockwise or anticlockwise, and the second direction being opposite to the first direction;

the thickness of the working part being less than or equal to 30mm.

2. The thin bidirectional ratchet wrench as claimed in claim 1, wherein, thickness of the first pawl element is less than or equal to 6.5mm, and thickness of the second pawl element is less than or equal to the thickness of the first pawl element.

3. The thin bidirectional ratchet wrench as claimed in claim 1, wherein, thickness of the second pawl element is less than or equal to 6.5mm, and thickness of the first pawl element is less than or equal to the thickness of the second pawl element.

4. The thin bidirectional ratchet wrench as claimed in claim 1, wherein, thickness of the transmission seat is less than 8mm, and modulus of the idle gear is less than or equal to 1.

5. The thin bidirectional ratchet wrench as claimed in claim 1, wherein, material of the first pawl element is injected powder metallurgy.

6. The thin bidirectional ratchet wrench as claimed in claim 1, wherein, the thickness of the first pawl element is 5mm, the thickness of the second pawl element is less than the first pawl element's, the thickness of the transmission seat is 6mm, the modulus of the idle gear is 0.6, and the thickness of the working part is 25mm.

7. The thin bidirectional ratchet wrench as claimed in claim 1, wherein, axis of the countershaft is parallel to but not overlap in the main shaft, and the countershaft engages with the main shaft and is capable of entraining the main shaft to rotate.

8. The thin bidirectional ratchet wrench as claimed in claim 7, wherein, the countershaft drills through the main shaft.

9. The thin bidirectional ratchet wrench as claimed in claim 1, wherein, the reversing switch comprises a newel, a spring, a first spring-loaded plunger and a second spring-loaded plunger, the newel being disposed inside the main shaft, the spring being disposed on the newel, the first spring-loaded plunger and the second spring-loaded plunger being fix on the newel in turn, and the first spring-loaded plunger and the second spring-loaded plunger being matched with the respectively.

10. The thin bidirectional ratchet wrench as claimed in claim 9, wherein, springs are disposed inside the first spring-loaded plunger and the second spring-loaded plunger.

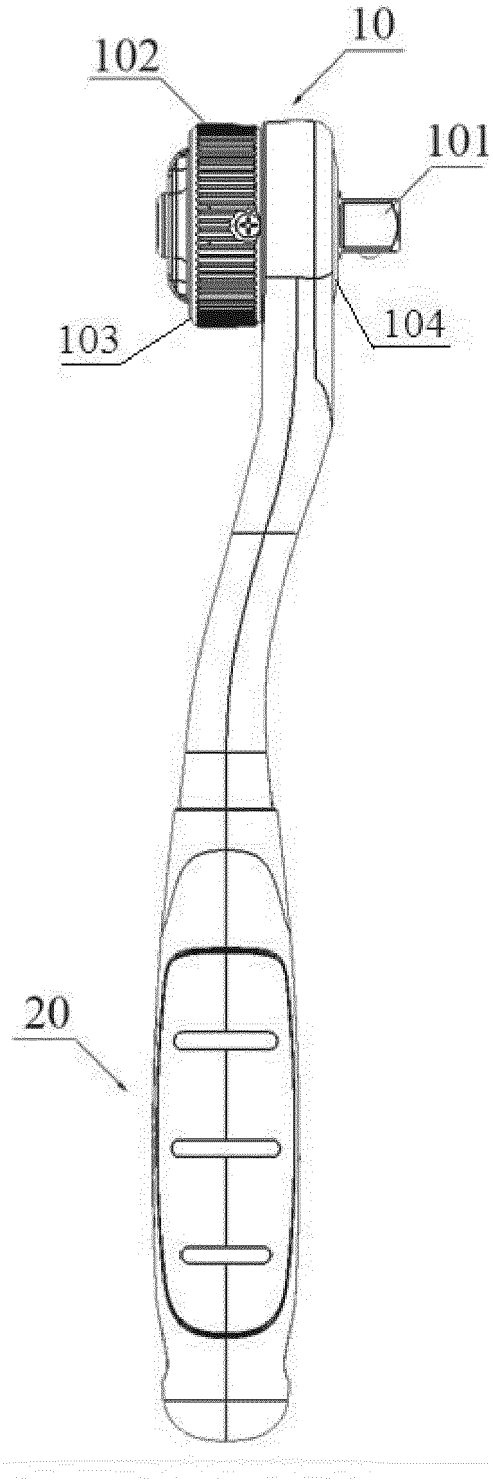

Fig. 1

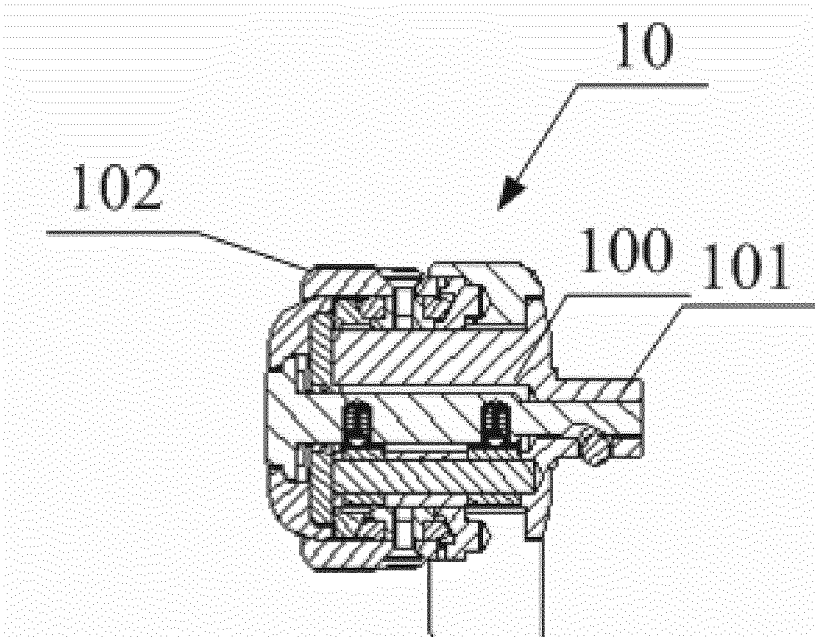

Fig. 2

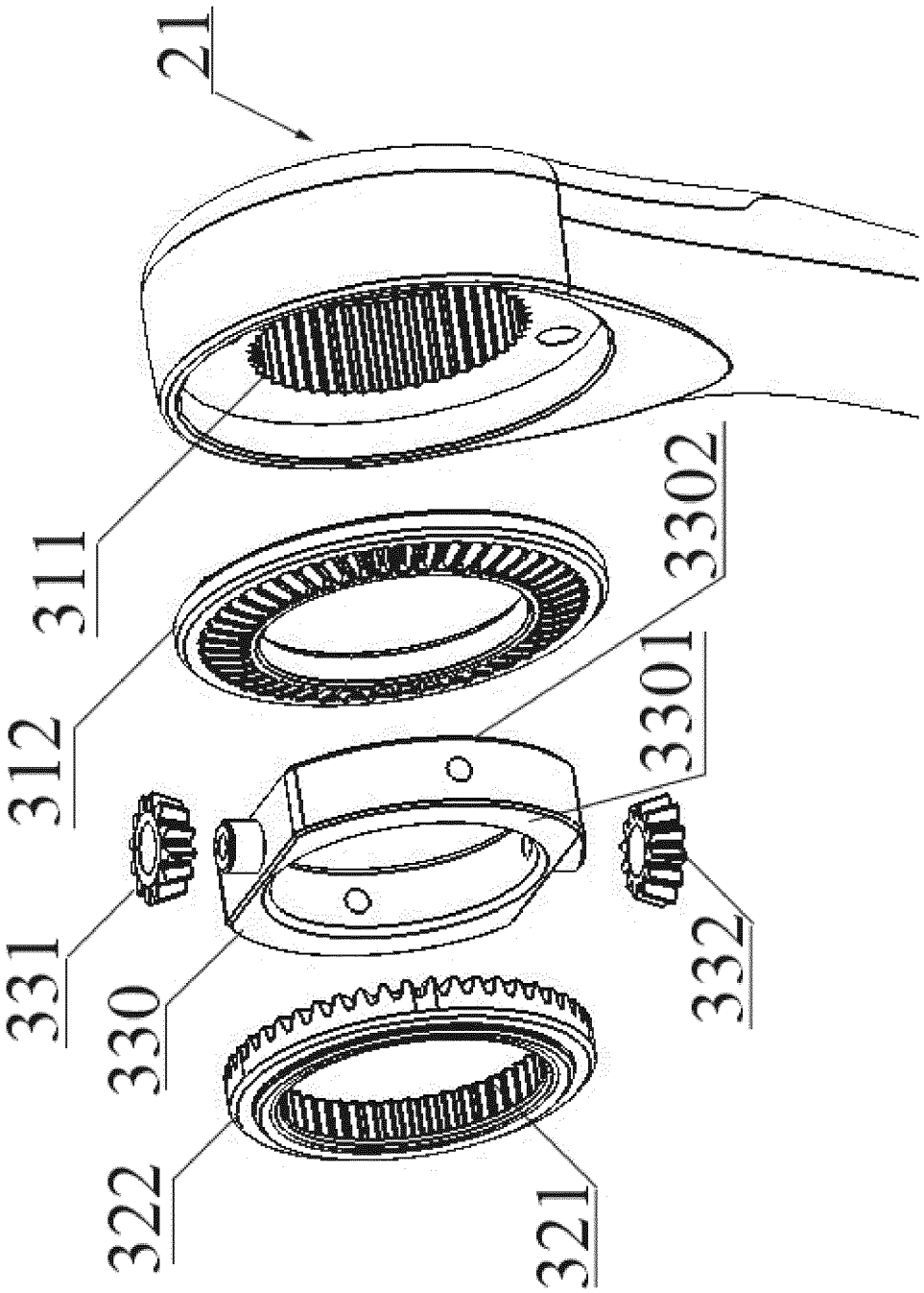

Fig. 3

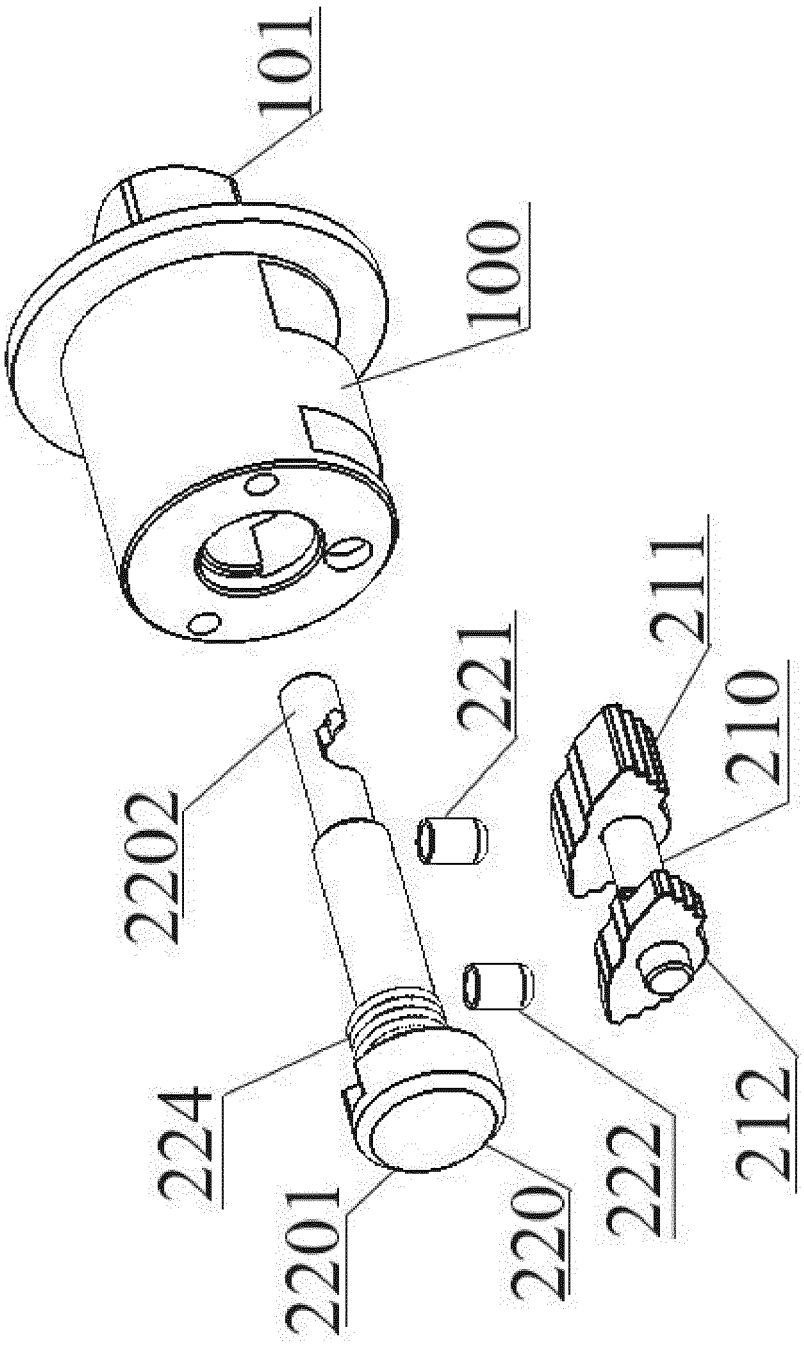

Fig. 4

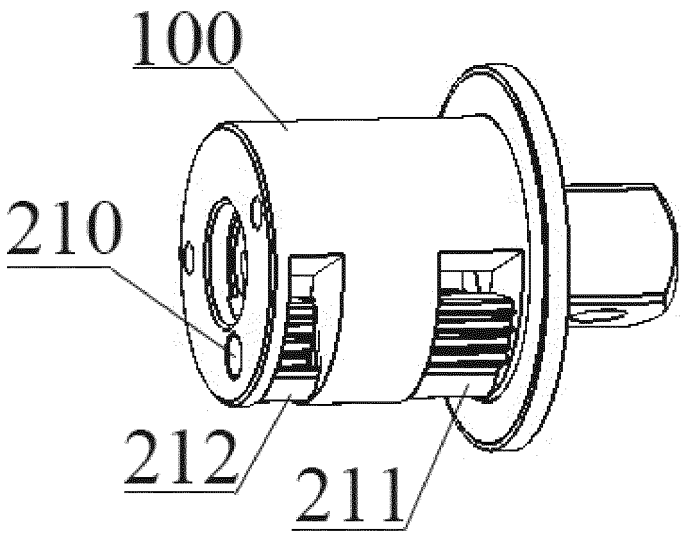

Fig. 5

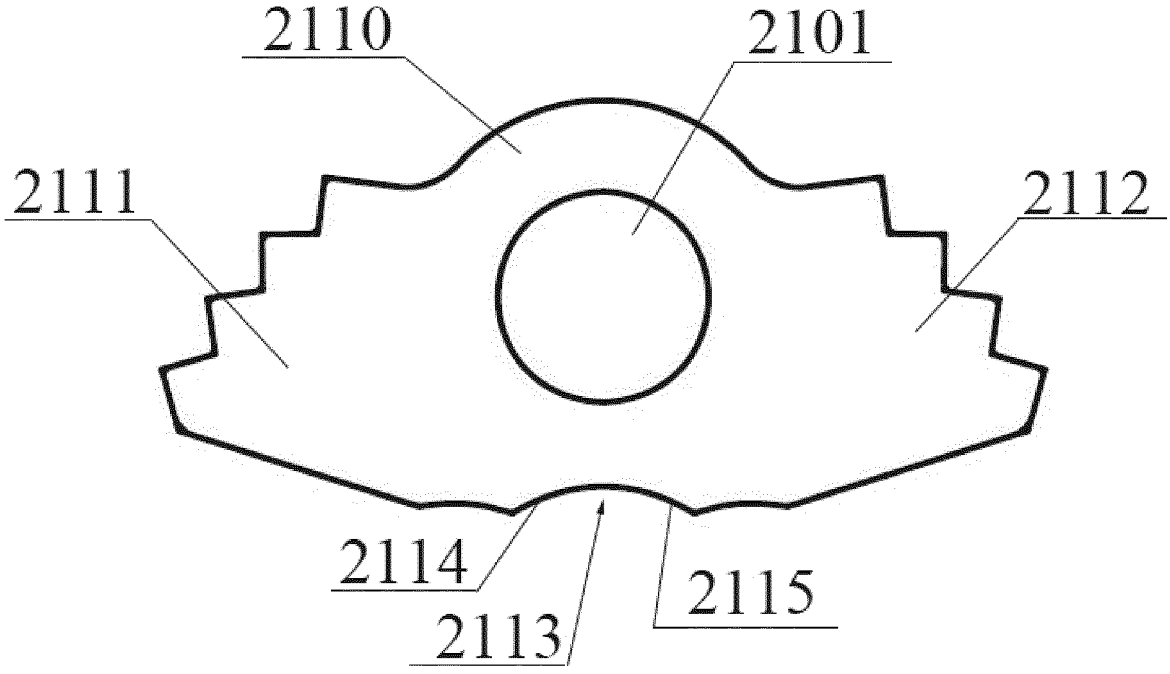

Fig. 6

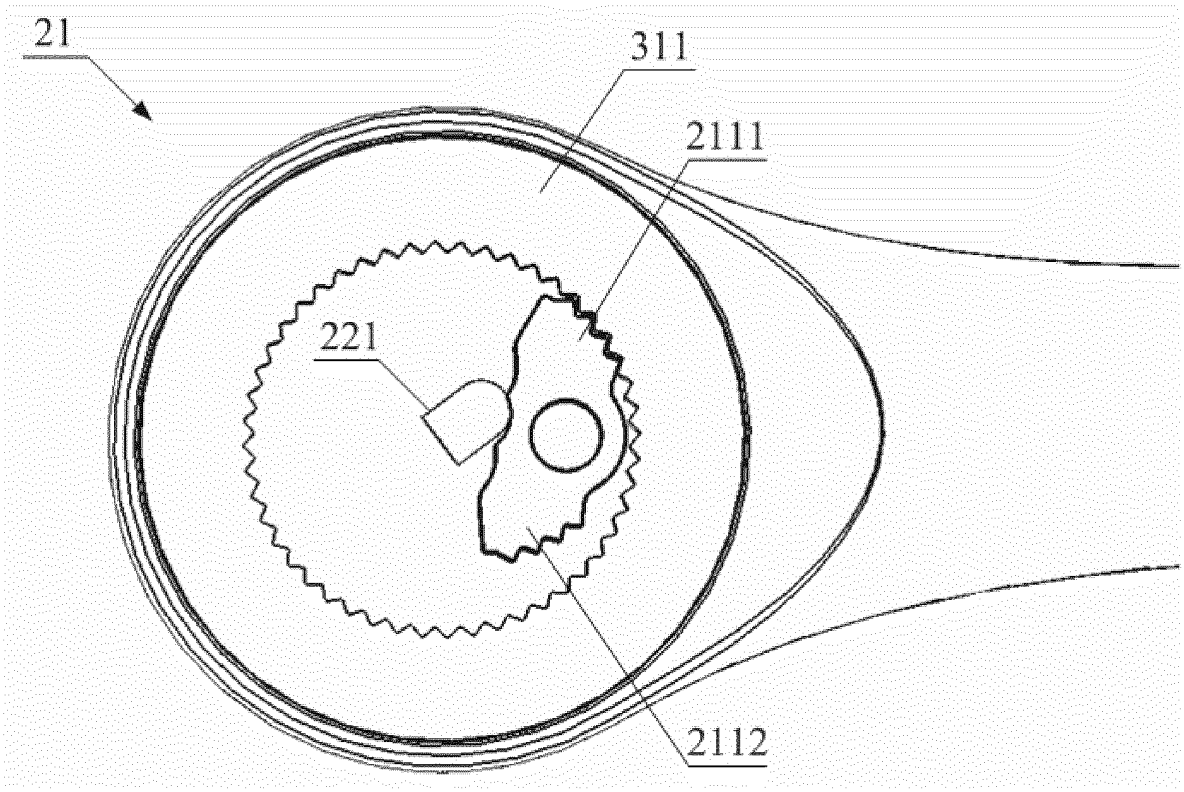

Fig. 7

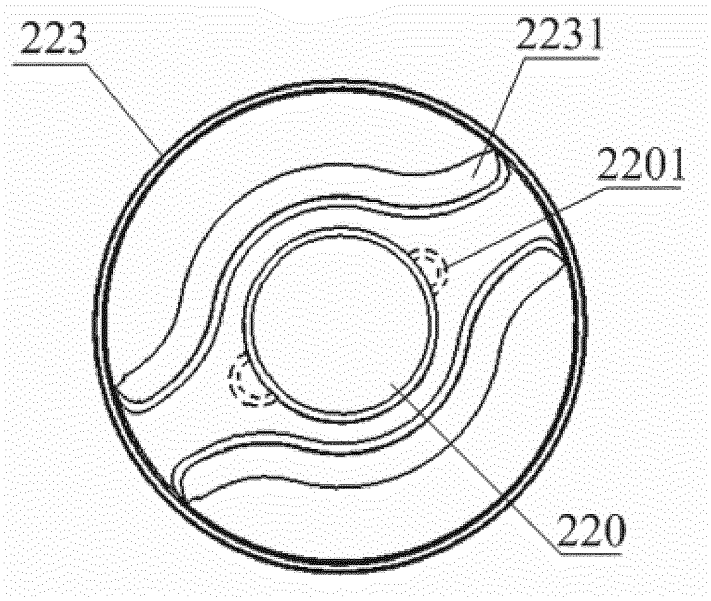

Fig. 8

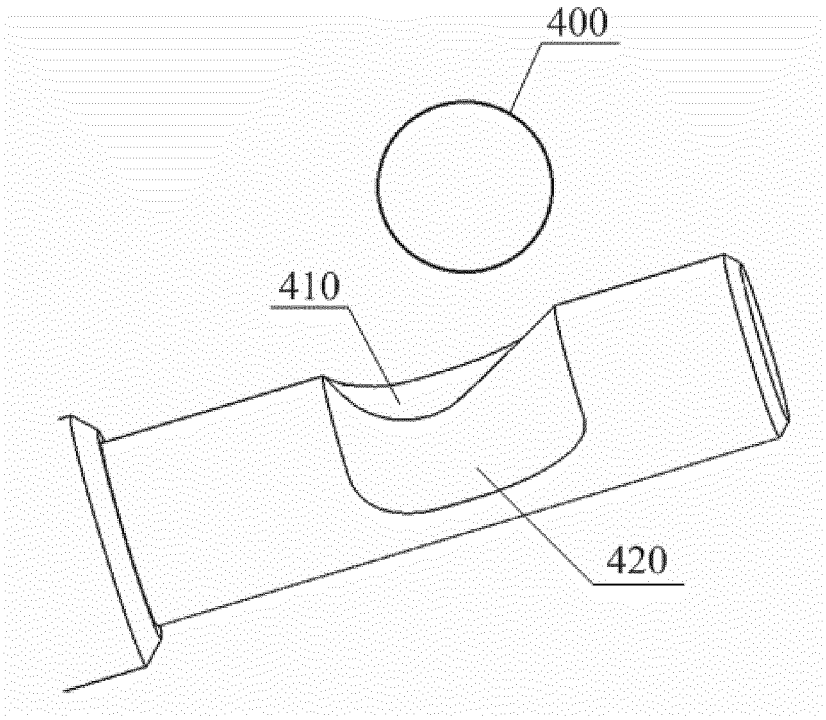

Fig. 9

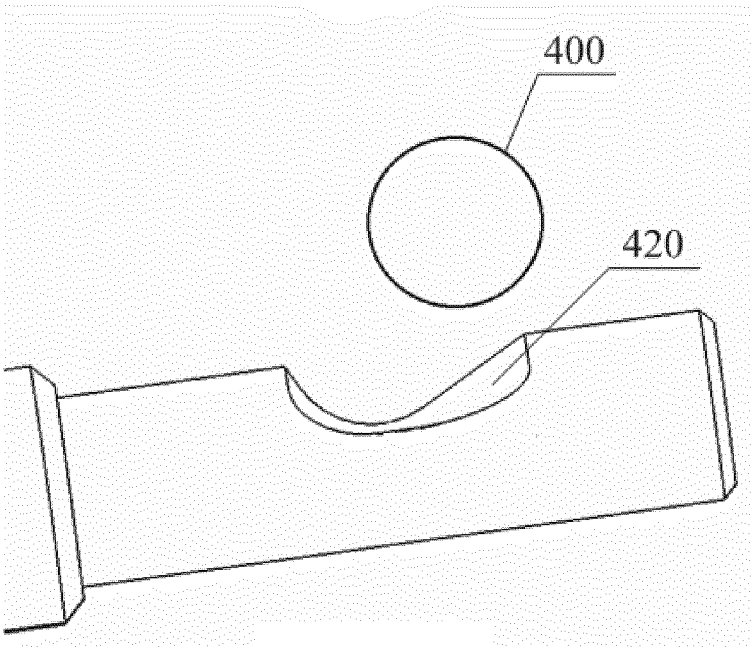

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2014/080303

A. CLASSIFICATION OF SUBJECT MATTER

B25B 13/46 (2006.01) i; B25B 23/00 (2006.01) i
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B25B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNKI, CNPAT, WPI, EPODOC: wrench, spanner, ratchet, wheel, tooth, gear, pawl, pallet, detent, bidirectional, reversible

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 203045591 U (HANGZHOU GREATSTAR TOOL CO LTD et al.) 10 July 2013 (10.07.2013) claims 1-10, and figures 1-10	1-10
A	CN 203245777 U (HANGZHOU GREATSTAR TOOL CO LTD et al.) 23 October 2013 (23.10.2013) the whole document	1-10
A	CN 201147913 Y (QI JIANZHONG et al.) 12 November 2008 (12.11.2008) the whole document	1-10
A	CN 201211654 Y (WU TIANGUO) 25 March 2009 (25.03.2009) the whole document	1-10
A	US 6044731 A (HSIEH, CHIH-CHING) 04 April 2000 (04.04.2000) the whole document	1-10
A	US 2010/0275737 A1 (LIN, CHIEN-YUEH) 04 November 2010 (04.11.2010) the whole document	1-10

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&"document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 August 2014	29 September 2014
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer YANG, Lin Telephone No. (86-10) 62413054

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2014/080303

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 203045591 U	10 July 2013	WO 2014110905 A1	24 July 2014
CN 203245777 U	23 October 2013	None	
CN 201147913 Y	12 November 2008	None	
CN 201211654 Y	25 March 2009	None	
US 6044731 A	04 April 2000	None	
US 2010/0275737 A1	04 November 2010	None	

Form PCT/ISA /210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5931062 A **[0003]**
- CN 201320028403 **[0004]**