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(54) **ELECTRIC POWER TOOL**

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to an electric power tool and, more particularly, to a structure of a manipulation part of a portable electric power tool.

BACKGROUND ART

[0002] A portable electric power tool such as an electric power driver, an impact driver, an electric power drill or the like can rotate a tip tool attached to a chuck thereof. Furthermore, the electric power tool includes a manipulation part capable of manipulating rotation of the chuck.

[0003] Such an electric power tool is used in works such as screw driving, drilling and the like. In these works, when switching tightening and loosening of a screw or when removing a drill after drilling, it is necessary to change the rotation direction of the chuck. Thus, there is available an electric power tool in which the rotation direction of a chuck can be changed by a manipulation part (see, e.g., Japanese Unexamined Patent Application Publication No. 2010-155294 (JP2010-155294A)).

[0004] JP2010-155294A discloses an electric power tool in which a cylinder capable of rotating about an axis parallel to a rotation axis of a chuck is used as a manipulation part. The cylinder is installed in a position where the cylinder can be manipulated by one hand while holding the electric power tool with the hand. The cylinder is biased to self-return to a neutral position where the rotation of the chuck stops. The chuck rotates in the same direction as the rotation direction of the cylinder manipulated from the neutral position.

[0005] In a screw tightening work or a drilling work, there is a need to press a tip tool against a work target.

[0006] When the electric power tool disclosed in JP2010-155294A is used in such a work, the cylinder is rotationally manipulated in a chuck rotation direction while pressing the gripped electric power tool in a rotation axis direction of the chuck. It is not easy to perform, with one hand, the manipulation of the cylinder in the direction differing from the pressing direction.

[0007] US 2014/048301 A1 discloses an electric tool including a tubular housing, a motor disposed within the housing, and a tool holder rotatably driven by the motor and capable of holding an end tool. A shoe may be supported by the housing and may determine a protruding length of the end tool from one end of the housing. A battery mount portion may be disposed at the other end of the housing. The battery may be mounted to the battery mount portion as the battery is slid relative to the battery mount portion along a direction intersecting the extending direction of the housing. WO 2012/134471 A1 discloses a power tool including a housing, an electric motor mounted in the housing, and a switching device for reversing rotation direction of the motor. The switching device includes an actuator slidably secured to the housing and

movable between first and second positions. The actuator includes a magnet. A first ferromagnetic member is attached to a first housing section so as to be within range of attraction force of the magnet when the actuator is in the first position and a second ferromagnetic member is attached to a second housing section so as to be within range of attraction force of the magnet when the actuator is in the second position. A hall sensor is attached to the housing so as to be proximate the magnet as the actuator is moved between first and second positions. Proximity of the magnet and hall sensor reverses the direction of rotation of the motor. US 2004/149553 discloses a trigger assembly and a power tool. The trigger assembly includes a housing and a trigger. The trigger is movably supported by the housing and includes a support portion and a contact portion. The housing includes an opening, and the support portion at least partially extends into the opening. The trigger includes an upper protrusion that may prevent the operator's finger from being pinched between the trigger and the housing. The trigger may include an angled portion extending between the support portion and the contact portion on opposite sides of the trigger. The angled portion may include multiple ribs defining grooves between the ribs.

SUMMARY OF THE INVENTION

[0008] In view of the above, the present disclosure provides an electric power tool which makes it easy to manipulate a manipulation part while pressing a tip tool against a work target.

[0009] In accordance with an embodiment of the present disclosure, there is provided an electric power tool,

including: a casing having an elongated tubular shape; a motor accommodated in the casing; a chuck installed at a front end of the casing to removably hold a tip tool and configured to be rotationally driven by the motor; a grip body installed at a rear end of the casing; a manipulation part provided to be exposed through an outer circumferential surface of the casing near the rear end of the casing and configured to be manipulated by a user from the outside; and a control unit configured to control and drive the motor based on a manipulation of the manipulation part. The manipulation part is configured to be pushed toward the front end of the casing or pulled toward the rear end of the casing by the user to change a position of the manipulation part from a neutral position thereof, and the control unit controls the motor such that a rotation direction of the motor when the manipulation part is pushed toward the front end of the casing becomes opposite to a rotation direction of the motor when the manipulation part is pulled toward the rear end of the casing.

[0010] With such configuration, the manipulation part is manipulated forward or backward in a direction along a rotation axis of the chuck. Thus, the pressing direction of the gripped electric power tool is coincident with the moving direction of the manipulation part. This makes it

easy to manipulate the manipulation part while pressing the tip tool against the work target. Accordingly, it is possible to improve the ease of use of the electric power tool.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The figures depict one or more implementations in accordance with the present teaching, by way of example only, not by way of limitations. In the figures, like reference numerals refer to the same or similar elements.

Fig. 1 is a perspective view of an electric power tool according to an embodiment of the present disclosure.

Fig. 2 is a front perspective view of a cross section of the electric power tool including a manipulation switch.

Fig. 3 is a perspective view of a cylinder.

Fig. 4 is a cross-sectional view of a surrounding of the manipulation switch, taken along a plane which includes an axis AX1 and which is parallel to an X-Y plane.

Fig. 5 shows a schematic configuration of a switch body and a connection of a battery, the switch body and a motor.

Fig. 6 shows the relationship between a rotation angle of a shaft and a rotation speed of the motor.

Fig. 7 is a cross-sectional view of the surrounding of the manipulation switch, taken along a plane which includes the axis AX1 and an axis AX2 and which is parallel to an X-Z plane.

Fig. 8A shows how to use the electric power tool kept in a posture in which a grip body is inclined with respect to a casing.

Fig. 8B shows how to use the electric power tool kept in a posture in which the grip body is stretched so as to be aligned with the casing on a straight line.

Fig. 8C shows how to use the electric power tool in the case where the electric power tool is used in an erected state.

Fig. 9 is a perspective view of a cylinder according to a modification.

Fig. 10 shows how to use an electric power tool according to the modification.

Fig. 11 is a cross-sectional view of an electric power tool according to another modification, taken along a plane which includes the axis AX2 and which is parallel to a Y-Z plane.

DETAILED DESCRIPTION

[0012] An embodiment of an electric power tool according to one aspect of the present disclosure will now be described with reference to the accompanying drawings.

1. Configuration of Electric Power Tool

[0013] Fig. 1 is a perspective view of an electric power driver which is one example of an electric power tool 1 according to the embodiment of the present disclosure. The outer shell of the electric power tool 1 includes a casing 2 having an elongated tubular-shape (e.g., an elongated cylindrical shape) and an elongated tubular-shaped (e.g., cylindrical shaped) grip body 3 having one end 3a connected to a rear end 2b of the casing 2.

[0014] The grip body 3 is pivotable with respect to the casing 2 about a connection portion at which the grip body 3 is connected to the casing 2. By virtue of this pivoting movement, the grip body 3 may be kept in a posture in which the longitudinal direction of the grip body 3 is inclined with respect to the longitudinal direction of the casing 2 as indicated by solid lines or may be kept in a posture in which the longitudinal direction of the grip body 3 is aligned with the longitudinal direction of the casing 2 on a straight line as indicated by double-dot chain lines.

[0015] In the following descriptions, the longitudinal direction of the casing 2 will be referred to as a front-back direction (or an X-axis direction). The side of the rear end 2b of the casing 2 to which the grip body 3 is connected will be referred to as a rear side of the casing 2. The side of a front end 2a of the casing 2 will be referred to as a front side of the casing 2. In the case where the grip body 3 is kept in an inclined state with respect to the casing 2, the direction orthogonal to the front-back direction within the plane including the center axes of the casing 2 and the grip body 3 will be referred to as an up-down direction (or a Z-axis direction). The side toward which the grip body 3 is inclined will be referred to as a lower side. In addition, the direction orthogonal to the front-back direction and the up-down direction will be referred to as a left-right direction (or a Y-axis direction).

[0016] Within the casing 2, a manipulation switch 4 and a motor 5 are sequentially accommodated from the rear side toward the front side. A chuck 6 connected to a rotation shaft 5a of the motor 5 is exposed to the outside at the front end 2a of the casing 2. A tip tool 30 such as a drill bit or a driver bit is attachable to the front side of the chuck 6. In the present embodiment, the center axis of the casing 2, the axis of the rotation shaft 5a of the motor 5, the rotation center axis of the chuck 6 and the center axis of the tip tool 30 are coincident with an axis AX1.

[0017] A battery 7 serving as a power source is attached to the other end 3b of the grip body 3.

[0018] The motor 5 is electrically connected to the battery 7 via the manipulation switch 4 and is rotationally driven by the drive current supplied by the operation of the manipulation switch 4.

[0019] The manipulation switch 4 includes a cylinder 14 having a substantially cylindrical shape rotatable about an axis AX2 extending in the up-down direction orthogonal to the axis AX1. The manipulation switch 4 is

capable of adjusting the drive current based on the rotation angle of the cylinder 14.

[0020] At the left side of an outer circumferential surface 2c of the casing 2, a manipulation window 9 is opened in a position near the rear end 2b of the casing 2. A portion of an outer circumferential surface 15 of the cylinder 14, which serves as a manipulation part 20, is exposed to the outside of the casing 2 through the manipulation window 9.

[0021] The manipulation part 20 is provided with a projection 21 which enables a finger to be easily put thereon for manipulation of the manipulation switch 4. The manipulation part 20 can be manipulated forward or backward in a direction along the axis AX1 by a user from the outside by pushing or pulling the projection 21 in the front-back direction. The expression "along the axis AX1" used herein does not necessarily mean "parallel to the axis AX1".

[0022] While not illustrated in Fig. 1, a manipulation window 9' is opened on the outer circumferential surface 2c of the casing 2 in a position which is axial symmetry with the opening position of the manipulation window 9. A portion of the outer circumferential surface 15 of the cylinder 14, which serves as a manipulation part 20', is exposed to the outside of the casing 2 through the manipulation window 9'.

[0023] An off-lock switch 8 for locking the manipulation switch 4 against manipulation is provided in the upper portion of the outer circumferential surface 2c of the casing 2.

2. Details of Manipulation Switch

[0024] Fig. 2 is a front perspective view of a cross section of the electric power tool 1 including the manipulation switch 4.

[0025] The manipulation switch 4 includes a switch body 11, a shaft 12, a biasing spring 13 and the cylinder 14.

[0026] The shaft 12 is pivotally supported by the case of the switch body 11 so that the shaft 12 can rotate about the axis AX2.

[0027] The biasing spring 13 biases the shaft 12 so that the shaft 12 self-returns to a neutral position. The expression "neutral position of the shaft 12" refers to a rotational position for instructing the stop of rotation of the motor 5. The cylinder 14 is attached to a tip 12a of the shaft 12 so that the center axis thereof becomes coaxial with the shaft 12. Fig. 3 is a perspective view of the cylinder 14. The cylinder 14 includes the upper and lower ends 14b and 14c opposite to each other in the up-down direction and a middle portion 14a formed thicker in the up-down direction than the upper and lower end 14b and 14c, so that an outer circumferential surface 15 of the cylinder 14 is formed in a barrel shape.

[0028] On the outer circumferential surface 15 of the cylinder 14, the projection 21 and a projection 21' are respectively formed in left and right positions which are

axially symmetric with each other. The projection 21 has an elongated shape with the longitudinal direction thereof extending in the up-down direction when the projection 21 formed on the outer circumferential surface 15 is seen in a plan view. The projection 21' has an elongated shape with the longitudinal direction thereof extending in the up-down direction when the projection 21' formed on the outer circumferential surface 15 is seen in a plan view.

[0029] The region hatched with oblique lines of the outer circumferential surface 15 in Fig. 3 indicates the manipulation part 20 including the projection 21, and the manipulation part 20 is exposed to the outside through the manipulation window 9 when the cylinder 14 is attached to the shaft 12. Furthermore, the region of the outer circumferential surface 15 including the projection 21' indicates the manipulation part 20' which is exposed to the outside through the manipulation window 9'. A cut-out 16 is formed in the upper end 14b of the cylinder 14.

[0030] Two spokes 17 extending from the positions corresponding to the projections 21 and 21' toward the axis AX2 are additionally formed in the upper end 14b. The two spokes 17 are connected to a hub 18. A rectangular opening 19 is provided in the center of the hub 18.

[0031] As illustrated in Fig. 2, the tip 12a of the shaft 12 is fitted and secured to the opening 19. Thus, the cylinder 14 is rotatable about the axis AX2 together with the shaft 12 in a state in which a biasing force is applied to the cylinder 14 so that the cylinder 14 self-returns to the neutral position. The neutral position of the cylinder 14 is a rotational position where the projections 21 and 21' are arranged along an imaginary line extending in the left-right direction. When the shaft 12 is in the neutral position, so is the cylinder 14.

[0032] The manipulation of the manipulation parts 20 and 20' will be described with reference to Fig. 4. Fig. 4 is a cross-sectional view of the surrounding of the manipulation switch 4, taken along a plane which includes the axis AX1 and which is parallel to the X-Y plane. In Fig. 4, the left side on the sheet surface is the side of the chuck 6, and the right side on the sheet surface is the side of the grip body 3. Furthermore, in Fig. 4, the cylinder 14 is arranged orthogonal to the axis AX1 and is rotatable about the axis AX2 perpendicular to the sheet surface.

[0033] The manipulation parts 20 and 20' are exposed to the outside of the casing 2 through the manipulation windows 9 and 9', respectively. The manipulation parts 20 and 20' can be manipulated forward or backward in a direction along the axis AX1.

[0034] The cylinder 14 is arranged so that, when the shaft 12 is in the neutral position, the projection 21 is positioned substantially at the center of the manipulation window 9 in the front-back direction and the projection 21' is positioned substantially at the center of the manipulation window 9' in the front-back direction as indicated by a solid line in Fig. 4. In the following descriptions, the state in which the projection 21 is positioned substantially at the center of the manipulation window 9 in the front-back direction will be referred to as a state in which the

manipulation part 20 is in the neutral position. The state in which the projection 21' is positioned substantially at the center of the manipulation window 9' in the front-back direction will be referred to as a state in which the manipulation part 20' is in the neutral position.

[0035] The operation ranges of the manipulation parts 20 and 20' are restricted by the contact between the edge 9a of the manipulation window 9 and the projection 21 and the contact between the edge 9a' of the manipulation window 9' and the projection 21'.

[0036] Thus, the manipulation part 20 can be manipulated forward to move the projection 21 up to the position indicated by a broken line 21a and can be manipulated backward to move the projection 21 up to the position indicated by a double-dot chain line 21b. The manipulation part 20' can be manipulated to move the projection 21' forward up to the position indicated by a double-dot chain line 21b' and can be manipulated to move the projection 21' backward to the position indicated by a broken line 21a'.

[0037] Since the manipulation parts 20 and 20' are manipulated within these ranges, the rotation angle θ of the cylinder 14 is about 30 degrees in both the left and right rotations from the neutral position.

[0038] Subsequently, the switch body 11 will be described with reference to Fig. 5. Fig. 5 shows a schematic configuration of the switch body 11 and the connection of the battery 7, the switch body 11 and the motor 5.

[0039] The switch body 11 is installed on a route which interconnects the battery 7 and the motor 5. The switch body 11 includes a detection unit 11a, a control unit 11b and a switching drive circuit 11c.

[0040] The detection unit 11a may be, e.g., a rotary potentiometer. The detection unit 11a detects the rotation direction and rotation angle of the shaft 12 from the neutral position and outputs the detection results to the control unit 11b.

[0041] The control unit 11b generates a pulse width modulation signal (PWM signal) corresponding to the rotation direction and rotation angle of the shaft 12 and outputs the PWM signal to the switching drive circuit 11c.

[0042] The switching drive circuit 11c includes an H-bridge circuit which makes use of switching elements (e.g., FETs). Under the PWM control executed by the control unit 11b, the switching drive circuit 11c generates a drive current to be supplied to the motor 5 from a current supplied from the battery 7. Thus, in response to the manipulation of the manipulation part 20, the control unit 11b controls the current supplied from the switching drive circuit 11c to the motor 5. Accordingly, the control unit 11b can perform the start/stop of the motor 5 and the adjustment of the rotation speed of the motor 5 during the operation thereof.

[0043] Details of the control of the motor 5 executed by the control unit 11b will be described with reference to Fig. 6. Fig. 6 shows the relationship between the rotation angle of the shaft 12 and the rotation speed of the motor 5. In Fig. 6, the horizontal axis indicates the rotation

angle of the shaft 12 and the vertical axis indicates the rotation speed of the motor 5.

[0044] When the manipulation part 20 is not manipulated and the cylinder 14 is kept in the neutral position, the shaft 12 is also maintained in the neutral position. In this state, the control unit 11b outputs, to the switching drive circuit 11c, a PWM signal to stop the supply of a drive current. During the input of this PWM signal, all the switching elements of the switching drive circuit 11c are opened at all times. As a result, no drive current is supplied. Thus, the rotation of the motor 5 and the rotation of the chuck 6 are stopped.

[0045] Under this state, when the forward movement manipulation of the manipulation part 20 is performed by pushing the projection 21 toward the chuck 6, a rightward rotational force is transmitted from the cylinder 14 to the shaft 12 via the spokes 17 and the hub 18, whereby the shaft 12 is rotated. When the rightward rotation of the shaft 12 is detected by the detection unit 11a, the control unit 11b outputs a PWM signal corresponding to the rotation angle, thereby allowing the switching drive circuit 11c to adjust the drive current.

[0046] More specifically, when the cylinder 14 is rotated to range "b" beyond range "a" as illustrated in Fig. 6, the control unit 11b outputs a PWM signal to the switching drive circuit 11c so that the switching drive circuit 11c generates a drive current for rotating the motor 5 rightward at a constant speed. When the cylinder 14 is further rotated and the rotation angle falls within range "c", the control unit 11b outputs a PWM signal to increase the drive current in proportion to the rotation angle of the cylinder 14. In addition, when the rotation angle of the cylinder 14 falls within range "d", the control unit 11b outputs a PWM signal so that the drive current becomes constant. When the cylinder 14 is rotated into range "e", the control unit 11b outputs a PWM signal so that the maximum drive current is generated to rotate the motor 5 rightward at a maximum speed. As a result, the chuck 6 connected to the rotation shaft 5a of the motor 5 is rotated rightward at the same rotation speed as that of the motor 5.

[0047] Further, when the backward movement manipulation of the manipulation part 20 is performed by pulling the projection 21 from the neutral position toward the grip body 3, a leftward rotational force is transmitted from the cylinder 14 to the shaft 12. Thus, the shaft 12 is rotated. The control unit 11b outputs a PWM signal corresponding to the rotation angle of the shaft 12 when the leftward rotation of the shaft 12 is detected, thereby allowing the switching drive circuit 11c to adjust the drive current.

[0048] In this case, the drive current for rotating the motor 5 leftward is generated. As illustrated in Fig. 6, even when the leftward rotation of the shaft 12 is detected, the rotation speed of the motor 5 corresponding to the rotation angle of the shaft 12 is controlled similar to the case where the rightward rotation of the shaft 12 is detected.

3. Configuration of Off-Lock Mechanism

[0049] Fig. 7 is a cross-sectional view of the surrounding of the manipulation switch 4, taken along a plane which includes the axis AX1 and the axis AX2 and which is parallel to the X-Z plane. When the cylinder 14 is in the neutral position, the center of the cutout 16 formed in the cylinder 14 is positioned on the sheet surface in Fig. 7.

[0050] A groove 2d elongated in the front-back direction is formed in the upper portion of the outer circumferential surface 2c of the casing 2. An off-lock switch 8 is installed to the groove 2d so that the off-lock switch 8 can slide in the front-back direction. The off-lock switch 8 includes a protrusion 22 formed on the upper surface 8a thereof and an off-lock lug 23 formed on the lower surface 8b thereof.

[0051] The protrusion 22 is exposed from the surface of the casing 2 so that the protrusion 22 can be manipulated.

[0052] The off-lock lug 23 protrudes inward of the casing 2 through an insertion hole 2e formed in the bottom surface of the groove 2d. When the protrusion 22 is manipulated as indicated by arrow C while the cylinder 14 is in the neutral position, the off-lock switch 8 is slid to the position indicated by a double-dot chain line. By virtue of this manipulation, the off-lock lug 23 is moved to engage with the cutout 16 of the cylinder 14 as indicated by arrow A'. This makes it possible to restrain the rotation of the cylinder 14.

[0053] This makes it possible to prevent the motor 5 from being unintentionally rotated due to erroneous manipulation of the manipulation part 20.

4. Use of Electric Power Tool

[0054] Descriptions will be made on how to use the electric power tool 1 in a work of tightening a right-hand screw.

[0055] Fig. 8A shows how to use the electric power tool 1 kept in a posture in which the grip body 3 is inclined with respect to the casing 2. In this posture, it is possible to apply a force to press the electric power tool 1 against a screw with the grip body 3 gripped by one hand. By holding the grip body 3 with the right hand, it is possible to put the thumb of the right hand on the projection 21 of the manipulation part 20. Under this state, when the projection 21 is manipulated with the thumb to be pressed toward the chuck 6 as indicated by arrow A, the chuck 6 is rotated rightward as indicated by arrow B. This makes it possible to tighten a right-hand screw with the tip tool 30.

[0056] In a work of tightening a screw at a narrow place or the like, the electric power tool 1 is used in a posture in which the grip body 3 is stretched to be aligned with the casing 2 on a straight line. This makes it possible to enhance the workability. Fig. 8B shows how to use the electric power tool 1 kept in the posture in which the grip body 3 is stretched to be aligned with the casing 3 on a

straight line. Even in this state, it is possible to put the thumb of the right hand on the projection 21 of the manipulation part 20 with the grip body 3 held by the right hand. Therefore, when the projection 21 is manipulated with the thumb to be pressed toward the chuck 6 as indicated by arrow A, the chuck 6 is rotated rightward as indicated by arrow B. This makes it possible to tighten a right-hand screw with the tip tool 30.

[0057] In a work of tightening a screw downward from a higher work position, the casing 2 is held underhand as illustrated in Fig. 8C. This makes it possible to apply a force to press the electric power tool 1 against the screw. When the casing 2 is held underhand with the right hand, it is possible to put the thumb of the right hand on the projection 21 of the manipulation part 20. Under this state, if the projection 21 is manipulated with the thumb to be pulled toward the chuck 6 as indicated by arrow A, the chuck 6 is rotated rightward as indicated by arrow B. This makes it possible to tighten a right-hand screw with the tip tool 30.

[0058] As described above, when the right-hand screw is tightened by the electric power tool 1 held with the right hand, the direction in which the electric power tool 1 is pressed against the screw is coincident with the direction in which the manipulation part 20 is manipulated by the thumb of the right hand.

5. Advantageous Effects

[0059] In the electric power tool 1 according to the present embodiment, the direction in which the manipulation part 20 can be manipulated forward or backward extends along the axis AX1 of the chuck 6. Specifically, the manipulation part 20 is configured to be pushed toward the front end 2a of the casing 2 or pulled toward the rear end 2b of the casing 2 by the user to change the position of the manipulation part 20 from the neutral position thereof. Further, the control unit 11b controls the motor 5 such that a rotation direction of the motor 5 when the manipulation part 20 is pushed toward the front end 2a of the casing 2 becomes opposite to a rotation direction of the motor 5 when the manipulation part 20 is pulled toward the rear end 2b of the casing. For that reason, even in a work in which the tip tool 30 needs to be pressed against a work target, the pressing direction of the gripped electric power tool 1 is coincident with the manipulation direction of the manipulation part 20. Accordingly, the electric power tool 1 is capable of obtaining high workability when the manipulation part 20 is manipulated with the hand holding the grip body 3.

[0060] As knockdown furniture becomes widespread, an electric power tool is widely used even to those persons who are unfamiliar to DIY. There may be a case where such users fail to grasp the relationship between the rotation direction of a screw and the tightening and loosening thereof. For example, the widely-used right-hand screw is tightened and screwed by rotating the same rightward. However, there may be a case where a

user unfamiliar to DIY fails to grasp the rotation direction and the moving direction of the screw.

[0061] In the electric power tool 1 according to the present embodiment, the chuck 6 is rotated rightward by manipulating the manipulation part 20 to move toward the chuck 6. For that reason, the manipulation direction of the manipulation part 20 can be brought into coincidence with the direction in which the right-hand screw moves during rotation thereof. Accordingly, even though a user is unfamiliar to DIY, it is possible to tighten or loosen the right-hand screw by intuitive manipulation.

[0062] Furthermore, in the electric power tool 1 according to the present embodiment, the manipulation parts 20 and 20' are provided on the outer circumferential surface 15 of the cylinder 14 having a substantially cylindrical shape. Within the casing 2, the cylinder 14 is pivotally supported so as to rotate about the axis AX2 orthogonal to the axis AX1. The manipulation window 9 is opened in the casing 2 at the position where the manipulation part 20 is provided. When observing only the manipulation part 20 exposed through the manipulation window 9, the rotational movement of the cylinder 14 can be approximate to linear movement. Thus, the user can rotate the cylinder 14 by linear manipulation carried out by moving the thumb of the hand holding the grip body 3 forward or backward. Since this linear manipulation is performed along the axis AX1, the manipulation part 20 is easy to use even in a work in which the tip tool 30 needs to be pressed against a work target.

[0063] Furthermore, in the electric power tool 1 according to the present embodiment, the control unit 11b performs a control to change the rotation speed of the motor 5 depending on the rotation angle of the cylinder 14 rotated by the manipulation of the manipulation part 20. For that reason, the chuck 6 rotationally driven by the motor 5 is also rotated at the rotation speed corresponding to the rotation angle of the cylinder 14. Since the manipulation of the manipulation part 20 and the rotation speed of the chuck 6 correspond to each other, it is easy to perform the manipulation of rotating the chuck 6 at a low speed when the electric power tool 1 is guided into a screw hole, and subsequently increasing the rotation speed of the chuck 6.

[0064] Furthermore, in the electric power tool 1 according to the present embodiment, the manipulation part 20 includes the projection 21 protruding from a portion of the outer circumferential surface 15 of the cylinder 14. By putting a finger on the projection 21 and pushing or pulling the projection 21, it is possible to easily manipulate the manipulation part 20.

[0065] Furthermore, in the electric power tool 1 according to the present embodiment, the manipulation parts 20 and 20' are respectively provided at two points, which are axially symmetric with each other, on the outer circumferential surface 15 of the cylinder 14.

[0066] In the case where the manipulation part 20' is manipulated forward or backward by pushing or pulling the projection 21' of the manipulation part 20', the forward

or backward manipulation direction of the manipulation part 20' is opposite to that of the manipulation part 20, whereby the chuck 6 is rotated in the opposite direction. For that reason, by holding the electric power tool 1 with the left hand and manipulating the manipulation part 20' with the thumb of the left hand, it is possible to bring the manipulation direction of the manipulation part 20' into coincidence with the movement direction of a left-hand screw. Accordingly, it is possible to tighten or loosen the left-hand screw by virtue of intuitive manipulation.

[0067] Furthermore, the electric power tool 1 according to the present embodiment includes the off-lock switch 8 capable of locking the rotation of the cylinder 14 when the manipulation part 20 is in the neutral position. It is therefore possible to prevent inadvertent rotation of the chuck 6 which may be caused by erroneous manipulation.

(Supplement)

[0068] While the exemplary embodiment has been described above, it goes without saying that the present disclosure is not limited to the above-described embodiment. The following cases are also included in the present disclosure.

(a) The shape of the manipulation part 20 of the cylinder 14 is not limited to that of the above-described embodiment. For example, as illustrated in Fig. 9, the projections 21 and 21' may be formed so that the longitudinal direction thereof is inclined with respect to the axis AX2 when the projections 21 and 21' are seen in the left-right direction.

In this modification, it is preferred that, as illustrated in Fig. 10, the longitudinal direction (indicated by broken line D1) of the projection 21 staying in the neutral position extends along the longitudinal direction (indicated by broken line D2) of the grip body 3 kept in a posture inclined with respect to the longitudinal direction of the casing 2. According to the manipulation part 20 including the projection 21 formed as described above, a person having a long finger is capable of manipulating the manipulation part 20 by putting the finger on a portion 21c of the projection 21 positioned away from the grip body 3. A person having a short finger is capable of manipulating the manipulation part 20 by putting the finger on the portion 21d of the projection 21 positioned close to the grip body 3. Accordingly, it is possible to reduce the difference in the manipulation feeling which depends on the length of a finger. This makes it possible to provide the ease of use to a wide range of users. However, the expression "along the longitudinal direction of the grip body 3" used herein does not necessarily mean that the longitudinal direction of the projection 21 is parallel to the longitudinal direction of the grip body 3.

(b) In another modification illustrated in Fig. 11, if the

distance from the axis A1 is assumed to be a height, the height r1 of the projection 21 and 21' may be set smaller than the height r2 of the casing 2 at the edge 9b of the manipulation window 9 and at the edge 9b' of the manipulation window 9'. Fig. 11 is a cross-sectional view of an electric power tool 1 according to another modification, taken along a plane which includes the axis AX2 and which is parallel to the Y-Z plane. As indicated by broken lines in Fig. 11, in this modification, the projection 21 of the manipulation part 20 and the projection 21' of the manipulation part 20' do not protrude beyond the outer circumferential surface of the casing 2. For that reason, when the electric power tool 1 is accommodated within a holster (not illustrated) and the like, it is possible to prevent the electric power tool 1 from being unintentionally operated by the contact of the projection 21 or 21' with the holster.

(c) The configuration of the manipulation part 20 is not limited to that of the above-described embodiment.

For example, in a further modification, a sliding member provided on the surface of the casing 2 and capable of sliding in the direction extending along the axis AX1 may be used as the manipulation part. A biasing spring is attached to the sliding member so that the sliding member self-returns to a center position of a slidable extent. In addition, as for the detection unit 11a, there may be used a linear potentiometer for detecting the sliding direction of the sliding member slid from the center position by virtue of manipulation and the movement amount of the sliding member.

In order to control the rotation direction and speed of the motor 5 based on the sliding direction and movement amount of the sliding member detected by the detection unit 11a, it may be possible to use the control unit 11b and the switching drive circuit 11c as in the above-described embodiment.

Accordingly, even in this modification, it is possible to obtain the same effects as those of the electric power tool 1 of the above-described embodiment.

(d) In the above-described embodiment, descriptions have been made on the configuration in which the center axis of the casing 2, the axis of the rotation shaft 5a of the motor 5, the rotation center axis of the chuck 6 and the center axis of the tip tool 30 are all coincident with the axis AX1. Furthermore, the manipulation part 20 is configured such that it can be manipulated forward or backward by the user from the outside in a direction along the axis AX1.

[0069] However, the center axis of the casing 2, the axis of the rotation shaft 5a of the motor 5 and the rotation center axis of the chuck 6 need not be necessarily placed on the same axis.

[0070] For example, in the case where a transmission is used in transmitting a torque from the motor 5 to the

chuck 6, the axis of the rotation shaft 5a of the motor 5 and the rotation center axis of the chuck 6 may be provided on different axes. In the case where the center axis of the casing 2, the axis of the rotation shaft 5a of the motor 5 and the rotation center axis of the chuck 6 are not provided on the same axis, the forward or backward manipulation direction of the manipulation part 20 may be set to extend along the rotation center axis of the chuck 6.

[0071] The electric power tool according to the present disclosure is useful as a portable electric power tool, such as an electric power driver, an impact driver or an electric power drill, which rotates a tip tool attached to a chuck.

[0072] While the foregoing has described what are considered to be the best mode and/or other examples, it is understood that various modifications may be made therein and that the subject matter disclosed herein may be implemented in various forms and examples, and that they may be applied in numerous applications, only some of which have been described herein. It is intended by the following claims to claim any and all modifications and variations that fall within the true scope of the present teachings.

Claims

1. An electric power tool (1), comprising:

a casing (2) having an elongated tubular-shape;
a motor (5) accommodated in the casing (2);
a chuck (6) installed at a front end of the casing (2) to removably hold a tip tool (30) and configured to be rotationally driven by the motor (5);
a grip body (3) installed at a rear end of the casing (2);
a manipulation part (20) provided to be exposed through an outer circumferential surface (15) of the casing (2) near the rear end of the casing (2) and configured to be manipulated by a user; and
a control unit (11 b) configured to control and drive the motor (5) based on a manipulation of the manipulation part (20),

characterized in that

the manipulation part (20) is configured to be pushed toward the front end of the casing (2) or pulled toward the rear end of the casing (2) by the user to change a position of the manipulation part (20) from a neutral position thereof, and wherein the control unit (11b) controls the motor (5) such that a rotation direction of the motor (5) when the manipulation part (20) is pushed toward the front end of the casing (2) from the neutral position becomes opposite to a rotation direction of the motor (5) when the manipulation part (20) is pulled toward the rear end of the casing (2) from the neutral position.

2. The electric power tool (1) of claim 1, further comprising:

a cylinder (14) having a substantially cylindrical shape pivotally supported in the casing (2) so as to rotate about an axis orthogonal to a rotation axis of the chuck (6),
 wherein the manipulation part (20) is provided on an outer circumferential surface (15) of the cylinder (14), and
 wherein the casing (2) has a manipulation window (9), in the outer circumferential surface (15) of the casing (2), through which the manipulation part (20) is exposed.

3. The electric power tool (1) of claim 2, wherein the control unit (11 b) controls the motor (5) such that a rotation speed of the motor (5) is changed depending on a rotation angle of the cylinder (14) rotated by the manipulation of the manipulation part (20).

4. The electric power tool (1) of claim 2 or 3, wherein the manipulation part (20) includes a projection (21) protruding from a portion of the outer circumferential surface (15) of the cylinder (14).

5. The electric power tool (1) of claim 4, wherein the grip body (3) is kept in a posture in which a longitudinal direction of the grip body (3) is inclined with respect to a longitudinal direction of the casing (2), and
 wherein the projection (21) has an elongated shape, a longitudinal direction of the projection being parallel to the longitudinal direction of the grip body (3).

6. The electric power tool (1) of claim 4 or 5, wherein the projection (21) is provided not to protrude beyond the outer circumferential surface (15) of the casing (2).

7. The electric power tool (1) of any one of claims 2 to 6, further comprising: an other manipulation part (20'), the two manipulation parts (20, 20') being provided on the outer circumferential surface (15) of the cylinder (14) respectively at two points which are symmetric with respect to the axis of the cylinder (14).

8. The electric power tool (1) of any one of claims 2 to 7, further comprising:

an off-lock switch (8) having an off-lock lug (23), wherein the cylinder (14) has a cutout and the off-lock lug (23) is configured to be engaged with the cutout when the manipulation part (20) is in the neutral position, so that a rotation of the cylinder (14) is prevented.

Patentansprüche

1. Ein Elektrowerkzeug (1), das Folgendes umfasst:

ein Gehäuse (2), das eine längliche rohrartige Form aufweist;
 einen Motor (5), der im Gehäuse (2) aufgenommen wird;
 ein Spannfutter (6), das an einem vorderen Ende des Gehäuses (2) angebracht ist, um ein Spitzenwerkzeug (30) lösbar zu halten, und konfiguriert ist, um vom Motor (5) drehangetrieben zu werden;
 einen Griffkörper (3), der an einem hinteren Ende des Gehäuses (2) angeordnet ist;
 ein Handhabungsteil (20), das bereitgestellt wird, um durch eine äußere Umfangsfläche (15) des Gehäuses (2) in der Nähe des hinteren Endes des Gehäuses (2) freiliegend zu sein und das konfiguriert ist, um durch einen Benutzer gehandhabt zu werden; und
 eine Steuereinheit (11 b), die konfiguriert ist, um den Motor (5), aufgrund einer Handhabung des Handhabungsteils (20), zu steuern und anzutreiben,

dadurch gekennzeichnet, dass

das Handhabungsteil (20) konfiguriert ist, um vom Benutzer zum vorderen Ende des Gehäuses (2) hin geschoben zu werden oder zum hinteren Ende des Gehäuses (2) hin gezogen zu werden, um eine Position des Handhabungsteils (20), ausgehend von einer neutralen Position davon, zu ändern, und
 wobei die Steuereinheit (11 b) den Motor (5) derart steuert, dass eine Rotationsrichtung des Motors (5), wenn das Handhabungsteil (20), ausgehend von der neutralen Position, zum vorderen Ende des Gehäuses (2) hin geschoben ist, gegenläufig zu einer Rotationsrichtung des Motors (5) wird, wenn das Handhabungsteil (20), ausgehend von der neutralen Position, zum hinteren Ende des Gehäuses (2) hin gezogen wird.

2. Das Elektrowerkzeug (1) nach Anspruch 1, das des Weiteren Folgendes umfasst:

einen Zylinder (14), der eine im Wesentlichen zylindrische Form aufweist, der schwenkend im Gehäuse (2) gelagert ist, sodass er um eine Achse rotiert, die zur Rotationsachse des Spannfutters (6) orthogonal ist,
 wobei das Handhabungsteil (20) auf einer äußeren Umfangsfläche (15) des Zylinders (14) bereitgestellt wird, und
 wobei das Gehäuse (2) ein Handhabungsfenster (9) aufweist, in der äußeren Umfangsfläche (15) des Gehäuses (2), durch welches das Handhabungsteil (20) freiliegt.

3. Das Elektrowerkzeug (1) nach Anspruch 2, wobei die Steuereinheit (11 b) den Motor (5) derart steuert, dass eine Rotationsgeschwindigkeit des Motors (5) entsprechend eines Rotationswinkels des Zylinders (14) geändert wird, der durch die Handhabung des Handhabungsteils (20) gedreht wird. 5
4. Das Elektrowerkzeug (1) nach Anspruch 2 oder 3, wobei das Handhabungsteil (20) einen Vorsprung (21) beinhaltet, der von einem Abschnitt der äußeren Umfangsfläche (15) des Zylinders (14) vorsteht. 10
5. Das Elektrowerkzeug (1) nach Anspruch 4, wobei der Griffkörper (3) in einer Stellung bzw. Positur gehalten wird, in der eine Längsrichtung des Griffkörpers (3) bezüglich einer Längsrichtung des Gehäuses (2) geneigt ist, und wobei der Vorsprung (21) eine längliche Form aufweist, wobei eine Längsrichtung des Vorsprungs zur Längsrichtung des Griffkörpers (3) parallel ist. 15 20
6. Das Elektrowerkzeug (1) nach Anspruch 4 oder 5, wobei der Vorsprung (21) auf eine Weise bereitgestellt wird, dass er jenseits der äußeren Umfangsfläche (15) des Gehäuses (2) nicht vorsteht. 25
7. Das Elektrowerkzeug (1) nach irgendeinem der Ansprüche von 2 bis 6, das des Weiteren Folgendes umfasst: ein weiteres Handhabungsteil (20'), wobei die beiden Handhabungsteile (20, 20') auf der äußeren Umfangsfläche (15) des Zylinders (14) bereitgestellt werden, jeweils an zwei Punkten, die zur Achse des Zylinders (14) symmetrisch sind. 30
8. Das Elektrowerkzeug (1) nach irgendeinem der Ansprüche von 2 bis 7, das des Weiteren Folgendes umfasst: 35

einen "Sperrn" deaktivieren bzw. einen Arretierungs-Schalter (*off-lock switch*) (8), der eine Arretierungs-Nase (23) aufweist, wobei der Zylinder (14) eine Aussparung aufweist und die Arretierungs-Nase (23) konfiguriert ist, um mit der Aussparung im Eingriff zu stehen, wenn sich das Handhabungsteil (20) in der neutralen Position befindet, sodass eine Rotation des Zylinders (14) verhindert wird. 40 45

Revendications

1. Un outil électrique (1), comprenant:

un boîtier (2) présentant une forme allongée tubulaire ; 55
 un moteur (5) logé dans le boîtier (2) ;
 un mandrin (6) qui est installé à l'extrémité frontale du boîtier (2) pour maintenir de manière

amovible un outil d'extrémité (30) et qui est configuré pour être entraîné de manière rotative par le moteur (5) ;
 un corps de préhension (3) installé à une extrémité arrière du boîtier (2) ;
 une pièce de manipulation (20) fournie pour être exposée à travers une surface circonférentielle extérieure (15) du boîtier (2) à proximité de l'extrémité arrière du boîtier (2) et configurée pour être manipulée par un utilisateur ; et
 une unité de commande (11 b) configurée pour commander et entraîner le moteur (5) en se basant sur une manipulation de la pièce de manipulation (20),

caractérisé en ce que

la pièce de manipulation (20) est configurée pour être poussée vers l'extrémité frontale du boîtier (2) ou tirée vers l'extrémité arrière du boîtier (2) par l'utilisateur afin de changer une position de la pièce de manipulation (20) à partir d'une position neutre de celle-ci, et sachant que l'unité de commande (11 b) commande le moteur (5) de manière qu'une direction de rotation du moteur (5), quand la pièce de manipulation (20) est poussée vers l'extrémité frontale du boîtier (2) à partir de la position neutre, devient opposée à une direction de rotation du moteur (5) quand la pièce de manipulation (20) est tirée vers l'extrémité arrière du boîtier (2) à partir de la position neutre.

2. L'outil électrique (1) d'après la revendication 1, comprenant en outre :

un cylindre (14) présentant une forme essentiellement cylindrique, soutenu de manière pivotante dans le boîtier (2) de manière à tourner autour d'un axe orthogonal par rapport à un axe de rotation du mandrin (6), sachant que la pièce de manipulation (20) est fournie sur une surface extérieure de circonférence (15) du cylindre (14), et sachant que le boîtier (2) présente une fenêtre de manipulation (9) dans la surface extérieure de circonférence (15) du boîtier (2), à travers laquelle la pièce de manipulation (20) est exposée.

3. L'outil électrique (1) d'après la revendication 2, sachant que l'unité de commande (11 b) commande le moteur (5) de manière qu'une vitesse de rotation du moteur (5) soit changée en fonction d'un angle de rotation du cylindre (14) qui est tourné par la manipulation de la pièce de manipulation (20). 50
4. L'outil électrique (1) d'après la revendication 2 ou 3, sachant que la pièce de manipulation (20) inclut une saillie (21) qui saille à partir d'une portion de la sur-

face extérieure de circonférence (15) du cylindre (14).

5. L'outil électrique (1) d'après la revendication 4, sachant que le corps de préhension (3) est maintenu dans une posture dans laquelle une direction longitudinale du corps de préhension (3) est inclinée par rapport à la direction longitudinale du boîtier (2), et sachant que la saillie (21) présente une forme allongée, une direction longitudinale de la saillie étant parallèle à la direction longitudinale du corps de préhension (3). 5
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6. L'outil électrique (1) d'après la revendication 4 ou 5, sachant que la saillie (21) est fournie afin de ne pas dépasser au-delà de la surface extérieure de circonférence (15) du boîtier (2). 15

7. L'outil électrique (1) d'après une quelconque des revendication de 2 à 6, comprenant en outre : une pièce de manipulation (20') ultérieure, les deux pièces de manipulation (20, 20') étant fournies sur la surface extérieure de circonférence (15) du cylindre (14) respectivement dans deux points qui sont symétriques par rapport à l'axe du cylindre (14). 20
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8. L'outil électrique (1) d'après une quelconque des revendication de 2 à 7, comprenant en outre :

un commutateur d'arrêt (*off-lock switch*) (8) présentant un ergot d'arrêt (*off-lock lug*) (23), sachant que le cylindre (14) présente un découpage et que l'ergot d'arrêt (23) est configuré pour être engagé avec le découpage quand la pièce de manipulation (20) se trouve dans la position neutre, de manière qu'une rotation du cylindre (14) soit empêchée.

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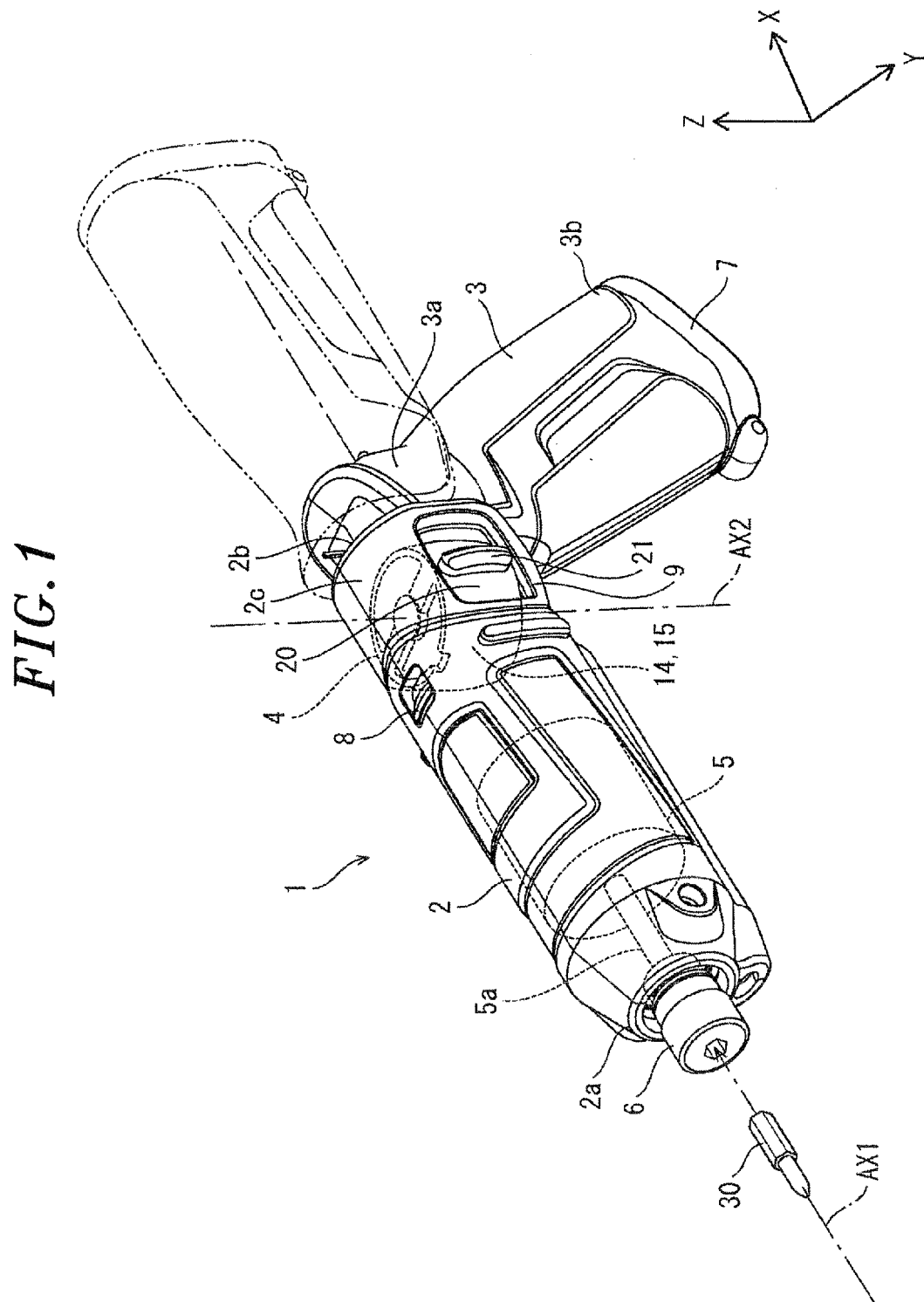


FIG. 2

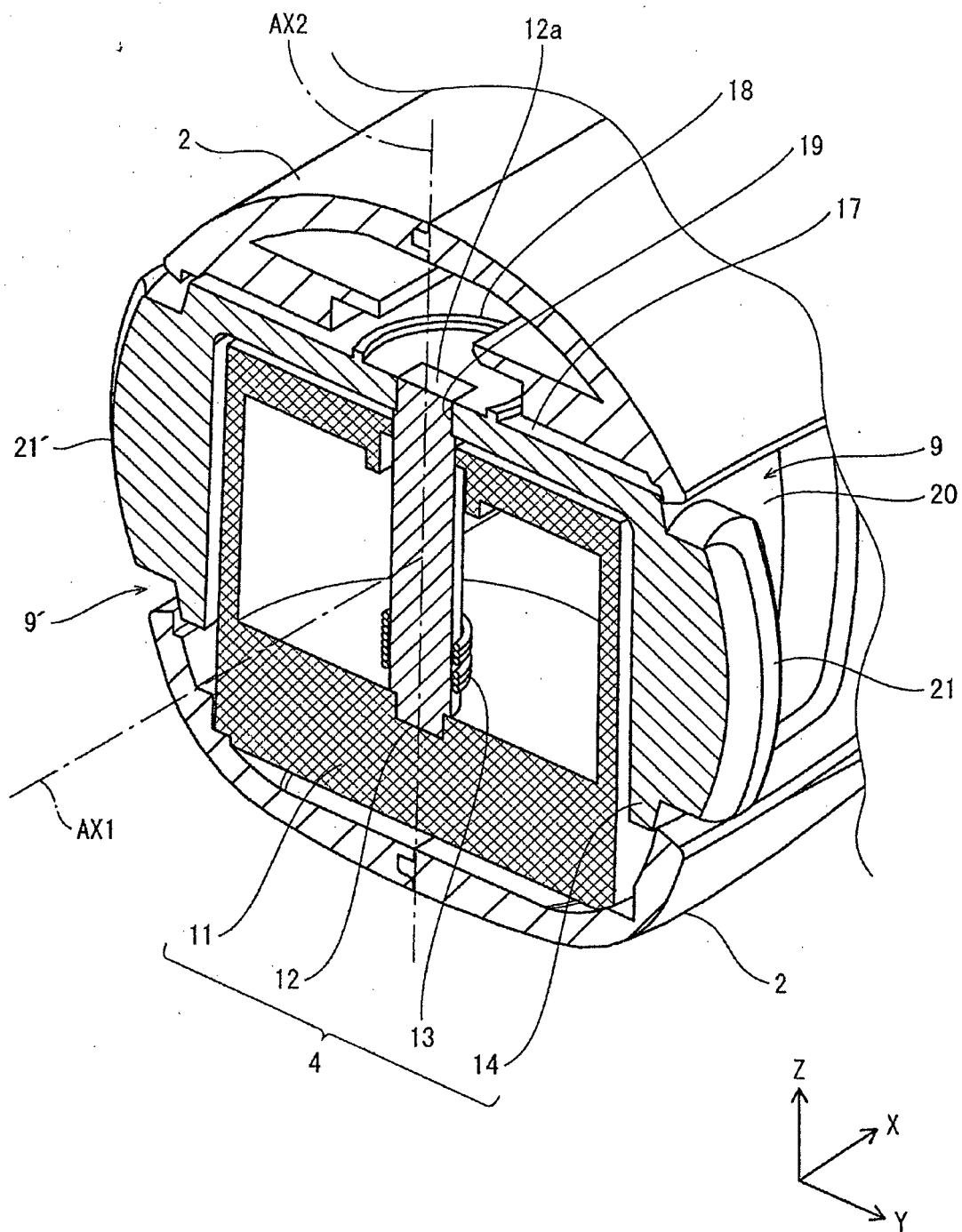


FIG. 3

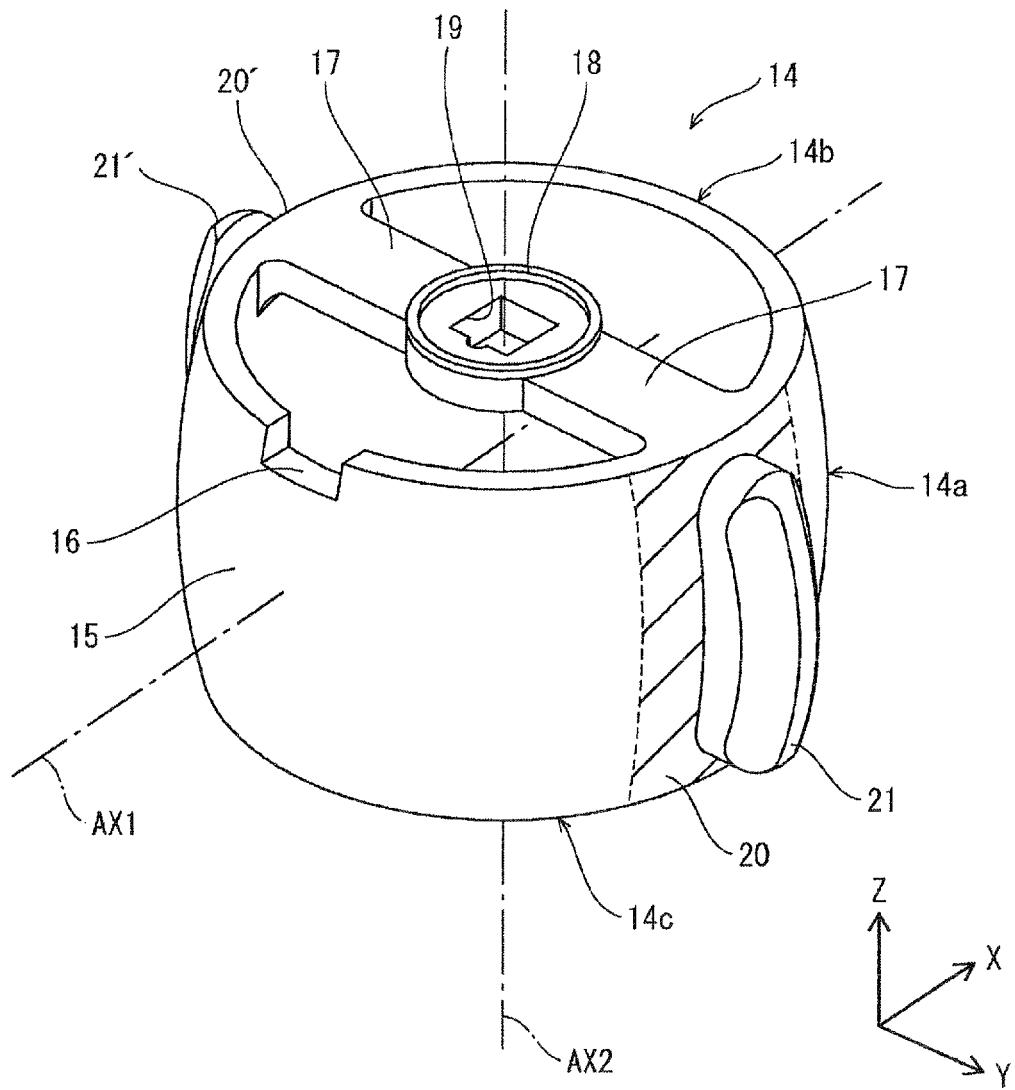


FIG. 4

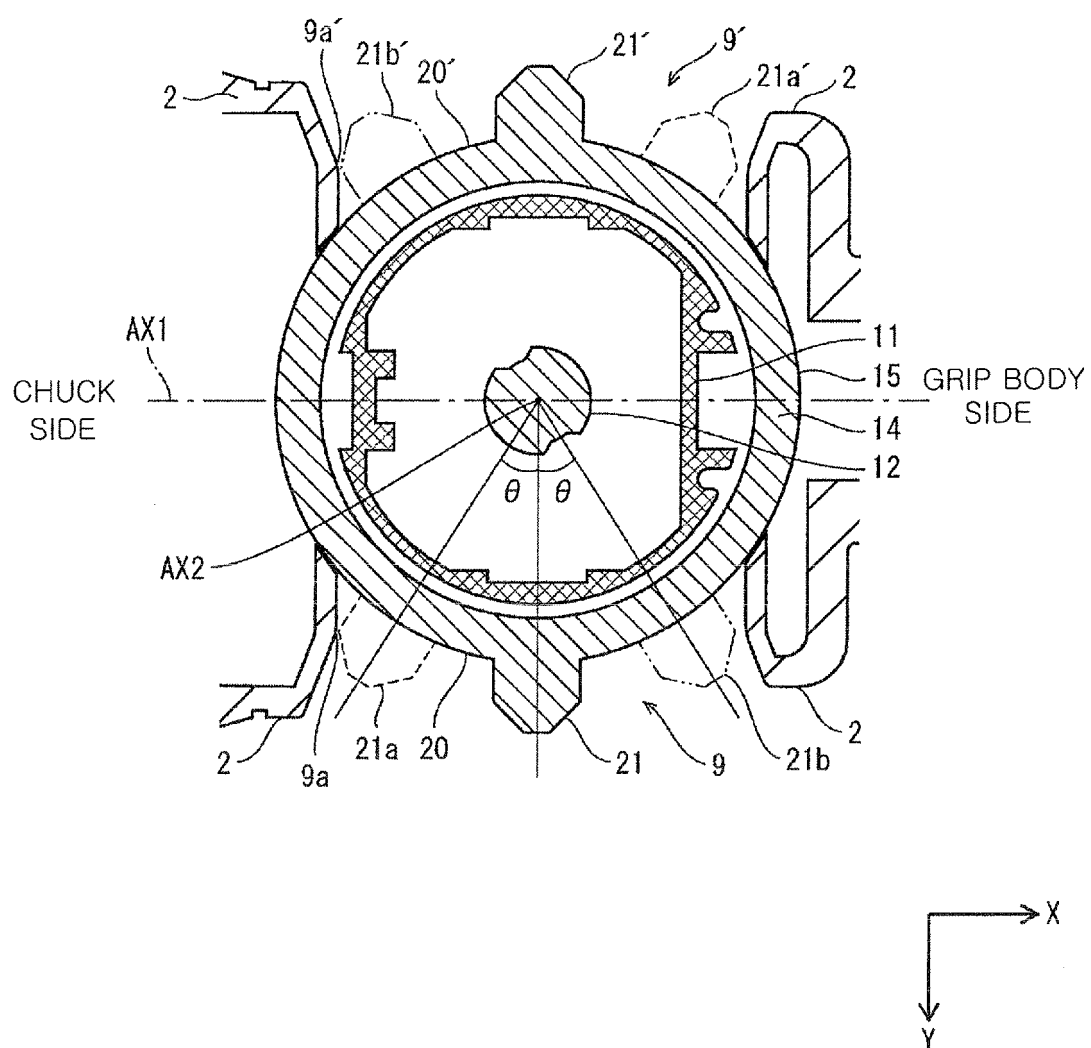


FIG. 5

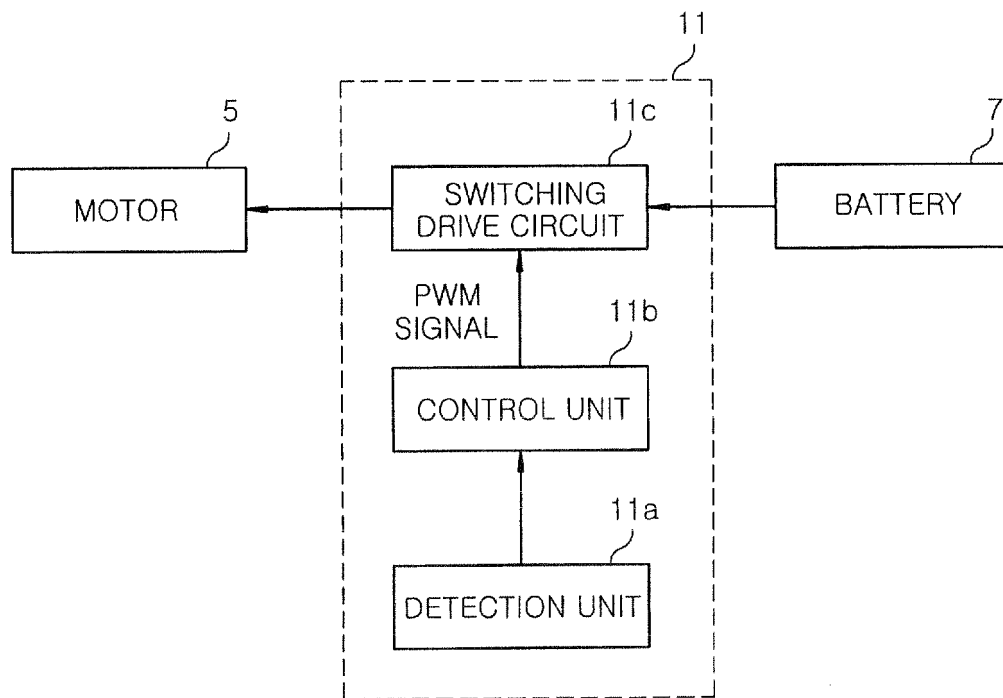


FIG. 6

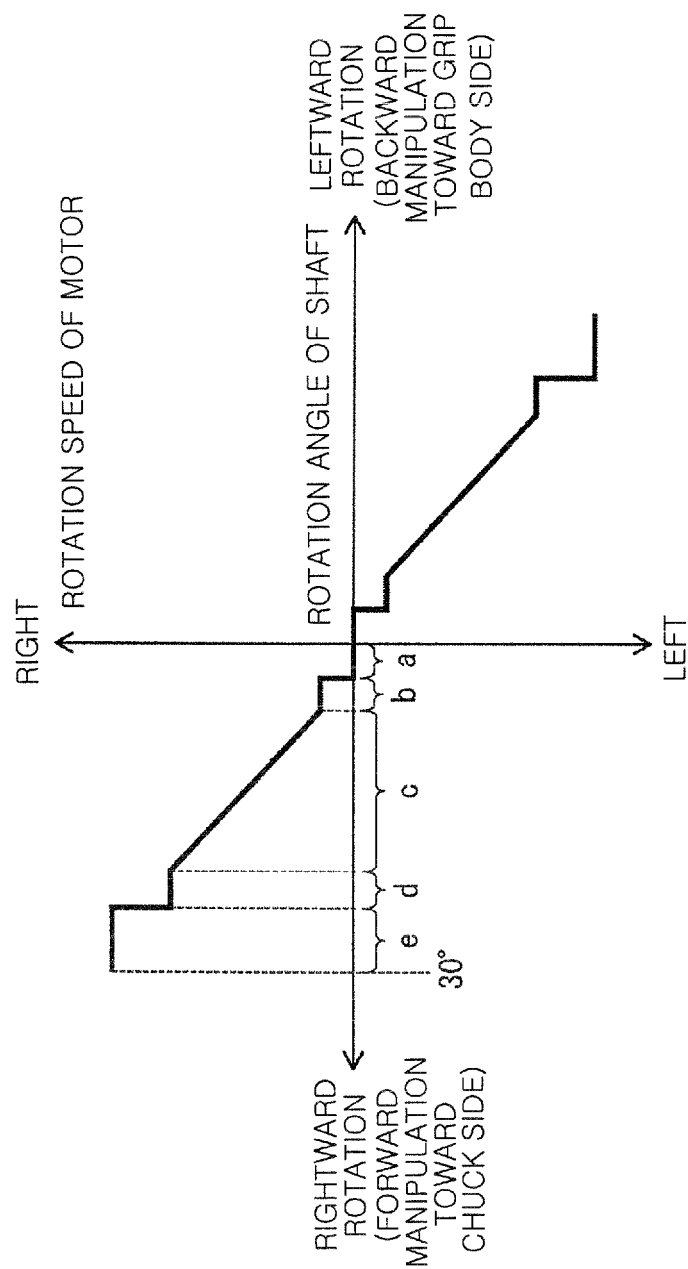


FIG. 7

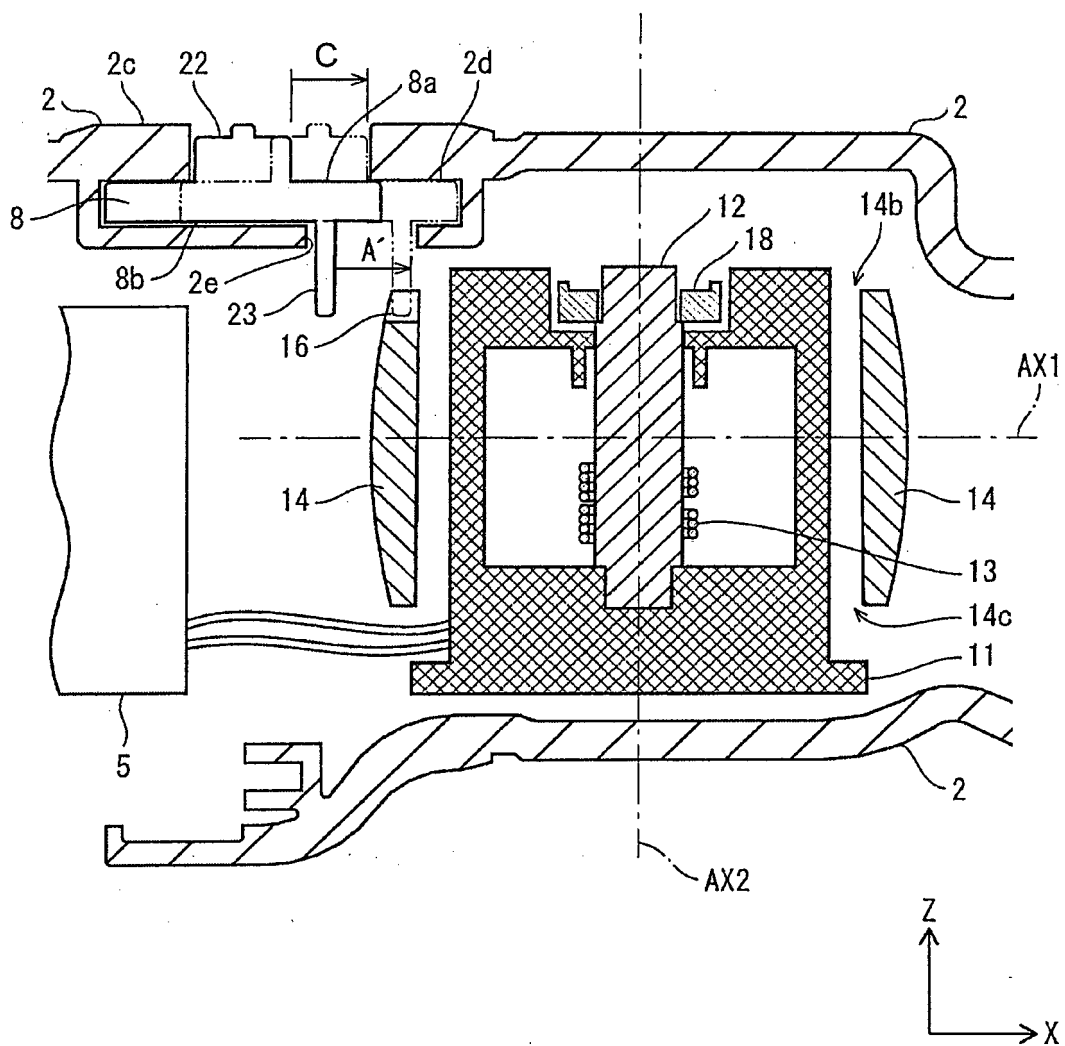


FIG. 8C

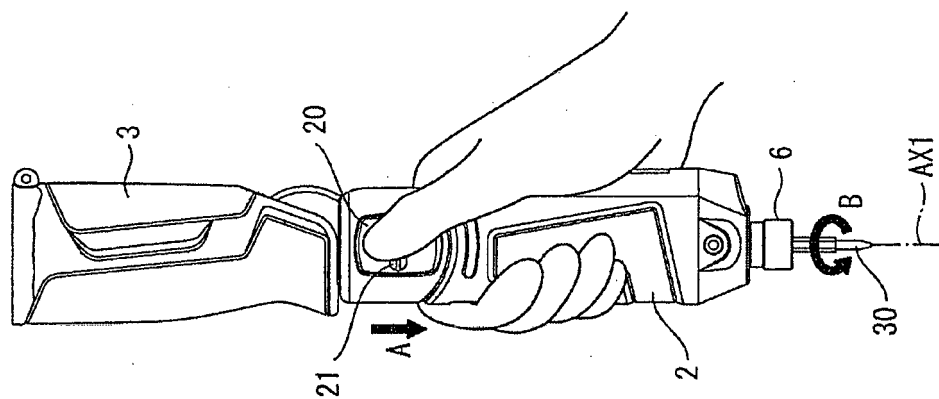


FIG. 8A

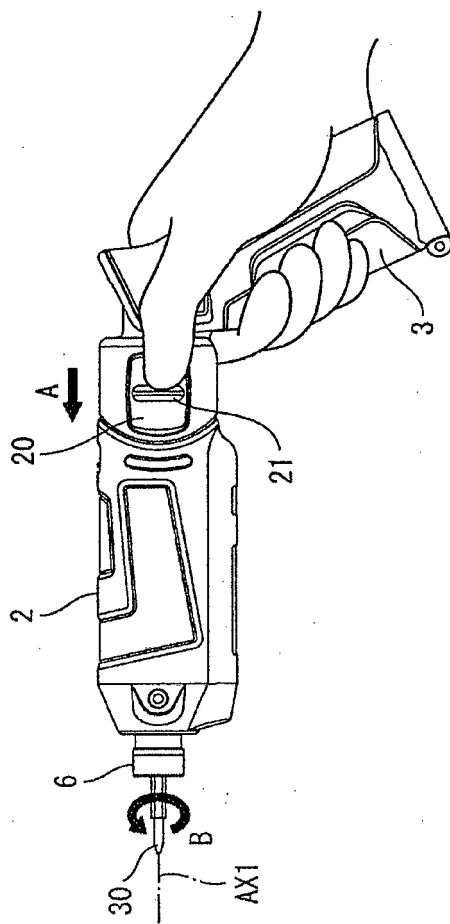


FIG. 8B

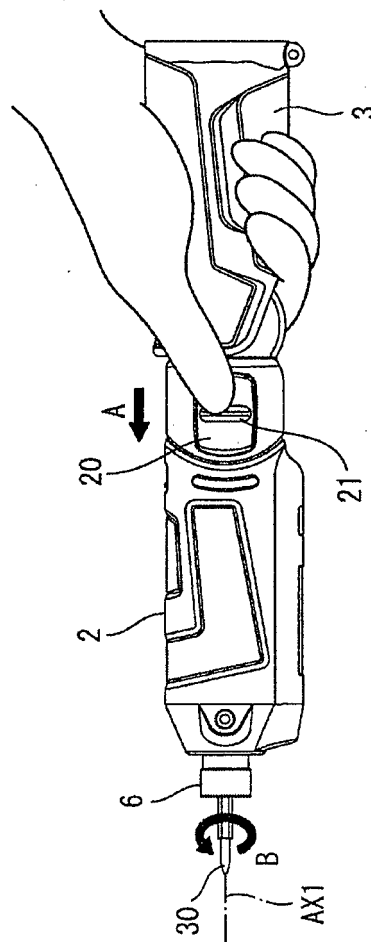


FIG. 9

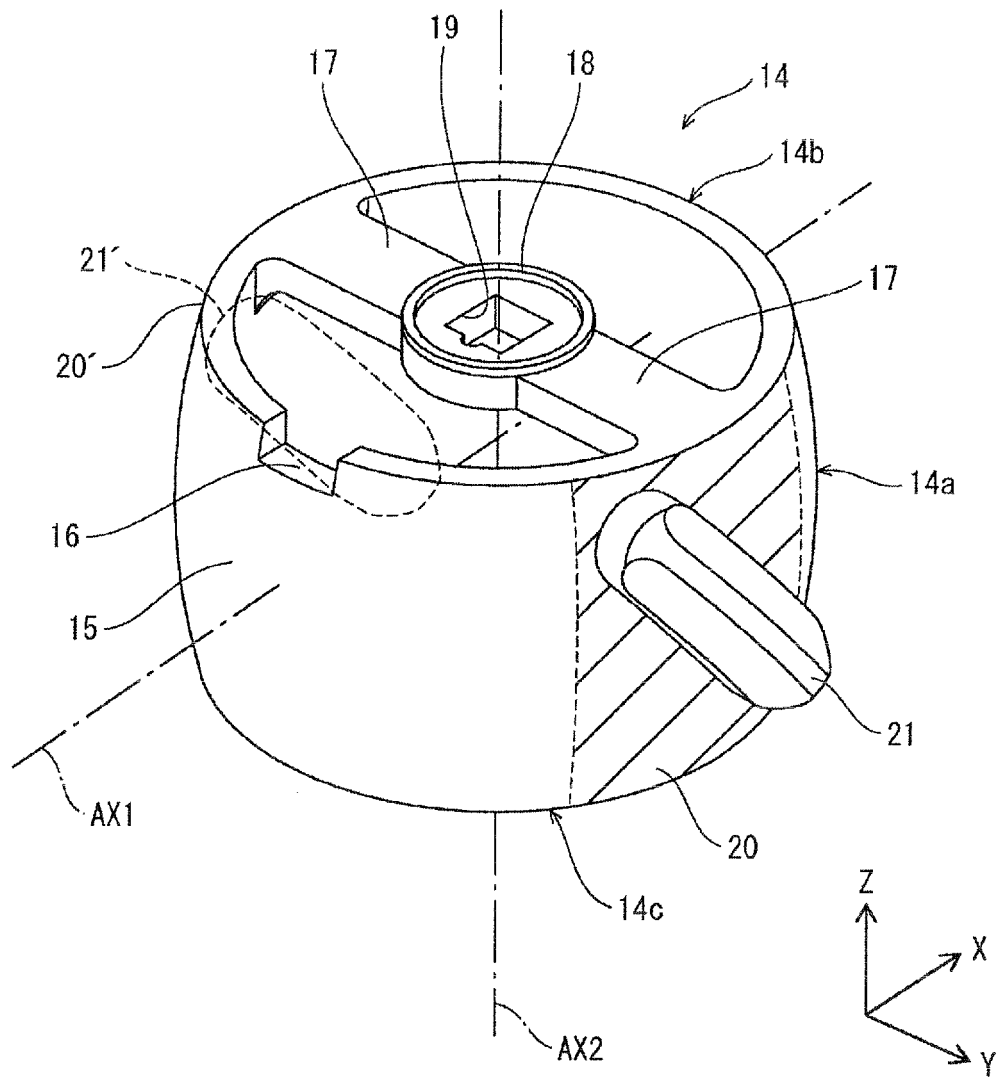


FIG. 10

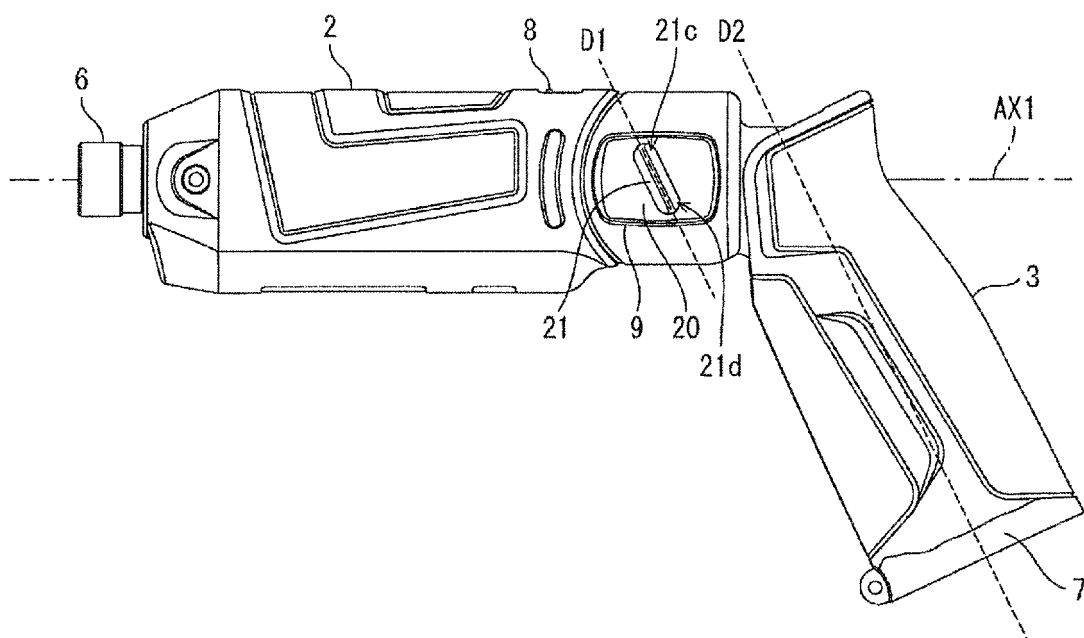
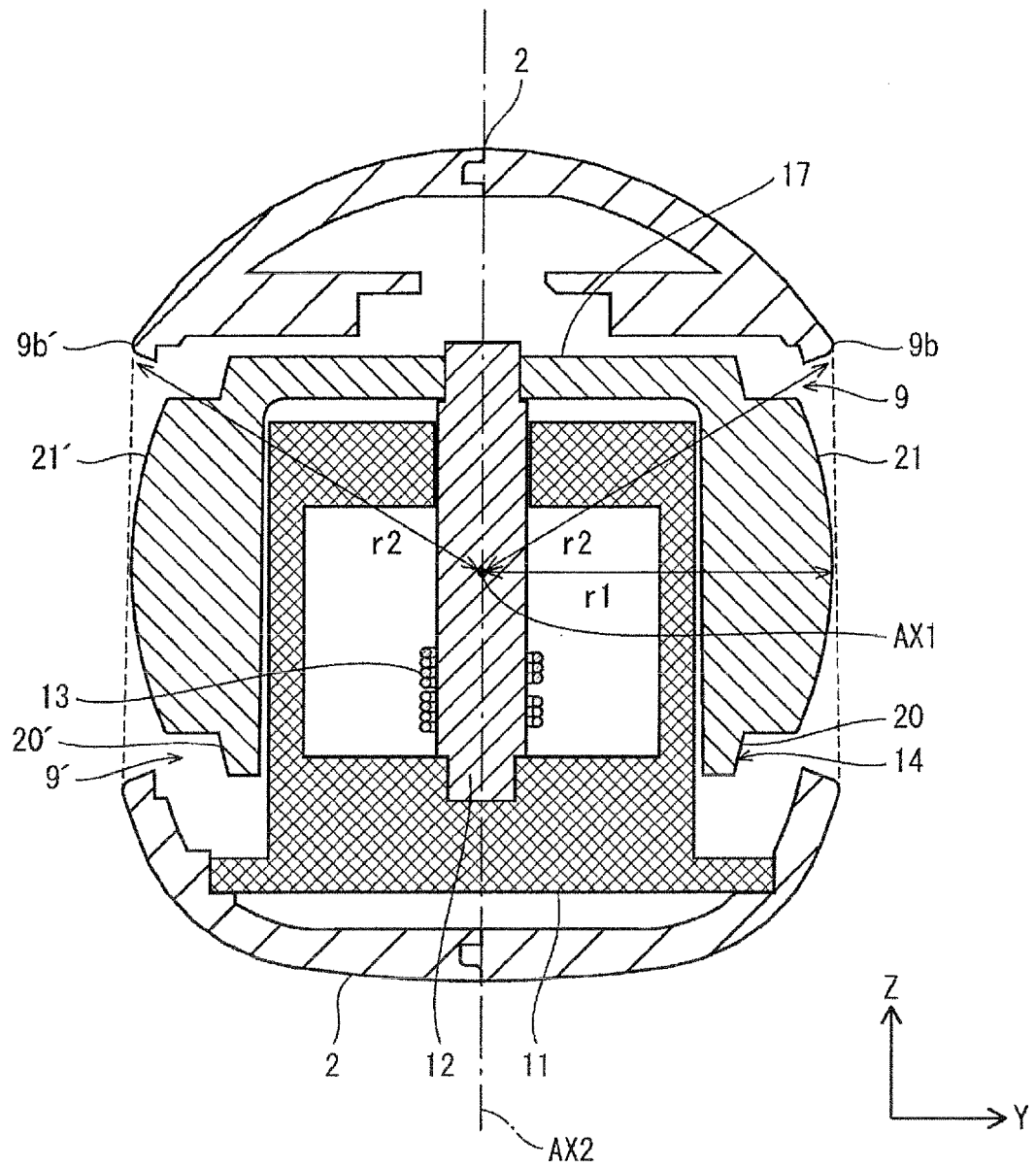


FIG. 11



REFERENCES CITED IN THE DESCRIPTION

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