



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
30.07.2014 Bulletin 2014/31

(21) Application number: **13152860.6**

(22) Date of filing: **28.01.2013**

(51) Int Cl.:
B25B 21/02 (2006.01) **B25D 11/06** (2006.01)
B25D 16/00 (2006.01) **B25F 3/00** (2006.01)
B25F 5/00 (2006.01) **B25C 1/06** (2006.01)
B25D 17/00 (2006.01)

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME

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(54) **A multi-tool for fasteners**

(57) This invention discloses a multi-tool for fasteners includes a housing (1), a power device (2), a transmission device (3) coupled to the power device mechanically, an output device (8) coupled to the transmission devices and a switching device which can be switched between at least two operating modes. In a first operating mode, the output device moves in a reciprocation manner without rotation along an axial direction, and in a second operating mode, the output device rotates with an intermittently increased torque along a circumferential direction. The switching device includes a limiting member (9; 10;11;12) and the limiting member can be moved between a first position and a second position, wherein, in the first position, the output device is in the first operating mode, and in the second position, the output device is in the second operating mode.

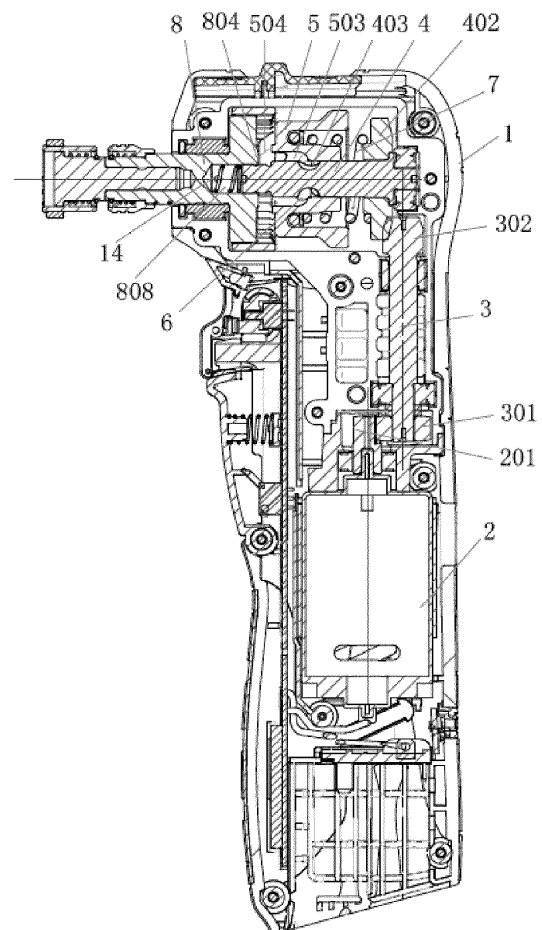


FIG. 1

Description

Technical Field of the Invention

[0001] The present invention generally relates to hand-held power tools for fasteners, and more particularly relates to a multi tool for fasteners.

Background of the Invention

[0002] During the process of manufacturing the wooden furniture and building the wooden frame structure houses, some fasteners such as screws, bolts, nails and the like are commonly used. Currently, various hand tools or hand-hold power tools are utilized to operate the above fasteners. For example, an electric screwdriver is used to screw up the screws, and an electric spanner is used to screw up the bolts, and an electric hammer is used to strike the nails. However, such tools are generally used to act on only one kind of the fasteners. For example, the electric hammer is only used to strike the nails but not to screw up the screws. Therefore, during the actual operation, it is necessary for the operator to frequently replace the tools to adapt to the different fasteners.

Summary of the Invention

[0003] This invention proposes a multi-tool for fasteners, which can be switched between different operating modes, so that different fasteners, such as screws, bolts, nails and the like, can be operated by only one tool.

[0004] The technical problem to be solved by the present invention is to provide a multi-tool for fasteners, wherein the output device of the multi-tool can be switched between at least two operating modes, so that different fasteners, such as screws, bolts, nails and the like, can be operated by only one tool.

[0005] A multi-tool for fastener includes a housing, a power device, a transmission device coupled to the power device mechanically; an output device coupled to the transmission device mechanically and can be switched between at least two operating modes. In a first operating mode, the output device moves in a reciprocation manner without rotation along an axial direction, and in a second operating mode, the output device rotates with an intermittently increased torque along a circumferential direction. And the multi-tool more includes a switching device. The switching device includes a limiting member and the limiting member being moveable between a first position and a second position. In the first position, the output device is in the first operating mode, and in the second position, the output device is in the second operating mode.

[0006] According to the multi-tool for fasteners, the transmission device includes a hammer having a striking portion at one end thereof. And the output device has a hammer anvil having an anvil portion to engage with the striking portion of the hammer. An engaging surface be-

tween the striking portion and the anvil portion is configured as one of inclined surface and curved surface.

[0007] According to the multi-tool for fasteners, the hammer anvil includes a teeth portion in the circumferential direction, and the limiting member is an inner gear ring, wherein, in the first position, the limiting member engages with the teeth portion of the hammer anvil, and in the second position, the limiting member disengages from the teeth portion of the hammer anvil.

[0008] According to the multi-tool for fasteners, define a locating hole in the hammer anvil, and the limiting member is a locking pin. In the first position, the limiting member engages with the locating hole of the hammer anvil, and in the second position, the limiting member disengages from the locating hole of the hammer anvil.

[0009] According to the multi-tool for fasteners, the limiting member is a locking ring, and at least a protruding portion is disposed on the inner side of the locking ring. In the first position, the protruding portion of the limiting member engages with the anvil portion of the hammer anvil, and in the second position, the protruding portion of the limiting member disengages from the anvil portion of the hammer anvil.

[0010] According to the multi-tool for fasteners, define at least a locating surface on the periphery surface of the hammer anvil, and the limiting member is a locking rod having a notch. In the first position, the notch of the limiting member is orientated opposite to the locating surface of the hammer anvil, and in the second position, the notch of the limiting member is orientated towards the locating surface of the hammer anvil.

[0011] According to the multi-tool for fasteners, the transmission device has a hammer and a hammer anvil, the output device has an output shaft. The hammer has a striking portion at one end thereof. The hammer anvil has an anvil portion which engages with the striking portion of the hammer at one end and a first engaging portion at the other end. The output shaft has a second engaging portion at one end. The first engaging portion can engage with the second engaging portion, and an engaging surface between the first engaging portion and the second engaging portion is configured as one of inclined surface and curved surface.

[0012] According to the multi-tool for fasteners, the output shaft is provided with at least one locating surface on the periphery surface, and the limiting member is a locking rod having a notch. In the first position, the notch of the limiting member is orientated opposite to the locating surface of the output shaft, and in the second position, the notch of the limiting member is orientated towards the locating surface of the output shaft.

[0013] According to the multi-tool for fasteners, further comprises a bias element disposed between the hammer and the hammer anvil to provide a bias pressure along a direction for separating the hammer from the hammer anvil.

[0014] According to the multi-tool for fasteners, the transmission device is coaxially connected with the out-

put device.

[0015] According to the multi-tool for fasteners, the output device comprises a strike-transmitting portion for transmitting striking force in the first operating mode and a rotation-transmitting portion for transmitting torque in the second operating mode.

[0016] According to the a multi-tool for fasteners, the output device comprises a hammer anvil; the rotation-transmitting portion is a gripping head disposed on one end of the hammer anvil; and the strike-transmitting portion is a striking accessory connected with the gripping head.

[0017] According to the multi-tool for fasteners, the striking accessory comprises a handle portion connected with the gripping head and a striking portion having a stressed end configured to contact the end of the hammer anvil.

[0018] According to the multi-tool for fasteners, the output device comprises a hammer anvil; the strike-transmitting portion is a rectangular head disposed on one end of the hammer anvil; and the rotation-transmitting portion is a rotating accessory connected with the rectangular head.

[0019] According to the multi-tool for fasteners, the strike-transmitting portion comprises a striking surface and a nail-accommodating mechanism.

[0020] According to the multi-tool for fasteners, the striking surface is configured as one of plane surface, inwards-concave surface or outwards-convex surface.

[0021] According to the multi-tool for fasteners, the nail-accommodating mechanism comprises a sleeve protruding out from the striking surface.

[0022] According to the multi-tool for fasteners, further comprising a magnetic element disposed at the periphery of the sleeve.

[0023] According to the multi-tool for fasteners, the sleeve is made of non-magnetic conduction materials, and the magnetic element is a magnetic ring.

[0024] According to the multi-tool for fasteners, the rotation-transmitting portion comprises a receiving portion for connecting with the fasteners and having a hexagon or square inner peripheral surface.

[0025] According to the present invention, the multi-tool for fasteners can be switched between different operating modes so as to adapt to different fasteners, such as screws, bolts, nails and the like; it can not only avoid the inconvenience caused by continually replacing the tools during the operation so as to enhance the work efficiency of the operator, but also greatly save the costs of the tools by using only one tool to obtain the functions of multiple tools, and then it has notable economic benefit.

Brief Description of the Drawings

[0026]

Fig. 1 is a structural drawing of the multi-tool for

fasteners according to a first embodiment of the present invention;

Fig. 2 is a structural drawing of a limiting member according to a first example in the first embodiment of the present invention;

Fig. 3 is a structural drawing of a limiting member according to a second example in the first embodiment of the present invention;

Fig. 4 is a structural drawing of a limiting member according to a third example in the first embodiment of the present invention;

Fig. 5 is a structural drawing of a limiting member according to a fourth example in the first embodiment of the present invention;

Fig. 6 is a structural drawing of the multi-tool for fasteners according to a second embodiment of the present invention;

Fig. 7 is a structural drawing of a limiting member according to an example in the second embodiment of the present invention;

Fig. 8-A is a structural drawing of an output device of the present invention according to an example, wherein the output device is in the beginning stage of the striking operation;

Fig. 8-B is a structural drawing of the output device of the present invention according to an example, wherein the output device is in the ending stage of the striking operation;

Fig. 9 is a top view of the output device of the present invention according to an example, wherein the output device is in the striking operation;

Fig. 10 is a top view of the output device of the present invention according to an example, wherein the output device is in the rotating operation;

Fig. 11-A is a structural drawing of an output device of the present invention according to another example, wherein the output device is in the beginning stage of the striking operation;

Fig. 11-B is a structural drawing of the output device of the present invention according to another example, wherein the output device is in the ending stage of the striking operation;

- Fig. 12** is a structural drawing of the output device of the present invention according to another example, wherein the output device is assembled with a rotating accessory;
- Fig. 13** is a top view of the output device of the present invention according to another example, wherein the output device is in the striking operation; and
- Fig. 14** is a top view of the output device of the present invention according to another example, wherein the output device is in the rotating operation.

Detailed Description of the Preferred Embodiments

[0027] As shown in Fig.1, a multi-tool for fasteners according to a first embodiment of the present invention includes a housing 1, a power device (not labeled), a transmission device (not labeled), an output device (not labeled), an on-off device (not labeled) and a switching device (not labeled). The housing 1 is configured in the form of a common hand-hold power tool, such as angle type, gun type or palm type. The power device includes a motor 2 disposed in the housing 1 and a battery portion. The on-off device is disposed on a gripping portion of the housing 1 for operationally controlling the motor 2 to turn on or turn off. Alternatively, the on-off device can be configured as a pushing device linked with the output device, so that the motor 2 can be controlled to turn on by pushing movement. The pushing device can also operationally control the rotating speed of the motor 2 via the force exerted by pushing movement. If the force is larger, the rotating speed of the motor may be enhanced or the torque force may be increased, and if the force is smaller, the rotating speed of the motor may be reduced or the torque force may be decreased.

[0028] The power device is connected with the transmission device and provides a first rotation torque to the transmission device. The transmission device includes a first rotating shaft 3, a second rotating shaft 4 and a hammer 5. The first rotating shaft 3 is provided with a pinion 301 and a small bevel gear 302 at two ends thereof, respectively, and the pinion 301 is engaged with a pivot gear 201 on a pivot shaft of the motor. The second rotating shaft 4 is provided with a large bevel gear 402 at one end thereof, and the large bevel gear 402 is engaged with the small bevel gear 302 on the first rotating shaft 3. The second rotating shaft 4 is also provided with a first groove 403. The hammer 5 is provided with a striking portion 504 at one end thereof and a second groove 503 on the inner side thereof. The hammer 5 can be made of one kind of the material or more than one kind of materials with different rigidities. If the hammer 5 is made of two materials with different rigidities, one of the materials is preferably a soft material. The hammer 5 is mounted around the second rotating shaft 4 and connected

therewith by a ball 6 which is received between the first groove 403 and the second groove 503. A spring 7 is disposed between the hammer 5 and the large bevel gear 402 so as to provide a bias pressure along the hammer 5 in the direction away from the large bevel gear 402. In addition, the spring 7 can alternatively be replaced by a pair of magnetic rings which repels one another. The transmission principle is that: the pivot shaft of the motor drives the first rotating shaft 3 to rotate via the engagement between the gears, the first rotating shaft 3 drives the second rotating shaft 4 to rotate via the engagement between the bevel gears, and the second rotating shaft 4 drives the hammer 5 to rotate via the ball 6. Moreover, when the hammer 5 rotates with resistance, due to the movement of the ball 6 along the groove, the hammer 5 will move a distance towards the large bevel gear 402 against the bias pressure of the spring 7, and then rotatably move to the initial position under the action of the bias pressure of the spring 7. With the resistance in the rotation direction, the hammer 5 can rotatably and axially move in a reciprocation manner on the second rotating shaft 4, thereby generating an intermittently increased torque. In addition, the transmission device can alternatively be configured to not comprise the first rotating shaft 3, that is, the pivot shaft of the motor can directly drive the second rotating shaft 4 to rotate via the engagement between the gears.

[0029] The transmission device is coaxially connected with the output device and provides a second rotation torque and a bias force to the output device. The output device is connected with a tool head to act on the fasteners. The output device can be a 1/4" gripper or automatic one-handed gripper. Further, the output device can also comprise an additional rotating head. The output device of the tool for fasteners includes a hammer anvil 8 which includes an anvil portion 804 to engage with the striking portion 504 of the hammer, wherein the engaging surface between the striking portion 504 and the anvil portion 804 is configured as inclined surface or curved surface. Moreover, since the striking portion 504 and the anvil portion 804 can positively and negatively rotate, the engaging surface can be configured to have a positive engaging surface and a negative engaging surface, wherein the two engaging surfaces can be symmetrically disposed with the same inclined angle or asymmetrically disposed with different inclined angles, and also can be configured in such way that one of them is an inclined surface and the other is a vertical surface. In addition, the striking portion 504 and the anvil portion 804 comprise at least two pairs, so as to provide at least two contacting positions for striking when the hammer 5 and the hammer anvil 8 are operated for striking, namely, the hammer anvil 8 can have more than two pressured positions. As a result, it can effectively reduce the striking pressure to enhance the tool lifetime. Further, the contacting positions of the striking portion 504 and the anvil portion 804 can be made of the hard materials so as to enhance the energy transmission efficiency between the hammer and

the hammer anvil and prolong the service lifetime of the members. Preferably, the hard materials comprise hard alloy. The transmission principle is that: the rotating movement of the hammer 5 is divided into the rotation torque in the circumferential direction and the bias force in the axial direction by the inclined surface or curved surface. The hammer anvil 8 receives the rotation torque in the circumferential direction so as to rotatably move with an intermittently increased torque, and the hammer anvil 8 receives the bias force in the axial direction, it can move in a reciprocation manner in the axial direction under the action of the pushing movement of the operator. The switching device includes an operating member and a limiting member, and the operator can control the limiting member to move between a first position and a second position by operating the operating member. Preferably, the operating member is disposed in a range on the housing at which the hand of the operator can touch the operating member upon gripping the tool for fasteners; hence, the operator can switch the operating modes of the tool for fasteners by one-handed control. In the first position, the limiting member acts on the output device so that the output device is in a first operating mode. At this time, the limiting member can limit the rotation of the output device in the circumferential direction, and with the pushing movement of the operator, the output device can move in a reciprocation manner without rotation in the axial direction. In the second position, the limiting member disengages from the output device so that the output device is in a second operating mode. At this time, the circumferential limiting function of the limiting member is released and the output device can simultaneously move in a reciprocation manner and rotate with an intermittently increased torque in the axial direction.

[0030] According to a first example, as shown in Fig. 2, the hammer anvil 8 of the output device is provided with a teeth portion 805 in the circumferential direction, and the limiting member is an inner gear ring 9. In the first position, the inner gear ring 9 engages with the teeth portion 805 of the hammer anvil 8 to limit the rotation of the hammer anvil 8 in the circumferential direction, so that the hammer anvil 8 can move in a reciprocation manner without rotation in the axial direction under the action of the pushing movement of the operator. In the second position, the inner gear ring 9 disengages from the teeth portion 805 of the hammer anvil 8, and the circumferential limiting function of the hammer anvil 8 is released, so that the hammer anvil 8 can simultaneously move in a reciprocation manner and rotate with an intermittently increased torque in the axial direction.

[0031] According to a second example, as shown in Fig. 3, the hammer anvil 8 of the output device is provided with a locating hole 806, and the limiting member is a locking pin 10. In the first position, the locking pin 10 engages with the locating hole 806 of the hammer anvil 8 to limit the rotation of the hammer anvil 8 in the circumferential direction, so that the hammer anvil 8 can move in a reciprocation manner without rotation in the axial

direction under the action of the pushing movement of the operator. In the second position, the locking pin 10 disengages from the locating hole 806 of the hammer anvil 8, and the circumferential limiting function of the hammer anvil 8 is released, so that the hammer anvil 8 can simultaneously move in a reciprocation manner and rotate with an intermittently increased torque in the axial direction.

[0032] According to a third example, as shown in Fig. 4, the limiting member is a locking ring 11, and a protruding portion 1104 is disposed on the inner side of the locking ring 11. In the first position, the locking ring 11 is mounted around the hammer anvil 8 and the protruding portion 1104 of the locking ring 11 is engaged with the anvil portion 804 of the hammer anvil 8 to limit the rotation of the hammer anvil 8 in the circumferential direction, so that the hammer anvil 8 can move in a reciprocation manner without rotation in the axial direction under the action of the pushing movement of the operator. In the second position, the locking ring 11 disengages from the hammer anvil 8, and the circumferential limiting function of the hammer anvil 8 is released, so that the hammer anvil 8 can simultaneously move in a reciprocation manner and rotate with an intermittently increased torque in the axial direction.

[0033] According to a fourth example, as shown in Fig. 5, the periphery of the front end of the hammer anvil 8 is provided with at least one locating surface 806, and the limiting member is a locking rod 12 having a notch 1206. In the first position, the notch 1206 of the locking rod 12 is orientated opposite to the locating surface 806 on the periphery of the front end of the hammer anvil 8, and then the locking rod 12 can limit the rotation of the hammer anvil 8 in the circumferential direction, so that the hammer anvil 8 can move in a reciprocation manner without rotation in the axial direction under the action of the pushing movement of the operator. In the second position, the notch 1206 of the locking rod 12 is orientated towards the locating surface 806 on the periphery of the front end of the hammer anvil 8, thus the hammer anvil 8 can simultaneously move in a reciprocation manner and rotate with an intermittently increased torque in the axial direction in the notch 1206 of the locking rod 12.

[0034] Referring to Fig. 6, a multi-tool for fasteners according to the second embodiment of the present invention has a changed transmission device and a changed output device on the basis of the first embodiment. In this embodiment, the transmission device includes a hammer anvil 8 and the output device is an output shaft 13. The hammer anvil 8 has a first engaging portion 807 at the other end thereof. The output shaft 13 is connected with a tool head at one end and has a second engaging portion 1307 at the other end for engaging with the first engaging portion 807 of the hammer anvil 8, wherein the engaging surface therebetween is configured as inclined surface or curved surface. Moreover, since the hammer anvil 8 and the output shaft 13 can positively and negatively rotate, the engaging surface between the first engaging

portion 807 and second engaging portion 1307 can be configured to have a positive engaging surface and a negative engaging surface, wherein the two engaging surfaces can be symmetrically disposed with the same inclined angle or asymmetrically disposed with the different inclined angles, and also can be configured in such way that one of them is an inclined surface and the other is a vertical surface. The transmission principle is that: the rotating movement of the hammer anvil 8 is divided into the rotation torque in the circumferential direction and the bias force in the axial direction by the inclined surface or curved surface. The output shaft 13 receives the rotation torque in the circumferential direction so as to rotatably move with an intermittently increased torque. The output shaft 13 receives the bias force in the axial direction, thus it can move in a reciprocation manner in the axial direction under the action of the pushing movement of the operator.

[0035] According to an example, as shown in Fig. 7, the periphery of the output shaft 13 is provided with at least one locating surface 1306, and the limiting member is a locking rod 12 having a notch 1206. In the first position, the notch 1206 of the locking rod 12 is orientated opposite to the locating surface 1306 on the periphery of the output shaft 13, and then the locking rod 12 can limit the rotation of the output shaft 13 in the circumferential direction, so that the output shaft 13 can move in a reciprocation manner without rotation in the axial direction under the action of the pushing movement of the operator. In the second position, the notch 1206 of the locking rod 12 is orientated towards the locating surface 1306 on the periphery of the output shaft 13, thus the output shaft 13 can simultaneously move in a reciprocation manner and rotate with an intermittently increased torque in the axial direction in the notch 1206 of the locking rod 12.

[0036] According to an embodiment of the present invention, in the tool for fasteners according to the first embodiment or the second embodiment, the output device includes a strike-transmitting portion for transmitting striking force to the fasteners such as nails and a rotation-transmitting portion for transmitting torque to the fasteners such as screws. The portion of the strike-transmitting portion which acts on the fasteners is defined as a striking portion, and the striking portion includes a striking surface which is configured as one of plane surface, concave surface or convex surface. The striking portion can be provided with an additional nail-support mechanism on the periphery thereof. The nail-support mechanism includes a sleeve, an elastic element and a stopper element. The elastic element is disposed between the sleeve and the striking portion and is preferably configured as a spring so as to provide a bias pressure to the sleeve in the axial direction. The stopper element is disposed on the periphery of the striking portion to provide a resistance to the sleeve in a direction opposite to the direction of the bias pressure of the elastic element. Under the action of the bias pressure of the elastic element and the resistance of the stopper element, the sleeve

can be retained in a position at which the sleeve protrudes from the striking surface for a distance. Preferably, the distance is slightly greater than the axial dimension of the cap of the fastener such as nails. The operating principle of the nail-support mechanism is that: during the striking operation, the fastener is limited in a range defined by the sleeve and the striking surface, so as to avoid the fastener sliding out from the striking surface to cause the mistaken striking, which can effectively enhance not only the stability but also the safety of the striking operation. When the cap of the fastener gets close to the operating surface, the operating surface may abut against the sleeve to make it move backwards against the elastic bias pressure under the action of the pushing movement of the operator, so that the affect on the striking operation can be avoided. Moreover, a magnetic element can be additionally disposed at the periphery of the sleeve to provide attracting force to the fastener, which is helpful for the nail-support mechanism to retain the stability of the fastener during the operation. Preferably, the magnetic element is a magnetic ring and the sleeve is made of non-magnetic conduction materials.

[0037] As shown in Fig. 8-A and Fig. 8-B, according to a specific embodiment, the rotation-transmitting portion of the output device is configured as a gripping element 14 disposed on the end of the hammer anvil, and the strike-transmitting portion is configured as a striking accessory 15 connected with the gripping element 14.

[0038] The gripping element 14 is located at the output end of the hammer anvil 8 and includes a receiving portion 1401 and a casing 1402. The receiving portion 1401 has a hexagon circumferential surface and is disposed in the output end of the hammer anvil 8, wherein the circumferential surface is provided with two holes 1403 which respectively has a diameter gradually increased from the inside to the outside. The periphery of the receiving portion 1401 is mated with the casing 1402, and a convex portion 1404 and a concave portion 1405 are disposed adjacent one another in the inside of the casing 1402. A spring 1406 is disposed between the receiving portion 1401 and the casing 1402 to provide a bias pressure along the direction of the end of the hammer anvil. The receiving portion 1401 is also provided with a stopper element 1407 at the periphery thereof. The stopper element 1407 provides a resistance in a direction opposite to the direction of the bias pressure of the spring. Under the action of the bias pressure of the spring 1406 and the resistance of the stopper element 1407, the casing 1402 can be retained in a position at which the convex portion 1404 may face to the hole 1403. A locking element 1408 is disposed between the convex portion 1404 and the hole 1403, and a portion of the locking element 1408 can pass through the hole to enter into the receiving portion 1401. Preferably, the locking element 1408 is a steel ball. By biasing and moving the casing 1402 against the spring, the concave portion 1405 may face to the hole 1403, and then the locking element 1408 can radially move in a space formed between the concave portion

1405 and the hole 1403.

[0039] The striking accessory 15 is removably connected with the gripping element 14 and includes a handle portion 1501 and a striking portion 1502. The outer circumferential surface of the handle portion 1501 is configured as hexagon surface to fit with the inner circumferential surface 1401 of the receiving portion of the gripping element 14. The striking portion 1502 has a stressed end 1503 configured to contact the end of the output end of the hammer anvil 8 to receive the axial striking force transmitted from the hammer anvil 8 and a striking surface 1504 located at the other surface opposite to the stressed end to contact the fastener.

[0040] The nail-support mechanism 16 is disposed at the periphery of the striking accessory 15 and includes a sleeve 1601, a spring 1602 and a stopper flange 1603, and a magnetic ring 1604 is disposed at the periphery of the sleeve 1601. Referring to Fig. 8-A and Fig. 8-B, which illustrate the states of the nail-support mechanism 16 at the beginning and ending stages of the striking operation. At the beginning stage and during the striking operation, the nail-support mechanism 16 is in a state as shown in Fig. 8-A, wherein the sleeve 1601 protrudes from the striking surface 1504 for a distance. At the ending stage of the striking operation, the nail-support mechanism 16 is in a state as shown in Fig. 8-B, wherein the sleeve 1601 gradually moves backwards against the bias pressure of the spring 1602 and finally moves to a position flush with the striking surface 1504.

[0041] Referring to Fig. 9, when the striking operation is required for striking the fasteners such as nails, the striking accessory 15 may be connected with the gripping element 14 and the operating member of the switching device is pushed to a hammer mode. Referring to Fig. 10, when the rotating operation is required for rotating the fasteners such as screws, the striking accessory 15 may be replaced by a tool head matched with the fastener and the operating member of the switching device is pushed to a rotation mode.

[0042] As shown in Fig. 11-A and Fig. 11-B, according to another specific embodiment, the strike-transmitting portion of the output device is configured as a rectangular head 17 disposed on the end of the hammer anvil, and the rotation-transmitting portion is configured as a rotating accessory 18 connected with the rectangular head 17.

[0043] Since the output end of the hammer anvil 8 is configured as the rectangular head 17, the rectangular head portion is the striking portion, and the end surface 1701 of the rectangular head is the striking surface. The rectangular head is provided with a receiving hole 1702 in which a locking element 1703 is located. A spring 1704 is disposed between the receiving hole 1702 and the locking element 1703. Preferably, the locking element 1703 is a steel ball.

[0044] The locking element 1703 is disposed in the receiving hole 1702 against the bias pressure of the spring 1704 and a portion of the locking element 1703 protrudes

from the receiving hole 1702.

[0045] When the striking operation is required, the nail-support mechanism 16 can be additionally disposed on the rectangular head. The sleeve 1601 of the nail-support mechanism is provided with at least one recess 1605 on the inner side thereof, and the recess 1605 can be mated with the locking element 1703 which partially protrudes from the receiving hole 1702. The magnetic ring 1604 is disposed at the periphery of the sleeve 1601. One end of the sleeve 1601 is connected with the hammer anvil 8 via the spring 1602, and the spring 1602 provides a bias pressure to the sleeve 1601 along the direction of the end surface 1701 of the rectangular head. Under the action of the bias pressure provided by the spring 1602 and the resistance provided by the locking element 1703, the sleeve 1601 can be retained in a position at which the sleeve protrudes from the end surface 1701 of the rectangular head for a distance. Referring to Fig. 11-A and Fig. 11-B, which illustrate the states of the nail-support mechanism 16 at the beginning and ending stages of the striking operation. At the beginning stage and during the striking operation, as shown in Fig. 11-A, the sleeve 1601 protrudes from the end surface 1701 of the rectangular head for a distance, while at the ending stage of the striking operation, as shown in Fig. 11-B, the sleeve 1601 gradually moves backwards against the bias pressure of the spring 1602 and finally moves to a position flush with the end surface 1701 of the rectangular head.

[0046] Referring to Fig. 12, when the rotating operation is required, the rotating accessory 18 may be mounted around the rectangular head 17. The rotating accessory 18 can be regarded as the rotation-transmitting portion herein, and the inner circumferential surface 1801 of the receiving portion of the rotating accessory 18 for mounting around the rectangular head 17 is configured as square so as to mate with the rectangular head 17 and has at least one recess 1802 to mate with the locking element 1703 which partially protrudes from the receiving hole 1702. The portion of the rotating accessory which protrudes from the rectangular head has the same configuration as the above gripping element to receive the handle portion of the tool head for the fasteners such as screws.

[0047] Referring to Fig. 13, when the striking operation is required for striking the fasteners such as nails, the nail-support mechanism 16 can be connected to the rectangular head 17 and the operating member of the switching device is pushed to the hammer mode. Referring to Fig. 14, when the rotating operation is required for rotating the fasteners such as screws, the nail-support mechanism 16 may be replaced by the rotating accessory 18 and the operating member of the switching device is pushed to the rotation mode.

[0048] According to an embodiment of the present invention, in the tool for fasteners according to the first embodiment or the second embodiment, the limiting member includes a circumferential limiting portion and an axial limiting portion. In the first position, the circum-

ferential limiting portion of the limiting member acts on the output device and the axial limiting member disengages from the output device, then the output device is operated in the first operating mode, the limiting member can limit the rotation of the output device in the circumferential direction and the output device can move in a reciprocation manner without rotation in the axial direction under the action of the pushing movement of the operator. In the second position, the circumferential limiting portion of the limiting member disengages from the output device and the axial limiting portion acts on the output device, then the output device is operated in the second operating mode, the limiting member limit the movement of the output device along the axial direction and the output device can rotate with an intermittently increased torque in the circumferential direction.

[0049] According to an embodiment of the present invention, the tool for fasteners has five operating modes. In the first operating mode, the limiting member limits the rotation of the output device in the circumferential direction, and the output device can move in a reciprocation manner without rotation in the axial direction, i.e. the output device is operated in the striking mode. In the second operating mode, the limiting member limits the movement of the output device in the axial direction, and the output device can rotate with an intermittently increased torque in the circumferential direction, i.e. the output device is operated in the rotating-striking mode. In the third operating mode, the limiting function of the limiting member to the output device is released, and the output device can simultaneously move in a reciprocation manner in the axial direction and rotate with an intermittently increased torque in the circumferential direction, i.e. the output device is operated in the combinational mode. In the fourth operating mode, the limiting member limits the movement of the hammer in the axial direction, and the output device can rotate with constant torque in the circumferential direction and move in a reciprocation manner in the axial direction, i.e. the output device is operated in the striking-rotating mode. In the fifth operating mode, the limiting member limits the movement of the hammer in the axial direction and the movement of the output device in the axial direction, and the output device can rotate with constant torque in the circumferential direction, i.e. the output device is operated in the rotating mode. Therefore, the tool for fasteners according to the present invention can be switched between different operating modes by controlling the location of the limiting member, so that the operator can flexibly choose an appropriate operating mode according to the different working conditions.

[0050] According to an embodiment of the present invention, the tool for fasteners discussed in the first and second embodiments includes a bias element disposed between the hammer 5 and the hammer anvil 8 to provide a bias pressure along a direction for separating the hammer 5 from the hammer anvil 8. The function of the bias element is that: the bias element can keep the hammer

5 separating from the hammer anvil 8 before the pushing action of the operator so as to cut the energy transmission between the hammer 5 and the hammer anvil 8, which can not only reduce the energy dissipation during the operation pause, but also effectively prevent the potential safety hazard caused by the accidental activation of the tool. The tool is only activated to be operated in an operating mode under the action of the pushing of the operator.

10 **[0051]** According to an example, as shown in Fig. 1, the hammer anvil 8 includes a receiving portion 808 in which the end of the second rotating shaft is located. The spring 14 is disposed between the hammer anvil 8 and the second rotating shaft 4 to provide a bias pressure along a direction for separating the second rotating shaft 4 from the hammer anvil 8, so that the hammer 5 and the hammer anvil 8 can be retained in the disengaged state. In addition, the receiving portion can alternatively be disposed on the end of the second rotating shaft 4, and the spring can alternatively be replaced by a pair of magnetic rings which repels each other.

15 **[0052]** According to an embodiment of the present invention, the tool for fasteners discussed in the first and second embodiments further includes a LED indicator light on the housing 1 which can be turned on when the motor is started by the on-off device. Moreover, the LED indicator light can also indicate the capacity of the battery portion in the power device, namely, if the capacity of the battery portion has decreased to a certain value, the operator will be alarmed by the reduced brightness, changed color or flashing of the LED indicator light so as to replace or charge up the battery. In addition, according to a preferable embodiment, the LED indicator light can be disposed in a switch trigger of the on-off device. In addition, according to a preferable embodiment, the visible operating area on the housing 1 can also be provided with a LCD screen to display the torque force values or torque force curved line of the tool for fasteners.

20 **[0053]** According to an embodiment of the present invention, in the tool for fasteners discussed in the first and second embodiments, the striking frequency of the hammer and the hammer anvil can be controlled by adjusting the rotating speed of the motor via the on-off device. Moreover, it can be provided with different striking frequency modes for various types of the fasteners. The operator can adjust the striking frequency to make the hammer anvil and the fasteners form the resonance, thereby enhancing the striking efficiency. Moreover, the striking manner of the hammer and the hammer anvil can also be controlled by adjusting the rotating speed of the motor via the on-off device, wherein the striking manner includes single-striking manner and continuous-striking manner.

25 **[0054]** According to an embodiment of the present invention, the tool for fasteners discussed in the first and second embodiments further includes a regulating device for torque force which can regulate the output device so as to output the constant torque force. In addition, the

regulating device for torque force further includes a feed-back system to modify the output of the torque force from the output device according to the working condition.

[0055] According to an embodiment of the present invention, the tool for fasteners discussed in the first and second embodiments further includes a controlling member. When the operator replaces the tool head according to the different fasteners, the controlling member can identify the type of the replaced tool head, alarm the operator to choose the corresponding operating mode for the fasteners or control the switching device to automatically switch to the corresponding operating mode. According to a specific embodiment, since the tool head for striking and the tool head for rotating have the different contacting surfaces with regard to the output device, a sensor is provided on respective contacting surfaces, thereby the sensor can generate corresponding sensed signals when different tool heads are installed. The controlling member detects the sensed signals and determines the relevant operating mode to alarm the operator or automatically switch the operating mode.

[0056] According to a embodiment of the present invention, in the tool for fasteners discussed in the first and second embodiments, a portion of the housing which envelopes the transmission device and the output device is defined as operating portion, and a portion of the housing which envelopes the motor and the battery portion is defined as body portion. A shock mitigation system is disposed in the part of the housing between the operating portion and the body portion. Specifically, this part of housing is made of soft material, thus it can effectively enhance the comfort level for gripping of the operator. Moreover, the on-off device can be disposed at several positions to meet the requirements of various working conditions, for example, the on-off device can be disposed at the operating portion, the gripping position and the tail portion on the body portion.

[0057] When the tool for fasteners according to the present invention is operated, if the fasteners are nails, the tool can be switched to the first operating mode by adjusting the switching device, and the output device of the tool may be pressed on the cap of the nail, then the on-off device is turned on, and the output device of the tool strikes in a reciprocation manner. If the fasteners are screws or bolts, the tool can be switched to the second operating mode by adjusting the switching device, and the output device of the tool may be mated with the screws or bolts, then the on-off device is turned on, and the output device of the tool rotates with an intermittently increased torque.

[0058] The above mentioned embodiments are only the explanations of the conception and the technical principle of the present invention, but not to limit the present invention. Those skilled in the art may conceive other modifications and changes to the present invention besides the above preferred embodiments, and such modifications and changes shall be fallen into the protection scope of the present invention. The protection scope of

the present invention is defined by the claims.

Claims

1. A multi-tool for fasteners, comprises:

a housing;
a power device;
a transmission device coupled to the power device mechanically;
an output device coupled to the transmission device mechanically and can be switched between at least two operating modes, wherein, in a first operating mode, the output device moves in a reciprocation manner without rotation along an axial direction, and in a second operating mode, the output device rotates with an intermittently increased torque along a circumferential direction; and
a switching device including a limiting member and the limiting member being moveable between a first position and a second position, wherein, in the first position, the output device is in the first operating mode, and in the second position, the output device is in the second operating mode.

2. The multi-tool for fasteners of claim 1, wherein the transmission device comprises a hammer having a striking portion at one end thereof, and the output device has a hammer anvil having an anvil portion to engage with the striking portion of the hammer, an engaging surface between the striking portion and the anvil portion is configured as one of inclined surface and curved surface.

3. The multi-tool for fasteners of claim 2, wherein the hammer anvil comprises a teeth portion in the circumferential direction, and the limiting member is an inner gear ring, in the first position, the limiting member engages with the teeth portion of the hammer anvil, and in the second position, the limiting member disengages from the teeth portion of the hammer anvil.

4. The multi-tool for fasteners of claim 2, wherein, define a locating hole in the hammer anvil, and the limiting member is a locking pin, wherein, in the first position, the limiting member engages with the locating hole of the hammer anvil, and in the second position, the limiting member disengages from the locating hole of the hammer anvil.

5. The multi-tool for fasteners of claim 2, wherein the limiting member is a locking ring, and at least a protruding portion is disposed on the inner side of the locking ring, wherein, in the first position, the pro-

truding portion of the limiting member engages with the anvil portion of the hammer anvil, and in the second position, the protruding portion of the limiting member disengages from the anvil portion of the hammer anvil. 1.

6. The multi-tool for fasteners of claim 2, wherein, define at least a locating surface on the periphery surface of the hammer anvil, and the limiting member is a locking rod having a notch, wherein, in the first position, the notch of the limiting member is orientated opposite to the locating surface of the hammer anvil, and in the second position, the notch of the limiting member is orientated towards the locating surface of the hammer anvil. 10
7. The multi-tool for fasteners of claim 1, wherein the transmission device has a hammer and a hammer anvil, the output device has an output shaft, wherein, the hammer has a striking portion at one end thereof; the hammer anvil has an anvil portion which engages with the striking portion of the hammer at one end and a first engaging portion at the other end; the output shaft has a second engaging portion at one end; wherein the first engaging portion can engage with the second engaging portion, and an engaging surface between the first engaging portion and the second engaging portion is configured as one of inclined surface and curved surface. 25
8. The multi-tool for fasteners of claim 7, wherein the output shaft is provided with at least one locating surface on the periphery surface, and the limiting member is a locking rod having a notch, wherein, in the first position, the notch of the limiting member is orientated opposite to the locating surface of the output shaft, and in the second position, the notch of the limiting member is orientated towards the locating surface of the output shaft. 30
9. The multi-tool for fasteners of claim 2, further comprises a bias element disposed between the hammer and the hammer anvil to provide a bias pressure along a direction for separating the hammer from the hammer anvil. 35
10. The multi-tool for fasteners of claim 1, wherein the transmission device is coaxially connected with the output device. 40
11. The multi-tool for fasteners of claim 1, wherein, the output device comprises a strike-transmitting portion for transmitting striking force in the first operating mode and a rotation-transmitting portion for transmitting torque in the second operating mode. 45
12. The multi-tool for fasteners of claim 11, wherein the output device comprises a hammer anvil; 50

the rotation-transmitting portion is a gripping head disposed on one end of the hammer anvil; and the strike-transmitting portion is a striking accessory connected with the gripping head.

13. The multi-tool for fasteners of claim 12, wherein the striking accessory comprises a handle portion connected with the gripping head and a striking portion having a stressed end configured to contact the end of the hammer anvil. 5
14. The multi-tool for fasteners of claim 11, wherein the output device comprises a hammer anvil; the strike-transmitting portion is a rectangular head disposed on one end of the hammer anvil; and the rotation-transmitting portion is a rotating accessory connected with the rectangular head. 10
15. The multi-tool for fasteners of claim 11, wherein the strike-transmitting portion comprises a striking surface and a nail-accommodating mechanism. 15

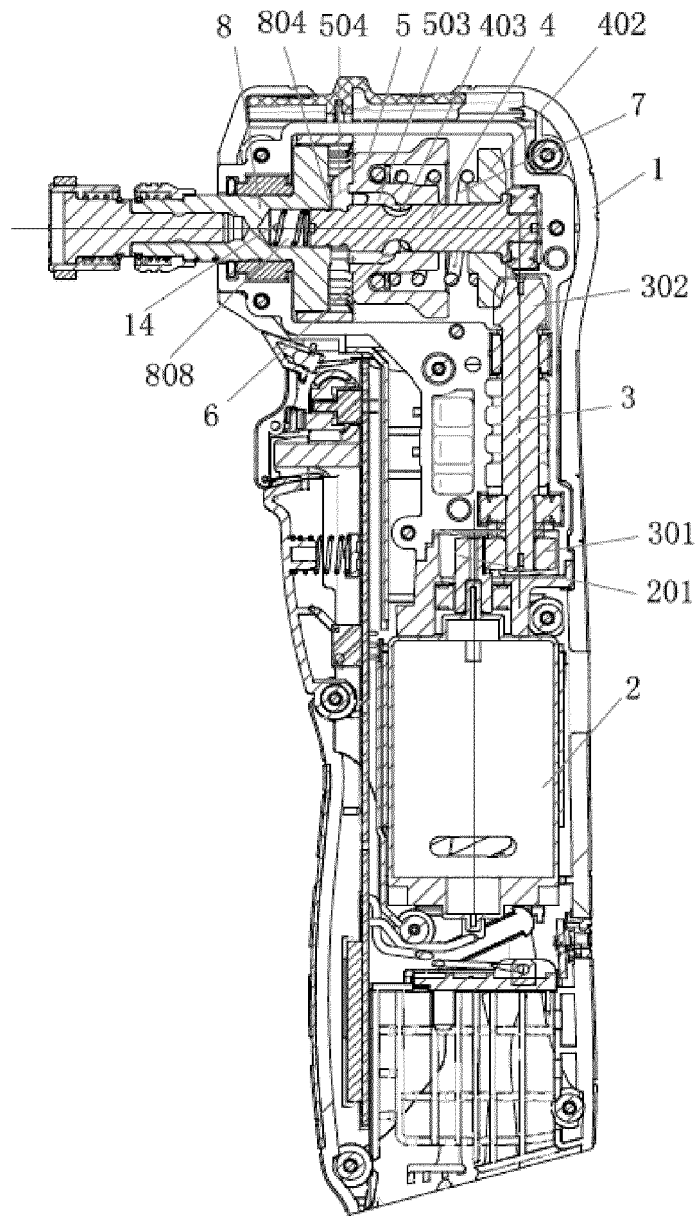


FIG. 1

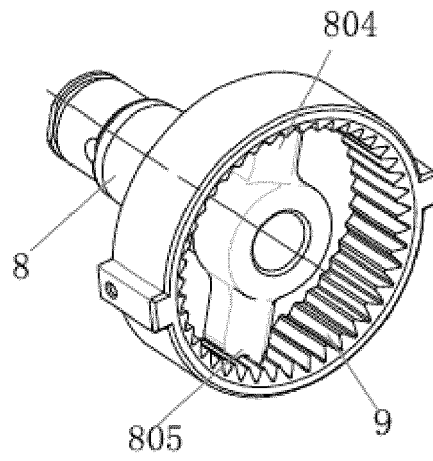


FIG. 2

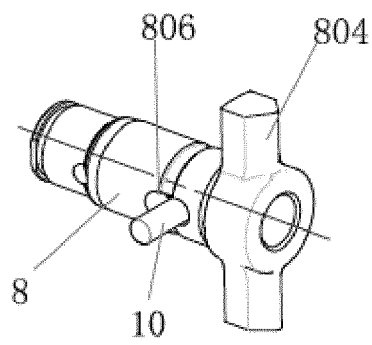


FIG. 3

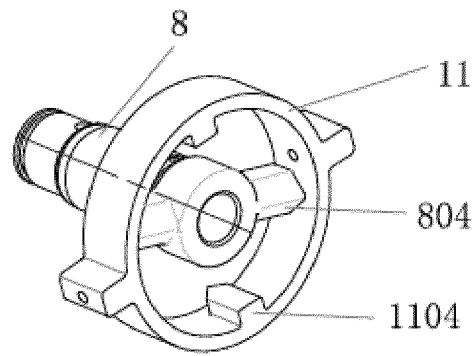


FIG. 4

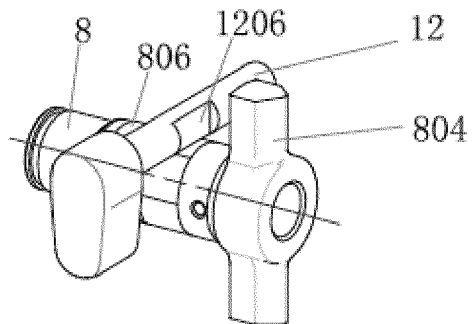


FIG. 5

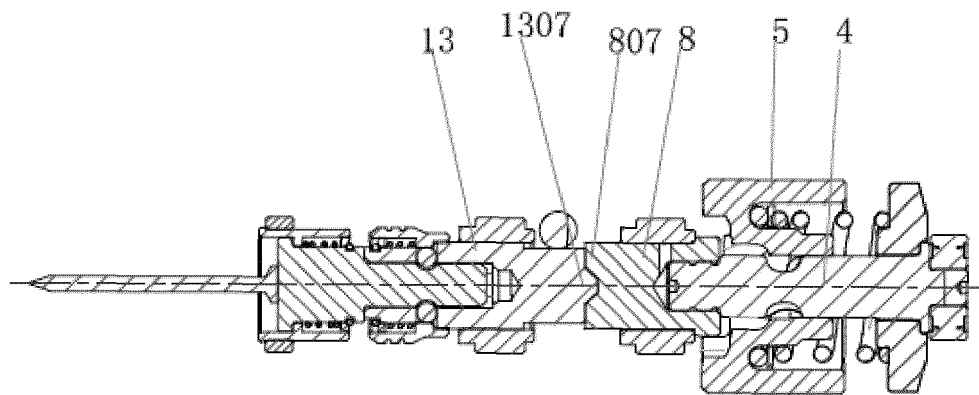


FIG. 6

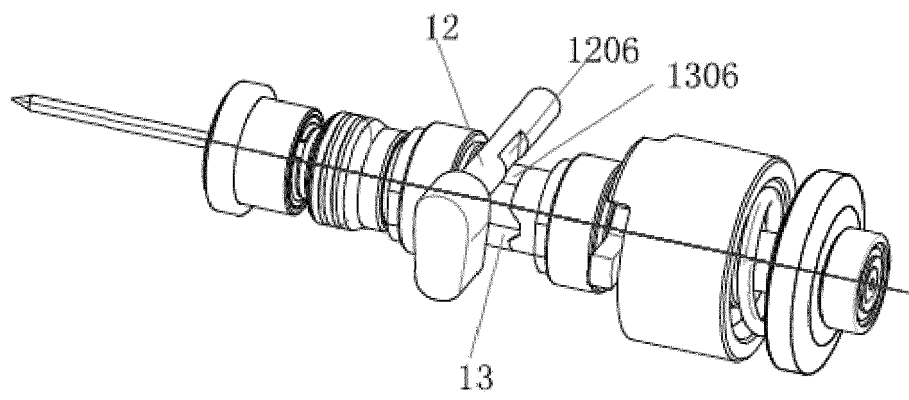


FIG. 7

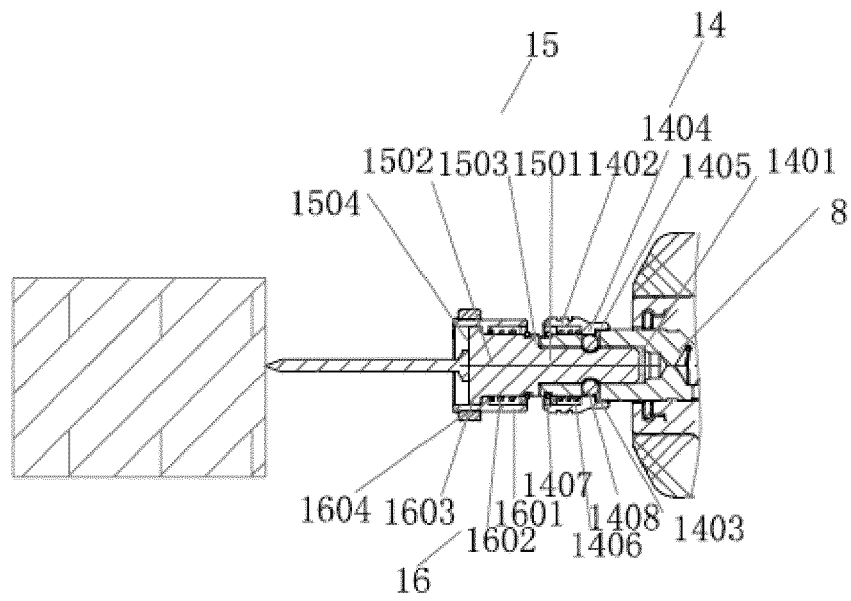


FIG. 8-A

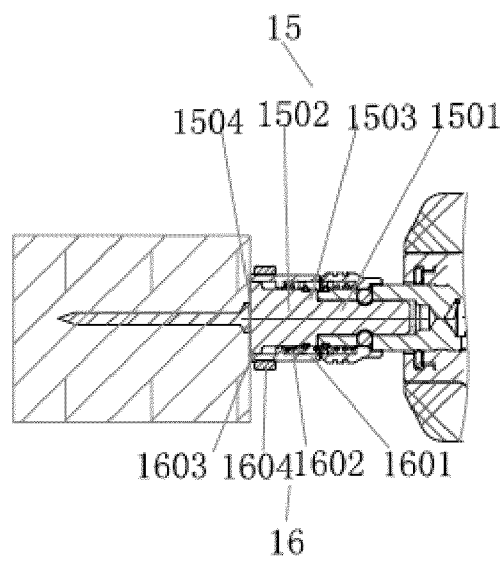


FIG. 8-B

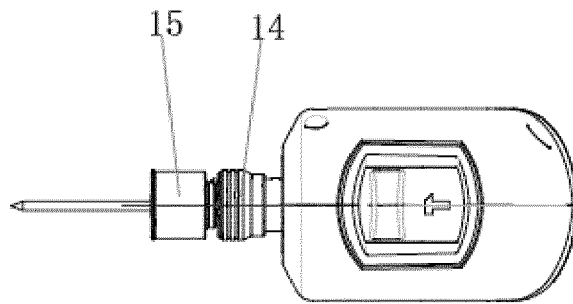


FIG. 9

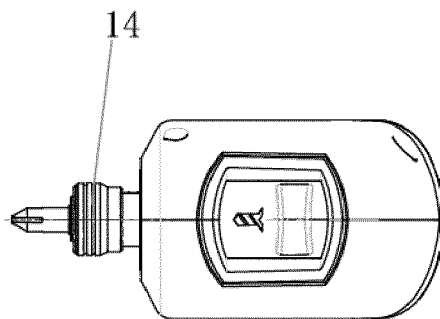


FIG. 10

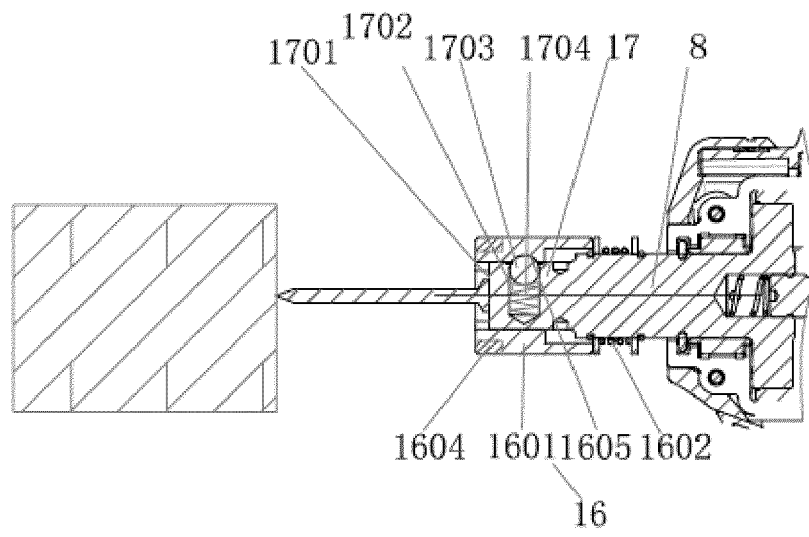


FIG. 11-A

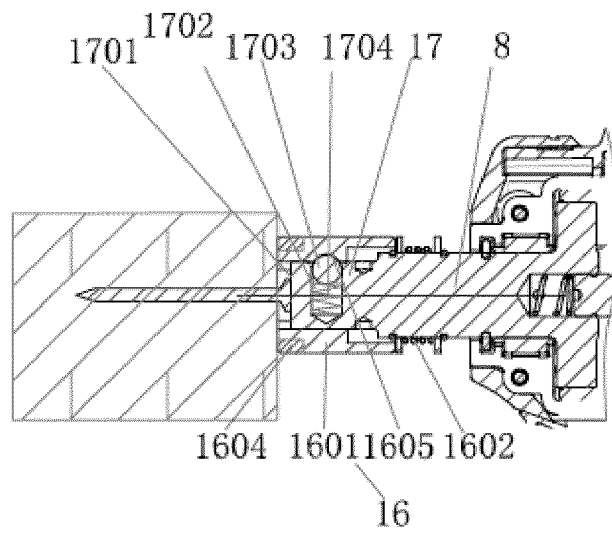


FIG. 11-B

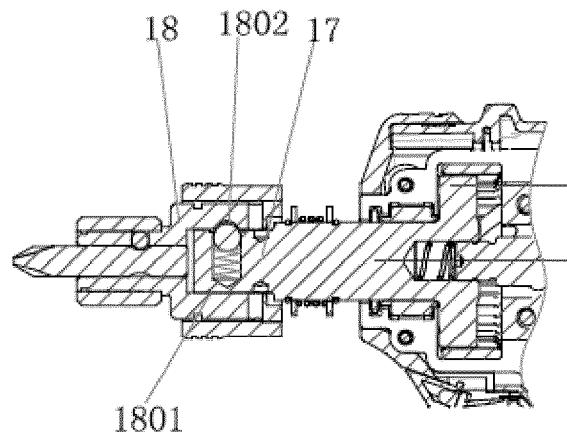


FIG. 12

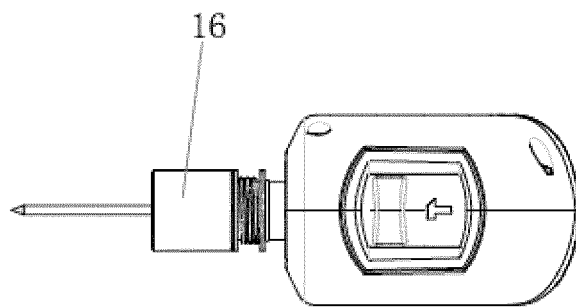


FIG. 13

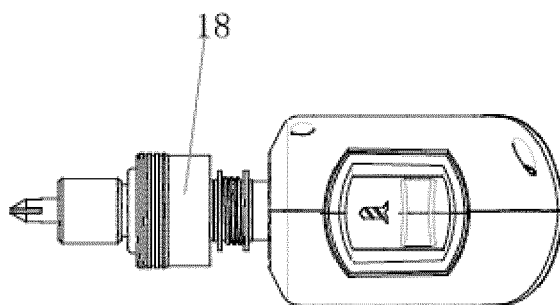


FIG. 14



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Application Number
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 11 September 2013	Examiner Kühn, Thomas
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