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(54) HANDHELD POWER TOOL

HANDWERKZEUGMASCHINE

OUTIL ÉLECTRIQUE PORTATIF

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(73) Proprietor: **Positec Power Tools (Suzhou) Co., Ltd**
Suzhou, Jiangsu 215123 (CN)

(72) Inventors:
- **XIE, Mingjian**
  Suzhou, Jiangsu 215123 (CN)
- **LI, Ji**
  Suzhou, Jiangsu 215123 (CN)
- **ZHONG, Hongfeng**
  Suzhou, Jiangsu 215123 (CN)
- **ZHANG, Shisong**
  Suzhou, Jiangsu 215123 (CN)
- **WU, Hongbing**
  Suzhou, Jiangsu 215123 (CN)

(74) Representative: **Kilburn & Strode LLP**
Lacon London
84 Theobalds Road
Holborn
London WC1X 8NL (GB)

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Description

BACKGROUND

Technical Field

[0001] The present invention relates to a handheld power tool, and in particular, to a handheld power tool with an axial striking function.

Related Art

[0002] In striking drill products with an axial striking function, different striking structures have different striking effects. In a conventional striking structure, a pair of dynamic and static end teeth are used, a main striking force is from an abutting force, which is applied by an operator, between a tool spindle and a working surface, and the dynamic end tooth fixedly connected to the tool spindle forms axial movement, which is relative to axial slope ascending of the static end tooth, of the tool spindle. Compared with the striking structure of the dynamic and static end teeth, an active striking structure has a greater striking force. During the striking, axial striking on the tool spindle is implemented by the active striking structure, rather than relying on an operator to apply an abutting force between the tool spindle and the working surface. A common active striking structure is a cam-type active striking structure. That is, a striking drill uses a cam structure to make a hammer first perform slope ascending before striking, to compress a spring to store energy, and then the spring releases the stored energy to the hammer to make the hammer rapidly move in an axial direction and then hit the tool spindle. During the continuous rotation of the cam structure, the above actions are repeated, which can further provide the tool spindle with an intermittent axial striking force. Therefore, an active striking technology is a technology to replace the conventional dynamic-and-static-end-tooth striking technology to achieve high efficiency and a great breaking force of striking and drilling and improve user experience. Moreover, during research and development of the active striking structure, how to obtain higher drilling efficiency is also a difficult problem and an opportunity faced by related fields, and a space for improvement is also provided.

[0003] US 2014/020921 A1 relates to a handheld power tool, disclosing the preamble of claim 1, having a mechanical impact mechanism which has an impact member provided with at least one drive cam and an output shaft which is provided with at least one output cam and which is connected to a tool receptacle for accommodating a tool, the drive cam being designed for the percussive drive of the output cam during the impact operation of the mechanical impact mechanism, the impact member having the drive cams is mounted upstream from the output cams in an axial direction of the output shaft pointing away from the tool receptacle.

SUMMARY

[0004] The invention is defined by the claims.

[0005] The present invention provides a handheld striking drill with high striking and drilling efficiency. A combination of two parameters is optimized through selection of a quantity of slope ascending tracks for the cam in the active striking structure and the range of the rotational speed of the tool spindle, so that a handheld power tool with a striking function obtains relatively high striking and drilling efficiency, thereby improving user experience.

[0006] The present invention provides a technical solution with a hand-held tool according to claim 1.

[0007] Preferably, there are two to four slope ascending portions.

[0008] Preferably, there are three slope ascending portions.

[0009] Preferably, the slope ascending portion includes a start point and an end point, and a distance between projections of the start point and the end point on an axis is 4 mm to 15 mm.

[0010] Preferably, the distance is preferably 4 mm to 8 mm.

[0011] Preferably, the curve guide is circumferentially provided on an inner circumferential surface of the guide member, and the conversion member is provided on an outer circumferential surface of the hammer.

[0012] Preferably, the guide member has an end surface perpendicular to a movement direction of the hammer, and a slope ascending angle of the slope ascending portion relative to the end surface is 5 degrees to 25 degrees.

[0013] Preferably, the descending portion is obliquely provided and extends away from the slope ascending portion in a circumferential direction of the guide member.

[0014] Additional aspects and advantages of the present invention will be partially provided in the following descriptions, and a part thereof will be become obvious from the following descriptions, or be understood through practice of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

FIG. 1 is a schematic structural diagram of a handheld tool;

FIG. 2 is a local structural exploded view of a handheld tool;

FIG. 3 is a schematic structural diagram of a mode adjustment mechanism of a handheld tool;

FIG. 4 is a schematic structural diagram of a mode adjustment mechanism of a handheld tool;

FIG. 5 is a schematic local structural cross-sectional diagram of a handheld tool;

FIG. 6 is a structural enlarged view of A in FIG. 5 ;

FIG. 7 is a structural enlarged view of B in FIG. 5 ;

FIG. 8 is a structural enlarged view of C in FIG. 5 ;

FIG. 9 is a schematic local structural cross-sectional diagram of a handheld tool;

FIG. 10 is a structural enlarged view of D in FIG. 9 ;

FIG. 11 is a schematic structural diagram of a guide member of a handheld tool;

FIG. 12 is a schematic cross-sectional structural diagram of a guide member of a handheld tool;

FIG. 13 is a schematic local structural cross-sectional diagram of a handheld tool;

FIG. 14 is a structural enlarged view of E in FIG. 13 ;

FIG. 15 is a structural enlarged view of F in FIG. 13 ;

FIG. 16 is a local structural exploded view of a handheld tool;

FIG. 17 is a schematic local structural cross-sectional diagram of a handheld tool;

FIG. 18 is a schematic local structural cross-sectional diagram of a handheld tool;

FIG. 19 is a local structural exploded view of a handheld tool;

FIG. 20 is a schematic local structural diagram of a handheld tool;

FIG. 21 is a schematic cross-sectional structural diagram of a handheld tool;

FIG. 22 is a structural enlarged view of G in FIG. 21;

FIG. 23 is a schematic cross-sectional structural diagram of a handheld tool;

FIG. 24 is a structural enlarged view of H in FIG. 23;

FIG. 25 is a schematic local structural cross-sectional diagram of a handheld tool;

FIG. 26 is a schematic local structural cross-sectional diagram of a handheld tool;

FIG. 27 is a schematic cross-sectional structural diagram of a handheld tool;

FIG. 28 is a schematic local structural diagram of a handheld tool;

FIG. 29 is a schematic local structural diagram of a handheld tool;

FIG. 30 is a schematic local structural diagram of a handheld tool;

FIG. 31 is a local sectional view of an output shaft at a press position;

FIG. 32 is a local sectional view of an output shaft at a release position;

FIG. 33 is a schematic unfolded diagram of a curve guide;

FIG. 34 is a local sectional view of a hammer in a first state in a striking mode;

FIG. 35 is a local sectional view of a hammer in a second state in a striking mode;

FIG. 36 is a local sectional view of a hammer in a third state in a striking mode;

FIG. 37 is a schematic diagram of assembly of an accessory and a tool body;

FIG. 38 is a schematic structural diagram of a handheld tool; and

FIG. 39 is a schematic local structural diagram of a handheld tool.

DETAILED DESCRIPTION

[0016] To make the objectives, the technical solutions, and the advantages of the present invention more comprehensible, embodiments of the present invention are described in further detail below by way of examples with reference to the accompanying drawings. It should be understood that specific embodiments described here are merely used to explain the present invention, and are not intended to limit the present invention, which is disclosed in the appended claims.

[0017] It should be noted that, unless otherwise defined, when an element is referred to as being "provided on" another element, it may be directly on the another element or an intervening element may also be present. When an element is considered as "connecting to"another element, it may be directly connected to the another element or an intervening element may co-exist. The terms "vertical", "horizontal", "left", "right" and similar expressions used herein are only for the purpose of description, and do not indicate a unique implementation. The "speed" or "rotational speed" described herein refers to the speed or rotational speed of a corresponding element when the tool is in a no-load state.

[0018] Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by a person skilled in the art to which the present invention belongs. The terms used herein in the specification of the present invention are merely for the purpose of describing specific embodiments and are not intended to limit the present invention. The term "and/or" used herein includes any and all combinations of one or more related items listed.

[0019] In the descriptions of the present invention, it should be understood that orientation or position relations indicated by the terms "center", "longitudinal", "horizontal", "length", "width", "thickness", "up", "down", "front", "back", "left", "right", "vertical", "horizontal", "top", "bottom", "inner", "outer", "clockwise", "counterclockwise", "axial", "radial", "circumferential", and the like are based on orientation or position relationships shown in the accompanying drawings, and are used only for ease of describing the present invention and simplifying the description, rather than indicating or implying that the mentioned apparatus or element needs to have a particular orientation or needs to be constructed and operated in a particular orientation. Therefore, such terms should not be construed as a limitation on the present invention. In addition, features qualified by "first" or "second" may explicitly or implicitly include one or more such features. In the descriptions of the present invention, unless it is otherwise indicated that "a plurality of" means two or more.

[0020] In the descriptions of the present invention, it should be noted that, unless otherwise explicitly specified or defined, the terms "mount", "connect", and "connection" should be understood in a broad sense, for example, the connection may be a fixed connection, or a detachable connection, or an integrated connection; the connection may be a mechanical connection or an electrical connection; the connection may also be a direct connection, or an indirect connection through an intermediate medium, or internal communication between two elements. For a person of ordinary skill in the art, specific meanings of the above terms in the present invention can be understood according to specific situations.

Example 1

[0021] As shown in FIG. 1 to FIG. 26, a handheld tool 1 includes a motor 60, a transmission shaft 10, a hammer striking mechanism 20, and a tool spindle 30.

[0022] Specifically, as shown in FIG. 2, FIG. 5, FIG. 9, FIG. 13, FIG. 17 to FIG. 18, FIG. 21, FIG. 23, and FIG. 25 to FIG. 26, the motor 60 may drive the transmission shaft 10 to rotate, and the transmission shaft 10 may rotate around an axis of the transmission shaft 10. The hammer striking mechanism 20 includes a hammer 200, the hammer 200 is sleeved over an outer side of the transmission shaft 10, and the hammer 200 can be driven by the transmission shaft 10 to rotate. It may be understood that the motor 60 is connected to the transmission shaft 10, and the "connect" mentioned here may refer to that the motor 60 is directly connected to the transmission shaft 10. For example, an output end of the motor 60 may be directly connected to an end portion of the transmission shaft 10. The "connect" may also refer to that the motor 60 is indirectly connected to the transmission shaft 10. For example, the motor 60 may be directly connected to an intermediate transmission component, and then be directly connected to the transmission shaft 10 through the intermediate transmission component.

[0023] The motor 60 may drive the transmission shaft 10 to rotate, that is, the motor 60 may drive the transmission shaft 10 to rotate around a central axis of the transmission shaft 10. The hammer 200 may be sleeved over an outer wall of the transmission shaft 10, the hammer 200 may be connected to the transmission shaft 10 in a matching manner, and the transmission shaft 10 may further drive the hammer 200 to rotate around the axis of the transmission shaft 10. It should be noted that, the "connect" mentioned here may refer to that the hammer 200 is directly connected to the transmission shaft 10, or refer to that the hammer 200 is indirectly connected to the transmission shaft 10. As shown in FIG. 5 to FIG. 9, the handheld tool 1 further includes a tool spindle 30, one end of the tool spindle 30 is connected to the transmission shaft 10, the other end is used for connecting to a tool head, and the tool spindle 30 is movable relative to the transmission shaft 10. The tool spindle 30 and the transmission shaft 10 may be movably connected together. For example, the tool spindle 30 may move relative to the transmission shaft 10 in an axis direction of the transmission shaft 10, and they are connected without relative rotation, that is, the tool spindle 30 is driven by the transmission shaft 10 to rotate. It should be noted that, as shown in FIG. 27, the hammer 200 may also be sleeved over an outer side of the tool spindle 30, or a part thereof is sleeved over an outer side of the tool spindle 30, and a part thereof is sleeved over an outer side of the transmission shaft 10.

[0024] As shown in FIG. 2 and FIG. 5 to FIG. 13, the hammer striking mechanism 20 further includes a guide member 210 provided on an outer side of the hammer 200, and an intermittent striking component 230. When the hammer 200 rotates, the intermittent striking component 230 guides the hammer 200 to linearly move relative to the guide member 210 according to a preset path and to hit the tool spindle 30 in at least one operating state. In other words, the hammer striking mechanism 20 includes a hammer 200, a guide member 210, and an intermittent striking component 230. The guide member 210 is sleeved over a peripheral wall of the hammer 200. Preferably, to enable the hammer 200 to produce a required hammering force when it hits the tool spindle 30, a weight of the hammer 200 is greater than or equal to 10% of a sum of weights of a chuck 50 and the tool spindle 30. To ensure that the tool is not too heavy and the overall structure is compact, preferably, the weight of the hammer 200 is less than or equal to 60% of the sum of the weights of the chuck 50 and the tool spindle 30. More preferably, the weight of the hammer 200 is less than or equal to 35% of the sum of the weights of the chuck 50 and the tool spindle 30.

[0025] As shown in FIG. 25 to FIG. 26, the tool spindle 30 is fixedly connected to the chuck 50 by threaded connection. Specifically, in this embodiment, one end of the tool spindle 30 close to the chuck 50 is provided with an external thread 300, the chuck 50 is provided with a threaded hole 500 matching the external thread 300, and the tool spindle 30 and the chuck 50 are connected through the external thread 300 and the threaded hole 500. It should be noted that, the motor 60 drives the tool spindle 30 to rotate in either a first direction (forward) or a second direction (reverse) opposite to the first direction. To prevent the threaded connection between the tool spindle 30 and the chuck 50 from detaching during operation, a reverse screw 90 is further provided between the chuck 50 and the tool spindle 30. The "reverse screw 90" here means that the thread direction of the screw is opposite to that of the external thread 300. In the connection manner, the hammering force of the hammer 200 on the tool head needs to be transmitted to the tool head through the reverse screw 90, that is, the hammer 200 transmits the hammering force to the tool spindle 30, then transmits the hammering force to the reverse screw 90 through the tool spindle 30, and finally transmits the hammering force to the working head through the reverse screw 90. Therefore, the loss of the hammering force transmitted to the working head through the hammer 200 is large.

[0026] Therefore, another connection manner between the tool spindle 30 and the chuck 50 is disclosed. Referring to FIG. 21, compared with the above connection manner between the tool spindle 30 and the chuck 50, the reverse screw 90 is removed in this connection manner, a binder is applied between the external thread 300 and the threaded hole 500 to prevent the tool spindle 30 from detaching from the tool head during operation, and at the same time, the tool spindle 30 includes a protruding portion in the front (not marked in the figure) for abutting the tool head, so that striking can be directly transmitted to the tool head from the tool spindle 30, reducing the energy loss during the striking.

[0027] When the hammer 200 rotates, the intermittent striking component 230 may control a motion path of the hammer 200, and the motion path can not only make the hammer 200 rotate around the circumferential direction of the transmission shaft 10, but also make the hammer 200 move along the axis direction of the transmission shaft 10, so that the hammer 200 can hit the tool spindle 30, and then the movement of the tool spindle 30 relative to the transmission shaft 10 is completed.

[0028] The handheld tool 1 is provided with a guide member 210 and an intermittent striking component 230, the hammer 200 may be guided to linearly move by using a matching relationship between the intermittent striking component 230, the hammer 200, and the guide member 210, and the hammer 200 may further hit the tool spindle 30 to achieve the movement of the tool spindle 30 in the axis direction, so that when the tool spindle 30 drills in an environment component (such as a wall or a plate), the tool spindle 30 forms a striking force on the environment component to improve the drilling efficiency of the handheld tool 1. Moreover, the handheld tool 1 may be compact and simple in structure, and may be convenient to carry.

[0029] As shown in FIG. 2, FIG. 5, FIG. 7, and FIG. 9 to FIG. 12, the intermittent striking component 230 includes an energy storage mechanism 231 abutting the hammer 200 and an conversion member 232 and a curve guide 233 that are provided between the guide member 210 and the hammer 200. The intermittent striking component 230 further includes an energy storage mechanism 231, the conversion member 232 and the curve guide 233 are both located between the guide member 210 and the hammer 200, and one end of the energy storage mechanism 231 abuts the hammer 200. Therefore, a motion trajectory of the conversion member 232 may be guided by constructing the specific shape of the curve guide 233, the conversion member 232 may be linked with the hammer 200, and the hammer 200 moves along the trajectory of the curve guide 233 under the action of the conversion member 232.

[0030] Further, as shown in FIG. 13 and FIG. 17 to FIG. 18, the transmission shaft 10 may be provided with a baffle 100, the baffle 100 is sleeved over a peripheral wall of the transmission shaft 10, the energy storage mechanism 231 is located between the hammer 200 and the baffle 100, and one end of the energy storage mechanism 231 away from the hammer 200 may be matched with the baffle 100. After the hammer 200 moves by a certain distance toward the energy storage mechanism 231, the hammer 200 and the baffle 100 may compress the energy storage mechanism 231. Therefore, the energy storage mechanism 231 may generate a driving force on the hammer 200. Certainly, other structures may be alternatively used for the axial limiting manner of the energy storage mechanism 231, and details are not described herein again.

[0031] As shown in FIG. 11 to FIG. 12, the curve guide 233 may be annular, and the curve guide 233 may circumferentially surround the transmission shaft 10. Specifically, the curve guide 233 may include a slope ascending portion 233a and a descending portion 233b, one end of the descending portion 233b is connected to one end of the slope ascending portion 233a, and the other end of the descending portion 233b extends toward the other end of the slope ascending portion 233a. Further, the slope ascending portion 233a may be spiral, the descending portion 233b may be linear, and the descending portion 233b extends along the axis direction of the transmission shaft 10. Preferably, to ensure that the hammer 200 generates a sufficient striking force on the tool spindle 30 and that the handheld tool 1 is compact, a slope ascending height of the slope ascending portion 233a in an axial direction is greater than 3 mm and less than or equal to 15 mm. Preferably, the slope ascending height is greater than or equal to 4 mm and less than or equal to 8 mm. Preferably, the slope ascending height is 5 mm. It should be noted that, the "slope ascending height" refers to an axial distance between the two ends of the slope ascending portion 233a in the axis direction of the transmission shaft 10.

[0032] When the conversion member 232 is matched with the slope ascending portion 233a, the conversion member 232 rolls from one end of the slope ascending portion 233a to the other end of the slope ascending portion 233a, the hammer 200 moves toward the baffle 100, and the hammer 200 and the baffle 100 may compress the energy storage mechanism 231. When the conversion member 232 is located on the other end of the slope ascending portion 233a and rolls toward the descending portion 233b, the energy storage mechanism 231 may push the hammer 200 to descend from one end of the descending portion 233b close to the baffle 100 to the other end of the descending portion 233b close to the tool head, that is, the hammer 200 rapidly descends in a direction away from the baffle 100 and close to the tool head, and a part of the hammer 200 approaches and hits a portion of the tool spindle 30 on an outer side of the transmission shaft 10, so that the tool spindle 30 moves relative to the transmission shaft 10 in the axis direction of the transmission shaft 10, and the hammer 200 hammers the tool spindle 30 and the tool head.

[0033] Further, as shown in FIG. 7 and FIG. 15, an end surface of the hammer 200 close to the energy storage mechanism 231 may be provided with a mounting groove 203, an end portion of the energy storage mechanism 231 may be located in the mounting groove 203, and the end portion of the energy storage mechanism 231 may abut a bottom wall of the mounting groove 203. Therefore, the assembly stability of the energy storage mechanism 231 and the hammer 200 may be improved.

[0034] As shown in FIG. 12, the curve guide 233 may include a plurality of segments, and each of the plurality of segments includes a slope ascending portion 233a and a descending portion 233b. There may be a plurality of conversion members 232, and the plurality of conversion members 232 may be arranged at intervals along a circumferential direction of the hammer 200. In this embodiment, to ensure rationality of the overall design of the handheld tool 1, the outer diameter of the hammer 200 is between 15 mm and 50 mm. Preferably, the outer diameter of the hammer 200 is between 20 mm and 40 mm, and the slope ascending height is greater than 3 mm and less than or equal to 15 mm. Preferably, the slope ascending height is greater than or equal to 4 mm and less than or equal to 8 mm. More preferably, the slope ascending height is 5 mm. It may be understood that, to ensure smooth slope ascending of the conversion member 232, preferably, the quantity of the segments ranges from 2 to 7, particularly advantageously from 3 to 4, and the quantity of the segments of the slope ascending portion 233a in this embodiment is preferably 3.

[0035] It should be noted that, it may be known from the above introduction that the conversion member 232 and the curve guide 233 are located between the hammer 200 and the guide member 210. Specifically, the conversion member 232 is located on one of the guide member 210 and the hammer 200, and the curve guide 233 is located on the other of the guide member 210 and the hammer 200. As shown in FIG. 16 to FIG. 18, in some other examples, the conversion member 232 may be located on the guide member 210, and the curve guide 233 is located on the hammer 200. For example, an inner circumferential wall of the guide member 210 is provided with an accommodating groove 211, a part of the conversion member 232 may be located in the accommodating groove 211, a peripheral wall of the hammer 200 may be provided with a curve guide 233, and another part of the conversion member 232 may be matched with the curve guide 233. As shown in FIG. 16 to FIG. 18, in some other examples, the conversion member 232 may be located on the guide member 210, and the curve guide 233 is located on the hammer 200. For example, an inner circumferential wall of the guide member 210 is provided with an accommodating groove 211, a part of the conversion member 232 may be located in the accommodating groove 211, a peripheral wall of the hammer 200 may be provided with a curve guide 233, and another part of the conversion member 232 may be matched with the curve guide 233. Therefore, an assembly relationship between the conversion member 232, the curve guide 233 and the hammer 200, the guide member 210 may be implemented, and then the relative motion of the hammer 200 relative to the guide member 210 may be implemented by using the matching relationship between the conversion member 232 and the curve guide 233 and the relative motion between the conversion member 232 and the curve guide 233. The hammer 200 may move relative to the transmission shaft 10 in the axis direction of the transmission shaft 10. The motion trajectory of the conversion member 232 in the curve guide 233 is the preset path of the hammer 200.

[0036] In this implementation, the hammer 200 rotates, the guide member 210 is fixed and does not rotate, and the rotation of the hammer 200 and the curve guide 233 relative to the guide member 210 makes the hammer 200 move in an axial direction, and then strike the tool spindle 30 under the action of the energy storage mechanism 231. During the striking, the conversion member 232 provided on an inner circumference surface of the guide member 210 has no position movement, and may rotate within the accommodating groove 211 without motion relative to a position change.

[0037] As shown in FIG. 2, FIG. 16, and FIG. 19, , the conversion member 232 may be provided as a steel ball. As shown in FIG. 11 to FIG. 12, preferably, to ensure the strength of the steel ball, the diameter of the steel ball is greater than 4 mm and less than or equal to 10 mm. More preferably, the diameter of the steel ball is greater than 4 mm and less than or equal to 6 mm. The diameter of the steel ball is 5 mm in this embodiment. The curve guide 233 may be provided as a cam surface or a cam groove. Therefore, the cam surface or the cam groove may define a movement trajectory of the steel ball, and the steel ball may move on the cam surface or in the cam groove. The steel ball has a smooth outer surface, which may reduce the relative motion friction between the conversion member 232 and the curve guide 233 and improve movement smoothness of the conversion member 232 in the curve guide 233. Moreover, the steel ball has a great structural strength and a good abrasion resistance performance, which may guarantee the working performance of the intermittent striking component 230. It should be noted that, the "cam" mentioned here may refer to that the curve guide 233 protrudes from the inner circumferential wall of the guide member 210, or the curve guide 233 protrudes from the peripheral wall of the hammer 200.

[0038] Further, the steel ball may be in point or line contact with the curve guide 233. It may be understood that as the steel ball moves in the curve guide 233, the steel ball is always in point or line contact with the curve guide 233, which helps to reduce the friction between the steel ball and the curve guide 233. For example, the radius of curvature of the cam surface may be basically the same as or slightly greater than the radius of the steel ball, so as to improve the matching between the steel ball and the cam surface, and then improve the assembly stability, the wear resistance, and the service life of the steel ball and the cam surface.

[0039] As shown in FIG. 2, FIG. 16, and FIG. 19, , the energy storage mechanism 231 may be provided as an elastic member. For example, the energy storage mechanism 231 may be a spring or an elastic rubber member. Therefore, the configuration and assembly of the energy storage mechanism 231 may be simplified, and the manufacturing costs of the energy storage mechanism 231 may also be reduced.

[0040] As shown in FIG. 5, FIG. 8 to FIG. 10, FIG. 13, and FIG. 15, , the hammer striking mechanism 20 further includes a detachable clutch mechanism 220, and the clutch mechanism 220 is configured to transmit rotational motion between the transmission shaft 10 and the hammer 200. It may be understood that the clutch mechanism 220 may be matched with the hammer 200, the clutch mechanism 220 may also be detached from the hammer 200, and when the clutch mechanism 220 is matched with the hammer 200, the rotational motion of the transmission shaft 10 may be transmitted to the hammer 200 through the clutch mechanism 220 to drive the hammer 200 to rotate; and when the clutch mechanism 220 is detached from the hammer 200, that is, the matching relationship between the clutch mechanism 220 and the hammer 200 is relieved, the transmission shaft 10 may rotate relative to the hammer 200, and the hammer 200 is static relative to the guide member 210. Therefore, the motion of the hammer 200 may be controlled through the clutch mechanism 220 to control whether the hammer 200 hits the tool spindle 30, and then control the working mode of the tool spindle 30.

[0041] Further, the clutch mechanism 220 may be configured to be closed by a force transmitted through the tool spindle 30. That is, when the tool head is in a working condition (with an axial load), the clutch mechanism 220 can automatically close to achieve striking, and the handheld tool 1 is in a striking state. Therefore, whether a matching relationship exists between the clutch mechanism 220 and the hammer 200 may be controlled through the tool spindle 30, and the tool spindle 30 may apply an external force to the clutch mechanism 220 to change the relationship between the clutch mechanism 220 and the hammer 200. Therefore, the working state of the handheld tool 1 may be easily switched without an additional control structure.

[0042] Further, the clutch mechanism 220 operably switches between a closed state and a detached state. When the clutch mechanism 220 is in the closed state, the hammer 200 is driven by the transmission shaft 10 to rotate; and when the clutch mechanism 220 is in the detached state, the hammer 200 cannot be driven by the transmission shaft 10. It may be understood that the tool spindle 30 may control the working state of the clutch mechanism 220 to enable the clutch mechanism 220 to be engaged with the hammer 200 or disengaged from the hammer 200, and the clutch mechanism 220 may switch between the two states under the action of the tool spindle 30. When the clutch mechanism 220 is engaged with the hammer 200, the transmission shaft 10 may drive the hammer 200 to rotate, and when the clutch mechanism 220 is detached from the hammer 200, the hammer 200 cannot be driven by the transmission shaft 10. Therefore, the motion of the hammer 200 may be controlled through the clutch mechanism 220 to implement that the handheld tool 1 automatically implements a striking function or enters the striking state when operating with a load.

[0043] As shown in FIG. 5, FIG. 8 to FIG. 10, FIG. 13, and FIG. 15, the clutch mechanism 220 includes a clutch member 221 provided on one of the transmission shaft 10 and the hammer 200, and a receiving portion 201 provided on the other of the transmission shaft 10 and the hammer 200. When the clutch mechanism 220 is in an engagement state, the clutch member 221 is engaged with the receiving portion 201 through a shape matching manner, and when the clutch mechanism 220 is in a disengagement state, the clutch member 221 is detached from the receiving portion 201.

[0044] It may be understood that the clutch mechanism 220 includes a clutch member 221 and a receiving portion 201, one of the transmission shaft 10 and the hammer 200 is provided with the clutch member 221, and the other is provided with the receiving portion 201. When the clutch mechanism 220 is in an engagement state, the clutch member 221 is matched with the receiving portion 201, and when the clutch mechanism 220 is in a disengagement state, the clutch member 221 is detached from the receiving portion 201. Therefore, the working state of the clutch mechanism 220 may be switched through the assembly relationship between the clutch member 221 and the receiving portion 201.

[0045] As shown in FIG. 5, FIG. 8 to FIG. 10, FIG. 13, and FIG. 15, the clutch member 221 may be configured to be in a shape of a ball or a column, and the receiving portion 201 may be configured to be a tank 201a. The ball or column has a smooth outer surface, and the smooth outer surface has less friction during the movement, making it easier to switch the state of the clutch member 221. The receiving portion 201 being provided as a tank 201a not only facilitates the configuration, but also facilitates the matching with the clutch member 221. For example, a part of the inner circumferential wall of the hammer 200 is recessed toward a radial outer side of the hammer 200 to form the receiving portion 201. Further, a bottom wall of the tank 201a may form a cambered surface, and the cambered surface may be recessed toward the radial outer side of the hammer 200. Therefore, the tank 201a may wrap a part of the clutch member 221, thus improving the matching stability of the clutch member 221 and the tank 201a.

[0046] The tool spindle 30 may be axially movable relative to the transmission shaft 10 but may be connected without relative rotation. In other words, in the circumferential direction of the transmission shaft 10, the tool spindle 30 and the transmission shaft 10 are relatively static or rotate together during rotation, and in the axis direction of the transmission shaft 10, the tool spindle 30 is movable relative to the transmission shaft 10. Therefore, the transmission shaft 10 may drive the tool spindle 30 to rotate in the circumferential direction of the transmission shaft 10, and the tool spindle 30 may further slide in the axis direction of the transmission shaft 10.

[0047] For example, as shown in FIG. 5, how the clutch mechanism 220 is closed or detached when the tool spindle 30 axially moves relative to the transmission shaft 10 and how the tool spindle 30 is axially movable relative to the transmission shaft 10 but is connected to the transmission shaft without rotation are described in detail below with reference to the accompanying drawings. The tool spindle 30 may be moved from a first position to a second position by an axial force. When the tool spindle 30 is at the second position, the hammer 200 can be driven by the transmission shaft 10 to rotate and can move along a preset path relative to the guide member 210, thereby hitting the tool spindle 30 along the axis of the tool spindle in at least one operating state; and when the tool spindle 30 is at the first position, the transmission shaft 10 cannot drive the hammer 200 to rotate. The tool spindle 30 includes a connecting end connected to the transmission shaft 10, and an output end connected to the tool head. A side of the transmission shaft 10 close to the connecting end is provided with a cavity 120 including an axial opening, and the cavity 120 may extend in the axis direction of the transmission shaft 10. The connecting end of the tool spindle 30 extends from the opening into the cavity 120, and an inner wall of the cavity 120 and an outer wall of the connecting end of the tool spindle 30 are matched through a spline 370 axially extending, so that the tool spindle 30 may axially move relative to the transmission shaft 10 and can rotate with the transmission shaft 10. Specifically, as shown in FIG. 2, an outer wall of the tool spindle 30 and an inner wall of the cavity 120 are provided with ribs 340, and adjacent ribs 340 on the tool spindle 30 form a recess 350 radially recessed, so that the inner wall of the cavity 120 may be matched with the recess 350.

[0048] Still referring to FIG. 5, FIG. 8 to FIG. 10, FIG. 13, and FIG. 15, a sidewall of the cavity 120 is provided with a radial hole 110, the radial hole 110 runs through the sidewall of the cavity 120 in a radial direction of the transmission shaft 10, the clutch member 221 is located in the radial hole 110 and can move in the radial hole 110, and the inner circumferential wall of the hammer 200 may be provided with the receiving portion 201. When the clutch mechanism 220 is in an engagement state, that is, referring to FIG. 13 and FIG. 15, when the tool spindle 30 moves to the first position, the radial hole 110 corresponds to the position of the recess 350, and the clutch member 221 moves along the radial hole 110 in a direction away from the receiving portion 201 of the hammer 200 and close to the recess 350, to make the clutch member 221 disengaged from the hammer 200. Referring to FIG. 9 and FIG. 10, when the tool spindle moves to the second position, the recess 350 no longer corresponds to the position of the radial hole 110, that is, there is no longer space for accommodating the clutch member 221 at the position corresponding to the radial hole on the tool spindle 30, the tool spindle 30 extrudes the clutch member 221 during the movement to make the clutch member 221 move along the radial hole 110 toward a direction close to the receiving portion 221 of the hammer, making a part of the clutch member located in the radial hole 110 and the other part located in the receiving portion 201, and the hammer 200 may rotate with the transmission shaft 10 under the action of the clutch member 221. It should be noted that, the cavity 120 may also be located at the connecting end of the tool spindle 30, one end, which is connected to the tool spindle 30, of the transmission shaft 10 extends into the cavity 120, and the implementation may be described in detail in the specification below.

[0049] As shown in FIG. 5, FIG. 9, and FIG. 13, the tool spindle 30 is provided with a striking receiving portion 400 matching the hammer 200. It may be understood that the tool spindle 30 may be provided with a striking receiving portion 400, and the hammer 200 may hit the striking receiving portion 400. Therefore, the hammer 200 may drive the tool spindle 30 to move by hitting the striking receiving portion 400, so as to enable the tool spindle 30 to drive the tool head to move relative to the transmission shaft 10 in the axis direction of the transmission shaft 10.

[0050] Further, as shown in FIG. 2, the striking receiving portion 400 may be annular, the striking receiving portion 400 is fixed to a peripheral wall of the tool spindle 30, the striking receiving portion 400 is located outside the transmission shaft 10, and the striking receiving portion 400 is connected to the tool spindle 30. For example, the striking receiving portion 400 may be clamped with the tool spindle 30, or the striking receiving portion 400 may be welded to the tool spindle 30. Therefore, when the hammer 200 hits the tool spindle 30, a contact area between the striking receiving portion 400 and the hammer 200 may be increased, so as to improve the stability of an impact force applied by the hammer 200 to the striking receiving portion 400.

Example 2

[0051] As shown in FIG. 1 to FIG. 30, a handheld tool 1 includes a housing 80, a motor 60, a transmission shaft 10, a tool spindle 30, and a hammer striking mechanism 20.

[0052] As shown in FIG. 1, FIG. 5, FIG. 13, FIG. 21, FIG. 23, and FIG. 25 to FIG. 27, the transmission shaft 10 may be driven by the motor 60 to rotate, and the transmission shaft 10 may rotate around its axis. The tool spindle 30 is used for connecting to a tool head, and the tool spindle 30 can be driven by the transmission shaft 10 to rotate. The hammer striking mechanism 20 includes a hammer 200, and the hammer 200 is sleeved over an outer side of at least one of the transmission shaft 10 and the tool spindle 30 and can be driven by the transmission shaft 10 to rotate. In other words, the hammer 200 shown in FIG. 1, FIG. 5, FIG. 13, FIG. 21, FIG. 23, and FIG. 25 to FIG. 26 may be sleeved over the transmission shaft 10, or as shown in FIG. 27, the hammer 200 may be sleeved over the tool spindle 30, or the hammer 200may be sleeved over both the transmission shaft 10 and the tool spindle 30. The transmission shaft 10 may directly or indirectly drive the hammer 200 to rotate.

[0053] As shown in FIG. 1, FIG. 5, FIG. 13, FIG. 21, FIG. 23, and FIG. 25 to FIG. 27, the hammer striking mechanism 20 further includes a guide member 210, and the guide member 210 is sleeved over an outer side of the hammer 200. The tool spindle 30 may be switched from a first position to a second position by an axial force. In other words, an external force in the axis direction of the tool spindle 30 exists to act on the tool spindle 30, so that the tool spindle 30 can switch from the first position to the second position. When the tool spindle 30 is at the second position, the hammer 200 can be driven by the transmission shaft 10 to rotate and can move relative to the guide member 210 along a preset path, so as to hit the tool spindle 30 along an axis of the tool spindle 30 in at least one operating state. When the tool spindle 30 is at the first position, the transmission shaft 10 cannot drive the hammer 200 to rotate.

[0054] According to the handheld tool 1, the position of the tool spindle 30 can be switched by applying a force along its axis direction to the tool spindle 30, then the relationship between the hammer 200 and the transmission shaft 10 can be controlled, further, the hammer 200 is guided through an intermittent striking component 230 to linearly move, and the hammer 200 can further hit the tool spindle 30 to achieve the movement of the tool spindle 30 in the axis direction, so that when the tool spindle 30 drills in an environment component (such as a wall or a plate), the tool spindle 30 forms a striking force on the environment component to improve the drilling efficiency of the handheld tool 1. Moreover, the handheld tool 1 is compact and simple in structure, and is convenient to carry.

[0055] As shown in FIG. 25 to FIG. 27, , two ends of the tool spindle 30 are a connecting end 380 and an output end 390 respectively. The connecting end 380 is connected to the transmission shaft 10, and the output end 390 is connected to the tool head. When an axial force on the tool spindle 30 is in a direction from the output end 390 to the connecting end 380, in other words, when the force on the tool spindle 30 is in the direction from the output end 390 of the tool spindle 30 to the connecting end 380, the tool spindle 30 can switch to the second position for matching relative to the transmission shaft 10. When the force on the tool spindle 30 is in a direction from the connecting end 380 of the tool spindle 30 to the output end 390, the tool spindle 30 switches to the first position for matching relative to the transmission shaft 10. Therefore, the position state of the tool spindle 30 may be switched through an acting direction of the external force applied to the tool spindle 30, thereby switching the working state of the handheld tool 1.

[0056] As shown in FIG. 1, FIG. 5, FIG. 13, FIG. 21, FIG. 23, and FIG. 25 to FIG. 27, the handheld tool 1 further includes a mode adjustment mechanism 40. The mode adjustment mechanism 40 operably switches between a first mode state and a second mode state. In the first mode state, the tool spindle 30 can switch between the first position and the second position relative to the transmission shaft 10. That is, when the mode adjustment mechanism 40 is in the first mode state, the handheld tool 1 can generate an axial striking under the action of an axial load, and the mode is hereinafter referred to as a "striking mode." In the second mode state, the tool spindle 30 axially abuts the mode adjustment mechanism 40 to limit the tool spindle 30 to switch from the first position to the second position. That is, when the mode adjustment mechanism 40 is in the second mode state, the handheld tool 1 generates no striking regardless of whether the tool spindle 30 is under an axial load, and the mode is hereinafter referred to as a "non-striking mode."

[0057] Further, as shown in FIG. 1, FIG. 5, FIG. 13, FIG. 21, FIG. 23, and FIG. 25 to FIG. 27, the handheld tool 1 further includes a mode adjustment mechanism 40. The mode adjustment mechanism 40 operably switches between a first mode state and a second mode state. When the mode adjustment mechanism 40 is in the first mode state, the guide member 210 is fixed to the housing 80, that is, the guide member 210 is static relative to the housing 80, and the hammer 200 can move along the guide member 210 according to a preset path to hit the tool spindle 30 during rotation. When the mode adjustment mechanism 40 is in the second mode state, the guide member 210 is rotatably provided on the housing 80, that is, the guide member 210 is movable relative to the housing 80, and the hammer 200 does not strike the tool spindle 30. Therefore, the operating state of the guide member 210 may be controlled by controlling the state of the mode adjustment mechanism 40, so as to control the matching relationship between the hammer 200 and the guide member 210 and then control the working state of the hammer 200 to implement switching of the working state of the handheld tool 1.

[0058] As shown in FIG. 19 to FIG. 20, the mode adjustment mechanism 40 includes a first tooth pattern 212 provided on the guide member 210, and a striking switching member provided with a second tooth pattern 431. The striking switching member is axially movable but is fixed in the housing 80 of the handheld tool 1 without rotation. Specifically, the striking switching member is a striking switching ring 430, and the striking switching ring 430 is movably sleeved over the hammer 200. When the mode adjustment mechanism 40 is in the first mode state, the first tooth pattern 212 is engaged with the second tooth pattern 431; and when the mode adjustment mechanism 40 is in the second mode state, the first tooth pattern 212 is disengaged from the second tooth pattern 431.

[0059] It may be understood that the striking switching ring 430 is sleeved over the hammer 200, the striking switching ring 430 and the hammer 200 are relatively movable, the striking switching ring 430 is provided with a second tooth pattern 431, the guide member 210 is provided with a first tooth pattern 212, and the first tooth pattern 212 may be connected to the second tooth pattern 431 in a matching manner, so as to connect the guide member 210 to the striking switching ring 430. In this case, the striking switching ring 430 may limit the motion of the guide member 210, the guide member 210 and the striking switching ring 430 are relatively static, and the hammer 200 may linearly move relative to the guide member 210 according to a preset path and hit the tool spindle 30 in at least one operating state.

[0060] The first tooth pattern 212 may also be spaced from the second tooth pattern 431 by switching the position of the striking switching ring 430. In this case, the guide member 210 is movable relative to the striking switching ring 430, the guide member 210 is driven by the intermittent striking component 230 and may rotate with the hammer 200, and the hammer 200 and the guide member 210 are relatively static. Therefore, the position relationship and the assembly relationship between the guide member 210 and the striking switching ring 430 may be adjusted by adjusting the matching relationship between the first tooth pattern 212 and the second tooth pattern 431, so as to control a motion state of the guide member 210 and then improve a motion state of the tool spindle 30 to control the working mode of the handheld tool 1.

[0061] Further, as shown in FIG. 19 and FIG. 21 to FIG. 26, the mode adjustment mechanism 40 further includes a cushioning member 440. One end of the cushioning member 440 abuts the striking switching ring 430 to constantly push the striking switching ring 430 to move toward the guide member 210. Therefore, the cushioning member 440 may constantly push the striking switching ring 430 to approach the guide member 210, so as to enable the first tooth pattern 212 to be matched with the second tooth pattern 431.

[0062] Further, as shown in FIG. 19 to FIG. 24, the mode adjustment mechanism 40 further includes a mode switching button 450. The mode switching button 450 is rotatably sleeved over the striking switching ring 430. The mode switching button 450 is rotatable relative to the striking switching ring 430. An inner circumferential wall of the mode switching button

450 is provided with a guide block 451, and a peripheral wall of the striking switching ring 430 is provided with a mating block 432 matching the guide block 451. The mode switching button 450 is rotated, when the guide block 451 axially abuts the mating block 432, the guide block 451 pushes against the striking switching ring 430 to compress the cushioning member 440 to move in a direction away from the guide member 210, and the first tooth pattern 212 is spaced from the second tooth pattern 431; and when the guide block 451 is staggered from the mating block 432, the striking switching ring 430 moves in a direction close to the guide member 210 under the action of the cushioning member 440, and the first tooth pattern 212 is engaged with the second tooth pattern 431.

[0063] It may be understood that the position relationship between the mode switching button 450 and the striking switching ring 430 may be switched by rotating the mode switching button 450 or the striking switching ring 430, so as to change a matching state between the guide block 451 and the mating block 432. Therefore, the matching relationship between the first tooth pattern 212 and the second tooth pattern 431 may be controlled by switching the matching relationship between the guide block 451 and the mating block 432. Further, as shown in FIG. 20, the guide block 451 has a guide bevel 451a to guide the mating block 432. Therefore, the matching relationship between the guide block 451 and the mating block 432 may be conveniently switched.

[0064] Alternatively, the mode switching mechanism 40 may also use other structures. Specifically, referring to FIG. 2 to FIG. 5, FIG. 9, and FIG. 13, the mode switching mechanism 40 includes a pressure stop ring 410 and a mode adjustment button 420. The pressure stop ring 410 is sleeved over the transmission shaft 10, and is specifically sleeved over the striking receiving portion 400, the pressure stop ring 410 is rotatable relative to the transmission shaft 10 but cannot axially move, and the mode adjustment button 420 is rotatably sleeved over the pressure stop ring 410. The pressure stop ring 410 is provided with an abutting stop portion 411. An inner circumferential wall of the mode adjustment button 420 is provided with a channel 422 suitable for the abutting stop portion 411 to move past, and the channel 422 extends in the axis direction of the transmission shaft 10.

[0065] When the mode adjustment mechanism 40 is in the first mode state, the abutting stop portion 411 stops and abuts against the mode adjustment button 420; and when the mode adjustment mechanism 40 is in the second mode state, the abutting stop portion 411 corresponds to the position of the channel 422, and the tool spindle 30 can drive the pressure stop ring to move in the axial direction of the tool spindle. Therefore, the motion state of the hammer 200 may be adjusted by adjusting the relative position relationship between the abutting stop portion 411 of the pressure stop ring 410 and the mode adjustment button 420, so as to adjust the working mode of the tool spindle 30. Specifically, as shown in FIG. 3 to FIG. 4, the mode adjustment button 420 further includes a flange 421 provided on an inner circumferential wall of the mode adjustment button 420, the flange 421 is annular and extends in a circumferential direction of the pressure stop ring 410, and the channel 422 runs through the flange 421 in an axis direction of the pressure stop ring 410. Therefore, the channel 422 may be constructed from the flange 421, and the flange 421 may also stop and abut against the abutting stop portion 411.

[0066] As shown in FIG. 3 to FIG. 4, the abutting stop portion 411 includes a fixed segment 411a, a connecting segment 411b, and a mating segment 411c. The fixed segment 411a extends out of the pressure stop ring 410, one end of the connecting segment 411b is connected to the fixed segment 411a, one end of the mating segment 411c is connected to the other end of the connecting segment 411b, the mating segment 411c is adapted to move past the channel 422, and the fixed segment 411a and the connecting segment 411b are spaced apart in the axis direction of the pressure stop ring 410. Further, a part of the connecting segment 411b connected to the fixed segment 411a smoothly transits; or a part of the connecting segment 411b connected to the mating segment 411c smoothly transits.

[0067] As shown in FIG. 2 and FIG. 6, a peripheral wall of the striking receiving portion 400 has a step surface 404, and the pressure stop ring 410 stops and abuts against the step surface 404. Therefore, the step surface 404 may limit the motion of the pressure stop ring 410 to prevent the pressure stop ring 410 from detaching from the striking receiving portion 400.

[0068] As shown in FIG. 25 to FIG. 27, one end of the transmission shaft 10 connected to the connecting end 380 is a transmission end 130, one of the connecting end 380 and the transmission end 130 is provided with an axial hole 360, and the other end portion extends into the axial hole 360. For example, an end surface of the transmission end 130 of the transmission shaft 10 may be provided with an axial hole 360, the axial hole 360 extends in the axis direction of the transmission shaft 10, the axial hole 360 is open toward the connecting end 380 of the tool spindle 30, and an end portion of the connecting end 380 of the tool spindle 30 may extend into the axial hole 360. In another example, the connecting end 380 of the tool spindle 30 may be provided with an axial hole 360, the axial hole 360 extends in the axis direction of the tool spindle 30, the axial hole 360 is open toward the transmission end 130 of the transmission shaft 10, and an end portion of the transmission end 130 of the transmission shaft 10 may extend into the axial hole 360. The connection manner of providing an opening on the connecting end of the tool spindle 30 to facilitate the transmission shaft 10 to perform insertion has been described in Embodiment 1, and details are not described herein again. A connection manner of providing an opening on the surface of the transmission end of the transmission shaft 10 is described in detail below.

[0069] As shown in FIG. 25 to FIG. 27, an inner wall of the axial hole 360 and an outer wall of the other end portion are provided with splines 370 for implementing torque transmission between the transmission shaft 10 and the tool spindle 30.

Therefore, the stability of the connection between the transmission shaft 10 and the tool spindle 30 can be improved; moreover, not only can the rotation of the tool spindle 30 and the transmission shaft 10 in the circumferential direction be transmitted, but also the tool spindle 30 and the transmission shaft 10 can relatively move in the axis direction.

[0070] Further, as shown in FIG. 13 and FIG. 25 to FIG. 27, a radial recess may be formed between the splines 370 on the other end portion that extends into the axial hole 360, and an outer wall of the axial hole 360 is provided with a radial hole 110; when the tool spindle 30 is at the first position, the radial hole 110 corresponds to the position of the radial recess, and the steel ball may at least partially fall into the radial recess and detach from the hammer; and when the tool spindle 30 is subject to an axial force from the output end 390 to the connecting end 380, that is, when the tool spindle 30 is at the second position, the radial hole 110 no longer corresponds to the radial recess, and the steel ball moves along the radial hole 110 and is connected to the hammer 200 to enable the transmission shaft to drive the hammer 200 to rotate. Therefore, by controlling the relative position relationship between the steel ball and the radial recess, the matching relationship between the hammer 200 and the tool spindle 30 or the transmission shaft 10 can be controlled, then the motion state of the hammer 200 can be controlled, and then the working state of the tool spindle 30 can be controlled, to switch the working mode of the handheld tool 1.

[0071] As shown in FIG. 1, FIG. 5, FIG. 13, FIG. 21, FIG. 23, and FIG. 25 to FIG. 27, the hammer striking mechanism 20 further includes an intermittent striking component 230. When the transmission shaft 10 drives the hammer 200 to rotate, the intermittent striking component 230 forces the hammer 200 to linearly move relative to the guide member 210 according to a preset path and to hit the tool spindle 30 in at least one operating state. It may be understood that the intermittent striking component 230 may be matched with the hammer 200, or the intermittent striking component 230 may be matched with the guide member 210. When the transmission shaft 10 drives the hammer 200 to rotate, the intermittent striking component 230 may change a motion path of the hammer 200, and the motion path can not only make the hammer 200 rotate around the circumferential direction of the transmission shaft 10, but also make the hammer 200 move along the axis direction of the transmission shaft 10, so that the hammer 200 can hit the tool spindle 30, and then the sliding of the tool spindle 30 relative to the transmission shaft 10 is completed.

[0072] As shown in FIG. 2, FIG. 5, FIG. 7, and FIG. 9 to FIG. 12, the intermittent striking component 230 includes an energy storage mechanism 231 abutting the hammer 200 and an conversion member 232 and a curve guide 233 that are provided between the guide member 210 and the hammer 200. It may be understood that the intermittent striking component 230 includes an energy storage mechanism 231, an conversion member 232, and a curve guide 233, the conversion member 232 and the curve guide 233 are both located between the guide member 210 and the hammer 200, and one end of the energy storage mechanism 231 abuts the hammer 200. Therefore, a motion trajectory of the conversion member 232 may be guided by constructing the specific shape of the curve guide 233, the conversion member 232 may be linked with the hammer 200, the hammer 200 may drive the conversion member 232 to rotate in the circumferential direction of the transmission shaft 10, and the conversion member 232 may drive the hammer to rotate along the trajectory of the curve guide 233.

[0073] Further, as shown in FIG. 13 and FIG. 17 to FIG. 18, the transmission shaft 10 may be provided with a baffle 100, the baffle 100 is sleeved over a peripheral wall of the transmission shaft 10, the energy storage mechanism 231 is located between the hammer 200 and the baffle 100, and one end of the energy storage mechanism 231 away from the hammer 200 may be matched with the baffle 100. After the hammer 200 moves by a certain distance toward the energy storage mechanism 231, the hammer 200 and the baffle 100 may compress the energy storage mechanism 231. Therefore, the energy storage mechanism 231 may generate a driving force on the hammer 200.

[0074] As shown in FIG. 11 to FIG. 12, the curve guide 233 may be annular, and the curve guide 233 may circumferentially surround the transmission shaft 10. The curve guide 233 may include a slope ascending portion 233a and a descending portion 233b, one end of the descending portion 233b is connected to one end of the slope ascending portion 233a, and the other end of the descending portion 233b extends toward the other end of the slope ascending portion 233a. Further, the slope ascending portion 233a may be spiral, the descending portion 233b may be linear, and the descending portion 233b extends along the axis direction of the transmission shaft 10. At least a part of the conversion member 232 may be matched with the curve guide 233. Preferably, to ensure that the hammer generates a sufficient striking force on the tool spindle 30 and that the handheld tool 1 is compact, a slope ascending height of the slope ascending portion 233a in an axial direction is greater than 3 mm and less than or equal to 20 mm. Preferably, a slope ascending height is between 4 mm and 15 mm. Preferably, the slope ascending height is 10 mm.

[0075] When the conversion member 232 is matched with the slope ascending portion 233a, the conversion member 232 rolls from one end of the slope ascending portion 233a to the other end of the slope ascending portion 233a, the hammer 200 moves toward the baffle 100, and the hammer 200 and the baffle 100 may compress the energy storage mechanism 231. When the conversion member 232 is located on the other end of the slope ascending portion 233a and rolls toward the descending portion 233b, the energy storage mechanism 231 may push the hammer 200 to descend from one end of the descending portion 233b close to the baffle 100 to the other end of the descending portion 233b close to the tool head, that is, the hammer 200 moves toward a direction away from the baffle 100 and close to the tool head, and a part of the hammer 200 approaches and hits a portion of the tool spindle 30 on an outer side of the transmission shaft 10, so that the tool spindle 30 moves relative to the transmission shaft 10 in the axis direction of the transmission shaft 10, and the hammer 200 hammers the tool spindle 30 and the tool head.

[0076] Further, as shown in FIG. 7 and FIG. 15, an end surface of the hammer 200 close to the energy storage mechanism 231 may be provided with a mounting groove 203, an end portion of the energy storage mechanism 231 may be located in the mounting groove 203, and the end portion of the energy storage mechanism 231 may abut a bottom wall of the mounting groove 203. Therefore, the assembly stability of the energy storage mechanism 231 and the hammer 200 may be improved.

[0077] As shown in FIG. 12, the curve guide 233 may include a plurality of segments, and each of the plurality of segments includes a slope ascending portion 233a and a descending portion 233b. There may be a plurality of conversion members 232, and the plurality of conversion members 232 may be arranged at intervals along a circumferential direction of the hammer 200. In this embodiment, the outer diameter of the hammer 200 is between 20 mm and 40 mm, and the sloping ascending height is greater than 3 mm and less than or equal to 15 mm. Preferably, the slope ascending height is greater than or equal to 4 mm and less than or equal to 8 mm. More preferably, the slope ascending height is 5 mm. It may be understood that, to ensure smooth slope ascending of the conversion member 232, preferably, the quantity of the segments ranges from 2 to 7, particularly advantageously from 3 to 4, and the quantity of the segments of the slope ascending portion 233a in this embodiment is preferably 3.

[0078] It should be noted that, the assembly positions and assembly relations of the conversion member 232 and the curve guide 233 on the hammer 200 and the guide member 210 are not specifically limited. The conversion member 232 may be located on one of the guide member 210 and the hammer 200, and the curve guide 233 is located on the other of the guide member 210 and the hammer 200. Therefore, an assembly relationship between the conversion member 232, the curve guide 233 and the hammer 200, the guide member 210 may be implemented, and then the relative motion of the hammer 200 relative to the guide member 210 may be implemented by using the matching relationship between the conversion member 232 and the curve guide 233 and the relative motion between the conversion member 232 and the curve guide 233. The hammer 200 may move relative to the transmission shaft 10 in the axis direction of the transmission shaft 10. The motion trajectory of the conversion member 232 in the curve guide 233 is the preset path of the hammer 200.

[0079] As shown in FIG. 9 to FIG. 12, the conversion member 232 may be located on the hammer 200, and the curve guide 233 is located on the guide member 210. For example, as shown in FIG. 2, FIG. 5, FIG. 7, and FIG. 11 to FIG. 12, a peripheral wall of the hammer 200 may be provided with an insertion groove 202, a part of the conversion member 232 may be located in the insertion groove 202, an inner circumferential wall of the guide member 210 is provided with a curve guide 233, and another part of the conversion member 232 may be matched with the curve guide 233.

[0080] As shown in FIG. 16 to FIG. 18, the conversion member 232 may be located on the guide member 210, and the curve guide 233 is located on the hammer 200. For example, an inner circumferential wall of the guide member 210 is provided with an accommodating groove 211, a part of the conversion member 232 may be located in the accommodating groove 211, a peripheral wall of the hammer 200 may be provided with a curve guide 233, and another part of the conversion member 232 may be matched with the curve guide 233.

[0081] As shown in FIG. 2, FIG. 16, and FIG. 19, the conversion member 232 may be provided as a steel ball. As shown in FIG. 11 to FIG. 12, preferably, to ensure the strength of the steel ball, the diameter of the steel ball is greater than 4 mm and less than or equal to 10 mm. Advantageously, the diameter of the steel ball is greater than 4 mm and less than or equal to 6 mm. The diameter of the steel ball is 5 mm in this embodiment. The curve guide 233 may be provided as a cam surface or a cam groove. Therefore, the cam surface or the cam groove may define a movement trajectory of the steel ball, and the steel ball may move on the cam surface or in the cam groove. The steel ball has a smooth outer surface, which may reduce the relative motion friction between the conversion member 232 and the curve guide 233 and improve movement smoothness of the conversion member 232 in the curve guide 233. Moreover, the steel ball has a great structural strength and a good abrasion resistance performance, which may guarantee the working performance of the intermittent striking component 230. It should be noted that, the "cam" mentioned here may refer to that the curve guide 233 protrudes from the inner circumferential wall of the guide member 210, or the curve guide 233 protrudes from the peripheral wall of the hammer 200.

[0082] Further, the steel ball may be in point or line contact with the curve guide 233. It may be understood that as the steel ball moves in the curve guide 233, the steel ball is always in point or line contact with the curve guide 233, which helps to reduce the friction between the steel ball and the curve guide 233. For example, the radius of curvature of the cam surface may be basically the same as or slightly greater than the radius of the steel ball, so as to improve the matching between the steel ball and the cam surface, and then improve the assembly stability, the wear resistance, and the service life of the steel ball and the cam surface.

[0083] As shown in FIG. 2, FIG. 16, and FIG. 19, the energy storage mechanism 231 may be provided as an elastic member. For example, the energy storage mechanism 231 may be a spring or an elastic rubber member. Therefore, the configuration and assembly of the energy storage mechanism 231 may be simplified, and the manufacturing costs of the energy storage mechanism 231 may also be reduced. Further, the energy storage mechanism 231 may be formed as a ring, and the energy storage mechanism 231 may be sleeved over a peripheral wall of the transmission shaft 10. Therefore, the assembly of the energy storage mechanism 231 is easy, and the force applied by the energy storage mechanism 231 to the hammer 200 can be even.

Example 3

[0084] As shown in FIG. 1 to FIG. 30, a handheld tool 1 includes a motor 60, a transmission shaft 10, a hammer striking mechanism 20, and a tool spindle 30.

[0085] Specifically, as shown in FIG. 1, FIG. 2, and FIG. 5, the transmission shaft 10 is driven by the motor 60 rotate and rotates around an axis of the transmission shaft 10. In other words, the motor 60 drives the transmission shaft 10 to rotate, and the transmission shaft 10 rotates around the axis of the transmission shaft 10. It may be understood that the motor 60 is connected to the transmission shaft 10, It should be noted that, the "connect" mentioned here may refer to that the motor 60 is directly connected to the transmission shaft 10. For example, an output end of the motor 60 may be directly connected to an end portion of the transmission shaft 10. The "connect" may also refer to that the motor 60 is indirectly connected to the transmission shaft 10. For example, the motor 60 may be directly connected to an intermediate transmission component, and then be directly connected to the transmission shaft 10 through the intermediate transmission component.

[0086] The tool spindle 30 is axially movable relative to the transmission shaft 10 but is connected to the transmission shaft without relative rotation. In other words, in the circumferential direction of the transmission shaft 10, the tool spindle 30 and the transmission shaft 10 are relatively static, and in the axis direction of the transmission shaft 10, the tool spindle 30 is movable relative to the transmission shaft 10. The transmission shaft 10 may drive the tool spindle 30 to rotate in the circumferential direction of the transmission shaft 10, and the tool spindle 30 may further slide in the axis direction of the transmission shaft 10.

[0087] As shown in FIG. 2 and FIG. 5 to FIG. 13, the hammer striking mechanism 20 includes a hammer 200, and the hammer 200 is sleeved over an outer side of the transmission shaft 10, and can be driven by the transmission shaft 10 to rotate. It may be understood that the hammer striking mechanism 20 includes a hammer 200, the hammer 200 may be sleeved over a peripheral wall of the transmission shaft 10, the hammer 200 may be connected to the transmission shaft 10 in a matching manner, and the transmission shaft 10 may further drive the hammer 200 to rotate around the axis of the transmission shaft 10. It should be noted that, the "connect" mentioned here may refer to that the hammer 200 is directly connected to the transmission shaft 10, or refer to that the hammer 200 is indirectly connected to the transmission shaft 10.

[0088] As shown in FIG. 5, FIG. 8 to FIG. 10, FIG. 13, and FIG. 15, the hammer striking mechanism 20 further includes a detachable clutch mechanism 220, and the clutch mechanism 220 is configured to transmit rotational motion between the transmission shaft 10 and the hammer 200. It may be understood that the clutch mechanism 220 may make the transmission shaft 10 matched with the hammer 200, and the clutch mechanism 220 may also make the transmission shaft 10 detach from the hammer 200. When the clutch mechanism 220 makes the transmission shaft 10 matched with the hammer 200, the rotational motion of the transmission shaft 10 may be transmitted to the hammer 200 through the clutch mechanism 220 to drive the hammer 200 to rotate; and when the clutch mechanism 220 makes them detach from each other, the matching relationship between the clutch mechanism 220 and the hammer 200 is relieved, the transmission shaft 10 rotates relative to the hammer 200, and the hammer 200 is static relative to the guide member 210. Therefore, the motion of the hammer 200 may be controlled through the clutch mechanism 220 to control whether the hammer 200 hits the tool spindle 30, and then the working state of the handheld tool 1 may be changed. The clutch mechanism 220 may be configured to be closed by a force transmitted through the tool spindle 30. It may be understood that whether a matching relationship exists between the clutch mechanism 220 and the hammer 200 may be controlled through the tool spindle 30, and the tool spindle 30 may apply an external force to the clutch mechanism 220 to change the relationship between the clutch mechanism 220 and the hammer 200. For example, when the tool head or the tool spindle 30 is in a working condition (that is, when the tool spindle 30 is subject to an axial load), the clutch mechanism 220 closes, and the handheld tool 1 switches to the striking state. Therefore, when the handheld tool 1 is in the working state, and when the tool head is in the working condition, the handheld tool 1 may automatically switch to the striking state, and the mode is hereinafter referred to as a "striking mode."

[0089] It should be noted that, in the actual work, not all working conditions are suitable for the handheld tool 1 to work in the striking state. In many cases, an operator hopes that when the handheld tool 1 is in the working state, and when the tool head or the tool spindle 30 is subject to a load from a working condition, the handheld tool 1 can still be in a non-striking working state, and the working mode is hereinafter referred to as a "non-striking working mode."

[0090] Therefore, to enable the handheld tool 1 to adapt to a plurality of working conditions, the handheld tool 1 further includes a mode adjustment mechanism 40. As shown in FIG. 2 to FIG. 6, FIG. 13 to FIG. 15, and FIG. 19 to FIG. 30, the mode adjustment mechanism 40 operably switches between a first mode state and a second mode state. When the mode adjustment mechanism 40 is in a first mode state (that is, at the position as shown in FIG. 5 to FIG. 6, FIG. 9 to FIG. 10, FIG. 21 to FIG. 22, and FIG. 25), the hammer 200 can be driven by the transmission shaft 10 to rotate to thus linearly move according to a preset path, and to hit the tool spindle 30 in at least one operating state. In other words, the transmission shaft 10 may be matched with the hammer 200, the transmission shaft 10 may provide power for the hammer 200 to make the hammer 200 move along the preset path, and the hammer 200 may hit the tool spindle 30 during the movement. When the mode adjustment mechanism 40 is in a second mode state (that is, at the position as shown in FIG. 13 to FIG. 15, FIG. 23 to FIG. 24, and FIG. 26), the transmission shaft 10 cannot drive the hammer 200 to rotate, and the hammer 200 does not hit the tool spindle 30.

[0091] The handheld tool 1 is provided with a mode adjustment mechanism 40, and the matching relationship between the transmission shaft 10 and the hammer 200 is changed by switching the state of the mode adjustment mechanism 40, so that the hammer 200 can be controlled whether to hit the tool spindle 30, the switching of the handheld tool 1 between a striking mode and a non-striking mode can be implemented, and then the performance of the handheld tool 1 can be improved, making the handheld tool 1 compact and simple in structure, versatile, and convenient to carry.

[0092] As shown in FIG. 5, FIG. 8 to FIG. 10, FIG. 13, and FIG. 15, the clutch mechanism 220 includes a clutch member 221 provided on one of the transmission shaft 10 and the hammer 200, and a receiving portion 201 provided on the other of the transmission shaft 10 and the hammer 200. When the clutch mechanism 220 is in an engagement state, the clutch member 221 is engaged with the receiving portion 201 through a shape matching manner, and when the clutch mechanism 220 is in a disengagement state, the clutch member 221 is detached from the receiving portion 201.

[0093] It may be understood that the clutch mechanism 220 includes a clutch member 221 and a receiving portion 201, one of the transmission shaft 10 and the hammer 200 is provided with the clutch member 221, and the other is provided with the receiving portion 201. When the clutch mechanism 220 is in the closed state, the clutch member 221 is matched with the receiving portion 201, and when the clutch mechanism 220 is in a disengagement state, the clutch member 221 is detached from the receiving portion 201. Therefore, the working state of the clutch mechanism 220 may be switched through the assembly relationship between the clutch member 221 and the receiving portion 201.

[0094] As shown in FIG. 5, FIG. 8 to FIG. 10, FIG. 13, and FIG. 15, the clutch member 221 may be configured to be in a shape of a ball or a column, and the receiving portion 201 may be configured to be a tank 201a. The ball or column has a smooth outer surface, and the smooth outer surface has less friction during the movement, making it easier to switch the state of the clutch member 221. The receiving portion 201 being provided as a tank 201a not only facilitates the configuration, but also facilitates the matching with the clutch member 221. For example, a part of the inner circumferential wall of the hammer 200 is recessed toward a radial outer side of the hammer 200 to form the receiving portion 201. Further, a bottom wall of the tank 201a may form a cambered surface, and the cambered surface may be recessed toward the radial outer side of the hammer 200. Therefore, the tank 201a may wrap a part of the clutch member 221, thus improving the matching stability of the clutch member 221 and the tank 201a.

[0095] The tool spindle 30 may be axially movable relative to the transmission shaft 10 but may be connected without relative rotation. In other words, in the circumferential direction of the transmission shaft 10, the tool spindle 30 and the transmission shaft 10 are relatively static or rotate together during rotation, and in the axis direction of the transmission shaft 10, the tool spindle 30 is movable relative to the transmission shaft 10. Therefore, the transmission shaft 10 may drive the tool spindle 30 to rotate in the circumferential direction of the transmission shaft 10, and the tool spindle 30 may further slide in the axis direction of the transmission shaft 10.

[0096] For example, as shown in FIG. 5, the tool spindle 30 may be switched, by an axial force, between a first position and a second position relative to the transmission shaft 10. When the tool spindle 30 is at the second position, the hammer 200 can be driven by the transmission shaft 10 to rotate and can move along a preset path relative to the guide member 210, thereby hitting the tool spindle 30 along the axis of the tool spindle in at least one operating state; and when the tool spindle 30 is at the first position, the transmission shaft 10 cannot drive the hammer 200 to rotate. The tool spindle 30 includes a connecting end connected to the transmission shaft 10, and an output end connected to the tool head. A side of the transmission shaft 10 close to the connecting end is provided with a cavity 120 including an axial opening, and the cavity 120 may extend in the axis direction of the transmission shaft 10. The connecting end of the tool spindle 30 extends from the opening into the cavity 120, and an inner wall of the cavity 120 and an outer wall of the connecting end of the tool spindle 30 are matched through a spline 370 axially extending, so that the tool spindle 30 may axially move relative to the transmission shaft 10 and can rotate with the transmission shaft 10. Specifically, as shown in FIG. 2, an outer wall of the tool spindle 30 and an inner wall of the cavity 120 are provided with ribs 340, and adjacent ribs 340 on the tool spindle 30 form a recess 350 radially recessed, so that the inner wall of the cavity 120 may be matched with the recess 350.

[0097] Still referring to FIG. 5, FIG. 8 to FIG. 10, FIG. 13, and FIG. 15, a sidewall of the cavity 120 is provided with a radial hole 110, the radial hole 110 runs through the sidewall of the cavity 120 in a radial direction of the transmission shaft 10, the clutch member 221 is located in the radial hole 110 and can move in the radial hole 110, and the inner circumferential wall of the hammer 200 may be provided with the receiving portion 201. Referring to FIG. 13 and FIG. 15, when the clutch mechanism 220 is in a disengagement state, that is, when the tool spindle 30 moves to the second position, the radial hole 110 corresponds to the position of the recess 350, and the clutch member 221 moves along the radial hole 110 in a direction away from the receiving portion 201 of the hammer 200 and close to the recess 350, to make the clutch member 221 disengaged from the hammer 200. Referring to FIG. 9 and FIG. 10, when the clutch mechanism 220 is in a closed state, that is, when the tool spindle moves to the second position, the recess 350 no longer corresponds to the position of the radial hole 110, that is, there is no longer space for accommodating the clutch member 221 at the position corresponding to the radial hole on the tool spindle 30, the tool spindle 30 extrudes the clutch member 221 during the movement to make the clutch member 221 move along the radial hole 110 toward a direction close to the receiving portion 221 of the hammer, making a part of the clutch member 221 located in the radial hole 110, and the other part located in the receiving portion 201, and the hammer 200 may rotate with the transmission shaft 10 under the action of the clutch member 221. It should be noted that, the cavity 120 may also be located at the connecting end of the tool spindle 30, and one end, which is connected to the tool spindle 30, of the transmission shaft 10 extends into the cavity 120.

[0098] As shown in FIG. 2, FIG. 5, FIG. 7, and FIG. 9 to FIG. 12, the intermittent striking component 230 includes an energy storage mechanism 231 abutting the hammer 200 and an conversion member 232 and a curve guide 233 that are provided between the guide member 210 and the hammer 200. The intermittent striking component 230 further includes an energy storage mechanism 231, the conversion member 232 and the curve guide 233 are both located between the guide member 210 and the hammer 200, and one end of the energy storage mechanism 231 abuts the hammer 200. Therefore, a motion trajectory of the conversion member 232 may be guided by constructing the specific shape of the curve guide 233, the conversion member 232 may be linked with the hammer 200, and the hammer 200 moves along the trajectory of the curve guide 233 under the action of the conversion member 232.

[0099] Further, as shown in FIG. 13 and FIG. 17 to FIG. 18, the transmission shaft 10 may be provided with a baffle 100, the baffle 100 is sleeved over a peripheral wall of the transmission shaft 10, the energy storage mechanism 231 is located between the hammer 200 and the baffle 100, and one end of the energy storage mechanism 231 away from the hammer 200 may be matched with the baffle 100. After the hammer 200 moves by a certain distance toward the energy storage mechanism 231, the hammer 200 and the baffle 100 may compress the energy storage mechanism 231. Therefore, the energy storage mechanism 231 may generate a driving force on the hammer 200. Certainly, other structures may be alternatively used for the axial limiting manner of the energy storage mechanism, and details are not described herein again.

[0100] As shown in FIG. 11 to FIG. 12, the curve guide 233 may be annular, and the curve guide 233 may circumferentially surround the transmission shaft 10. Specifically, the curve guide 233 may include a slope ascending portion 233a and a descending portion 233b, one end of the descending portion 233b is connected to one end of the slope ascending portion 233a, and the other end of the descending portion 233b extends toward the other end of the slope ascending portion 233a. Further, the slope ascending portion 233a may be spiral, the descending portion 233b may be linear, and the descending portion 233b extends along the axis direction of the transmission shaft 10. Preferably, to ensure that the hammer generates a sufficient striking force on the tool spindle 30 and that the handheld tool 1 is compact, a slope ascending height of the slope ascending portion 233a in an axial direction is greater than 3 mm and less than or equal to 15 mm. Preferably, the slope ascending height is greater than or equal to 4 mm and less than or equal to 8 mm. Preferably, the slope ascending height is 5 mm.

[0101] When the conversion member 232 is matched with the slope ascending portion 233a, the conversion member 232 rolls from one end of the slope ascending portion 233a to the other end of the slope ascending portion 233a, the hammer 200 moves toward the baffle 100, and the hammer 200 and the baffle 100 may compress the energy storage mechanism 231. When the conversion member 232 is located on the other end of the slope ascending portion 233a and rolls toward the descending portion 233b, the energy storage mechanism 231 may push the hammer 200 to descend from one end of the descending portion 233b close to the baffle 100 to the other end of the descending portion 233b close to the tool head, that is, the hammer 200 rapidly descends in a direction away from the baffle 100 and close to the tool head, and a part of the hammer 200 approaches and hits a portion of the tool spindle 30 on an outer side of the transmission shaft 10, so that the tool spindle 30 moves relative to the transmission shaft 10 in the axis direction of the transmission shaft 10, and the hammer 200 hammers the tool spindle 30 and the tool head.

[0102] As shown in FIG. 5, FIG. 9, and FIG. 13, the tool spindle 30 is provided with a striking receiving portion 400 matching the hammer 200. It may be understood that the tool spindle 30 may be provided with a striking receiving portion 400, and the hammer 200 may hit the striking receiving portion 400. Therefore, the hammer 200 may drive the tool spindle 30 to move by hitting the striking receiving portion 400, so as to enable the tool spindle 30 to move relative to the transmission shaft 10 in the axis direction of the transmission shaft 10.

[0103] Further, as shown in FIG. 7 and FIG. 15, an end surface of the hammer 200 close to the energy storage mechanism 231 may be provided with a mounting groove 203, an end portion of the energy storage mechanism 231 may be located in the mounting groove 203, and the end portion of the energy storage mechanism 231 may abut a bottom wall of the mounting groove 203. Therefore, the assembly stability of the energy storage mechanism 231 and the hammer 200 may be improved.

[0104] As shown in FIG. 12, the curve guide 233 may include a plurality of segments, and each of the plurality of segments includes a slope ascending portion 233a and a descending portion 233b. There may be a plurality of conversion members 232, and the plurality of conversion members 232 may be arranged at intervals along a circumferential direction of the hammer 200. In this embodiment, to ensure rationality of the overall design of the handheld tool, the outer diameter of the hammer 200 is between 15 mm and 50 mm. Preferably, the outer diameter of the hammer is between 20 mm and 40 mm, and the sloping ascending height is greater than 3 mm and less than or equal to 15 mm. Preferably, the slope ascending height is greater than or equal to 4 mm and less than or equal to 8 mm. More preferably, the slope ascending height is 5 mm. It may be understood that, to ensure smooth slope ascending of the conversion member 232, preferably, the quantity of the segments ranges from 2 to 7, particularly advantageously from 3 to 4, and the quantity of the segments of the slope ascending portion 233a in this example is preferably 3.

[0105] It should be noted that, it may be known from the above introduction that the conversion member 232 and the curve guide 233 are located between the hammer 200 and the guide member 210. Specifically, the conversion member 232 is located on one of the guide member 210 and the hammer 200, and the curve guide 233 is located on the other of the guide member 210 and the hammer 200. As shown in FIG. 16 to FIG. 18, the conversion member 232 may be located on the guide member 210, and the curve guide 233 is located on the hammer 200. For example, an inner circumferential wall of the guide member 210 is provided with an accommodating groove 211, a part of the conversion member 232 may be located in the accommodating groove 211, a peripheral wall of the hammer 200 may be provided with a curve guide 233, and another part of the conversion member 232 may be matched with the curve guide 233. As shown in FIG. 16 to FIG. 18, the conversion member 232 may be located on the guide member 210, and the curve guide 233 is located on the hammer 200. For example, an inner circumferential wall of the guide member 210 is provided with an accommodating groove 211, a part of the conversion member 232 may be located in the accommodating groove 211, a peripheral wall of the hammer 200 may be provided with a curve guide 233, and another part of the conversion member 232 may be matched with the curve guide 233. Therefore, an assembly relationship between the conversion member 232, the curve guide 233 and the hammer 200, the guide member 210 may be implemented, and then the relative motion of the hammer 200 relative to the guide member 210 may be implemented by using the matching relationship between the conversion member 232 and the curve guide 233 and the relative motion between the conversion member 232 and the curve guide 233. The hammer 200 may move relative to the transmission shaft 10 in the axis direction of the transmission shaft 10. The motion trajectory of the conversion member 232 in the curve guide 233 is the preset path of the hammer 200.

[0106] As shown in FIG. 2, FIG. 16, and FIG. 19, the conversion member 232 may be provided as a steel ball. As shown in FIG. 11 to FIG. 12, preferably, to ensure the strength of the steel ball, the diameter of the steel ball is greater than 4 mm and less than or equal to 10 mm. More preferably, the diameter of the steel ball is greater than 4 mm and less than or equal to 6 mm. The diameter of the steel ball is 5 mm in this example. The curve guide 233 may be provided as a cam surface or a cam groove. Therefore, the cam surface or the cam groove may define a movement trajectory of the steel ball, and the steel ball may move on the cam surface or in the cam groove. The steel ball has a smooth outer surface, which may reduce the relative motion friction between the conversion member 232 and the curve guide 233 and improve movement smoothness of the conversion member 232 in the curve guide 233. Moreover, the steel ball has a great structural strength and a good abrasion resistance performance, which may guarantee the working performance of the intermittent striking component 230. It should be noted that, the "cam" mentioned here may refer to that the curve guide 233 protrudes from the inner circumferential wall of the guide member 210, or the curve guide 233 protrudes from the peripheral wall of the hammer 200.

[0107] Further, the steel ball may be in point or line contact with the curve guide 233. It may be understood that as the steel ball moves in the curve guide 233, the steel ball is always in point or line contact with the curve guide 233, which helps to reduce the friction between the steel ball and the curve guide 233. For example, the radius of curvature of the cam surface may be basically the same as or slightly greater than the radius of the steel ball, so as to improve the matching between the steel ball and the cam surface, and then improve the assembly stability, the wear resistance, and the service life of the steel ball and the cam surface.

[0108] A specific form of performing mode switching by the mode adjustment mechanism 40 of the handheld tool 1 is described below in combination with the specific structure of the handheld tool 1.

[0109] As shown in FIG. 19 to FIG. 20, the mode adjustment mechanism 40 includes a first tooth pattern 212 provided on the guide member 210, and a striking switching member provided with a second tooth pattern 431. The striking switching member is axially movable but is fixed in the housing of the handheld tool 1 without rotation. Specifically, the striking switching member is a striking switching ring 430, and the striking switching ring 430 is movably sleeved over the hammer 200. When the mode adjustment mechanism 40 is in the first mode state, the first tooth pattern 212 is engaged with the second tooth pattern 431; and when the mode adjustment mechanism 40 is in the second mode state, the first tooth pattern 212 is disengaged from the second tooth pattern 431.

[0110] It may be understood that the striking switching ring 430 is sleeved over the hammer 200, the striking switching ring 430 and the hammer 200 are relatively movable, the striking switching ring 430 is provided with a second tooth pattern 431, the guide member 210 is provided with a first tooth pattern 212, and the first tooth pattern 212 may be connected to the second tooth pattern 431 in a matching manner, so as to connect the guide member 210 to the striking switching ring 430. In this case, the striking switching ring 430 may limit the motion of the guide member 210, the guide member 210 and the striking switching ring 430 are relatively static, and the hammer 200 may linearly move relative to the guide member 210 according to a preset path and hit the tool spindle 30 in at least one operating state.

[0111] The first tooth pattern 212 may also be spaced from the second tooth pattern 431 by switching the position of the striking switching ring 430. In this case, the guide member 210 is movable relative to the striking switching ring 430, the guide member 210 is driven by the intermittent striking component 230 and may rotate with the hammer 200, and the hammer 200 and the guide member 210 are relatively static. Therefore, the position relationship and the assembly relationship between the guide member 210 and the striking switching ring 430 may be adjusted by adjusting the matching relationship between the first tooth pattern 212 and the second tooth pattern 431, so as to control a motion state of the guide member 210 and then improve a motion state of the tool spindle 30 to control the working mode of the handheld tool 1.

[0112] Further, as shown in FIG. 19 and FIG. 21 to FIG. 26, the mode adjustment mechanism 40 further includes a cushioning member 440. One end of the cushioning member 440 abuts the striking switching ring 430 to constantly push the striking switching ring 430 to move toward the guide member 210. Therefore, the cushioning member 440 may constantly push the striking switching ring 430 to approach the guide member 210, so as to enable the first tooth pattern 212 to be matched with the second tooth pattern 431.

[0113] Further, as shown in FIG. 19 to FIG. 24, the mode adjustment mechanism 40 further includes a mode switching button 450. The mode switching button 450 is rotatably sleeved over the striking switching ring 430. The mode switching button 450 is rotatable relative to the striking switching ring 430. An inner circumferential wall of the mode switching button 450 is provided with a guide block 451, and a peripheral wall of the striking switching ring 430 is provided with a mating block 432 matching the guide block 451. The mode switching button 450 is rotated, when the guide block 451 axially abuts the mating block 432, the guide block 451 pushes against the striking switching ring 430 to compress the cushioning member 440 to move in a direction away from the guide member 210, and the first tooth pattern 212 is spaced from the second tooth pattern 431; and when the guide block 451 is staggered from the mating block 432, the striking switching ring 430 moves in a direction close to the guide member 210 under the action of the cushioning member 440, and the first tooth pattern 212 is engaged with the second tooth pattern 431.

[0114] It may be understood that the position relationship between the mode switching button 450 and the striking switching ring 430 may be switched by rotating the mode switching button 450 or the striking switching ring 430, so as to change a matching state between the guide block 451 and the mating block 432. Therefore, the matching relationship between the first tooth pattern 212 and the second tooth pattern 431 may be controlled by switching the matching relationship between the guide block 451 and the mating block 432. Further, as shown in FIG. 20, the guide block 451 has a guide bevel 451a to guide the mating block 432. Therefore, the matching relationship between the guide block 451 and the mating block 432 may be conveniently switched.

[0115] The mode switching mechanism 40 may also use other structures. Specifically, referring to FIG. 2 to FIG. 5, FIG. 9, and FIG. 13, the mode switching mechanism 40 includes a pressure stop ring 410 and a mode adjustment button 420. The pressure stop ring 410 is sleeved over the transmission shaft 10, and is specifically sleeved over the striking receiving portion 400, the pressure stop ring 410 is rotatable relative to the transmission shaft 10 but cannot axially move, and the mode adjustment button 420 is rotatably sleeved over the pressure stop ring 410. The pressure stop ring 410 is provided with an abutting stop portion 411. An inner circumferential wall of the mode adjustment button 420 is provided with a channel 422 suitable for the abutting stop portion 411 to move past, and the channel 422 extends in the axis direction of the transmission shaft 10.

[0116] When the mode adjustment mechanism 40 is in the first mode state, the abutting stop portion 411 stops and abuts against the mode adjustment button 420; and when the mode adjustment mechanism 40 is in the second mode state, the abutting stop portion 411 corresponds to the position of the channel 422, and the tool spindle 30 can drive the pressure stop ring to move in the axial direction of the tool spindle. Therefore, the motion state of the hammer 200 may be adjusted by adjusting the relative position relationship between the abutting stop portion 411 of the pressure stop ring 410 and the mode adjustment button 420, so as to adjust the working mode of the tool spindle 30. Specifically, as shown in FIG. 3 to FIG. 4, the mode adjustment button 420 further includes a flange 421 provided on an inner circumferential wall of the mode adjustment button 420, the flange 421 is annular and extends in a circumferential direction of the pressure stop ring 410, and the channel 422 runs through the flange 421 in an axis direction of the pressure stop ring 410. Therefore, the channel 422 may be constructed from the flange 421, and the flange 421 may also stop and abut against the abutting stop portion 411.

[0117] As shown in FIG. 3 to FIG. 4, the abutting stop portion 411 includes a fixed segment 411a, a connecting segment 411b, and a mating segment 411c. The fixed segment 411a extends out of the pressure stop ring 410, one end of the connecting segment 411b is connected to the fixed segment 411a, one end of the mating segment 411c is connected to the other end of the connecting segment 411b, the mating segment 411c is adapted to move past the channel 422, and the fixed segment 411a and the connecting segment 411b are spaced apart in the axis direction of the pressure stop ring 410. Further, a part of the connecting segment 411b connected to the fixed segment 411a smoothly transits; or a part of the connecting segment 411b connected to the mating segment 411c smoothly transits.

[0118] As shown in FIG. 2 and FIG. 6, a peripheral wall of the striking receiving portion 400 has a step surface 404, and the pressure stop ring 410 stops and abuts against the step surface 404. Therefore, the step surface 404 may limit the motion of the pressure stop ring 410 to prevent the pressure stop ring 410 from detaching form the striking receiving portion 400.

Example 4

[0119] As shown in FIG. 1 to FIG. 30, a handheld tool 1 includes a motor 60, a transmission shaft 10, a tool spindle 30, a hammer striking mechanism 20, and a striking switching ring 430.

[0120] Specifically, a rotation direction of the motor 60 includes a first direction and a second direction, one of the first direction and the second direction may be a clockwise direction, and the other is a counterclockwise direction. The motor 60 may drive the transmission shaft 10 to rotate. The tool spindle 30 is connected to the transmission shaft 10, and the tool spindle 30 is movable relative to the transmission shaft 10. For example, the tool spindle 30 may move relative to the transmission shaft 10. The hammer striking mechanism 20 includes a hammer 200 and a guide member 210, the hammer 200 is sleeved over an outer side of the transmission shaft 10, and the transmission shaft 10 may drive the hammer 200 to rotate. The handheld tool 1 is provided with a guide member 210 and an intermittent striking component 230, the hammer 200 may be guided to linearly move by using a matching relationship between the intermittent striking component 230, the hammer 200, and the guide member 210, and the hammer 200 may further hit the tool spindle 30 to achieve the movement of the tool spindle 30 in the axis direction, so that when the tool spindle 30 drills in an environment component (such as a wall or a plate), the tool spindle 30 forms a striking force on the environment component to improve the drilling efficiency of the handheld tool 1. Moreover, the handheld tool 1 is compact and simple in structure, and may be convenient to carry.

[0121] As shown in FIG. 2, FIG. 5, FIG. 7, and FIG. 9 to FIG. 12, the intermittent striking component 230 includes an energy storage mechanism 231 abutting the hammer 200 and an conversion member 232 and a curve guide 233 that are provided between the guide member 210 and the hammer 200. The intermittent striking component 230 further includes an energy storage mechanism 231, the conversion member 232 and the curve guide 233 are both located between the guide member 210 and the hammer 200, and one end of the energy storage mechanism 231 abuts the hammer 200. Therefore, a motion trajectory of the conversion member 232 may be guided by constructing the specific shape of the curve guide 233, the conversion member 232 may be linked with the hammer 200, and the hammer 200 moves along the trajectory of the curve guide 233 under the action of the conversion member 232.

[0122] Further, as shown in FIG. 13 and FIG. 17 to FIG. 18, the transmission shaft 10 may be provided with a baffle 100, the baffle 100 is sleeved over a peripheral wall of the transmission shaft 10, the energy storage mechanism 231 is located between the hammer 200 and the baffle 100, and one end of the energy storage mechanism 231 away from the hammer 200 may be matched with the baffle 100. After the hammer 200 moves by a certain distance toward the energy storage mechanism 231, the hammer 200 and the baffle 100 may compress the energy storage mechanism 231. Therefore, the energy storage mechanism 231 may generate a driving force on the hammer 200. Certainly, other structures may be alternatively used for the axial limiting manner of the energy storage mechanism, and details are not described herein again.

[0123] As shown in FIG. 11 to FIG. 12, the curve guide 233 may be annular, and the curve guide 233 may circumferentially surround the transmission shaft 10. Specifically, the curve guide 233 may include a slope ascending portion 233a and a descending portion 233b, one end of the descending portion 233b is connected to one end of the slope ascending portion 233a, and the other end of the descending portion 233b extends toward the other end of the slope ascending portion 233a. Further, the slope ascending portion 233a may be spiral, the descending portion 233b may be linear, and the descending portion 233b extends along the axis direction of the transmission shaft 10. Preferably, to ensure that the hammer generates a sufficient striking force on the tool spindle 30 and that the handheld tool 1 is compact, a slope ascending height of the slope ascending portion 233a in an axial direction is greater than 3 mm and less than or equal to 15 mm. Preferably, the slope ascending height is greater than or equal to 4 mm and less than or equal to 8 mm. Preferably, the slope ascending height is 5 mm.

[0124] When the conversion member 232 is matched with the slope ascending portion 233a, the conversion member 232 rolls from one end of the slope ascending portion 233a to the other end of the slope ascending portion 233a, the hammer 200 moves toward the baffle 100, and the hammer 200 and the baffle 100 may compress the energy storage mechanism 231. When the conversion member 232 is located on the other end of the slope ascending portion 233a and rolls toward the descending portion 233b, the energy storage mechanism 231 may push the hammer 200 to descend from one end of the descending portion 233b close to the baffle 100 to the other end of the descending portion 233b close to the tool head, that is, the hammer 200 rapidly descends in a direction away from the baffle 100 and close to the tool head, and a part of the hammer 200 approaches and hits a portion of the tool spindle 30 on an outer side of the transmission shaft 10, so that the tool spindle 30 moves relative to the transmission shaft 10 in the axis direction of the transmission shaft 10, and the hammer 200 hammers the tool spindle 30 and the tool head.

[0125] Further, as shown in FIG. 7 and FIG. 15, an end surface of the hammer 200 close to the energy storage mechanism 231 may be provided with a mounting groove 203, an end portion of the energy storage mechanism 231 may be located in the mounting groove 203, and the end portion of the energy storage mechanism 231 may abut a bottom wall of the mounting groove 203. Therefore, the assembly stability of the energy storage mechanism 231 and the hammer 200 may be improved.

[0126] As shown in FIG. 12, the curve guide 233 may include a plurality of segments, and each of the plurality of segments includes a slope ascending portion 233a and a descending portion 233b. There may be a plurality of conversion members 232, and the plurality of conversion members 232 may be arranged at intervals along a circumferential direction of the hammer 200. In this example, to ensure rationality of the overall design of the handheld tool, the outer diameter of the hammer 200 is between 15 mm and 50 mm. Preferably, the outer diameter of the hammer is between 20 mm and 40 mm, and the sloping ascending height is greater than 3 mm and less than or equal to 15 mm. Preferably, the slope ascending height is greater than or equal to 4 mm and less than or equal to 8 mm. More preferably, the slope ascending height is 5 mm. It may be understood that, to ensure smooth slope ascending of the conversion member 232, preferably, the quantity of the segments ranges from 2 to 7, particularly advantageously from 3 to 4, and the quantity of the segments of the slope ascending portion 233a in this example is preferably 3.

[0127] It should be noted that, it may be known from the above introduction that the conversion member 232 and the curve guide 233 are located between the hammer 200 and the guide member 210. Specifically, the conversion member 232 is located on one of the guide member 210 and the hammer 200, and the curve guide 233 is located on the other of the guide member 210 and the hammer 200. As shown in FIG. 16 to FIG. 18, the conversion member 232 may be located on the guide member 210, and the curve guide 233 is located on the hammer 200. For example, an inner circumferential wall of the guide member 210 is provided with an accommodating groove 211, a part of the conversion member 232 may be located in the accommodating groove 211, a peripheral wall of the hammer 200 may be provided with a curve guide 233, and another part of the conversion member 232 may be matched with the curve guide 233. As shown in FIG. 16 to FIG. 18, the conversion member 232 may be located on the guide member 210, and the curve guide 233 is located on the hammer 200. For example, an inner circumferential wall of the guide member 210 is provided with an accommodating groove 211, a part of the conversion member 232 may be located in the accommodating groove 211, a peripheral wall of the hammer 200 may be provided with a curve guide 233, and another part of the conversion member 232 may be matched with the curve guide 233. Therefore, an assembly relationship between the conversion member 232, the curve guide 233 and the hammer 200, the guide member 210 may be implemented, and then the relative motion of the hammer 200 relative to the guide member 210 may be implemented by using the matching relationship between the conversion member 232 and the curve guide 233 and the relative motion between the conversion member 232 and the curve guide 233. The hammer 200 may move relative to the transmission shaft 10 in the axis direction of the transmission shaft 10. The motion trajectory of the conversion member 232 in the curve guide 233 is the preset path of the hammer 200.

[0128] Still referring to FIG. 11 and FIG. 12, because the guide member 210 is provided with the slope ascending portion 233a and the descending portion 233b, when the motor 60 rotates forward, in the "striking mode", the hammer 200 hits the tool spindle 30 to achieve a hammering effect. However, when the motor 60 rotates reversely, the conversion member 232 needs to cross the descending portion 233b and move to the ascending portion 233a. To ensure the striking effect of the hammer 200, the descending portion 233b is basically parallel to the axis. Therefore, when the conversion member 232 rotates in the axial direction, the conversion member 232 cannot cross the descending portion 233b, causing the motor to "stall" or even causing machine burnout.

[0129] Therefore, referring to FIG. 28 to FIG. 30, the handheld tool 1 further includes a striking ring 11a fixed to the housing 80 without rotation. The striking ring 11a is provided with a first end tooth 12a, and the guide member 210 is provided with a second end tooth 213a that can be engaged with the first end tooth 12a. When the motor 60 rotates in the first direction, the first end tooth 12a limits, through the second end tooth 213a engaged with it, the guide member 210 to rotate, and the conversion member 232 moves along the curve guide according to a preset direction to make the hammer 200 hit the tool spindle 30 in at least one operating state; and when the motor 60 rotates in the second direction, the second end tooth 213a and the guide member 213 are driven by the motor 60 to rotate relative to the first end tooth 12a engaged with the second end tooth, that is, the second end tooth 213a on the guide member 213 makes slope ascending motion relative to the first end tooth 12a. The first end tooth 12a includes a plurality of first teeth 121a, the first teeth 121a each include a guide segment 121b and a stop segment 121c, and the guide segment 121b is connected to a free end of the stop segment 121c. The second end tooth 213a includes a plurality of second teeth 2131a. When the motor 60 rotates in the first direction, the second teeth 2131a move from the stop segment 121c to the guide segment 121b, and the stop segment 121c abuts the second teeth 2131a, so that the guide member 210 cannot rotate; and when the motor 60 rotates in the second direction, the second teeth 2131a move from the guide segment 121b to the stop segment 121c, the second teeth 2131a can move along the guide segment 121b, so that the guide member 213 rotates relative to the first end tooth 12a. The guide segment 121b and the stop segment 121c are sequentially arranged at intervals in a circumferential direction of the first end tooth 12a, and the stop segment 121c is parallel to the axis of the transmission shaft 10. When the second teeth 2131a moves from the stop segment 121c to the guide segment 121b, a side of the second teeth 2131a abutting the stop segment 121c is parallel to the stop segment 121c. The striking ring 11a can move in the axial direction to achieve engagement or disengagement of the first end tooth 12a with or from the second end tooth 213a. When the first end tooth 12a is disengaged from the second end tooth 213a, the guide member 210 is driven by the motor to rotate, and the tool is in a non-striking mode. It may be understood that in this example, when the striking ring 11a is axially movable, the striking ring 11a in this example not only has an "anti-stalling" function, but also has the functions implemented by the striking switching ring 430 described above. In other words, in the above example, the tooth-pattern shape of the first tooth pattern

212 and the second tooth pattern 431 in the above example are set to the tooth shape of the first teeth 121a and the second teeth 2131a in this example, and then the mode switching mechanism 40 in the above example not only has a mode switching function, but also has an anti-stalling function in the striking mode.

[0130] As shown in FIG. 5, FIG. 8 to FIG. 10, FIG. 13, and FIG. 15, the hammer striking mechanism 20 further includes a detachable clutch mechanism 220, and the clutch mechanism 220 is configured to transmit rotational motion between the transmission shaft 10 and the hammer 200. It may be understood that the clutch mechanism 220 may make the transmission shaft 10 matched with the hammer 200, and the clutch mechanism 220 may also make the transmission shaft 10 detach from the hammer 200. When the clutch mechanism 220 makes the transmission shaft 10 matched with the hammer 200, the rotational motion of the transmission shaft 10 may be transmitted to the hammer 200 through the clutch mechanism 220 to drive the hammer 200 to rotate; and when the clutch mechanism 220 makes them detach from each other, the matching relationship between the clutch mechanism 220 and the hammer 200 is relieved, the transmission shaft 10 rotates relative to the hammer 200, and the hammer 200 is static relative to the guide member 210. Therefore, the motion of the hammer 200 may be controlled through the clutch mechanism 220 to control whether the hammer 200 hits the tool spindle 30, and then the working state of the handheld tool 1 may be changed. The clutch mechanism 220 may be configured to be closed by a force transmitted through the tool spindle 30. It may be understood that whether a matching relationship exists between the clutch mechanism 220 and the hammer 200 may be controlled through the tool spindle 30, and the tool spindle 30 may apply an external force to the clutch mechanism 220 to change the relationship between the clutch mechanism 220 and the hammer 200. For example, when the tool head or the tool spindle 30 is in a working condition (that is, when the tool spindle 30 is subject to an axial load), the clutch mechanism 220 closes, and the handheld tool 1 switches to the striking state.

[0131] As shown in FIG. 5, the tool spindle 30 may be switched, by an axial force, between a first position and a second position relative to the transmission shaft 10. When the tool spindle 30 is at the second position, the hammer 200 can be driven by the transmission shaft 10 to rotate and can move along a preset path relative to the guide member 210, so as to hit the tool spindle 30 along the axis of the tool spindle 30 in at least one operating state; and when the tool spindle 30 is at the first position, the transmission shaft 10 cannot drive the hammer 200 to rotate. The tool spindle 30 includes a connecting end connected to the transmission shaft 10, and an output end connected to the tool head. A side of the transmission shaft 10 close to the connecting end is provided with a cavity 120 including an axial opening, and the cavity 120 may extend in the axis direction of the transmission shaft 10. The connecting end of the tool spindle 30 extends from the opening into the cavity 120, and an inner wall of the cavity 120 and an outer wall of the connecting end of the tool spindle 30 are matched through a spline 370 axially extending, so that the tool spindle 30 may axially move relative to the transmission shaft 10 and can rotate with the transmission shaft 10. Specifically, as shown in FIG. 2, an outer wall of the tool spindle 30 and an inner wall of the cavity 120 are provided with ribs 340, and adjacent ribs 340 on the tool spindle 30 form a recess 350 radially recessed, so that the inner wall of the cavity 120 may be matched with the recess 350.

[0132] Still referring to FIG. 5, FIG. 8 to FIG. 10, FIG. 13, and FIG. 15, a sidewall of the cavity 120 is provided with a radial hole 110, the radial hole 110 runs through the sidewall of the cavity 120 in a radial direction of the transmission shaft 10, the clutch member 221 is located in the radial hole 110 and can move in the radial hole 110, and the inner circumferential wall of the hammer 200 may be provided with the receiving portion 201. Referring to FIG. 13 and FIG. 15, when the clutch mechanism 220 is in a disengagement state, that is, when the tool spindle 30 moves to the second position, the radial hole 110 corresponds to the position of the recess 350, and the clutch member 221 moves along the radial hole 110 in a direction away from the receiving portion 201 of the hammer 200 and close to the recess 350, to make the clutch member 221 disengaged from the hammer 200. Referring to FIG. 9 and FIG. 10, when the clutch mechanism 220 is in a closed state, that is, when the tool spindle 30 moves to the second position, the recess 350 no longer corresponds to the position of the radial hole 110, that is, there is no longer space for accommodating the clutch member 221 at the position corresponding to the radial hole 110 on the tool spindle 30, the tool spindle 30 extrudes the clutch member 221 during the movement to make the clutch member 221 move along the radial hole 110 toward a direction close to the receiving portion 221 of the hammer, making a part of the clutch member 221 located in the radial hole 110, and the other located in the receiving portion 201, and the hammer 200 may rotate with the transmission shaft 10 under the action of the clutch member 221. It should be noted that, the cavity 120 may also be located at the connecting end of the tool spindle 30, and one end, which is connected to the tool spindle 30, of the transmission shaft 10 extends into the cavity 120.

Example 5

[0133] A handheld tool 1 is described in detail below with reference to FIG. 1 to FIG. 27. It is worth understanding that the following descriptions are merely exemplary descriptions, and are not specific limitations on the present invention.

[0134] As shown in FIG. 1 to FIG. 15, a handheld tool 1 includes a motor 60, a transmission shaft 10, a tool spindle 30, a reset member 70, a hammer striking mechanism 20, a striking receiving portion 400, a pressures stop ring 410, and a mode adjustment button 420.

[0135] Specifically, the motor 60 is connected to the transmission shaft 10, the motor 60 may drive the transmission shaft

10 to rotate in an axis direction of the transmission shaft 10, and the transmission shaft 10 rotates around an axis of the transmission shaft 10. The transmission shaft 10 may be formed as a cylindrical shape with an opening at one end, that is, the transmission shaft 10 may form a cavity 120 with an opening at one end, the cavity 120 may extend in the axis direction of the transmission shaft 10, the tool spindle 30 may extend from the one end of the cavity 120 with the opening into the transmission shaft 10, the transmission shaft 10 may form a flat square 140 at the other end, and performs torque transmission with the motor 60 through the flat square 140, the reset member 70 is located in the cavity 120, one end of the reset member 70 axially abuts the tool spindle 30, and the other end of the reset member 70 abuts a bottom wall of the cavity 120 away from the opening. The reset member 70 may constantly push the tool spindle 30 to move from the bottom wall of the cavity 120 to the direction of the end of the cavity 120 with the opening.

[0136] As shown in FIG. 2, one end of the tool spindle 30 close to the transmission shaft 10 may include a first segment 310, a second segment 320, and a third segment 330. The first segment 310 is connected to one end of the second segment 320, and one end of the second segment 320 is connected to the third segment 330. An axis of the first segment 310 coincides with that of the third segment 330, the third segment 330 totally extends into the cavity 120 of the transmission shaft 10, a part of the first segment 310 may extend into the cavity 120, the other of the first segment 310 is located outside the cavity 120, the cross-sectional radius of the third segment 330 is less than that of the first segment 310, and a peripheral wall of the second segment 320 is a cambered surface. A peripheral wall of the third segment 330 is provided with a plurality of ribs 340, the plurality of ribs 340 are arranged at intervals in a circumferential direction of the third segment 330, any one of the plurality of ribs 340 extends in an axis direction of the third segment 330, and any two adjacent ones of the plurality of ribs 340 may be constructed into a recess 350.

[0137] An inner circumferential wall of the transmission shaft 10 corresponding to the cavity 120 may be provided with a plurality of protruding blocks, the plurality of protruding blocks are arranged at intervals in a circumferential direction of the transmission shaft 10, and any one of the plurality of protruding blocks extends along an axis direction of the transmission shaft 10. Any two adjacent ones of the plurality of protruding blocks may be constructed into a mating groove, any one of the plurality of ribs 340 corresponds to a mating groove, and each of the plurality of ribs 340 may extend into the corresponding mating groove. When the transmission shaft 10 rotates, the ribs 340 may abut at least one of the two protruding blocks corresponding to a mating groove, so as to drive the tool spindle 30 to rotate in the circumferential direction of the transmission shaft 10. In the axis direction of the transmission shaft 10, the tool spindle 30 is movable relative to the transmission shaft 10, and the tool spindle 30 may slide in the axis direction of the transmission shaft 10.

[0138] As shown in FIG. 5, FIG. 8 to FIG. 10, FIG. 13, and FIG. 15, the hammer striking mechanism 20 includes a hammer 200, a guide member 210, a clutch mechanism 220, and an intermittent striking component 230. The clutch mechanism 220 includes a clutch member 221 and a receiving portion 201, and the intermittent striking component 230 includes an energy storage mechanism 231, an conversion member 232, and a curve guide 233.

[0139] As shown in FIG. 5, FIG. 8 to FIG. 10, FIG. 13, and FIG. 15, the hammer 200 is sleeved over a peripheral wall of the transmission shaft 10, the hammer 200 is close to one end of the transmission shaft 10 away from the reset member 70, and an inner circumferential wall of the hammer 200 is spaced from the peripheral wall of the transmission shaft 10. a part of the transmission shaft 10 over which the hammer 200 is sleeved may be provided with a radial hole 110, the radial hole 110 runs through the transmission shaft 10 in a radial direction of the transmission shaft 10, the clutch member 221 may be located in the radial hole 110, and the clutch member 221 may move within the radial hole 110. The inner circumferential wall of the hammer 200 may be provided with a receiving portion 201, the receiving portion 201 may run through the hammer 200 in the axis direction of the transmission shaft 10, the receiving portion 201 may be provided as a tank 201a, the tank 201a may be constructed by recessing a part of the inner circumferential wall of the hammer 200 toward a radial outer side of the hammer 200, and the clutch member 221 may be provided as a steel ball. The diameter of the steel ball is greater than or equal to 3 mm and less than or equal to 8 mm. A bottom wall of the tank 201a may be formed as a curved surface, and the curved surface may be recessed toward the radial outer side of the hammer 200.

[0140] When the clutch mechanism 220 is in a closed state, the steel ball moves between the transmission shaft 10 and the hammer 200, that is, when a part of the steel ball is located in the radial hole 110 and the other of the steel ball is located in the tank 201a, the part of the steel ball located in the tank 201a may abut the tank 201a by in a matching manner. When the steel ball rotates with the transmission shaft 10, the steel ball may drive the hammer 200 to rotate along the circumferential direction of the transmission shaft 10. When the clutch mechanism 220 is in a disengagement state, and when the steel ball moves between the transmission shaft 10 and the tool spindle 30, that is, when a part of the steel ball is located in the radial hole 110 and the other part of the steel ball is located in the recess 350, the transmission shaft 10 is spaced from the hammer 200, and the hammer 200 is in a static state.

[0141] It should be noted that, the position of the steel ball may be switched through the position relationship of the tool spindle 30 relative to the transmission shaft 10. When a tool head is in a working state and is subject to an axial abutment force from a working condition, that is, when the tool spindle 30 moves toward a direction close to the reset member 70, the reset member 70 compresses, the first segment 310 of the tool spindle 30 is opposite to the radial hole 110, the first segment 310 may extrude the steel ball, the steel ball radially moves from the recess 350 along the radial hole 110 into the tank 201a, a part of the steel ball is matched with the radial hole 110, and the other is matched with the tank 201a, so that the transmission shaft 10 drives the hammer 200 to rotate, the clutch mechanism 220 is in an engagement state, and the handheld tool 1 is in the above striking state. When the axial force from the working condition disappears, the tool spindle 30 moves toward a direction close to the tool head under the action of the reset member 70, and the tool spindle 30 moves from the first segment 310 opposite to the radial hole 110 to the third segment 330 opposite to the radial hole 110. Therefore, the first segment 310 no longer extrudes the steel ball, the steel ball moves, under the action of the hammer 200, along the radial hole 110 into the recess 350 and detaches from the tank 201a, the transmission shaft 10 cannot drive the hammer 200 to rotate, and the clutch mechanism 220 is in a disengagement state. Referring to FIG. 15, in this example, when the clutch mechanism 220 is in a disengagement state, the steel ball remains at least partially within the radial hole 110 to facilitate the clutch mechanism 220 to switch between the engagement state and the disengagement state.

[0142] As shown in FIG. 5, FIG. 8 to FIG. 10, FIG. 13, and FIG. 15, a guide member 210 is sleeved over the peripheral wall of the hammer 200, a curve guide 233 is formed on an inner circumferential wall of the guide member 210, the curve guide 233 may be annular, and the curve guide 233 may circumferentially surround the transmission shaft 10. The curve guide 233 may include a plurality of segments, and each of the plurality of segments corresponds to an conversion member 232. Each of the plurality of segments includes a slope ascending portion 233a and a descending portion 233b. The slope ascending portion 233a may be spiral, and the descending portion 233b may be linear. The conversion member 232 may be provided as a steel ball.

[0143] Referring to FIG. 16 to FIG. 18, different from the examples shown in FIG. 1 to FIG. 15, the inner circumferential wall of the guide member 210 may be provided with an accommodating groove 211, a part of the conversion member 232 may be located in the accommodating groove 211, and the conversion member 232 is connected to (for example, clamped with) the guide member 210. The peripheral wall of the hammer 200 may be provided with a curve guide 233, and another part of the conversion member 232 may be matched with the curve guide 233.

[0144] As shown in FIG. 5, FIG. 7 to FIG. 10, FIG. 13, and FIG. 15, an end surface of the hammer 200 facing the reset member 70 may be provided with a mounting groove 203. The transmission shaft 10 may be provided with a baffle 100, the baffle 100 is sleeved over a peripheral wall of the transmission shaft 10, the baffle 100 is connected to the transmission shaft 10, and the baffle 100 is opposite to the mounting groove 203. The energy storage mechanism 231 is located between the hammer 200 and the baffle 100, one end of the energy storage mechanism 231 may extend into the mounting groove 203, an end portion of the energy storage mechanism 231 may abut a bottom wall of the mounting groove 203, and the other end of the energy storage mechanism 231 may abut the baffle 100. The energy storage mechanism 231 may be provided as a ring spring, and the ring spring may be sleeved over the transmission shaft 10.

[0145] As shown in FIG. 2, FIG. 5, FIG. 1, FIG. 9 to FIG. 10, and FIG. 13, a peripheral wall of the hammer 200 may be provided with an insertion groove 202, and a part of the conversion member 232 may be located in the insertion groove 202, to connect the conversion member 232 to the hammer 200; a part of the conversion member 232 outside the insertion groove 202 may be matched with the curve guide 233, to enable the conversion member 232 to move along the curve guide 233, so that the hammer 200 is driven by a rotating force of the transmission shaft 10 to move along a path of the curve guide 233.

[0146] When the conversion member 232 is matched with the slope ascending portion 233a, the conversion member 232 rolls from the other end of the slope ascending portion 233a to one end of the slope ascending portion 233a, the hammer 200 moves toward the baffle 100, and the hammer 200 and the baffle 100 may compress the energy storage mechanism 231. When the conversion member 232 is located at one end of the slope ascending portion 233a and rolls toward the descending portion 233b, the energy storage mechanism 231 may constantly push the hammer 200 to descend from one end of the descending portion 233b to the other end of the descending portion 233b, and the hammer 200 moves toward a direction away from the baffle 100.

[0147] As shown in FIG. 5, FIG. 9, and FIG. 13, the tool spindle 30 may be provided with a striking receiving portion 400, the striking receiving portion 400 may be fixedly connected to the tool spindle 30, the striking receiving portion 400 may be annular, the striking receiving portion 400 may be sleeved over the first segment 310 of the tool spindle 30, the striking receiving portion 400 is located outside the transmission shaft 10, and the striking receiving portion 400 is connected to (for example, clamped with or welded to) the tool spindle 30. After the hammer 200 moves a distance toward the direction away from the baffle 100, the hammer 200 may contact with the striking receiving portion 400, moreover, due to the driving effect of the energy storage mechanism 231, the hammer 200 may have a hitting effect on the striking receiving portion 400, so that the tool spindle 30 may move along an axis direction of the transmission shaft 10 toward a direction away from the reset member 70.

[0148] The environmental component (such as a wall or plate) drilled by the handheld tool 1 has a load effect on the tool spindle 30 the tool spindle 30 may move toward a direction close to the reset member 70, and the cycle repeats, so that the tool spindle 30 may move in the circumferential direction of the transmission shaft 10 under the driving of the transmission shaft 10, and the tool spindle 30 may also move in the axis direction of the transmission shaft 10 under the hitting effect of the hammer 200 and the external force of the environment component.

[0149] The above introduces that when the handheld tool 1 is in the working state, that is, when the tool head is subject to an axial force, the handheld tool 1 can implement a hammering function. However, in an actual operation, the operator does not need the hammering function under some working conditions; therefore, the handheld tool of the present disclosure further includes a mode adjustment mechanism 40.

[0150] As shown in FIG. 6, the peripheral wall of the striking receiving portion 400 may include a first surface 401, a second surface 402, and a third surface 403. The first surface 401 is connected to one end of the second surface 402, the other end of the second surface 402 is connected to the third surface 403, the first surface 401 extends in the same direction as the third surface 403, the first surface 401 and the third surface 403 are spaced apart in a radial direction of the striking receiving portion 400, and the first surface 401 is located on a radial outer side of the third surface 403. The first surface 401, the second surface 402, and the third surface 403 are constructed into a step surface 404. A pressure stop ring 410 is sleeved over the striking receiving portion 400 corresponding to the third surface 403, and the striking receiving portion 400 corresponding to the first surface 401 may axially limit the pressure stop ring 410 to the third surface 403.

[0151] As shown in FIG. 3 to FIG. 6, a mode adjustment button 420 is rotatably sleeved over the pressure stop ring 410, the pressure stop ring 410 is provided with an abutting stop portion 411, an inner circumferential wall of the mode adjustment button 420 is provided with a flange 421, the flange 421 is annular and extends in a circumferential direction of the pressure stop ring 410, a channel 422 may be constructed from the flange 421, the channel 422 runs through the flange 421 in the axis direction of the pressure stop ring 410, and the abutting stop portion 411 may move past the channel 422.

[0152] As shown in FIG. 3 to FIG. 4, the abutting stop portion 411 includes a fixed segment 411a, a connecting segment 411b, and a mating segment 411c. The fixed segment 411a extends out of the pressure stop ring 410, one end of the connecting segment 411b is connected to the fixed segment 411a, one end of the mating segment 411c is connected to the other end of the connecting segment 411b, the mating segment 411c is adapted to move past the channel 422, and the fixed segment 411a and the connecting segment 411b are spaced apart in the axis direction of the pressure stop ring 410. A part of the connecting segment 411b connected to the fixed segment 411a smoothly transits, and a part of the connecting segment 411b connected to the mating segment 411c smoothly transits.

[0153] When the abutting stop portion 411 abuts the mode adjustment button 420, the pressure stop ring 410 is static relative to the mode adjustment button 420, the pressure stop ring 410 further abuts the striking receiving portion 400 corresponding to the first surface 401, the striking receiving portion 400 is static, the striking receiving portion 400 further limits the movement of the tool spindle 30, the external force applied by the environment component to the tool spindle 30 cannot drive the tool spindle 30 to move, the clutch mechanism 221 is located between the tool spindle 30 and the transmission shaft 10, the hammer 200 is spaced from the transmission shaft 10, the motor 60 drives the transmission shaft 10 to rotate, the transmission shaft 10 further drives the tool spindle 30 to rotate, and the tool spindle 30 has only rotational motion.

[0154] When the abutting stop portion 411 is located in the channel 422, the abutting stop portion 411 may move within the channel 422, the external force applied by the environment component to the tool spindle 30 drives the tool spindle 30 to move toward the reset member 70, and then drives the clutch mechanism 221 to be placed between the transmission shaft 10 and the hammer 200, the transmission shaft 10 may drive the hammer 200 to rotate, the hammer 200 may move in the axis direction of the transmission shaft 10 under the coordination of the conversion member 232 and the curve guide 233, and hit the striking receiving portion 400, the striking receiving portion 400 may further drive the pressure stop ring 410 to move within an inner ring of the mode adjustment button 420, and the tool spindle 30 has not only the movement in the axis direction, but also the rotation in the circumferential direction.

[0155] Alternatively, the mode adjustment mechanism 40 may be of other structures.

[0156] Different from the examples shown in FIG. 1 to FIG. 15, in the examples shown in FIG. 19 to FIG. 26, the mode adjustment mechanism 40 includes a striking switching ring 430, a cushioning member 440, and a mode switching button 450. Specifically, the guide member 210 includes a first tooth pattern 212, the mode adjustment mechanism 40 includes a striking switching ring 430, the striking switching ring 430 is movably sleeved over the hammer 200, and the striking switching ring 430 includes a second tooth pattern 431 matching the first tooth pattern 212. One end of the cushioning member 440 abuts the striking switching ring 430 to constantly push the striking switching ring 430 to move toward the guide member 210. The mode switching button 450 is rotatably sleeved over the striking switching ring 430. The mode switching button 450 is rotatable relative to the striking switching ring 430. An inner circumferential wall of the mode switching button 450 is provided with a guide block 451, a peripheral wall of the striking switching ring 430 is provided with a mating block 432 matching the guide block 451, and the striking switching ring 430 is axially movable but is fixed to the housing without rotation.

[0157] The mode switching button 450 is rotated; when the guide block 451 abuts the mating block 432, the first tooth pattern 212 is spaced from the second tooth pattern 431. In this case, the guide member 210 is movable relative to the striking switching ring 430, the guide member 210 is driven by the intermittent striking component 230 and may rotate with the hammer 200, and the hammer 200 and the guide member 210 relatively static. Therefore, the hammer 200 may not hit the tool spindle 30. The mode switching button 450 is continuously rotated; when the guide block 451 is staggered from the mating block 432, the first tooth pattern 212 is engaged with the second tooth pattern 431, so as to connect the guide member 210 to the striking switching ring 430. In this case, the striking switching ring 430 may limit the motion of the guide member 210, the guide member 210 and the striking switching ring 430 are relatively static, and the hammer 200 may linearly move relative to the guide member 210 according to a preset path and hit the tool spindle 30 in at least one operating state. In this example, axial movement of the striking switching ring 430 is implemented by rotating the mode switching button 450, while in other examples, to implement the axial movement of the striking switching ring, a toggle button connected to the striking switching ring 430 may be further provided, and the axial movement of the striking switching ring 430 is directly driven by toggling the toggle button for axial movement.

[0158] As shown in FIG. 20, the first tooth pattern 212 includes a protruding portion 212a. The second tooth pattern 431 includes a guide segment 431a and an abutment stop segment 431b, the guide segment 431a may include a straight segment and an inclined segment, one end of the inclined segment is connected to a free end of the abutment stop segment 431b, and the other end of the inclined segment is connected to one end of the straight segment. The abutment stop segment 431b extends in an axis direction of the striking switching ring 430, and the straight segment is perpendicular to the abutment stop segment 431b. There may be a plurality of abutment stop segments 431b, the plurality of abutment stop segments 431b may be arranged at intervals in the circumferential direction of the guide member 210, a guide segment 431a is provided between any two adjacent ones of the plurality of abutment stop segments 431b, and two ends of any guide segment 431a are connected to the two adjacent abutment stop segments 431b respectively. There may be a plurality of protruding portions 212a, and the plurality of protruding portions 212a one-to-one correspond to the plurality of abutment stop segments 431b. The protruding portion 212a may be formed as a triangle. The free end of the protruding portion 212a may be formed as a tip 212a1.

[0159] When the motor 60 moves forward, there are two cases, one of which is as follows: the guide block 451 abuts the mating block 432, the first tooth pattern 212 is spaced from the second tooth pattern 431, in this case, the guide member 210 is movable relative to the striking switching ring 430, the guide member 210 is driven by the intermittent striking component 230 and may rotate with the hammer 200, and the hammer 200 and the guide member 210 are relatively static; and the other is as follows: when the guide block 451 is staggered from the mating block 432, the protruding portion 212a stops and abuts against the abutment stop segment 431b, and the first tooth pattern 212 and the second tooth pattern 431 are relatively static, so as to connect the guide member 210 to the striking switching ring 430, in this case, the striking switching ring 430 may limit the motion of the guide member 210, the guide member 210 and the striking switching ring 430 are relatively static, and the hammer 200 may linearly move relative to the guide member 210 according to a preset path and hit the tool spindle 30 in at least one operating state. When the motor 60 rotates reversely, the protruding portion 212a may slide along the guide segment 431a, relative rotation may be formed between the first tooth pattern 212 and the second tooth pattern 431, the guide member 210 may rotate relative to the striking switching ring 430, and the guide member 210 may rotate with the hammer 200.

[0160] In the related art, when the first tooth pattern 212 is in contact with the second tooth pattern 431, the guide member 210 and the striking switching ring 430 are relatively static, when the motor 60 rotates reversely, since the conversion member 232 stops at the descending portion 233b, the rotation of the motor 60 may be hindered, thereby damaging the performance of the guide member 210 and the motor 60 and affecting the service life of the handheld tool 1. Compared with the related art, the handheld tool 1 has more considerations, and thus has good safety performance.

[0161] Different from the example shown in FIG. 20, in the examples shown in FIG. 28 to FIG. 30, the handheld tool 1 further includes a striking ring 11a fixed to the housing 80 without rotation. The striking ring 11a is provided with a first end tooth 12a, and the guide member 210 is provided with a second end tooth 213a that can be engaged with the first end tooth 12a. When the motor 60 rotates in the first direction, the first end tooth 12a limits, through the second end tooth 213a engaged with it, the guide member 213 to rotate, and the conversion member 232 moves along the curve guide according to a preset direction to make the hammer 200 hit the tool spindle 30 in at least one operating state; and when the motor 60 rotates in the second direction, the second end tooth 213a and the guide member 213 are driven by the motor 60 to rotate relative to the first end tooth 12a engaged with the second end tooth, that is, the second end tooth 213a on the guide member 213 makes slope ascending motion relative to the first end tooth 12a. The first end tooth 12a includes a plurality of first teeth 121a, the first teeth 121a each include a guide segment 121b and a stop segment 121c, and the guide segment 121b is connected to a free end of the stop segment 121c. The second end tooth 213a includes a plurality of second teeth 2131a. When the motor 60 rotates in the first direction, the second teeth 2131a move from the stop segment 121c to the guide segment 121b, and the stop segment 121c abuts the second teeth 2131a, so that the guide member 210 cannot rotate; and when the motor 60 rotates in the second direction, the second teeth 2131a move from the guide segment 121b to the stop segment 121c, the second teeth 2131a can move along the guide segment 121b, so that the guide member 213 rotates relative to the first end tooth 12a. The guide segment 121b and the stop segment 121c are sequentially arranged at intervals in a circumferential direction of the first end tooth 12a, and the stop segment 121c is parallel to the axis of the transmission shaft 10. When the second teeth 2131a moves from the stop segment 121c to the guide segment 121b, a side of the second teeth 2131a abutting the stop segment 121c is parallel to the stop segment 121c. The striking ring 11a can move in the axial direction to achieve engagement or disengagement of the first end tooth 12a with or from the second end tooth 213a. When the first end tooth 12a is disengaged from the second end tooth 213a, the guide member 210 is driven by the motor to rotate, and the tool is in a non-striking mode. It may be understood that in this example, when the striking ring 11a is axially movable, the striking ring 11a in this example not only has an "anti-stalling" function, but also has the functions implemented by the striking switching ring 430 described in the above.

[0162] FIG. 23 is a schematic cross-sectional structural diagram of a handheld tool, including a motor 60 and a transmission mechanism. The transmission mechanism includes a transmission shaft 10, a hammer striking mechanism 20, and a tool spindle 30. The transmission shaft 10 is driven by the motor 60 to rotate to make the transmission shaft 10 rotate around an axis of the transmission shaft, and the transmission shaft 10 drives the tool spindle 30 to rotate around an axis of the cuter axle. In this implementation, the axis of the transmission shaft 10 is coaxial with the axis of the tool spindle 30, and the transmission shaft 10 is sleeved outside the tool spindle 30 and is rotationally connected to the tool spindle 30 through flat-square matching. The connection manner of the transmission shaft 10 and the tool spindle 30 is not limited to the structure in this implementation. In other implementations, the axes of the transmission shaft 10 and the tool spindle 30 may be parallel and non-collinear, and the transmission shaft 10 may not be sleeved outside the tool spindle 30.

[0163] With reference to FIG. 31, FIG. 32, and FIG. 11, the hammer striking mechanism 20 includes a hammer 200, a guide member 210, and an intermittent striking component 230 provided between the hammer 200 and the guide member 210. The hammer 200 can intermittently axially strike the tool spindle 30 to provide higher striking energy for the tool spindle 30. The axial striking motion of the hammer 200 is implemented by the intermittent striking component 230. In this implementation, the intermittent striking component 230 includes a curve guide 233 provided on the guide member 210, and an conversion member 232. The conversion member 232 is connected to the curve guide 233 and the hammer 200 to enable the curve guide 233 to drive the hammer 200 to move in a direction opposite to the striking direction to compress an energy storage mechanism 231 to store energy. The intermittent striking component 230 further includes an energy storage mechanism 231 abutting the hammer 200, and the energy storage mechanism 231 can drive the hammer 200 to move in the striking direction. The striking direction here is the movement direction of the hammer 200 from the back to the front along the axis direction parallel to the tool spindle 30.The striking direction of the hammer is the second direction, and the first direction is a direction opposite to the striking direction. A direction close to the free end of the tool spindle 30 is the front. In other implementations, the curve guide may be provided on the hammer.

[0164] The curve guide includes a plurality of slope ascending portions and descending portions. When the conversion member 232 moves past the slope ascending portion, the conversion member 232 drives the hammer 200 to overcome an applied force of the energy storage mechanism 231 to move in a first direction, and when the conversion member 232 moves past the descending portion, the energy storage mechanism 231 drives the hammer 200 to move in a second direction opposite the first direction to strike the tool spindle 30. Here, "the conversion member moves past the slope ascending portion" may be understood as a process in which the conversion member contacts with the slope ascending portion and performs slope ascending during the motion relative to the curve guide, and the conversion member here may or may not be moving, as long as the conversion member has relative motion relative to the curve guide. "The conversion member moves past the descending portion" may be understood as that the conversion member is in an avoidance space formed by the descending portion. Herein, the conversion member may not contact with the descending portion, which may be described in detail below.

[0165] In this implementation, the curve guide 233 is provided on the guide member 210, the guide member 210 is fixedly provided relative to the housing, the conversion member 232 is provided on the hammer 200, and the hammer 200 is driven to rotate relative to the guide member 210 through the matching between the conversion member 232 and the curve guide 233, so as to make the hammer 200 perform slope ascending on the curve guide 233, that is, the hammer 200 moves backward along an axis. The hammer 200 may make the energy storage mechanism 231 store energy while moving backward along the axis, and when the hammer 200 performs slope ascending to the highest point on the slope ascending portion of the curve guide 233, the energy stored by the energy storage mechanism 231 is also correspondingly at the maximum value. The descending portion of the curve guide 233 may form a falling avoidance space, for providing the hammer 200 with a falling space. When the hammer 200 is in the falling space formed by the descending portion, the energy stored by the energy storage mechanism 231 may be converted into kinetic energy of the hammer 200, that is, the energy storage mechanism 231 drives the hammer 200 to move in the striking direction to apply an axial striking to the tool spindle 30.

[0166] In this implementation, the hammer 200 is driven by the rotation of the transmission shaft 10, and the hammer 200 is sleeved over an outer side of the transmission shaft 10. The motor 60 drives the transmission shaft 10 to rotate, the transmission shaft 10 drives the tool spindle 30 to rotate, and the transmission shaft 10 selectively drives the hammer 200 to rotate, that is, the transmission shaft 10 drives the hammer striking mechanism 20 to move.

[0167] In this implementation, the curve guide 233 is a cam surface, the curve guide 233 is provided on the guide member 210, the conversion member 232 is a steel ball, the energy storage mechanism 231 is a spring, the rotation of the hammer 200 causes the hammer striking mechanism 20 to move, and the rotation of the hammer 200 is driven by the transmission shaft 10. However, it is not limited to the specific form and structure in this example, and other structure solutions can implement forward movement of the hammer along the axis. For example, in other implementations, the conversion member may be a cam end surface provided on one of the hammer and the guide member, a curve guide is provided on the other of the hammer and the guide member, the cam end surface and the curve guide form matching between an active cam surface and a passive cam surface by end surface matching, the rotational motion can be converted into linear motion, and then reciprocating axial striking motion of the hammer can be implemented In combination with the effect of the energy storage mechanism.

[0168] Specifically, FIG. 2 is a three-dimensional exploded view of an implementation of the present disclosure. Referring to FIG. 2, the conversion member 232 may be provided as a steel ball, and to ensure the strength of the steel ball, the diameter of the steel ball is greater than 4 mm and less than or equal to 10 mm. Advantageously, the diameter of the steel ball is greater than 4 mm and less than or equal to 6 mm. The diameter of the steel ball is 5 mm in this example. The curve guide 233 may be provided as a cam surface or a cam groove. Therefore, the cam surface or the cam groove may define a movement trajectory of the steel ball, and the steel ball may move on the cam surface or in the cam groove. The steel ball has a smooth outer surface, which may reduce the relative motion friction between the conversion member 232 and the curve guide 233 and improve movement smoothness of the conversion member 232 in the curve guide 233. Moreover, the steel ball has a great structural strength and a good abrasion resistance performance, which may guarantee the working performance of the intermittent striking component 230. It should be noted that, the "cam" mentioned here may refer to that the curve guide 233 protrudes from the inner circumferential wall of the guide member 210, or the curve guide 233 protrudes from the peripheral wall of the hammer 200.

[0169] Further, the steel ball may be in point or line contact with the curve guide 233. It may be understood that as the steel ball moves in the curve guide 233, the steel ball is always in point or line contact with the curve guide 233, which helps to reduce the friction between the steel ball and the curve guide 233. For example, the radius of curvature of the cam surface may be basically the same as or slightly greater than the radius of the steel ball, so as to improve the matching between the steel ball and the cam surface, and then improve the assembly stability, the wear resistance, and the service life of the steel ball and the cam surface.

[0170] Further, in this implementation, the peripheral wall of the hammer 200 is provided with an insertion groove 202, a part of the steel ball serving as the conversion member 232 may be located in the insertion groove 202 to connect the conversion member 232 to the hammer 200, and a part of the conversion member 232 located outside the insertion groove 202 is matched with the curve guide 233 to enable the conversion member 232 to move along the curve guide 233, so that the hammer 200 is driven by a rotating force of the transmission shaft 10 to move along a path of the curve guide 233.

[0171] In this implementation, the curve guide 233 is provided on an inner circumferential surface of one of the hammer 200 and the guide member 210, that is, the guide member 210, and the conversion member 232 is provided on the other of the two, that is, the hammer 200. A connection relationship between the conversion member 232 and the hammer 200 is as follows: a part of the conversion member 232 is provided in the insertion groove 202 on the hammer 200, and the steel ball 232 may rotate in the insertion groove 202. Moreover, 3 insertion grooves 202 are provided on an outer circumferential surface of the hammer 200, 3 steel balls serving as the conversion member 232 are also correspondingly provided, and the corresponding curve guide 233 includes 3 slope ascending portions.

[0172] In the present disclosure, to better describe the motion state of the hammer in the striking mode in this implementation, the present disclosure provides sectional views of the hammer in several different states during the operation in the striking mode. Referring to FIG. 34 to FIG. 36, FIG. 34 is a diagram of the hammer in a first state in the striking mode, that is, the hammer is performing slope ascending, i.e., the hammer is on the slope ascending portion; in this case, the hammer is compressing the energy storage mechanism to store energy. FIG. 35 is a diagram of the hammer in a second state, that is, the hammer is in the highest position of the slope ascending portion; in this case, the hammer compresses the energy storage mechanism to the maximum extent to maximize the energy storage. FIG. 36 is a diagram of the hammer in a third state, that is, the hammer is in an avoidance space formed by the descending portion; in this case, the energy storage mechanism releases energy to drive the hammer to strike in a striking direction.

[0173] Specifically, as shown in FIG. 34, the tool spindle 30 is at a position of being pressed down, the transmission shaft 10 drives the hammer 200 to rotate, and under the driving of the conversion member 232, the hammer 200 performs slope ascending relative to the curve guide 233 on an inner circumferential side of the guide member 210, and then the hammer 200 compresses the energy storage mechanism in a first direction A to store energy.

[0174] On the basis of FIG. 34, while the hammer 200 continues the slope ascending in the first direction A to compress the energy storage mechanism 231, the energy storage mechanism 231 may be compressed to a maximum compression amount, that is, the energy storage mechanism 231 is at a maximum energy storage amount; in this case, the hammer 200 performs slope ascending to the highest point of the slope ascending portion, that is, the second state of the hammer 200 shown in FIG. 35.

[0175] When the hammer 200 is in the highest point of the slope ascending portion in FIG. 35, due to continuous rotation of the transmission shaft 10, the hammer 200 may also be driven to rotate, and then may move to an avoidance area formed by the descending portion, the hammer 200 in the area abuts the energy storage mechanism 231, and the energy storage mechanism 231 storing sufficient energy may drive the hammer 200 to move in a second direction B opposite to the first direction A while releasing energy, and then cause the hammer 200 to strike the tool spindle 30.

[0176] The above process is one striking completed by the hammer 200. The curve guide 233 includes 3 slope ascending portions and descending portions corresponding to the slope ascending portions, therefore, after moving past the first slope ascending portion and the first descending portion to complete one striking, the hammer 200 may continue to perform the same striking motion along the second slope ascending portion and the second descending portion, and then may also perform a third striking motion along the third slope ascending portion and the third descending portion.

[0177] Since 3 slope ascending portions are provided on the inner circumferential surface of the guide member, that is, the hammer 200 may perform three striking motions during one rotation, the striking frequency is improved, and then the striking and drilling efficiency is improved.

[0178] The energy storage mechanism 231 may be provided as an elastic member. For example, the energy storage mechanism 231 may be a spring or an elastic rubber member. Therefore, the configuration and assembly of the energy storage mechanism 231 may be simplified, and the manufacturing costs of the energy storage mechanism 231 may also be reduced. Further, the energy storage mechanism 231 may be formed as a ring, and the energy storage mechanism 231 may be sleeved over a peripheral wall of the transmission shaft 10. Therefore, the assembly of the energy storage mechanism 231 is easy, and the force applied by the energy storage mechanism 231 to the hammer 200 can be even.

[0179] In other implementations, the hammer may not rotate, but the guide member rotates. In this implementation, the transmission shaft is fixedly connected to the guide member, that is, the transmission shaft drives the guide member and the tool spindle to simultaneously rotate, that is, the guide member rotates at the same speed as the tool spindle, that is, the rotational speed of the tool spindle is the same as that of the hammer relative to the guide member, and the hammer is connected to the housing without rotation, that is, the hammer can axially move relative to the housing, but cannot relatively rotate. The transmission shaft drives the guide member to rotate, the rotation of the guide member drives the curve guide on the inner circumferential surface of the guide member to rotate, axial movement of the hammer is driven, the spring is compressed for energy storage, and then the hammer axially moves in the striking direction to hit the tool spindle.

[0180] The specific structure of the cam-type hammer striking mechanism in this implementation is described above, due to different striking principles, the cam-type hammer striking mechanism has higher striking energy than the conventional dynamic-and-static-end-tooth axial striking structure, that is, the energy of a single striking of the cam-type hammer striking mechanism is higher than that of the conventional dynamic-and-static-end-tooth striking structure. In addition, it is found through research that the cumulative hit energy per unit time may also affect the striking effect, that is, if the cumulative hit energy per unit time is too low, it will lead to an insufficient breaking force, and relatively hard working surfaces made of materials such as concrete cannot be broken.

[0181] Parameters that affect the cumulative hit energy per unit time are as follows. The first parameter is a quantity of periodic segments on the curve guide, that is, a quantity of slope ascending tracks, and the more the slope ascending tracks are, the more the striking times of the hammer are, and the more the striking times per rotation of the hammer are. The second parameter is the rotational speed of the hammer, and the higher the speed of the hammer is, the larger a quantity of turns of the hammer per unit time is, that is, the more the striking times of the hammer are. Therefore, if the speed of the hammer is too low, the cumulative hit energy per unit time may be too low, resulting in a failure to break the material. Conversely, the higher the speed of the hammer is, the greater the cumulative hit energy per unit time is, and the stronger the breaking capability is. The "rotational speed of the hammer" referred to herein, in other examples, may refer to the relative rotation speed of the hammer, that is, the rotation speed of the hammer relative to the guide member or of the guide member. For example, in an implementation where the hammer only axially moves without rotation and the guide member rotates, the rotational speed of the hammer may be understood as the relative rotational speed of the hammer relative to the guide member.

[0182] However, if the speed of the hammer is too high, it may bring another problem. If the speed of the hammer is too high, the time for the steel ball to fall from the highest point of the slope ascending portion may be less, which may greatly increase the probability of the steel ball hitting the track. In addition, the more periodic segments of the curve guide distributed on a circle are, that is, the more the slope ascending tracks are, the shorter the length of each periodic segment may be, thus increasing the probability of the steel ball hitting the track. Therefore, whether the steel ball may hit the track needs to be determined in combination with the speed of the hammer and the quantity of the slope ascending tracks.

[0183] Referring to FIG. 23, FIG. 31, and FIG. 32, in this implementation, the tool spindle 30 and the hammer 200 are simultaneously driven by the rotation of the transmission shaft 10, that is, the tool spindle 30 rotates at the same speed as the hammer 200. Therefore, the probability of the steel ball hitting the track is also indirectly related to the rotational speed of the tool spindle 30. In addition, the higher the rotational speed of the tool spindle 30, the higher the rotational speed of the working head may be. In a case that the hit energy is met, the higher the rotational speed of the working head, the higher the drilling efficiency may be. Conversely, if the rotational speed of the tool spindle 30 is lower, the rotational speed of the working head may be reduced, leading to poor chip removal capability, large drilling resistance, poor breaking capability, and then there may be a phenomenon of being unable to hit.

[0184] In other implementations where the tool spindle rotates at the same speed as the hammer, the tool spindle may directly drive the hammer to rotate, that is, the transmission shaft drives the tool spindle to rotate, and the tool spindle drives the hammer to rotate. Compared with this implementation, the technical solution of the transmission shaft simultaneously driving the tool spindle and the hammer to rotate may save the axial size, that is, a more compact axial power tool is obtained.

[0185] Influencing factors of the steel ball hitting the track are described in detail below with reference to FIG. 33. FIG. 33

is a schematic unfolded diagram of a curve guide 233, and FIG. 11 is a schematic view of a guide member.

[0186] In FIG. 11, the curve guide 233 is distributed at 360 degrees on the inner circumferential surface of the guide member 210. In other implementations, the curve guide may be distributed at 360 degrees around the outer circumferential surface of the hammer. FIG. 33 is a schematic view of the curve guide 233 expanded in a circumferential direction. As shown in the figure, the curve guide 233 includes three evenly distributed, identical and end-to-end periodic segments, also known as slope ascending tracks. The three periodic segments or slope ascending tracks are A-B-C-D, A1-B1-C1-D1, and A2-B2-C2-D2 respectively. An end point D of the first periodic segment is connected to a start point A1 of the second periodic segment, an end point D1 of the second periodic segment is connected to a start point A2 of the third periodic segment, and an end point D2 of the third periodic segment, that is, the final periodic segment, is connected to a start point A of the first periodic segment. Herein, "evenly distributed" means that each of the three periodic segments is distributed at the same angle in the circumferential direction, "identical" means that each of the three periodic segments includes identical regional segments, and angles, heights, and lengths of each regional segment are all identical. In this implementation, each periodic segment includes a horizontal segment 233c, a slope ascending portion 233a, and a descending portion 233b; and lengths of the horizontal segments are the same, slope ascending heights and slope ascending angles of the slope ascending portions are the same, and heights and angles of the descending portions are the same. In other implementations, the horizontal segments may not be provided, as long as the end point of the descending portion of the first periodic segment is disconnected from the start point of the next periodic segment, which may also extend the flight distance of the steel ball in the range of the descending portion of the first periodic segment.

[0187] Referring to FIG. 33, when an conversion member 232, that is, the steel ball in this implementation, is in the striking operation mode, and the steel ball is at the end point C of the slope ascending portion B-C of the first periodic segment, that is, the highest point, the hammer 200 may continuously rotate, and the steel ball partially received in the insertion groove 202 on the outer circumferential surface of the hammer 200 may rotate around the axis of the hammer 200 at the same speed with the hammer 200. In a case that the slope ascending height is fixed, the higher the speed of the hammer 200 and the steel ball, the greater the probability of the steel ball hitting the slope ascending portion B1-C1 in the next periodic segment; and the more the slope ascending tracks, the greater the probability of the steel ball hitting the slope ascending portion B1-C1 in the next periodic segment. On the other hand, the higher the speed of the hammer 200 is, the higher the probability of the hammer 200 to be blocked, because, when the motor power is fixed, the higher the rotational speed of the hammer is, the lower the corresponding output torque may be; and when the output torque is less than the torque required during the slope ascending, stalling may occur.

[0188] In a case that the rotational speed of the hammer 200 and the quantity of the slope ascending tracks are fixed, the higher the slope ascending track is, the lower the probability of the steel ball hitting the slope ascending portion of the next periodic segment is; however, the higher the height of the slope ascending track, the greater the axial length of the hammer, and therefore, the longer the body.

[0189] Based on the above analysis, the range of the relative rotational speed of the hammer relative to the guide member is set to an optimal range of 1000 revolutions per minute to 2500 revolutions per minute. Moreover, a ratio of the striking frequency of the hammer to the relative rotational speed of the hammer is 2 times per revolution to 4 times per revolution. The striking frequency of the hammer refers to the number of times the hammer hits the tool spindle when the tool spindle rotates in one turn, measured in times per minute, that is, the striking frequency refers to the number of times the hammer hits the tool spindle when the tool spindle rotates for one minute. The relative rotational speed of the hammer refers to the relative rotational speed between the hammer and the guide member, measured in revolutions per minute, that is, the relative rotational speed of the hammer refers to the number of turns of the hammer relative to the guide member within one minute. A ratio of the striking frequency of the hammer to the relative rotational speed of the hammer is 2 to 4, and the corresponding ratio is measured in times per minute, that is, the number of times the hammer hits the tool spindle is 2 to 4 in the process of the tool spindle rotating in one turn. It should be noted that, the striking frequency of the hammer is a positive integer, the relative rotational speed of the hammer is also a positive integer, but the ratio of the two may or may not be an integer, that is, may be a positive decimal. The striking frequency of the hammer increased through the technical solution of increasing the number of slope ascending portions on the curve guide is increased by an integer multiple. However, in other technical solutions, the multiple of the increase may be a non-integer. For example, in some implementations, a speed increasing mechanism may be added between the transmission mechanism and the hammer striking mechanism. The speed increasing mechanism is used for increasing a rotational speed output by the transmission mechanism, so as to increase the rotational speed transmitted to the hammer striking mechanism. Since the rotational speed output by the transmission mechanism is directly transmitted to the tool spindle, the rotational speed of the tool spindle is the same as that output by the transmission mechanism, and then the rotational speed of the hammer striking mechanism transmitted to the tool spindle may be greater than the rotational speed of the tool spindle. The multiple of the increase depends on the configuration of the speed increasing mechanism. Preferably, the speed increasing mechanism may be a planetary gear speed-increasing mechanism, and a transmission ratio of the planetary gear speed-increasing mechanism, that is, the ratio of the speed at the output end to the speed at the input end, is the multiple of the speed increase. The transmission ratio is sometimes a decimal, and therefore, the multiple of the increase using the technical solution is likely to be a decimal.

[0190] In other implementations, the planetary gear speed-increasing mechanism may be replaced with other forms of speed increasing mechanisms, as long as the rotational speed at the output end of the speed increasing mechanism output is greater than that at the input end.

[0191] In other implementations, different types of speed increasing mechanisms may be superimposed. For example, the technical solution of the planetary gear speed-increasing mechanism may be used in conjunction with the technical solution of increasing the number of the slope ascending portions on the curve guide, and the multiple of the speed increase obtained is the product of the transmission ratio of the speed-increasing mechanism to the number of the slope ascending portions. For example, in other implementations, the hammer rotates, the guide member provided on an outer side of the hammer does not rotate, the inner circumferential surface of the guide member is provided with a curve guide, the number of the slope ascending portions on the curve guide is set to 2, and the transmission shaft drives the tool spindle to rotate. In addition, a planetary gear speed-increasing mechanism is provided between the transmission shaft and the hammer, the transmission shaft drives an input end of the planetary gear speed-increasing mechanism to rotate, an output end of the planetary gear speed-increasing mechanism drives the hammer to rotate, the rotational speed of the transmission shaft is the same as the speed of the input end of the planetary gear speed-increasing mechanism, the rotational speed of the output end of the planetary gear speed-increasing mechanism is the same as the speed of the hammer, and the transmission ratio of the planetary gear speed-increasing mechanism is 1.6. Then, in this implementation, when the tool spindle rotates in one turn, the number of times the hammer hits the tool spindle is 3.2, that is to say, in this implementation, the ratio of the striking frequency of the hammer to the relative rotational speed of the hammer is 3.2, and refer to the above content for the unit of measurement for the striking frequency of the hammer, the unit of measurement for the relative rotational speed of the hammer relative to the guide member, and the unit of measurement for the ratio of the two.

[0192] The relative rotational speed of the hammer described in the present disclosure refers to the relative rotational speed between the hammer and the guide member. The rotational speeds being the same described in the present disclosure means that only the values of the rotational speeds are the same.

[0193] The optimal range of the relative rotational speed of the hammer 200 relative to the guide member 210 is 1000 revolutions per minute to 2500 revolutions per minute, the range has a maximum value and a minimum value, and the reason for selecting the maximum value lies in whether the steel ball hits the track or stalling occurs. In the process of selecting the maximum value of 2500 revolutions per minute, a large number of experiments were conducted, which are referred to as an experiment A. Before the experiment started, the number of the slope ascending portions was first set to 3, and the height of the slope ascending track was set to 9 mm; based on this, a large number of selective experiments were conducted on the rotational speed of the hammer 200. During the experiment, when the rotational speed of the hammer 200 was less than or equal to 2300 revolutions per minute, both the steel ball hitting the track and the stalling did not occur. However, when the rotational speed of the hammer 200 was equal to 2600 revolutions per minute, motor stalling occurred. To overcome the phenomenon of the steel ball hitting the track caused by the improper landing point of the steel ball, on the basis of the original experimental conditions, the rotational speed of the hammer 200 was set at 2500 revolutions per minute; in this case, there was no phenomena of the steel ball hitting the track and the stalling.

[0194] The reason for selecting the rotational speed of the hammer 200 as the minimum value of 1000 revolutions per minute lies in whether the cumulative energy per unit time is sufficient, and in this implementation, the tool spindle 30 and the hammer 200 were both driven by the rotation of the transmission shaft 10, and were at the same rotational speed, and therefore, the selection of the minimum speed of the hammer 200 also considers the influence of the low speed of the tool spindle 30. If the rotational speed of the tool spindle 30 is too small, on the one hand, the chip removal capability of the drill bit becomes poor, the drilling resistance is large, and then the drilling efficiency is low; on the other hand, if the rotational speed of the tool spindle 30 is too small, the rotational speed of the drill bit in the striking mode may be affected, that is, the drilling resistance is affected, the drilling resistance in a drill and screwdriver mode may also be affected, and then operation experience is affected.

[0195] During the experiment A, the number of the slope ascending tracks was first selected as three, and then adjusted to two, and the selection and adjustment of the value were based on another experiment, which is referred to as an experiment B.

[0196] Before the experiment B started, the rotational speed of the tool spindle 30 was first set, the selection of the speed was based on the speed of the tool spindle on a multi-functional drill with an axial striking function in the prior art, a better speed of 1800 revolutions per minute was selected, and a basis for determining whether the speed is better may be selecting a speed value above average in the range of the speed. As for the height of the slope ascending track, a slope ascending height of 10 mm was selected for the experiment; based on this, the number of the slope ascending tracks was set to two, three, and four respectively, that is to say, when the number of the slope ascending tracks was two, the hammer 200 hit the tool spindle 30 twice per revolution; when the number of the slope ascending tracks was three, the hammer 200 hit the tool spindle 30 three times per revolution; and when the number of the slope ascending tracks was four, the hammer 200 hit the tool spindle 30 four times per revolution. Then, a drilling experiment at the same depth was conducted on concrete working surfaces made of the same material with the working head of the same specification, that is, the drill bit, and the corresponding completion time of the drilling was recorded in seconds (S). The conventional passive striking drill also participated in the comparison. The "conventional passive striking" here refers to a striking structure that realizes axial striking by engagement of dynamic and static end teeth.

[0197] The conventional drill of a dynamic-and-static-end-tooth structure also participated in the comparison.

[0198] Four samples were given in this experiment, which were "sample 1", "sample 2", "sample 3", and "sample 4" respectively. The "sample 1" indicates that the number of the slope ascending portions in the cam-type active striking drill is two; the "sample 2" indicates that the number of the slope ascending portions in the cam-type active striking drill is three; the "sample 3" indicates that the number of the slope ascending portions in the cam-type active striking drill is four; and the "sample 4" indicates that the conventional passive striking structure, that is, a dynamic-and-static-end-tooth passive striking structure, is used for the striking drill. In addition, a mean value method was adopted in this experiment, that is, a set of experiments were conducted for each sample, each set of experiments were repeated six times, the drilling operation was repeated six times, each operation time was recorded, and a mean value was calculated, thereby obtaining an average drilling time value of each set of experiments corresponding to each sample.

[0199] When the height of the slope ascending track was 9 mm, Specific experimental data during the experiment is shown in Chart 1 below, and experimental results correspondingly output are shown in a bar graph 2 below.

[0200] In Chart 1, "the curve guide includes two slope ascending portions", "the curve guide includes three slope ascending portions", and "the curve guide includes four slope ascending portions" mean that the number of the slope ascending tracks in the active striking structure of the striking drill is set to two, three, and four respectively. The "conventional passive striking" means that the striking structure in the striking drill is a dynamic-and-static-end-tooth striking structure.

Sample type / Experimental data		Sample 1 Two slope ascending portions	Sample 2 Three slope ascending portions	Sample 3 Four slope ascending portions	Sample 4 Passive striking
Experimental record/s	The first time	8.28	4.88	6.55	7.53
	The second time	8.11	4.61	5.53	8.35
	The third time	7.05	5.77	6.14	8.83
	The fourth time	8.15	5.05	6.53	8.58
	The fifth time	7.88	4.8	6.87	7.1
	The six time	7.67	4.91	6.33	8.48
Mean value/s		7.86	5.00	6.33	8.15

Chart 1

[0201] It may be found according to the experimental values and average information in Chart 1 that under the same working condition, different striking structures take different time to punch holes of the same depth in the same material with the same drill bit, the shortest time is 5 s, that is, the active striking structure with the number of the slope ascending tracks being three, that is to say, when the number of the slope ascending tracks is set to three, the hammer takes the shortest time and has the highest efficiency when performing three strikings per revolution. The second shortest time is

6.33 s, that is, the active striking structure with the number of the slope ascending tracks being four, that is to say, when the number of the slope ascending tracks is set to four, the hammer takes the second shortest time and has the second highest efficiency when performing four strikings per revolution. Next, the third shortest time is 7.86 s, that is, the active striking structure with the number of the slope ascending tracks being two, that is to say, when the number of the slope ascending tracks is set to two, the time taken by the hammer to perform two strikings per revolution is greater than the time taken by the hammer performs three or four strikings per revolution, the time taken ranks the third, and the efficiency also ranks the third. The longest time is 8.15 s, that is, the conventional passive striking structure, that is to say, the time taken by the conventional passive striking structure is greater than the time taken by the active striking structure, namely, the striking and drilling efficiency of the conventional passive striking structure is less than that of the active striking structure.

[0202] The above conclusions can be more intuitively illustrated in Chart 2 below. Chart 2 is a bar graph derived from the average value information in Chart 1.

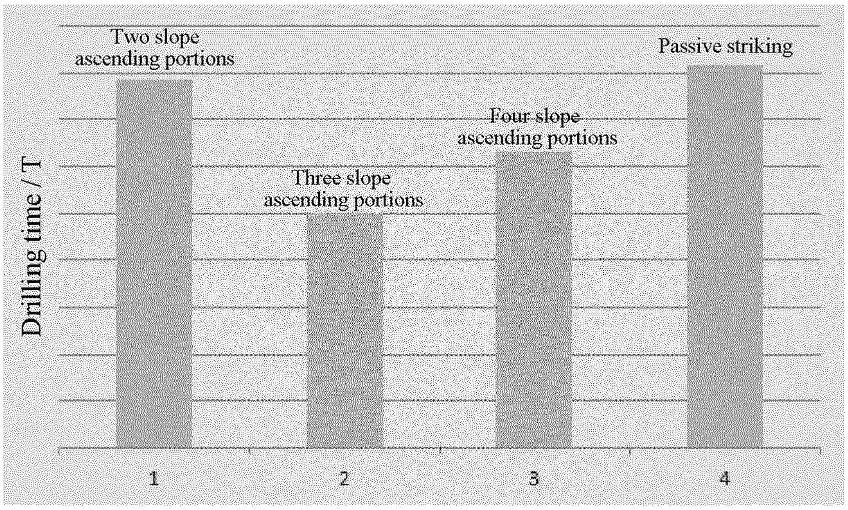

Chart 2

[0203] It can be intuitively found from Chart 2 that the drilling time of the active impact structure is shorter than that of the conventional striking structure to complete the same task under the same working condition. Moreover, in the active striking structure, when the number of the slope ascending tracks is set to three, the drilling time is the shortest, the drilling time is the second shortest when the number of the slope ascending tracks is set to four, and the drilling time is the longest when the number of the slope ascending tracks is set to two.

[0204] Herein, the drilling efficiency is compared through the drilling time, because when the same work task is completed under the same working condition, the shorter the drilling time, the higher the drilling efficiency.

[0205] Later, the slope ascending height was changed to 8 mm and 9 mm. Two groups of experiments were conducted under the same experimental condition and experimental results obtained were the same as those obtained when the slope ascending height was 10 mm: the times taken by the active striking structure to drill are all less than those taken by the conventional passive striking structure. Moreover, in the active striking structure, when the number of the slope ascending tracks is three, the time taken is the shortest, when the number of the slope ascending tracks is four, the time taken is the second shortest, and when the number of the slope ascending tracks is two, the time taken is the longest.

[0206] Therefore, when the rotational speed of the hammer is (1000 to 2500) revolutions per minute, and the number of the slope ascending tracks is (2 to 4), the drilling efficiency may be the highest.

[0207] Regarding the height of the slope ascending track, the present disclosure also gives an optimal range, (4 to 15) mm, and an experiment C was conducted to verify the value range.

[0208] After the rotational speeds of the hammer and the tool spindle and the number of the slope ascending tracks meet the optimal range, the height of the slope ascending track may affect the magnitude of the striking energy and the axial length of the body. In other words, in a case that the rotational speeds of the hammer and the tool spindle are fixed and the number of the slope ascending tracks is fixed, the higher the height of the slope ascending track, the greater the compression amount of the spring is, the greater the energy stored, and the greater the striking energy obtained by the hammer. However, if the height of the slope ascending track is too high, the axial length of the hammer may be longer, which undoubtedly increases the length of the whole machine.

[0209] Before the experiment C started, an experimental condition was first set, the rotational speed of the hammer was set to 1800 revolutions per minute according to the above speed range, and the number of the slope ascending tracks was set to three. A data graph of the correspondence between the heights of the slope ascending tracks and the striking energy of the striking hammer obtained on this basis is as in the following Chart 3. The "striking energy" here refers to the energy produced by a single impact of the hammer, rather than the accumulated impact energy when the hammer rotates in one turn.

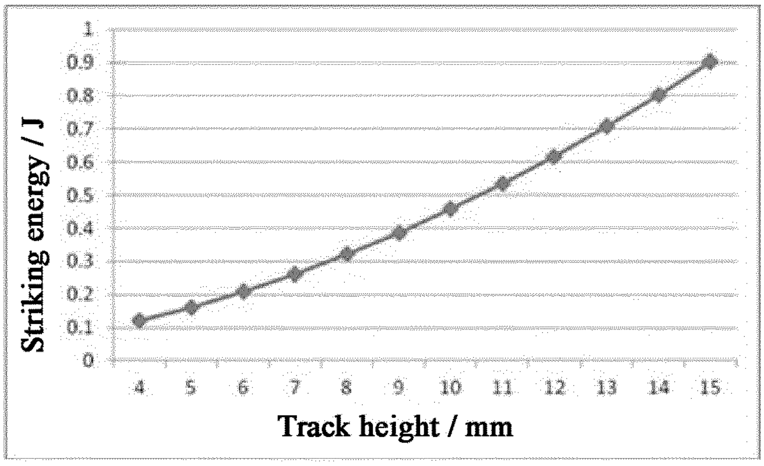

Chart 3

[0210] It may be found according to the data in Chart 3 that when the height of the slope ascending track is less than 4 mm, the striking energy may be less than 0.1 J; since a drilling object of the active striking drill includes concrete, the working surface of the hard material has certain requirements on the striking energy; the striking energy is too low to break the working surface of the hard material, or even if the striking energy is barely able to break the working surface, the operation cannot be performed within the normal drilling efficiency. Therefore, when the height of the track is less than 4 mm, it is considered unable to meet the requirement of certain breaking energy.

[0211] When the height of the slope ascending track is 15 mm, the striking energy is 0.9 J, the energy should be sufficient to break a working surface of a common high hardness material to which the striking drill is adapted. When the slope ascending height is greater than 15 mm, the striking energy obtained by the hammer can be sufficient or even excessive, and when the slope ascending height is greater than 15 mm, the axial length of the whole machine may be increased. Therefore, the height being greater than 15 mm is not a preferred range.

[0212] In addition, the slope ascending portion has a slope ascending angle, that is, an inclination angle of a slope ascending surface of the slope ascending portion relative to the horizontal plane. The horizontal plane refers to the plane perpendicular to the axis of the hammer or the axis of the tool spindle. In the present disclosure, a better effect may be had based on the above technical solution and in combination with the range of the slope ascending angle of the slope ascending portion. Regarding the slope ascending angle, if the slope ascending angle is too small, due to the limited circumference length of the circumferential surface of the hammer or the guide member, the set number of the periodic segments may be restricted, that is, the number of the slope ascending portions may also be restricted. If the slope ascending angle is too large, the probability of the hammer stalling during the slope ascending may increase. Based on the above considerations, the slope ascending angle is set in the range of 5 degrees to 25 degrees, so that the number of the slope ascending portions on the curve guide may not be restricted, and the hammer is not likely to stall due to the failure of slope ascending.

[0213] In addition, in order that the hammer does not stall, the power supplied by the motor also needs to be within a certain range, which is at least 180 W to 300 W.

[0214] In addition, the rotational speed of the motor shaft is 18000 revolutions per minute to 26000 revolutions per minute, and to obtain the speed range of 1000 revolutions per minute to 2500 revolutions per minute of the hammer or the tool spindle, the reduction ratio of the planetary gear transmission mechanism is required to be in the range of 7.2 to 26.

[0215] In addition, for the slope ascending portion and the descending portion included in the curve guide, it needs to be explained that the slope ascending portion can drive, through the contact with the conversion member, that is, the steel ball, the hammer to move in the axis direction. For the descending portion, , the descending portion forms a falling space for making the hammer fall in the space. The steel ball, as an conversion member, moving past the descending portion should be understood as that the steel ball is in the falling space formed by the descending portion, and in another implementation, may also be understood as that the steel ball is on the surface of the curve guide of the descending portion.

[0216] In another implementation, the descending portion may also function. For example, the descending portion is obliquely provided and extends away from the slope ascending portion in a circumferential direction of the guide member;

please refer to the diagram of the descending portion in FIG. 33 for details. In the technical solution, the steel ball may slide down slowly along the descending portions C-D, C1-D1, and C2-D2, so that the steel ball is at the highest point of the slope ascending portion, and when the motor shuts down suddenly, the steel ball can slide down slowly along the descending portions, preventing the steel ball from directly hitting the tool spindle, because the hammer hitting the tool spindle may lead to a poor operation experience in the shutdown state.

[0217] In addition, in another implementation, the hammer striking mechanism may also be used in conjunction with non-electric-drill tools, as long as the tools need the function of the hammer striking mechanism, such as an electric hammer, and the tools are not listed here one by one.

[0218] In addition, in another implementation, the hammer striking mechanism may also be used as an accessory to be detachably mounted on the main body of the electric drill. When the active striking function is needed, the accessory is mounted. When the active striking function is not needed, the accessory is replaced with other functional accessories needed. The accessory with the hammer striking mechanism is more convenient to use, and the tool may also have diversified functions.

[0219] Referring to FIG. 37, in the implementation shown, an accessory 730 can be detachably connected to a tool body 740. The accessory 730 includes a hammer striking mechanism 20, and a tool spindle 30. The tool spindle 30 can bear intermittently reciprocating axial strikes from the hammer striking mechanism 20. Specifically, the tool spindle can bear reciprocating axial strikes from the hammer 200.

[0220] The accessory 730 further includes an accessory housing 731 for receiving the hammer striking mechanism 20. The tool body 740 includes a body housing 741, and the body housing 741 can receive the motor, a reducing mechanism, and so on in the tool body 740. The accessory housing 731 and the body housing 741 can be detachably connected to each other, and they may be specifically connected by screw fastening, or axially connected by clamping, or circumferentially connected by shape fitting.

[0221] In this implementation, the accessory 730 further includes a connecting shaft 733. The connecting shaft 733 is connected to the tool spindle 30 without relative rotation to drive the rotation of the tool spindle 30. The connecting shaft 733 can also be connected to the hammer 200 without relative rotation to drive the hammer 200 to rotate relative to the guide member 210, thereby implementing slope ascending to compress the energy storage mechanism 231 and then making the energy storage mechanism 231 to drive the hammer 200 to hit the tool spindle 30.

[0222] In this implementation, the tool body 740 further includes an output shaft 742 for rotational output. When the accessory 730 is mounted on a handheld tool body, the output shaft 742 is rotationally connected to the connecting shaft 733 to rotationally drive the rotation of the connecting shaft 733, thereby driving the rotation of the tool spindle 30 and the hammer 200. The output shaft 742 on the tool body 740 described here and the tool spindle 30 on the accessory 730 are two different shafts, the tool spindle 30 is a shaft for bearing the strikes from the hammer 200, while the output shaft 742 is a shaft on the tool body 740 and is used as an output portion on the tool body 740. The output shaft 742 may be fitted with other types of accessories to implement other corresponding functions.

[0223] In this implementation, the accessory 730 further includes a mounting component 732 detachably connected to the tool spindle 30 for mounting the working head to the tool spindle 30, so as to enable the tool spindle 30 to rotationally drive the working head to rotate.

[0224] The specific structure of the mounting component 732 is not shown in FIG. 37. Referring to the structure in the implementation of FIG. 23, the mounting component 732 may preferably be a gripper drill chuck, and mainly includes a gripper that can clamp or loosen the working head, a core for mounting the gripper, a nut sleeve that can drive the gripper to move back and forth through screw transmission, and so on, and the descriptions thereof are omitted herein.

[0225] In another implementation, the mounting component may also be other forms of mounting components that can mount the working head, for example, such a mounting component (not shown) that includes a clutch member can optionally axially connect the tool spindle to the working head. Specifically, the clutch member may be a steel ball, and the steel ball moves between two positions in a groove to make the tool spindle and the working head switch between two modes of axial connection and axial separation. The mounting component further includes an operating member that can operate the steel ball to move from an axial connection position to an axial separation position. The mounting component further includes a reset member. The reset member is generally a spring, and the spring can provide a partial pressure to move the ball from the axial separation position to the axial connection position. In the mounting component, the rotational connection between the tool spindle and the working head is implemented by shape fitting. For example, the tail of the working head may be an external hexagonal column, and the free end of the tool spindle may be set as an internal hexagonal hole. In addition, the mounting component may also be obtained with reference to a mounting structure of a driver bit on a screwdriver and a corresponding tool spindle, or a mounting structure of a hammerhead and a tool spindle on an electric hammer, and the descriptions thereof are omitted herein.

[0226] The hammer striking mechanism included in the accessory in the implementation of FIG. 37 is the same as the hammer striking mechanism described above, and the hammer 200 in the hammer striking mechanism 20 can hit the tool spindle 30 to and fro. In the implementation, the hammer striking mechanism 20 includes a hammer 200, a guide member 210, a curve guide 233 provided on the guide member, an conversion member 232 provided on the hammer 200, namely, a steel ball, and an energy storage mechanism 231 abutting the hammer 200. When the hammer 200 rotates relative to the guide member 210, the fitting between the curve guide 233 and the conversion member 232, namely, the steel ball, can implement that the hammer 200 moves in a first direction, and the energy storage mechanism 231 stores energy at the same time. When the energy storage mechanism 231 completes energy storage, that is, the hammer 200 performs slope ascending to the highest point of a slope ascending portion of the curve guide, the energy storage mechanism 231 may drive the hammer 200 to move in a second direction and then strike the tool spindle 30.

[0227] In addition, in the implementation shown in FIG. 37, an accessory 730 with a striking function includes a hammer striking mechanism 20, a mounting component 732, a tool spindle 30, and a connecting shaft 733 driving the tool spindle 30 and the hammer 200 to rotate.

[0228] In another implementation, the accessory may not include the mounting component.

[0229] In another implementation, the accessory may not include the connecting shaft either, that is to say, in the implementation, the accessory includes a hammer striking mechanism and a tool spindle. The tool spindle is used for bearing intermittent reciprocating strikes from the hammer. The tool spindle is rotationally connected to the output shaft 742 of the tool body 740. The tool spindle drives one of the hammer and the guide member to rotate to enable the hammer to perform slope ascending and then implement striking under the action of the energy storage mechanism. In the implementation, the tool spindle can also rotationally drives the rotation of the working head.

[0230] In the present disclosure, "connected without relative rotation" may be understood as that one element can drive another element to rotate and that they are at the same rotational speed.

[0231] Therefore, in the cam-type active striking structure, the hammer may perform slope ascending along the axis under the action of a cam track, namely, the curve guide, and then is driven by the energy storage mechanism to strike the tool spindle. In different implementations, the cam track, namely, the curve guide, may be provided at different positions, that is, it may be provided on the hammer or on the guide member. The setting of the position relation between the guide member and the hammer may also be different; the guide member may be on an outer circumferential side of the hammer or on an inner circumferential side of the hammer. Moreover, between the hammer and the guide member, either the hammer rotates and axially moves with the guide member fixed, or the hammer only axially moves without rotation and the guide member rotates. Therefore, the setting manners of the hammer, the guide member, and the cam track are not limited to this example, and they may also be structurally combined with each other, as long as the axial movement of the hammer can be implemented. In this way, the hammer axially moving can provide an energy storage opportunity for the energy storage mechanism, thereby preparing for hitting the tool spindle. In the implementation where the hammer only axially moves without rotation, "relative rotational speed" should be understood as the relative rotational speed at which the hammer rotates relative to the guide member.

[0232] In the implementation, the speed of the hammer may affect the magnitude of the cumulative striking energy per unit time and the probability of the steel ball hitting the track. Therefore, the speed of the striking hammer and the number of times the hammer performs slope ascending per revolution, namely, the number of slope ascending tracks, are set in an optimized combination to obtain a relatively high energy output value per unit time without stalling. The setting of the value range setting of the optimized combination also satisfies other implementations, as long as the active striking structure of the implementation includes a hammer and a cam track, and the number of the slope ascending track in the cam track may affect the number of axial strikes produced by the rotation of hammer in one turn. Certainly, the same applies to an example where the hammer only axially moves without rotation. For example, in the implementation, the hammer only axially moves without rotation, the cam guide member is provided inside the hammer, the cam track is provided on an outer circumferential surface of the cam guide member, and rotation of the cam guide member may bring rotation of the cam track, thereby driving the hammer to axially move. In the implementation, by applying the optimized combination, the range of the relative rotational speed at which the hammer rotates relative to the guide member is 1000 revolutions per minute to 2500 revolutions per minute, and when the number of the slope ascending tracks of the cam track is 2 to 4, the striking energy may be as high as possible under the condition that the steel ball does not hit the track. In the implementation, the relative rotational speed at which the hammer rotates relative to the guide member is also the rotational speed of the guide member.

[0233] In the implementation shown in FIG. 31, the transmission shaft 10 is rotationally connected to the tool spindle 30 through a flat square, and the transmission shaft 10 and the hammer 200 are optionally rotationally connected through the clutch member 221. Therefore, in the implementation, the tool spindle 30 is at the same rotational speed as the hammer 200. Therefore, in the experiment A, it is also the optimal combination of the rotational speed range of the tool spindle and the number of the slope ascending tracks, and the technical effect achieved is as follows: the drilling efficiency is as high as possible under the condition that the steel ball does not hit the track.

[0234] In addition, in the implementation of fig. 31, the transmission shaft 10 is rotationally connected to the tool spindle 30 and the hammer 200, so that the output shaft 30 can rotate at the same speed as the hammer 200 to achieve a relatively high striking effect. If there is a speed difference between the rotational speeds of the output shaft 30 and the hammer 200, the hammer 200 may relatively rotate relative to the output shaft 30 while hitting the output shaft 30, which may result in energy loss and reduce the striking effect. The "rotationally connected" here may be understood as being rotationally driven, that is, the rotation of the transmission shaft 10 may can be simultaneously transmitted to the tool spindle 30 and the hammer 200.

[0235] In this implementation, the transmission shaft 10 is sleeved outside the output shaft 30, and the hammer 200 is sleeved outside the transmission shaft 10. such a sleeving relation in this implementation causes projections of the transmission shaft 10, the output shaft 30, and the hammer 200 in the axial direction to at least partially overlap with each other, or the hammer 200 surrounds the transmission shaft 10 and the tool spindle 30 in at least one plane, thereby saving the axial size, reducing the length of the body in the axial direction, and making the body wholly short and compact.

[0236] In this implementation, the guide member 210 is sleeved over an outer circumferential side of the hammer 200, and then the guide member 210 surrounds, in at least one plane, the hammer 200, the tool spindle 30, and the transmission shaft 10 driving the hammer 200 to rotate. In the technical solution, projections of the guide member 210, the hammer 200, the tool spindle 30, and the transmission shaft 10 in the axial direction at least partially overlap with each other, thereby saving the axial size and making the whole machine short and compact. In the implementation, the guide member is sleeve-like, and is sleeved outside the hammer. In another implementation, the guide member may not be sleeve-like, as long as it can be fitted with the hammer and implement axial movement of the hammer.

[0237] It should be noted that, in the handheld tool of the present disclosure, the handheld tool includes a transmission mechanism, a hammer striking mechanism, and a tool spindle. The transmission mechanism includes a transmission shaft rotationally output after moving past a motor and a gear reducing mechanism, the tool spindle is driven by rotation of the transmission shaft, and the tool spindle can rotate to drive the working head to implement rotation of the handheld tool. Moreover, the tool spindle further needs to bear the strikes of the hammer striking mechanism, and then can transmit the axial strikes to the working head. The hammer striking mechanism includes a hammer shaft, the hammer shaft is capable of driving the rotation of the hammer relative to the guide member, and the rotational driving of the hammer shaft may be directly or indirectly implemented by the transmission shaft. Here, the hammer shaft being capable of driving the rotation of the hammer relative to the guide member may be understood as that the hammer shaft drives one of the hammer and the guide member to rotate, so that relative rotation can be produced between the hammer and the guide member, and then the hammer can perform slope ascending relative to the guide member, so as to hit the tool spindle under the driving of the energy storage mechanism.

[0238] In the present disclosure, the tool spindle, the transmission shaft, and the hammer shaft have corresponding functions. In the present disclosure, the three shafts with the corresponding functions are indispensable. However, in another implementation, the tool spindle may also serve as a hammer shaft, that is to say, there may be a shaft with two functions: rotationally driving the working head and driving the hammer to rotate relative to the guide member. In another implementation, the transmission shaft may also serve as a hammer shaft, that is to say, the transmission shaft drives the rotation of the tool spindle and can also drive the rotation of the hammer relative to the guide member.

[0239] In addition, it is found through analysis and research that during the operation of the striking mode, the steel ball hitting the track may also exist in the following situation. Specifically, referring to FIG. 23-3, when the tool spindle 30 of the lifting tool is separated from the working surface, since the handheld tool 1 is not subject to an axial abutment force, the tool spindle 30 may move from a press position to a release position under the bias action of the reset member 70. FIG. 31 shows a state where the tool spindle 30 is at a press position, and FIG. 32 is a state diagram of the tool spindle 30 at a release position. During the operation of the striking mode, the tool spindle 30 is at the press position. Compared with the release position, the press position is closer to the hammer 200 in the axial direction, and before the hammer 200 hits the tool spindle 30, the spring is still in a compressed state, that is, the spring has accumulated energy and is ready to release. In this case, if the tool spindle 30 is separated from the working surface, the tool spindle 30 may be at the release position, that is, farther away from the hammer 200, so that an impact surface of the hammer 200 may first hit the curve guide 233 on the inner circumferential surface of the guide member 210 before contacting with an impact surface of the tool spindle 30, that is, the phenomenon that the steel ball hits the track occurs. In this case, the damage caused by the steel ball hitting the track is as follows: the hammer hits the track and then the strike is transmitted to the housing, which may lead to the burr of the track, the hammer may get stuck, and the strike may be transmitted to a user.

[0240] The press position of the tool spindle 30 refers to a position where the tool spindle 30 moves due to a down force of an operator when in the working state, and the release position of the tool spindle 30 refers to a position where the tool spindle 30 moves under the action of the reset member 70 when in the non-working state. The axial distance between the tool spindle 30 and the hammer 200 may be understood as an axial distance between the impact surface of the tool spindle 30 and the impact surface of the hammer 200, and the tool spindle 30 being closers to or farther away from the hammer 200 may also be understood in this way. The impact surface may be understood as an end surface when an axial hit occurs between the hammer 200 and the tool spindle 30 during the operation of the striking mode.

[0241] To solve the above problems, the present disclosure provides a technical solution of providing a cushioning member 710 between the hammer 200 and a striking mechanism housing 720 in a striking direction of the hammer 200, so that, after the tool spindle 30 returns to the release position, the hammer 200 may directly hit the cushioning member 710 to unload the striking energy applied to the impact hammer 200 by the energy storage mechanism 231 and prevent the hammer 200 from directly hitting the striking mechanism housing 720. The position of the cushioning member 710 is between the hammer 200 and the striking mechanism housing 720. The "between" here may be understood as between two opposite end surfaces on the hammer 200 and the striking mechanism housing 720 or between planes where the two end surfaces are located, or understood as that the position of the cushioning member can meet the requirement that the striking energy can be first released to the cushioning member 710 during the striking of the hammer 200 to a free end portion of the tool spindle 30 and that the cushioning member 710 may release a small amount of energy to the striking mechanism housing 720.

[0242] The cushioning member 710 may be a rubber ring or a spring member. In this implementation, a rubber ring is used. Moreover, in this implementation, a maximum compression amount of the buffer 710, specifically a rubber ring, which can be compressed by the hammer 200 is approximately 2 mm. The compression amount of the rubber ring that can be compressed by the hammer 200 may affect a striking stroke and a cushioning effect. A too large compression amount may lead to a much smaller striking stroke, which needs to be made up by lengthening the whole machine. A too small compression amount may lead to reduction of the cushioning effect.

[0243] Another example is described below with reference to FIG. 1 to FIG. 38. A handheld tool 1 is described in detail. It is worth understanding that the following descriptions are illustrative rather than specific limitations.

[0244] A handheld tool 1 may include: a housing 80, a power mechanism, a tool spindle 30, a hammer striking mechanism 20, and so on. The hammer striking mechanism 20 may include: an intermittent striking component 230, a hammer 200, and a guide member 210. Specific compositions, functions, structures, and so on of the components in the handheld tool 1 may be obtained with reference to the specific descriptions in the above examples.

[0245] The intermittent striking component 230 may include: a curve guide 233 provided on one of the hammer 200 and the guide member 210, an conversion member provided on the other thereof, and an energy storage mechanism 220 abutting the hammer 200. When the hammer 200 rotates relative to the guide member 210, the curve guide 233 makes, through the conversion member, the hammer 200 overcome an applied force of the energy storage mechanism 220 to move in a first direction, and the energy storage mechanism 220 drives the hammer 200 to move in a second direction opposite to the first direction. The first direction may be a direction away from a chuck of the handheld tool 1.

[0246] In different examples, specific positions where the conversion member and the curve guide 233 are provided are different, and motion states respectively corresponding thereto are also different. As shown in FIG. 11, in some examples, the curve guide 233 may be provided on an inner surface of the guide member 210; and correspondingly, the conversion member may be located in the hammer 200. In this case, the conversion member may be the conversion member 232 described in the above example. In use, the conversion member 232 can guide the hammer 200 to overcome an applied force of the energy storage mechanism 220 to rotate relative to the guide member 210. In this case, the conversion member 232 may perform slope ascending in the curve guide 233.

[0247] In some other implementations, the curve guide 233 may be provided on an outer surface of the hammer 200; and correspondingly, the conversion member may be fixed to the inner surface of the guide member 210. In use, the guide member 210 and the conversion member may be in a static state. The hammer 200 drives the curve guide 233 to rotate relative to the guide member 210 and the conversion member, and the hammer 200 provided with the curve guide 233 overcomes, under the coordination of the conversion member and the curve guide 233, the applied force of the energy storage mechanism 220 to move in the first direction.

[0248] The power mechanism may include a motor 60 and a reducing mechanism 601 reducing the speed output by the motor 60 for output. Specifically, the reducing mechanism 601 may be a three-stage planetary gear reducing mechanism 601, and certainly, the reducing mechanism 601 may also be in other forms, which is not specifically limited here in this application.

[0249] The tool spindle 30 may be a revolving body with a central axis. The tool spindle 30 is driven by the power mechanism and is rotatable around the central axis. The body of the tool spindle 30 extends in a longitudinal direction, and includes a first end away from the power mechanism and a second end close to the power mechanism. The first end of the tool spindle 30 is provided with a chuck for mounting a working head. The second end of the tool spindle 30 may be directly connected to the reducing mechanism 601 in the power mechanism. Certainly, the second end of the tool spindle 30 may also be indirectly connected to the reducing mechanism 601 through an intermediate transmission member. The intermediate transmission member may be the transmission shaft 10, and certainly, the intermediate transmission member may also be in other forms, which is not specifically limited here in this application.

[0250] The handheld tool includes at least a striking drilling mode. When the handheld tool is in the striking drilling mode, that is, used for striking drilling, the tool spindle 30 rotates around the central axis, and while rotationally moving relative to the guide member 210, the hammer 200 moves to and fro in the direction of the central axis under the coordination of the intermittent striking component 230 and the guide member 210 to periodically hit the tool spindle 30. Subsequently, the tool spindle 30 transmits the torque and striking force to the working head on the chuck to achieve striking drilling.

[0251] The working head may be a drill bit, and certainly, the working head may vary according to actual application scenarios, which is not specifically limited here in this application. For the rotational movement of the hammer 200 relative to the guide member 210, specifically, a speed difference exists between the hammer 200 and the guide member 210. Specifically, one of the hammer 200 and the guide member 210 may be rotating while the other may be static. In addition, the hammer 200 and the guide member 210 may be both rotating. When the hammer 200 and the guide member 210 are both rotating, the hammer 200 and the guide member 210 may rotate in the same direction with a speed difference, or the hammer 200 and the guide member 210 may rotate in opposite directions with a speed difference.

[0252] The handheld tool 1 may have a variety of functional modes. For example, it may include a striking mode and a non-striking mode on the whole. The striking mode may be specifically a striking drilling mode or the like, and the non-striking mode may be specifically a screwdriver mode or the like. Certainly, the specific functional modes may be adaptively integrated and selected according to actual requirements, which are not specifically limited here in this application. Correspondingly, a multi-functional handheld tool may also be provided with a mode adjustment mechanism to switch between different modes. Specifically, the mode adjustment mechanism, the specific adjustment principle, and so on may be obtained with reference to the specific descriptions in Example 2, and the descriptions thereof are omitted here in this application.

[0253] On the one hand, the tool spindle 30 serves as a transmission shaft, and is used for transmitting the torque of the power mechanism to the chuck, thereby driving the working head in the chuck to rotate. On the other hand, as a hit member during hit, a striking force after the hit member is hit by the hammer 200 is transmitted to the working head through the chuck, thereby implementing striking drilling on the working head. The tool spindle 30 serves as a hammer shaft in some examples.

[0254] The handheld tool 1 includes a first casing portion 650 for accommodating the hammer striking mechanism 20. Specifically, an outer contour cross-section of the first casing portion 650 may be circular or in other shapes, such as a regular polygon, which is not specifically limited here in this application. The outer contour cross-section of the first casing portion 650 being circular is mainly taken as an example in the following. The other shapes may be analogically referred to, and the descriptions thereof are omitted here in this application.

[0255] The hammer striking mechanism 20 and the mode adjustment mechanism 40 are reasonably distributed at the first casing portion 650, so that a radial size of the first casing portion 650 may be controlled within a predetermined size range, such as between 45 mm and 70 mm. Specifically, the mode adjustment mechanism 40 at least partially radially overlaps with the hammer striking mechanism 20. When the mode adjustment mechanism 40 and the hammer striking mechanism 20 have an overlapping part in the radial direction, the radial size may be saved to reduce the radial size at the first casing portion 650 to a relatively small range as much as possible, so that the body is compact and small and is easy to operate, and the user experience is better.

[0256] Specifically, the mode adjustment mechanism 40 at least partially radially overlaps with at least one of the guide member 210 and the hammer 200.

[0257] For example, as shown in FIG. 21, the mode adjustment mechanism 40 includes a striking switching ring 430, and the striking switching ring 430 partially overlaps with the guide member 210 in the radial direction. Besides, in addition to the guide member 210 being overlapping with the striking switching ring 430 in the axial direction (that is, projections in the axial direction have an overlap), to ensure that the radial size at the first casing portion 650 is controlled within a predetermined size range, other parts in the handheld tool 1 may also be reasonably overlapped and distributed in the radial direction. Certainly, the other parts may be expanded and arranged according to actual requirements, which are not specifically limited here in this application. Specifically, the radial size of the first casing portion 650 of the handheld tool 1 may be matched with the specific model, working parameters, part configuration, and so on of the handheld tool 1.

[0258] For example, as shown in FIG. 19 and FIG. 20, specifically, the mode adjustment mechanism 40 may include a striking switching ring 430 and a mode switching button 450. At least one of the striking switching ring 430 and the mode switching button 450 at least partially axially overlaps with the guide member 210.

[0259] The mode switching button 450 operably drives the striking switching ring 430 to move between a first position and a second position. When the striking switching ring 430 is at the first position, the striking switching ring 430 is engaged with the hammer striking mechanism 20, relative rotation may be produced between the guide member 210 and the hammer 200, and the handheld tool 1 is in the striking mode. When the striking switching ring 430 is at the second position, the striking switching ring 430 is disengaged from the hammer striking mechanism 20, relative rotation cannot be produced between the guide member 210 and the hammer 200, and the handheld tool 1 is in the non-striking mode.

[0260] The striking switching ring 430 may be fitted with the guide member 210 in the hammer striking mechanism 20 to switch the handheld tool 1 between the striking mode and the non-striking mode. Specifically, the guide member 210 is provided with a first tooth pattern 212, the striking switching ring 430 is provided with a second tooth pattern 431. In the striking mode, the first tooth pattern 212 is engaged with the second tooth pattern 431; in the second striking mode, the first tooth pattern 212 is disengaged from the second tooth pattern 431.

[0261] In other examples, the mode adjustment mechanism 40 may further adopt other structures. Specifically, referring to FIG. 2 to FIG. 5, FIG. 9, and FIG. 13, the mode adjustment mechanism 40 includes a pressure stop ring 410 and a mode switching button 420. The pressure stop ring 410 is a striking switching ring, and is used for fitting with the mode switching button 420 to implement a striking switching function. The pressure stop ring 410 has overlaps with both the guide member 210 and the hammer 200 in the radial direction.

[0262] Specifically, the mode switching button 420 is rotationally connected to the housing 80, the striking switching ring is connected relative to the housing 80 without relative rotation, and the mode switching button 420 drives the striking switching ring to move along the central axis of the tool spindle 30.

[0263] To enable the handheld tool 1 to work in a narrow space and make an external size more harmonious and an external appearance more beautiful, the radial size at the first casing portion 650 is obtained within the range of 45 mm to 70 mm. When the radial size at the first casing portion 650 of the handheld tool 1 is within the above range, a ratio of the outer diameter of the hammer striking mechanism 20 to the radial size of the first casing portion 650 is between 0.6 and 0.9.

[0264] The ratio of the outer diameter of the hammer striking mechanism 20 to the radial size of the first casing portion 650 may vary according to different configurations of the parts of the handheld tool 1. The handheld tool 1 may further include a torque adjustment mechanism, and the torque adjustment mechanism may be used for adjusting an output torque to adapt to different application conditions.

[0265] Specifically, the torque adjustment mechanism includes any one of the following: a mechanical torque adjustment structure, and an electronic torque adjustment mechanism. According to different torque adjustment mechanisms, the ratio of the outer diameter of the hammer striking mechanism 20 to the radial size of the first casing portion 650 is within different ranges.

[0266] As shown in FIG. 21 and FIG. 22, in an example, the torque adjustment mechanism may be a mechanical torque adjustment mechanism. The mechanical torque adjustment mechanism may generally include: an adjustment hood rotatably provided on a casing of the handheld tool 1, an adjustment unit fitted with the adjustment hood, a cushioning member 440 fitted with the adjustment unit, and so on. The adjustment unit can adjust a compression amount of the cushioning member 440 when the adjustment hood rotates, and then can adjust a pre-compression amount of the energy storage mechanism 231 axially linked with the adjustment unit. The adjustment unit may be in the form of a striking switching ring 430. An inner side of the adjustment hood may be provided with an internal thread, correspondingly, an outer side of the striking switching ring 430 is provided with an internal thread matched with the internal thread, and both are connected by thread fitting.

[0267] Since the adjustment hood may occupy a certain radial size, the ratio of the outer diameter of the hammer striking mechanism 20 to the radial size of the first casing portion 650 is generally not greater than 0.9 at the adjustment hood.

[0268] As shown in FIG. 38, in another example, the torque adjustment mechanism may be an electronic torque adjustment mechanism. The electronic torque adjustment mechanism may generally include: a current threshold setting unit electrically connected to a controller, a current detection unit, and so on.

[0269] In use, a user may select a required current threshold through the current threshold setting unit according to an actual working condition. After the handheld tool 1 is started, a working current of the motor is detected through the current detection unit. When the working current reaches the selected current threshold, the controller sends a specific control instruction and controls actions of the motor and so on. The current threshold setting unit may be specifically in the form of a knob, and certainly may also be in other forms. The current threshold setting unit may be provided on a casing at a handle position of the handheld tool 1. The current detection unit may be provided inside the casing at the handle position.

[0270] Compared with the mechanical torque adjustment mechanism, the electronic torque adjustment mechanism does not need to be provided with the mechanical adjustment hood and the adjustment unit at the first casing portion 650, and no additional radial size is occupied. Therefore, the ratio of the outer diameter of the hammer striking mechanism 20 to the radial size of the first casing portion 650 may be controlled to be not less than 0.6. When the ratio of the outer diameter of the hammer striking mechanism 20 to the radial size of the first casing portion 650 is less than 0.6, the rationality of arrangement of the elements in the first casing portion 650 is reduced and the space utilization is low, which may increase the radial size of the first casing portion 650.

[0271] For example, when the hammer striking mechanism 20 is reasonably arranged, a size difference between the first casing portion 650 and the hammer striking mechanism 20 is a casing provided outside the hammer striking mechanism 20; in this case, the ratio of the outer diameter of the hammer striking mechanism 20 to the radial size of the first casing portion 650 may be above 0.6. Theoretically, the larger the better, and it may be close to 0.9 or so.

[0272] The speed output by the power mechanism is the same as the rotational speed of the hammer shaft, where the hammer shaft can drive the hammer 200 to rotate relative to the guide member 210. The mode adjustment mechanism 40 at least partially axially overlaps with the hammer striking mechanism 20. When the mode adjustment mechanism 40 at least partially overlaps with the hammer striking mechanism 20 in the axial direction, that is, projections of the mode adjustment mechanism and the hammer striking mechanism 20 in the axial direction have an overlap, it is conducive to reducing the length of the whole machine of the handheld tool 1, making the overall appearance coordinated, and making it easy for the user to hold.

[0273] The hammer shaft may be a shaft that can drive the hammer 200 to rotate relative to the guide member 210. Specifically, the hammer shaft may vary in different examples. For example, for an example where a transmission shaft 10 and a tool spindle 30 are both provided, as shown in FIG. 21, the hammer shaft is a transmission shaft 10, and the transmission shaft 10 can drive the hammer 200 to rotate relative to the guide member 210; or as shown in FIG. 27, the hammer shaft is a tool spindle 30, and the tool spindle 30 can drive the hammer 200 to rotate relative to the guide member 210.

[0274] Since a plurality of slope ascending tracks are provided in the circumferential direction between the hammer 200 and the guide member 210, in a case where the shaft (the transmission shaft 10) directly connected to an output end of the power mechanism rotates one turn, the hammer 200 can implement a plurality of strikes and achieve higher striking efficiency, without setting an additional hammer speed-increasing mechanism.

[0275] On the whole, an axial length of the body of the handheld tool 1 provided in the example of the specification may be 185 mm to 250 mm. The axial length may be a length of the body of the handheld tool 1 in the axis direction corresponding to the tool spindle 30. Specifically, the axial length of the body of the handheld tool 1 may include: a housing 80 and a chuck 50 portion extending out of the housing 80, but does not include a working head (drill bit) portion mounted on the chuck 50. Generally, the axial length of the body is mainly affected by: the motor 60 provided in the housing 80, the transmission mechanism, and the hammer striking mechanism 20.

[0276] The hammer striking mechanism 20, after a reasonable structural design, has basically reached size optimization. For example, specifically, the mode adjustment mechanism 40 includes a striking switching ring 430, and the striking switching ring 430 partially overlaps with the guide member 210 in the axial direction. In addition, various parts of the hammer striking mechanism 20 are also superimposed with each other in the axial direction. For example, the guide member 210 and the hammer 200 at least partially overlap with each other in the axial direction. The intermittent striking component also at least partially overlaps with the guide member 210 and the hammer 200 in the axial direction. On the whole, the axial length of the body of the handheld tool 1 may be between 190 mm and 230 mm. If the axial length of the body of the handheld tool 1 needs to be further reduced, a brushless motor may be used as the motor 60 on condition of meeting the existing working parameters of the handheld tool 1, so as to further reduce the axial length of the body of the handheld tool 1. The axial length of the body of the handheld tool 1 provided in the specification may be controlled on average to be around 200 mm.

[0277] The handheld tool 1 may further include a transmission shaft 10. Specifically, the transmission shaft 10 is disposed between the power mechanism and the tool spindle 30, and the hammer 200 is sleeved over an outer side of the transmission shaft 10 and is in transmission fitting with the transmission shaft 10. The transmission shaft 10 can simultaneously drive the hammer 200 and the tool spindle 30 to rotate.

[0278] When the transmission shaft 10 can simultaneously drive the hammer 200 and the tool spindle 30 to rotate, since the hammer 200 and the tool spindle 30 are simultaneously driven by the transmission shaft 10, no relative rotation exists between them, so that no additional energy loss may exist in the circumferential direction when the hammer 200 hits the tool spindle 30, thereby better ensuring that the working head can output greater striking energy.

[0279] In addition, in a case where the guide member 210 is static and the hammer 200 needs to be driven to rotationally move along the guide member 210, if the hammer 200 is driven to rotate not through the output torque of the transmission shaft 10, an additional transmission mechanism or a combination of a transmission mechanism and a power mechanism needs to be provided, thereby driving the hammer 200 to rotate relative to the guide member 210. If a new transmission mechanism or a combination of a transmission mechanism and a power mechanism is additionally provided, not only may the size of handheld tool 1 be increased and structural complexity and manufacturing costs be increased, but also a new control mechanism needs to be introduced in order to ensure rotational speeds of the hammer 200 and the tool spindle 30 to be consistent.

[0280] The guide member 210 may be sleeved over an outer side of the hammer 200.

[0281] An conversion member 232 and a curve guide 233 are provided between the guide member 210 and the hammer 200, a motion trajectory of the conversion member 232 may be guided by constructing the specific shape of the curve guide 233, the conversion member 232 may be linked with the hammer 200, and the hammer 200 moves along the trajectory of the curve guide 233 under the action of the conversion member 232.

[0282] As shown in FIG. 11 to FIG. 12, the curve guide 233 may be formed as a ring, and the curve guide 233 may be circumferentially around the transmission shaft 10. Specifically, the curve guide 233 may include a slope ascending portion 233a and a descending portion 233b, one end of the descending portion 233b is connected to one end of the slope ascending portion 233a, and the other end of the descending portion 233b extends toward the other end of the slope ascending portion 233a. A slope ascending portion 233a and a descending portion 233b may be fitted to form a slope ascending track. One or more slope ascending tracks may be provided in the circumferential direction of the curve guide 233 according to the circumference of the curve guide 233.

[0283] Compared with an example where the guide member 210 is provided on an inner side of the hammer 200, in the example where the guide member 210 is sleeved over the outer side of the hammer 200, the circumference of the curve guide 233 can be increased, so that the curve guide 233 is provided with a plurality of slope ascending tracks in the circumferential direction, and the striking frequency of the handheld tool 1 is improved on condition of ensuring that the motor does not stall, thereby improving the striking efficiency of the handheld tool 1.

[0284] In some examples, the curve guide 233 is provided with a plurality of slope ascending portions 233a and descending portions 233b corresponding to the slope ascending portions 233a in the circumferential direction, and when the conversion member moves past the slope ascending portions 233a, the hammer 200 moves in a first direction; and when the conversion member moves past the descending portions 233b, the hammer 200 moves in a second direction to achieve striking. The number of the slope ascending portions 233a is 2 to 4.

[0285] When the curve guide 233 is provided with 2 to 4 slope ascending portions 233a in the circumferential direction and when the motor 30 drives the hammer 200 to rotate in one turn, the number of times the hammer 200 strikes in the direction of the tool spindle 30 is equal to the number of the slope ascending portions 233a, namely, 2 to 4, and the handheld tool 1 may be ensured to be at a high striking frequency without the need to increase the rotational speed of the hammer 200 in the circumferential direction.

[0286] Further, the hammer 200 is movably supported on an inner circumferential surface of the guide member 210.

[0287] The hammer 200 may be located in an annular cavity between the guide member 210 and the transmission shaft 10. In the striking mode, the hammer 200 moves to and fro in the direction of the central axis under the coordination of the intermittent striking component 230 and the guide member 210 to periodically hit the tool spindle 30. When the hammer 200 moves to and fro in direction of the central axis, the hammer 200 axially moves relative to the transmission shaft 10. It is found that, if the hammer 200 directly abuts against the transmission shaft 10, during axial movement of the hammer 200 relative to the transmission shaft 10, due to the contact friction between the hammer 200 and the clutch member 221 during the long-term transmission of torque, the hammer 200 may generate barbs on the inner surface, thereby affecting the axial movement of the hammer 200, especially reducing the striking energy output to the tool spindle 30 by the hammer 200.

[0288] To overcome the above problems, the hammer 200 may be supported on the inner circumferential surface of the guide member 210, and clearance fit is provided between the hammer 200 and the transmission shaft 10. Specifically, a clearance is provided between the inner surface of the hammer 200 and the outer surface of the transmission shaft 10, for example, a unilateral clearance may be 0.1 mm to 0.2 mm. Certainly, the specific value of the small clearance is not limited to the above example, and is not specifically limited here in this application. The outer surface of the hammer 200 may abut against the inner circumferential surface of the guide member 210, and the hammer 200 can be driven by the transmission shaft 10 to rotate. When the hammer 200 rotates, the intermittent striking component 230 guides the hammer 200 to linearly move relative to the guide member 210 according to a preset path and to hit the tool spindle 30 in at least one operating state. During the motion of the hammer 200 relative to the guide member 210, the motion trajectory of the hammer 200 may be a spiral motion trajectory combining a circular motion trajectory with a linear motion trajectory.

[0289] Specifically, the composition of the intermittent striking component 230, the structure of the guide member 210, the principle for forming active striking, and so on may be all obtained with reference to the specific descriptions in Example 1 to Example 5, and the descriptions thereof are omitted here in this application.

[0290] For the example where the guide member 210 is sleeved outside the hammer 200 and the hammer 200 is supported on the guide member 210, the curve guide 233 may be provided on an inner wall of the guide member 210, and an outer wall of the hammer 200 is provided with an insertion groove for mounting the conversion member 232. Specifically, the curve guide 233 may by a cam surface formed in the inner wall of the guide member 210. The cam surface includes has a slope ascending portion 233a and a descending portion 233b, as the conversion member moves toward the descending portion 233b from the slope ascending portion 233a, the elastic member stores elastic potential energy, and as the conversion member 232 descends to the descending portion 233b from the slope ascending portion 233a, the elastic member releases the stored elastic potential energy to drive the hammer 200 to strike the tool spindle 30, thus forming active striking.

[0291] Other hand tools are described in detail below with reference to FIG. 1 to FIG. 39. It is worth understanding that the following descriptions are illustrative rather than specific limitations.

[0292] A handheld tool 1 may include: a housing 80, a power mechanism, a tool spindle 30, a hammer striking mechanism 20, and so on. The hammer striking mechanism 20 may include: an intermittent striking component 230, a hammer 200, and a guide member 210. Specific compositions, functions, structures, and so on of the components in the handheld tool 1 may be obtained with reference to the specific descriptions in the above examples.

[0293] The intermittent striking component 230 may include: a curve guide 233 provided on one of the hammer 200 and the guide member 210, an conversion member provided on the other thereof, and an energy storage mechanism 220 abutting the hammer 200. When the hammer 200 rotates relative to the guide member 210, the curve guide 233 makes, through the conversion member, the hammer 200 overcome an applied force of the energy storage mechanism 220 to move in a first direction, and the energy storage mechanism 220 drives the hammer 200 to move in a second direction opposite to the first direction. The first direction may be a direction away from a chuck of the handheld tool 1.

[0294] In different examples, specific positions where the conversion member and the curve guide 233 are provided are different, and motion states respectively corresponding thereto are also different. As shown in FIG. 11, in some examples, the curve guide 233 may be provided on an inner surface of the guide member 210; and correspondingly, the conversion member may be located in the hammer 200. In this case, the conversion member may be the conversion member 232 described in the above example. In use, the conversion member 232 can guide the hammer 200 to overcome an applied force of the energy storage mechanism 220 to rotate relative to the guide member 210. In this case, the conversion member 232 may perform slope ascending in the curve guide 233.

[0295] In some other implementations, the curve guide 233 may be provided on an outer surface of the hammer 200; and correspondingly, the conversion member may be fixed to the inner surface of the guide member 210. In use, the guide member 210 and the conversion member may be in a static state. The hammer 200 drives the curve guide 233 to rotate relative to the guide member 210 and the conversion member, and the hammer 200 provided with the curve guide 233 overcomes, under the coordination of the conversion member and the curve guide 233, the applied force of the energy storage mechanism 220 to move in the first direction.

[0296] The power mechanism may include a motor 60 and a reducing mechanism reducing the speed output by the motor 60 for output. Specifically, the reducing mechanism may be a three-stage planetary gear reducing mechanism, and certainly, the reducing mechanism may also be in other forms, which is not specifically limited here in this application.

[0297] The tool spindle 30 may be a revolving body with a central axis. The tool spindle 30 is driven by the power mechanism and is rotatable around the central axis. The body of the tool spindle 30 extends in a longitudinal direction, and includes a first end away from the power mechanism and a second end close to the power mechanism. The first end of the tool spindle 30 is provided with a chuck for mounting a working head 600. The second end of the tool spindle 30 may be directly connected to the reducing mechanism in the power mechanism. Certainly, the second end of the tool spindle 30 may also be indirectly connected to the reducing mechanism through an intermediate transmission member. The intermediate transmission member may be the transmission shaft 10, and certainly, the intermediate transmission member may also be in other forms, which is not specifically limited here in this application.

[0298] The handheld tool includes at least a striking drilling mode. When the handheld tool is in the striking drilling mode, that is, used for striking drilling, the tool spindle 30 rotates around the central axis, and the hammer 200 moves to and fro in the direction of the central axis under the coordination of the intermittent striking component 230 and the guide member 210 to periodically hit the tool spindle 30. Subsequently, the tool spindle 30 transmits the torque and striking force to the working head 600 on the chuck to achieve striking drilling. The working head 600 may be a drill bit, and certainly, the working head 600 may vary according to actual application scenarios, which is not specifically limited here in this application.

[0299] The handheld tool may have a variety of functional modes, for example, it may include a striking mode and a non-striking mode on the whole. The striking mode may be specifically a striking drilling mode or the like, and the non-striking mode may be specifically a screwdriver mode or the like. Certainly, the specific functional modes may be adaptively integrated and selected according to actual requirements, which are not specifically limited here in this application. Correspondingly, a multi-functional handheld tool may also be provided with a mode adjustment mechanism to switch between different modes. Specifically, the mode adjustment mechanism, the specific adjustment principle, and so on may be obtained with reference to the specific descriptions in Example 2, and the descriptions thereof are omitted here in this application.

[0300] On the one hand, the tool spindle 30 serves as a transmission shaft, and is used for transmitting the torque of the power mechanism to the chuck, thereby driving the working head 600 in the chuck to rotate. On the other hand, as a hit member during hit, a striking force after the hit member is hit by the hammer 200 is transmitted to the working head 600 through the chuck, thereby implementing striking drilling on the working head 600.

[0301] The following is an analysis of the collision motion involving the hammer 200 and the tool spindle 30.

[0302] The hammer 200 and the tool spindle 30 are generally made of higher-hardness materials, and the collision of the two may be equivalent to inelastic collision. The mass of the hammer 200 is relatively fixed due to axial and radial sizes of the whole machine. In a case where the mass of the hammer 200 is fixed, to obtain higher striking efficiency, the tool spindle 30 serving as a hit member with a lower mass may obtain greater striking energy.

[0303] In theory, the tool spindle 30 serving as the hit member with a lower mass is better. However, as the tool spindle 30 serves as the transmission shaft 10, it has certain strength requirements. On the whole, on condition that the material of the tool spindle 30 is given, the larger the span of a support bearing for supporting the tool spindle 30 (that is, the larger the length of the tool spindle 30), and the larger the diameter of the cutter bearing, the greater the strength of the tool spindle 30.

[0304] Based on the above, to reduce, on condition that the tool spindle 30 meets strength requirements, the mass of the tool spindle 30 as much as possible to obtain higher striking energy so as to obtain higher striking efficiency, the range of the mass of the tool spindle 30 is between 40 g and 100 g.

[0305] Specifically, the range of the mass of the tool spindle 30 may be adaptively adjusted according to an actual usage scenario, such as the magnitude of the torque transmitted. For example, for a small-torque handheld tool (such as a 20-Nm electric drill), the shaft strength is required to be small due to the small torque transmitted, the diameter of the tool spindle 30 may be small, and therefore the mass is low, which may be close to or equal to 40 g.

[0306] For a large-torque electric drill (such as an 80-Nm electric drill), the shaft strength is required to be great due to the large torque transmitted, the diameter of the tool spindle 30 is required to be large, and therefore the mass is high, which may be close to or equal to 100 g.

[0307] According to some examples, the handheld tool may further include a transmission shaft 10. Specifically, the transmission shaft 10 is disposed between the power mechanism and the tool spindle 30, and the hammer 200 is sleeved over an outer side of the transmission shaft 10 and is in transmission fitting with the transmission shaft 10. The transmission shaft 10 can simultaneously drive the hammer 200 and the tool spindle 30 to rotate.

[0308] When the transmission shaft 10 can simultaneously drive the hammer 200 and the tool spindle 30 to rotate, since the hammer 200 and the tool spindle 30 are simultaneously driven by the transmission shaft 10, no relative rotation exists between them, so that no additional energy loss may exist in the circumferential direction when the hammer 200 hits the tool spindle 30, thereby better ensuring that the working head 600 can output greater striking energy.

[0309] In addition, in a case where the guide member 210 is static and the hammer 200 needs to be driven to rotationally move along the guide member 210, if the hammer 200 is driven to rotate not through the output torque of the transmission shaft 10, an additional transmission mechanism or a combination of a transmission mechanism and a power mechanism needs to be provided, thereby driving the hammer 200 to rotate relative to the guide member 210. If a new transmission mechanism or a combination of a transmission mechanism and a power mechanism is additionally provided, not only may the size of handheld tool be increased and structural complexity and manufacturing costs be increased, but also a new control mechanism needs to be introduced in order to ensure rotational speeds of the hammer 200 and the tool spindle 30 to be consistent.

[0310] Further, according to some examples, the transmission shaft 10 is a hollow revolving body, a portion of the tool spindle 30 close to the first end extends into the transmission shaft 10, and the range of the mass of the tool spindle 30 is between 50 g and 80 g.

[0311] For the transmission shaft 10 provided with a hollow revolving body structure, a portion thereof is sleeved outside the tool spindle 30, and one end close to the power mechanism is fitted with the bearing, for providing a radial support for the tool spindle 30. Part of the support function of the tool spindle 30 is shared by sleeving the transmission shaft 10 outside the tool spindle 30, so that both the axial length and the diameter of the tool spindle 30 may be reduced to some extent. Specifically, the range of the mass of the tool spindle 30 may be reduced to between 50 g and 80 g.

[0312] For example, for a small-torque handheld tool, such as an electric drill, the strength thereof needs to be guaranteed to have a certain safety factor, so the minimum mass of the tool spindle 30 may be improved to some extent.

[0313] For a large-torque handheld tool, such as an electric drill, in a case where the torque is guaranteed, the head size of the handheld tool should be comprehensively taken into consideration. Too much redundancy in size leads to problems in appearance and accessibility. Therefore, the mass of the tool spindle 30 may be appropriately reduced by setting the sleeving relation between the transmission shaft 10 and the tool spindle 30, so as to ensure an optimal combination of the size, the appearance, and the performance.

[0314] According to some examples, the guide member 210 may be sleeved over an outer side of the hammer 200.

[0315] An conversion member 232 and a curve guide 233 are provided between the guide member 210 and the hammer 200, a motion trajectory of the conversion member 232 may be guided by constructing the specific shape of the curve guide 233, the conversion member 232 may be linked with the hammer 200, and the hammer 200 moves along the trajectory of the curve guide 233 under the action of the conversion member 232.

[0316] As shown in FIG. 11 to FIG. 12, in some examples, the curve guide 233 may be formed as a ring, and the curve guide 233 may be circumferentially around the transmission shaft 10. Specifically, the curve guide 233 may include a slope ascending portion 233a and a descending portion 233b, one end of the descending portion 233b is connected to one end of the slope ascending portion 233a, and the other end of the descending portion 233b extends toward the other end of the slope ascending portion 233a. A slope ascending portion 233a and a descending portion 233b may be fitted to form a slope ascending track. One or more slope ascending tracks may be provided in the circumferential direction of the curve guide 233 according to the circumference of the curve guide 233.

[0317] Compared with an example where the guide member 210 is provided on an inner side of the hammer 200, in the example where the guide member 210 is sleeved over the outer side of the hammer 200, the circumference of the curve guide 233 can be increased, so that the curve guide 233 is provided with a plurality of slope ascending tracks in the circumferential direction, and the striking frequency of the handheld tool is improved on condition of ensuring that the motor does not stall, thereby improving the striking efficiency of the handheld tool.

[0318] Further, the hammer 200 is movably supported on an inner circumferential surface of the guide member 210.

[0319] In some examples, the hammer 200 is located in an annular cavity between the guide member 210 and the transmission shaft 10. In the striking mode, the hammer 200 moves to and fro in the direction of the central axis under the coordination of the intermittent striking component 230 and the guide member 210 to periodically hit the tool spindle 30. When the hammer 200 moves to and fro in direction of the central axis, the hammer 200 axially moves relative to the transmission shaft 10. It is found that, if the hammer 200 directly abuts against the transmission shaft 10, during axial movement of the hammer 200 relative to the transmission shaft 10, due to the contact friction between the hammer 200 and the steel ball 221 during the long-term transmission of torque, barbs may be generated, thereby affecting the axial movement of the hammer 200, especially reducing the striking energy output to the tool spindle 30 by the hammer 200.

[0320] To overcome the above problems, the hammer 200 may be supported on the inner circumferential surface of the guide member 210, and a clearance is provided between the hammer 200 and the transmission shaft 10. Specifically, small-clearance fit may be provided between the inner surface of the hammer 200 and the outer surface of the transmission shaft 10, for example, a unilateral clearance may be 0.1 mm to 0.2 mm. Certainly, the specific value of the small clearance is not limited to the above example, and is not specifically limited here in this application. The outer surface of the hammer 200 may abut against the inner circumferential surface of the guide member 210, and the hammer 200 can be driven by the transmission shaft 10 to rotate. When the hammer 200 rotates, the intermittent striking component 230 guides the hammer 200 to linearly move relative to the guide member 210 according to a preset path and to hit the tool spindle 30 in at least one operating state. During the motion of the hammer 200 relative to the guide member 210, the motion trajectory of the hammer 200 may be a spiral motion trajectory combining a circular motion trajectory with a linear motion trajectory.

[0321] Specifically, the composition of the intermittent striking component 230, the structure of the guide member 210, the principle for forming active striking, and so on may be all obtained with reference to the specific descriptions in Example 1 to Example 5, and the descriptions thereof are omitted here in this application.

[0322] For the example where the guide member 210 is sleeved outside the hammer 200 and the hammer 200 is supported on the guide member 210, the curve guide 233 may be provided on an inner wall of the guide member 210, and an outer wall of the hammer 200 is provided with an insertion groove for mounting the conversion member 232. Specifically, the curve guide 233 may by a cam surface formed in the inner wall of the guide member 210. The cam surface includes has a slope ascending portion 233a and a descending portion 233b, as the conversion member moves toward the descending portion 233b from the slope ascending portion 233a, the elastic member stores elastic potential energy, and as the conversion member 232 descends to the descending portion 233b from the slope ascending portion 233a, the elastic member releases the stored elastic potential energy to drive the hammer 200 to strike the tool spindle 30, thus forming active striking.

[0323] In some examples, referring to FIG. 39, the first end of the tool spindle 30 is provided with a mounting hole 613 for clamping the working head 600, an outer side close to the first end of the tool spindle 30 is provided with a mounting accessory, and the mounting hole 613 and the mounting accessory form a quick-change chuck 610 for mounting the working head 600. The working head 600 is movable along the central axis after being clamped into the quick-change chuck 610.

[0324] The quick-change chuck 610 may be in the form of a Special Direct System (SDS) output head. Specifically, the main body of the quick-change chuck 610 may be formed by the first end of the tool spindle 30. The first end of the tool spindle 30 is provided with a mounting hole 613 for being clamped with the working head 600, and after the working head 600 is inserted into the mounting hole 613, the two can form a circumferentially limited clamping structure.

[0325] In a specific example, a structure with a plurality of protrusions 611 and pits 612 matching with each other may be formed in the circumferential direction at a position where the working head 600 is fitted with the mounting hole 613. Specifically, the protrusion 611 may be provided on an inner wall of the mounting hole 613 or provided on the working head 600. Similarly, the pit 612 may be provided on the working head 600 or provided on the inner wall of the mounting hole 613. For example, the mounting hole 613 may be wholly a round hole, and a plurality of protrusions 611 are provided in the circumferential direction on a hole wall of the mounting hole 613. Correspondingly, an outer wall at one end of the working head 600 clamped with the mounting hole 613 is provided with pits 612 matched with the protrusions 611.

[0326] The number of the protrusions 611 may be two, and the two are symmetrically distributed in the circumferential direction of the tool spindle 30. The pits 612 on the working head 600 may be classified into two groups, one of which is used for matching the protrusions 611 to transmit the torque, hereinafter referred to as torque transmission pits. Specifically, the group of torque transmission pits may include two pits provided in opposite directions of the circumferential direction of the working head 600. Specifically, the torque transmission pits on the working head 600 is in a semi-open form, and is provided with an opening on one side close to the casing. When the torque transmission pits of the working head 600 are clamped with the protrusions 611 of the mounting hole 613, the working head 600 is static relative to the circumferential direction of the tool spindle 30 without relative rotation, so it can be driven by the tool spindle 30 to achieve synchronous rotation.

[0327] In addition, the working head 600 may be further provided with another group of pits for accommodating the steel ball, hereinafter referred to as steel ball locking pits, to prevent the working head 600 from falling from the quick-change chuck 610. The group of steel ball locking pits may include two pits provided in opposite directions of the circumferential direction of the working head 600. The steel ball locking pit is a long non-penetrating groove, the diameter of the steel ball is less than the length of the steel ball locking pit. After the working head 600 is stuck into the quick-change chuck 610, it can make a small range of axial displacement along the central axis of the tool spindle 30, so as to coordinate with the striking mode to achieve striking drilling.

[0328] In another specific example, the mounting hole 613 may be in the form of an internal hexagonal hole. When the mounting hole 613 is an internal hexagonal hole, the cross section of one end of the working head 600 clamped with the mounting hole 613 is hexagonal. After the working head 600 with the hexagonal cross section is loaded into the internal hexagonal hole, the working head 600 is relatively static relative to the tool spindle 30 in the circumferential direction and may relatively move in the axial direction.

[0329] When the chuck is in the form of the quick-change chuck 610, the sum of the mass of the quick-change chuck 610 and the tool spindle 30 ranges from 50 g to 150 g. The mass range is determined mainly based on that the mass range of the tool spindle 30 is between 40 g and 100 g and the mass of the mounting accessory of the quick-change chuck 610 is generally between 10 g and 50 g.

[0330] Specifically, the mounting accessory may vary according to different specific forms of the quick-change chuck

610. For example, when the quick-change chuck 610 is mounted in the same manner as the internal hexagonal hole, the mounting accessory mainly includes elements such as a connecting steel ball, the mass of which is about 10 g. When the quick-change chuck 610 is mounted in a "four pits" mounting manner, the mounting accessory mainly includes elements such as a locking sleeve, a steel ball, and a pressing plate, the mass of which is about 50 g. Certainly, the quick-change chuck 610 is not limited to the above description, and those skilled in the art may further make other changes under the teaching of the technical essence of this application, but as long as the functions and effects achieved are the same as or similar to those in this application, the changes should be encompassed within the protection scope of this application.

[0331] Referring to FIG. 21 or FIG. 23 or FIG. 27, in some other examples, the first end of the tool spindle 30 is provided with a gripper chuck by fixed connection, and the gripper chuck includes: a core with one end fixed to the first end of the tool spindle 30, an operating shell sleeved outside the core, and a chuck connected to the core.

[0332] For the gripper chuck, the chuck thereof may generally include three split claws. The three split claws may grip the working head 600 of different sizes and different cross sections, and have good versatility on the whole. The gripper chuck has a core. The core may be wholly a hollow revolving body, and one end thereof may be sleeved at the first end of the tool spindle 30. The core and the tool spindle 30 may be connected and fixed by thread or in other means at the fitting position. The other end of the core may also be connected to the split claws by threaded connection or in other manners. A tapered bore with a predetermined conical degree is formed at the position where the core is fitted with the split claws. When the core rotates relative to the split claws, the split claws may be opened or closed. In addition, the specific transmission relation, the specific connection manner, and so on of the gripper chuck may be obtained with reference to the specific descriptions in the above implementation, and the descriptions thereof are omitted here in this application.

[0333] In a case of striking drilling, since the chuck and the tool spindle 30 as a whole serve as a hit member, the lower the mass, the better. The density of the core may be between 1 g/cm^3 (grams per cubic centimeter) and 8 g/cm^3 (grams per cubic centimeter). Specifically, a material of the core may be selected from any one of the following: plastic, aluminum, steel, and so on. In principle, provided that the core has sufficient strength, the density of the core is preferred to be small.

[0334] When the chuck is a gripper chuck, the sum of the mass of the gripper chuck and the tool spindle 30 ranges between 120 g and 450 g.

[0335] Main factors affecting the mass of the gripper chuck may include: a material of the core, a specific structure of the core, and a material of the operating shell. For the gripper chuck in FIG. 21 or FIG. 23 or FIG. 27, in a case where the material of the operating shell is plastic, if the material of the core is plastic, the sum of the mass of the core and the operating shell is about 80 g; if the material of the core is aluminum, the sum of the mass of the core and the operating shell is about 160 g; and if the material of the core is steel, the mass of the core is about 260 g. In a case where the material of the operating shell is steel, if the material of the core is steel, the mass of the core is about 300 g. In addition, if the structure of the core is improved to such an extent that it can be fitted with the two groups of split claws, the mass of the core may be increased to some extent, such as to about 350 g. Certainly, when the core is of other uncommon structures, the mass thereof may be even greater, which is not specifically limited here in this application.

[0336] When the chuck is a gripper chuck, after all the factors affecting the mass of the chuck are comprehensively considered, the mass range of the gripper chuck may be between 80 g and 350 g, and correspondingly, the sum of the mass of the gripper chuck and the tool spindle 30 may be between 120 g and 450 g.

[0337] As shown in FIG. 21, FIG. 23, and FIG. 25 to FIG. 27, the tool spindle 30 is fixedly connected to the chuck 50 by threaded connection. Specifically, in this example, one end of the tool spindle 30 close the chuck 50 is provided with an external thread 300, the core 501 of the chuck 50 is provided with a threaded hole 500 matching the external thread 300, and the tool spindle 30 and the chuck 50 are connected through the external thread 300 and the threaded hole 500.

[0338] The chuck 50 includes a core 501, a claw 502, and a locking ring 503. The locking ring 503 is sleeved over the core 501, the claw 502 for clamping a tool head is provided at an end portion of the core 501, and the core 501 is provided with a threaded hole 500. Preferably, to make the kinetic energy of the hammer 200 be more efficiently transferred to the tool head when the hammer hits the tool spindle 30, make the tool head obtain more kinetic energy, and improve the drilling efficiency, based on the principle of momentum conservation in inelastic collision, the tool head needs to obtain a greater speed after impact, and to this end, the mass of the chuck 50 may be reduced. Here, preferably, the density of a material for manufacturing the core 501 is 1 g/cm^3 to 5 g/cm^3. For example, the core 501 may be made of aluminum or an aluminum alloy material. The density of a material for manufacturing the claw 502 is 5 g/cm^3 to 8 g/cm^3. For example, the claw 502 may be made of a stainless steel material to thus guarantee the strength of the claw 502. In a case where the strength meets the requirements, the core 501 may be made of a plastic material, so that the tool head may obtain more kinetic energy after impact than that using the core made of aluminum or an aluminum alloy.

[0339] The rated torque of the handheld tool 1 is less than or equal to 55 Nm. The rated torque means that the handheld tool 1 may work normally within a range of the rated torque. If the handheld tool 1 works in excess of the rated torque, an abnormal condition such as a reduced service life or a damaged part may occur to the handheld tool 1. It may be understood that the strength of the core 501 is less than that of the core made of stainless steel because the core 501 is made of aluminum or an aluminum alloy and the aluminum or aluminum alloy cannot be thermally treated. Moreover, the core 501 needs to be adapted to the working head, the claw 502, and other parts with standard specifications, so it is inconvenient to improve its structure to make the core 501 have higher strength. By limiting the rated power of the handheld tool 1, the drilling speed may be improved while the normal operation of the handheld tool 1 is ensured.

[0340] The torque, the speed, and the power of the motor have the following relationship: T=9549*P/n.

[0341] Specifically, T represents the rated torque of the handheld tool 1 in Nm; P represents the maximum power of the motor, in KW; and n represents the speed output by the motor after reduction through the reducer, which is, in this implementation, the speed of the tool spindle in revolutions per minute (r/min). When the rated torque of the handheld tool 1 is less than or equal to 55 Nm, 55≥9549P/n may be obtained, that is, n/P≥173.618, and n/P≥174 may be obtained by rounding.

[0342] It may be understood that, because the density of the material of the core 501 is 1 g/cm^3 to 5 g/cm^3, the mass of the core 501 is lower than that of the core made of stainless steel of the prior art, and then the overall mass of the handheld tool 1 may be reduced. Moreover, since the core 501 is located in the front of the handheld tool 1 and the handle for holding the handheld tool is located in the middle and back of the handheld tool 1, the reduction of the mass of the core 501 may also shift the center of gravity of the handheld tool 1 toward the handle, making the center of gravity of the handheld tool 1 close to the handle, making it easy to hold the handle to operate the handheld tool 1, and making it comfortable to hold.

[0343] Two handheld tools different only in the materials of the core 501 are used for drilling. The handheld tools are provided with the same tool head with the diameter of 8 mm to drill 50-mm-deep holes in the concrete. That is to say, two handheld tools different only in the materials of the core 501 are used for drill two holes of the same size in the same material in the same environment. Each handheld tool drilled three times. The time spent in drilling by the two handheld tools was recorded, and the average time spent for each handheld tool was calculated for comparison. The drilling efficiency is obtained by dividing the drilling depth by the time spent in drilling. As shown in Table 4, the average time spent in drilling was 15.26 seconds for one handheld tool with a steel chuck core and was 10.00 seconds for the other handheld tool with an aluminum chuck core. As can be seen, the use of the core made of aluminum or an aluminum alloy can improve the drilling efficiency of the handheld tool 1 and shorten the time spent in drilling. In the above experiment, the time may be shortened by about 30%, exhibiting a significant effect.

Table 4

	Steel chuck core	Aluminum chuck core
Experimental value/ s	15.81	9.3
	14.9	9.98
	15.08	10.73
Average value/s	15.26333333	10.00333333

[0344] The present disclosure further provides a chuck accessory, including a chuck 50, a tool spindle 30, and a hammer striking mechanism 20. The tool spindle 30 is fixedly connected to the chuck 50. The hammer striking mechanism 20 includes a hammer 200. The hammer 200 can strike the tool spindle 30 to and fro along the axis direction of the tool spindle 30. The chuck accessory is used for being detachably connected to an output shaft of a handheld tool body. The output shaft of the handheld tool body described here and the tool spindle are two different shafts, the tool spindle is used for bearing an impact from the hammer, while the output shaft is a shaft in the handheld tool body. The output shaft may be a transmission shaft or an output shaft of a reducer. The output shaft is an output portion on the handheld tool body and is used for outputting power of rotation. The handheld tool body is used for providing power, and the output shaft of the handheld tool body may be fitted with other types of accessories to implement other corresponding functions.

[0345] It may be understood that although specific implementations of the present disclosure are described in detail in the above examples, it should be still noted that:

(1) The hammer striking mechanism 20 is not limited to the above structure, and the hammer striking mechanism should be understood in particular as a hammer striking mechanism including at least one hammer 200 linearly moving to and fro along the axis direction of the tool spindle. For example, the hammer striking mechanism elastomatically and/or pneumatically and/or hydraulically drives the hammer by means of a chute device, a bearing, and/or an eccentric unit. Therefore, the hammer striking mechanism may be a pneumatic hammer striking mechanism or an eccentric hammer striking mechanism. Particularly, the pneumatic hammer striking mechanism may be provided as a crank connecting rod mechanism to drive a piston of a compressed cylinder to move to and fro to produce compressed air, and the compressed air drives the hammer to hammer the tool spindle. Particularly, the eccentric hammer striking mechanism may be provided as a hammer striking structure which rotates to produce a linear motion perpendicular to an axis of rotation of a rotational motion. Preferably, the eccentric hammer striking mechanism includes an eccentric element connected to the driving element without relative rotation.

(2) In the present invention, the guide member 210 is not limited to being sleeved over the outer circumferential wall of the hammer 200. In another implementation, the guide member may also be provided on an inner circumferential side of the hammer, as long as the relative rotation between the guide member and the hammer can implement the axial motion of the hammer.

[0346] The technical features of the above examples may be arbitrarily combined, and not all possible combinations of the technical features in the above embodiments are described for the sake of brevity; however, as long as there is no contradiction in the combinations of the technical features, they shall be considered as falling within the scope of the specification.

[0347] The above examples express only several implementations of the present invention, and the descriptions thereof are relatively specific and detailed, but they cannot be interpreted as limitations to the scope of the invention patent. It should be indicated that those of ordinary skill in the art can further make deformations and improvements without departing from the conception of the present invention, all of which fall within the protection scope of the present invention. Therefore, the protection scope of the invention patent shall be subject to the appended claims.

Claims

1. A handheld power tool, comprising:

    a housing (80);
    a power mechanism provided in the housing, the power mechanism comprising a motor (60) and a transmission mechanism driven by the motor (60);
    a tool spindle (30) driven by the transmission mechanism to rotate around an axis; and
    a hammer striking mechanism (20) comprising a hammer (200) configured to intermittently strike the tool spindle (30) along the axis;
    a guide member (210) being rotatable relative to the hammer (200); and
    an energy storage mechanism (231) abutting the hammer (200);
    wherein one of the hammer (200) and the guide member (210) is provided with a curve guide (233), the other of the hammer and the guide member is correspondingly provided with a conversion member (232); the curve guide (233) comprises a plurality of slope ascending portions (233a) and a plurality of descending portions (233b) corresponding to the slope ascending portions, when the conversion member (232) moves past the slope ascending portion, the conversion member drives the hammer, overcomes the force of the energy storage mechanism (231) and moves in a first direction, when the conversion member (232) moves past the descending portion, the energy storage mechanism (231) drives the hammer (200) to move to produce a striking in a second direction which is opposite to the first direction;
    characterized in that a rotational speed of the hammer relative the guide member (210) is 1000 rpm to 2500 rpm, and a ratio of the striking frequency of the hammer (200) to the relative rotational speed of the hammer is 2 times per revolution to 4 times per revolution.

2. The handheld power tool according to claim 1, **characterized in that** the curve guide (233) comprises two to four slope ascending portions (233a).

3. The handheld power tool according to claim 2, **characterized in that** each slope ascending portion (233a) comprises a start point and an end point, and a distance between the projection of the start point on the axis and the projection of the end point on the axis is 4 mm to 15 mm.

4. The handheld power tool according to claim 1, **characterized in that** the curve guide (233) is circumferentially provided on an inner circumferential surface of the guide member (210), and the conversion member (232) is provided on an outer circumferential surface of the hammer (200).

5. The handheld power tool according to claim 1, **characterized in that** the hammer striking mechanism (20) further comprises a hammer shaft configured to drive the hammer (200) to rotate relative to the guide member (210), and the hammer shaft is driven rotatably by the motor(60).

6. The handheld power tool according to claim 1, **characterized in that** transmission mechanism comprises a transmission shaft (10) configured to drive the tool spindle (30) to rotate, the hammer striking mechanism (20) further comprises a hammer shaft driving the hammer (200) to rotate relative to the guide member (210), and the

rotational speed of the transmission shaft is the same as that of the hammer shaft.

7. The handheld power tool according to claim 6, **characterized in that** the transmission shaft and the hammer shaft are arranged coaxially.

8. The handheld power tool according to claim 1, **characterized in that** the handheld power tool further comprises a mode adjustment mechanism (40) being configured to adjust the working mode of the handheld power tool between a striking mode and a non-striking mode, the mode adjustment mechanism (40) and the hammer striking mechanism (20) are at least partially overlapped in a radial direction; and the housing(80) comprises a first case portion(650) used for accommodating the hammer striking mechanism(20), and the radial size of the first case portion(650) is ranged from 45 mm to 70 mm.

9. The handheld power tool hand according to claim 8, **characterized in that** the mode adjustment mechanism (40) and at least one of the guide member (210) and the hammer (200) are at least partially overlapped in the radial direction.

10. The handheld power tool according to claim 8, **characterized in that** the mode adjustment mechanism(40) comprises a striking switching ring(430) and a mode switching button(450), the mode switching button(450) is operable to drive the striking switching ring(450) to move between a first position and a second position;when the striking switching ring(430) is at the first position, the striking switching ring(430) is engaged with the hammer striking mechanism(20), the guide member(210) and the hammer(200) are relatively rotatable, and the handheld power tool is in the striking mode; when the striking switching ring(430) is at the second position, the striking switching ring(430) is separated from the hammer striking mechanism(20), the guide member(210) and the hammer(200) cannot rotate relative to each other, the handheld power tool is in the non-striking mode; and at least one of the striking switching ring(430) and the mode switching button(450) at least partially overlaps with the guide member(210) in the radial direction.

11. The handheld power tool according to claim 8, **characterized in that** the hammer striking mechanism (20) comprises a hammer shaft (10) disposed between the transmission mechanism and the tool spindle (30), and the hammer (200) is sleeved over an outer side of the hammer shaft (10), the hammer shaft (10) is capable of driving the hammer (200) to rotate and is connected with the tool spindle (30) nonrotatably.

12. The handheld power tool according to claim 8, **characterized in that** the guide member (210) is sleeved over an outer side of the hammer (200), the hammer (200) is movably supported on an inner circumferential surface of the guide member (210) along the axis.

13. The handheld power tool according to claim 8, **characterized in that** the guide member (210) is configured as a hollow cylinder body, the curve guide (233) is arranged on an inner wall of the guide member (210), and an insertion groove (211) is disposed on an outer wall of the hammer (200) for installing the conversion member (232).

14. The handheld power tool according to claim 8, **characterized in that** a ratio of the outer diameter of the hammer striking mechanism (20) to the radial size of the first case portion (650) is 0.6 to 0.9.

15. The handheld power tool power according to claim 11, **characterized in that** the rotational speed output by the power mechanism is same as that of the hammer shaft (10), the hammer shaft (10) is capable of driving the hammer (200) to rotate relative to the guide member (210), and the mode adjustment mechanism (40) and the hammer striking mechanism (20) are at least partially overlapped in an axial direction.

Patentansprüche

1. Handwerkzeugmaschine, umfassend:

ein Gehäuse (80),
ein in dem Gehäuse vorgesehenes Kraftglied, wobei das Kraftglied einen Motor (60) und einen von dem Motor (60) angetriebenen Kraftübertragungsmechanismus umfasst,
eine Werkzeugspindel (30), die durch den Kraftübertragungsmechanismus angetrieben wird, um sich um eine Achse zu drehen, und einen Hammerschlagmechanismus (20), der einen Hammer (200) umfasst, der dazu ausgestaltet ist, intermittierend entlang der Achse auf die Werkzeugspindel (30) zu schlagen,
ein Führungsglied (210), das bezüglich des Hammers (200) drehbar ist, und

einen Energiespeichermechanismus (231), der an dem Hammer (200) anliegt,
wobei der Hammer (200) oder das Führungsglied (210) mit einer Kurvenführung (233) versehen ist und das jeweils andere Element von Hammer und Führungsglied entsprechend mit einem Umwandlungsglied (232) versehen ist, die Kurvenführung (233) eine Vielzahl von ansteigenden Abschnitten (233a) und eine Vielzahl von abfallenden Abschnitten (233b), die den ansteigenden Abschnitten entsprechen, umfasst, wenn sich das Umwandlungsglied (232) an dem ansteigenden Abschnitt vorbeibewegt, das Umwandlungsglied den Hammer antreibt, die Kraft des Energiespeichermechanismus (231) überwindet und sich in einer ersten Richtung bewegt, wenn sich das Umwandlungsglied (232) an dem abfallenden Abschnitt vorbeibewegt, der Energiespeichermechanismus (231) den Hammer (200) antreibt, um sich zum Erzeugen eines Schlags in einer zweiten Richtung, die der ersten Richtung entgegengesetzt ist, zu bewegen,
dadurch gekennzeichnet, dass eine Drehzahl des Hammers bezüglich des Führungsglieds (210) 1000 U/min bis 2500 U/min beträgt und ein Verhältnis der Schlagfrequenz des Hammers (200) zur relativen Drehzahl des Hammers 2 Mal pro Umdrehung bis 4 Mal pro Umdrehung beträgt.

2. Handwerkzeugmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** die Kurvenführung (233) zwei bis vier ansteigende Abschnitte (233a) umfasst.

3. Handwerkzeugmaschine nach Anspruch 2, **dadurch gekennzeichnet, dass** jeder ansteigende Abschnitt (233a) einen Startpunkt und einen Endpunkt umfasst und ein Abstand zwischen der Projektion des Startpunkts auf der Achse und der Projektion des Endpunkts auf der Achse 4 mm bis 15 mm beträgt.

4. Handwerkzeugmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** die Kurvenführung (233) umfangsmäßig an einer Innenumfangsfläche des Führungsglieds (210) vorgesehen ist und das Umwandlungsglied (232) an einer Außenumfangsfläche des Hammers (200) vorgesehen ist.

5. Handwerkzeugmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** der Hammerschlagmechanismus (20) ferner eine Hammerwelle umfasst, die dazu ausgestaltet ist, den Hammer (200) anzutreiben, um sich bezüglich des Führungsglieds (210) zu drehen, und die Hammerwelle durch den Motor (60) drehangetrieben wird.

6. Handwerkzeugmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** der Kraftübertragungsmechanismus eine Kraftübertragungswelle (10) umfasst, die dazu ausgestaltet ist, die Werkzeugspindel (30) zum Drehen anzutreiben, und der Hammerschlagmechanismus (20) ferner eine Hammerwelle umfasst, die den Hammer (200) antreibt, um sich bezüglich des Führungsglieds (210) zu drehen, und die Drehzahl der Kraftübertragungswelle die gleiche ist wie die der Hammerwelle.

7. Handwerkzeugmaschine nach Anspruch 6, **dadurch gekennzeichnet, dass** die Kraftübertragungswelle und die Hammerwelle koaxial angeordnet sind.

8. Handwerkzeugmaschine nach Anspruch 1, **dadurch gekennzeichnet, dass** die Handwerkzeugmaschine ferner einen Moduseverstellmechanismus (40) umfasst, der dazu ausgestaltet ist, den Arbeitsmodus der Handwerkzeugmaschine zwischen einem Schlagmodus und einem Nicht-Schlagmodus zu verstellen, wobei der Modusverstellmechanismus (40) und der Hammerschlagmechanismus (20) mindestens teilweise in einer radialen Richtung überlappen, und das Gehäuse (80) einen ersten Gehäuseabschnitt (650) umfasst, der zur Aufnahme des Hammerschlagmechanismus (20) dient, und die radiale Größe des ersten Gehäuseabschnitts (650) im Bereich von 45 mm bis 70 mm liegt.

9. Handwerkzeugmaschine nach Anspruch 8, **dadurch gekennzeichnet, dass** der Modusverstellmechanismus (40) und das Führungsglied (210) und/oder der Hammer (200) in der radialer Richtung mindestens teilweise überlappen.

10. Handwerkzeugmaschine nach Anspruch 8, **dadurch gekennzeichnet, dass** der Modusverstellmechanismus (40) einen Schlagschaltring (430) und einen Modusschaltknopf (450) umfasst, der Modusschaltknopf (450) dahingehend betätigbar ist, den Schlagschaltring (450) anzutreiben, so dass er sich zwischen einer ersten Position und einer zweiten Position bewegt, wobei, wenn der Schlagschaltring (430) in der ersten Position ist, der Schlagschaltring (430) mit dem Hammerschlagmechanismus (20) in Eingriff steht, das Führungsglied (210) und der Hammer (200) bezüglich einander drehbar sind, und die Handwerkzeugmaschine im Schlagmodus ist, und wobei, wenn der Schlagschaltring (430) in der zweiten Position ist, der Schlagschaltring (430) von dem Hammerschlagmechanismus (20) getrennt ist, das Führungsglied (210) und der Hammer (200) sich nicht bezüglich einander drehen können und die Handwerkzeugmaschine im Nicht-Schlagmodus ist, und wobei der Schlagschaltring (430) und/oder der Modusschaltknopf (450) das

Führungsglied (210) mindestens teilweise in der radialen Richtung überlappen.

11. Handwerkzeugmaschine nach Anspruch 8, **dadurch gekennzeichnet, dass** der Hammerschlagmechanismus (20) eine Hammerwelle (10) umfasst, die zwischen dem Kraftübertragungsmechanismus und der Werkzeugspindel (30) angeordnet ist, und der Hammer (200) über eine Außenseite der Hammerwelle (10) aufgeschoben ist, und die Hammerwelle (10) in der Lage ist, den Hammer (200) zum Drehen anzutreiben, und drehfest mit der Werkzeugspindel (30) verbunden ist.

12. Handwerkzeugmaschine nach Anspruch 8, **dadurch gekennzeichnet, dass** das Führungsglied (210) über eine Außenseite des Hammers (200) aufgeschoben ist und der Hammer (200) entlang der Achse beweglich auf einer Innenumfangsfläche des Führungsglieds (210) gestützt ist.

13. Handwerkzeugmaschine nach Anspruch 8, **dadurch gekennzeichnet, dass** das Führungsglied (210) als Hohlzylinderkörper ausgestaltet ist, die Kurvenführung (233) an einer Innenwand des Führungsglieds (210) angeordnet ist und an einer Außenwand des Hammers (200) eine Einführnut (211) zum Einbau des Umwandlungsglieds (232) angeordnet ist.

14. Handwerkzeugmaschine nach Anspruch 8, **dadurch gekennzeichnet, dass** ein Verhältnis des Außendurchmessers des Hammerschlagmechanismus (20) zu der radialen Größe des ersten Gehäuseabschnitts (650) 0,6 bis 0,9 beträgt.

15. Handwerkzeugmaschine nach Anspruch 11, **dadurch gekennzeichnet, dass** die Drehzahlabgabe des Kraftglieds gleich der der Hammerwelle (10) ist, die Hammerwelle (10) in der Lage ist, den Hammer (200) anzutreiben, so dass er sich bezüglich des Führungsglieds (210) dreht, und der Modusverstellmechanismus (40) und der Hammerschlagmechanismus (20) mindestens teilweise in einer axialen Richtung überlappen.

Revendications

1. Outil électrique portatif, comprenant :

un carter (80) ;
un mécanisme de puissance disposé dans le carter, le mécanisme de puissance comprenant un moteur (60) et un mécanisme de transmission entraîné par le moteur (60) ;
une broche d'outil (30) entraînée par le mécanisme de transmission pour tourner autour d'un axe ; et un mécanisme de frappe de marteau (20) comprenant un marteau (200) conçu pour frapper par intermittence la broche d'outil (30) le long de l'axe ;
un élément de guidage (210) pouvant tourner par rapport au marteau (200) ; et
un mécanisme de stockage d'énergie (231) venant en butée contre le marteau (200) ;
l'un parmi le marteau (200) et l'élément de guidage (210) étant pourvu d'un guide courbe (233), l'autre parmi le marteau et l'élément de guidage étant pourvu de façon correspondante d'un élément de conversion (232) ; le guide courbe (233) comprenant une pluralité de parties ascendantes de pente (233a) et une pluralité de parties descendantes (233b) correspondant aux parties ascendantes de pente, lorsque l'élément de conversion (232) se déplace au-delà de la partie ascendante de pente, l'élément de conversion entraînant le marteau, surmontant la force du mécanisme de stockage d'énergie (231) et se déplaçant dans une première direction, lorsque l'élément de conversion (232) se déplace au-delà de la partie descendante, le mécanisme de stockage d'énergie (231) entraînant le marteau (200) pour le déplacer pour produire une frappe dans une deuxième direction qui est opposée à la première direction ;
caractérisé en ce qu'une vitesse de rotation du marteau par rapport à l'élément de guidage (210) est comprise entre 1000 tr/min et 2500 tr/min, et un rapport de la fréquence de frappe du marteau (200) par rapport à la vitesse de rotation relative du marteau est compris entre 2 fois par tour et 4 fois par tour.

2. Outil électrique portatif selon la revendication 1, **caractérisé en ce que** le guide courbe (233) comprend deux à quatre parties ascendantes de pente (233a).

3. Outil électrique portatif selon la revendication 2, **caractérisé en ce que** chaque partie ascendante de pente (233a) comprend un point de départ et un point d'arrivée, et une distance entre la projection du point de départ sur l'axe et la projection du point d'arrivée sur l'axe est comprise entre 4 mm et 15 mm.

4. Outil électrique portatif selon la revendication 1, **caractérisé en ce que** le guide courbe (233) est disposé circonférentiellement sur une surface circonférentielle intérieure de l'élément de guidage (210), et l'élément de conversion (232) est disposé sur une surface circonférentielle extérieure du marteau (200).

5. Outil électrique portatif selon la revendication 1, **caractérisé en ce que** le mécanisme de frappe de marteau (20) comprend en outre un arbre de marteau conçu pour entraîner le marteau (200) pour le faire tourner par rapport à l'élément de guidage (210), et l'arbre de marteau est entraîné en rotation par le moteur (60).

6. Outil électrique portatif selon la revendication 1, **caractérisé en ce que** le mécanisme de transmission comprend un arbre de transmission (10) conçu pour entraîner la broche d'outil (30) pour la faire tourner, le mécanisme de frappe de marteau (20) comprend en outre un arbre de marteau entraînant le marteau (200) pour le faire tourner par rapport à l'élément de guidage (210), et la vitesse de rotation de l'arbre de transmission est la même que celle de l'arbre de marteau.

7. Outil électrique portatif selon la revendication 6, **caractérisé en ce que** l'arbre de transmission et l'arbre de marteau sont agencés de manière coaxiale.

8. Outil électrique portatif selon la revendication 1, **caractérisé en ce que** l'outil électrique portatif comprend en outre un mécanisme de réglage de mode (40) qui est conçu pour régler le mode de fonctionnement de l'outil électrique portatif entre un mode de frappe et un mode sans frappe, le mécanisme de réglage de mode (40) et le mécanisme de frappe de marteau (20) se chevauchent au moins partiellement dans une direction radiale ; et le carter (80) comprend une première partie de boîtier (650) utilisée pour loger le mécanisme de frappe de marteau (20), et la taille radiale de la première partie de boîtier (650) est dans la plage comprise entre 45 mm et 70 mm.

9. Outil électrique portatif selon la revendication 8, **caractérisé en ce que** le mécanisme de réglage de mode (40) et au moins l'un parmi l'élément de guidage (210) et le marteau (200) se chevauchent au moins partiellement dans la direction radiale.

10. Outil électrique portatif selon la revendication 8, **caractérisé en ce que** le mécanisme de réglage de mode (40) comprend une bague de commutation de frappe (430) et un bouton de commutation de mode (450), le bouton de commutation de mode (450) peut être utilisé pour entraîner la bague de commutation de frappe (450) pour la déplacer entre une première position et une deuxième position ; lorsque la bague de commutation de frappe (430) est dans la première position, la bague de commutation de frappe (430) est en prise avec le mécanisme de frappe de marteau (20), l'élément de guidage (210) et le marteau (200) sont rotatifs l'un par rapport à l'autre, et l'outil électrique portatif est en mode de frappe ; lorsque la bague de commutation de frappe (430) est dans la deuxième position, la bague de commutation de frappe (430) est séparée du mécanisme de frappe de marteau (20), l'élément de guidage (210) et le marteau (200) ne peuvent pas tourner l'un par rapport à l'autre, l'outil électrique portatif est en mode sans frappe ; et au moins l'un parmi la bague de commutation de frappe (430) et le bouton de commutation de mode (450) chevauche au moins partiellement l'élément de guidage (210) dans la direction radiale.

11. Outil électrique portatif selon la revendication 8, **caractérisé en ce que** le mécanisme de frappe de marteau (20) comprend un arbre de marteau (10) disposé entre le mécanisme de transmission et la broche d'outil (30), et le marteau (200) est emmanché sur un côté extérieur de l'arbre de marteau (10), l'arbre de marteau (10) est capable d'entraîner le marteau (200) en rotation et est relié à la broche d'outil (30) de manière non rotative.

12. Outil électrique portatif selon la revendication 8, **caractérisé en ce que** l'élément de guidage (210) est emmanché sur un côté extérieur du marteau (200), le marteau (200) est supporté de façon mobile sur une surface circonférentielle intérieure de l'élément de guidage (210) le long de l'axe.

13. Outil électrique portatif selon la revendication 8, **caractérisé en ce que** l'élément de guidage (210) est conçu sous forme de corps de cylindre creux, le guide courbe (233) est agencé sur une paroi intérieure de l'élément de guidage (210), et une rainure d'insertion (211) est ménagée sur une paroi extérieure du marteau (200) pour installer l'élément de conversion (232).

14. Outil électrique portatif selon la revendication 8, **caractérisé en ce qu'**un rapport du diamètre extérieur du mécanisme de frappe de marteau (20) sur la taille radiale de la première partie de boîtier (650) est compris entre 0,6 et 0,9.

15. Outil électrique portatif selon la revendication 11, **caractérisé en ce que** la vitesse de rotation délivrée par le mécanisme de puissance est la même que celle de l'arbre de marteau (10), l'arbre de marteau (10) est capable d'entraîner le marteau (200) en rotation par rapport à l'élément de guidage (210), et que le mécanisme de réglage de mode (40) et le mécanisme de frappe de marteau (20) se chevauchent au moins partiellement dans une direction axiale.

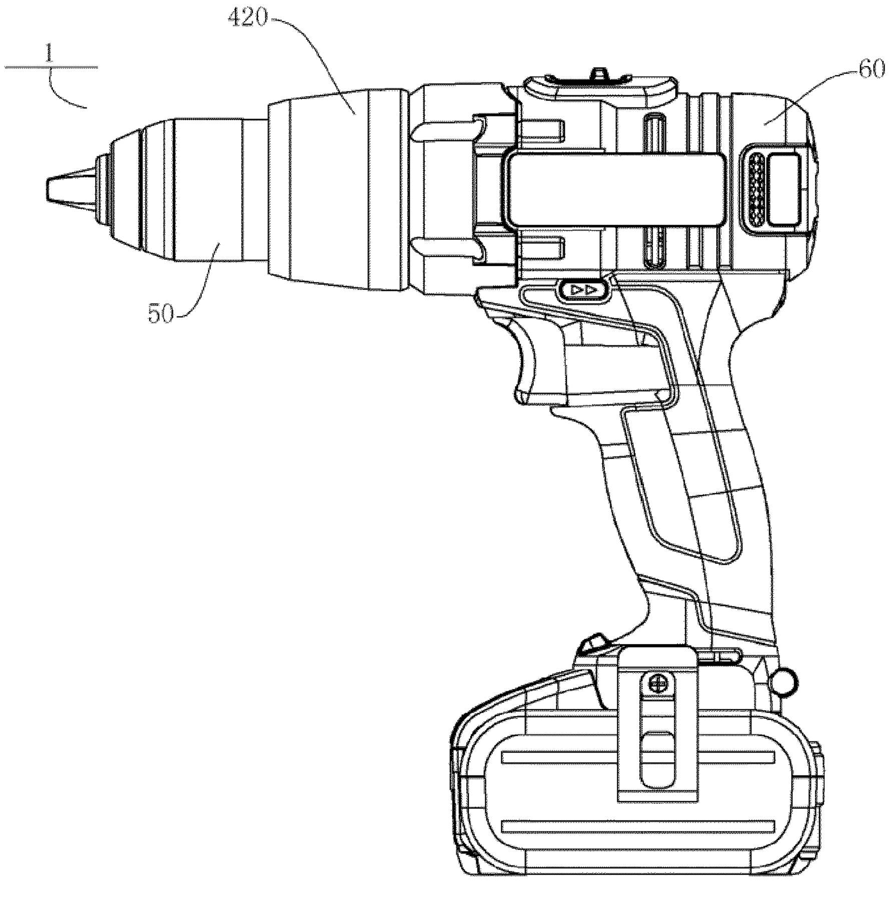

FIG. 1

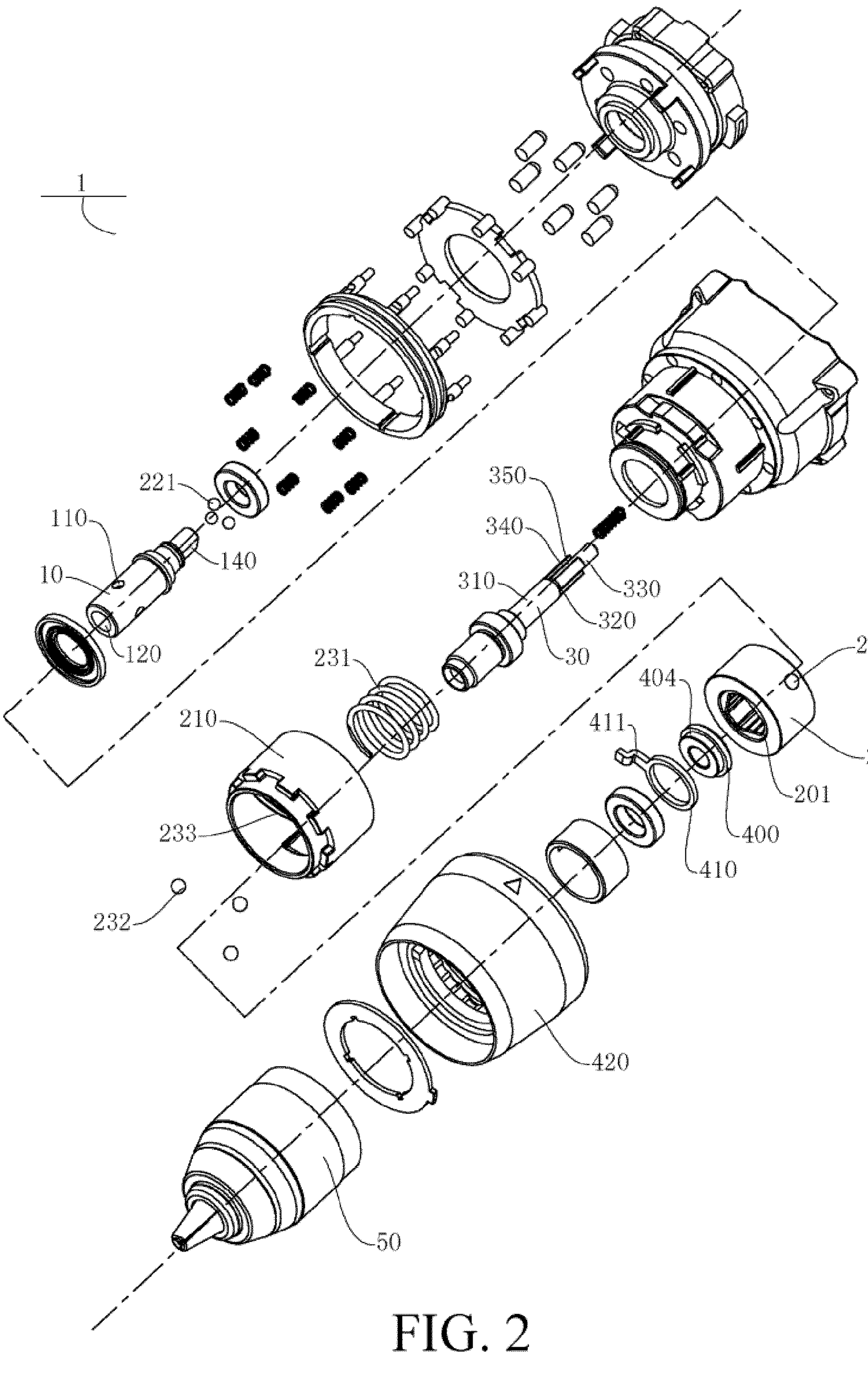
1
221
110
140
10
120
350
340
330
310
320
30
231
202
404
210
411
200
201
400
233
410
232
420
50

FIG. 2

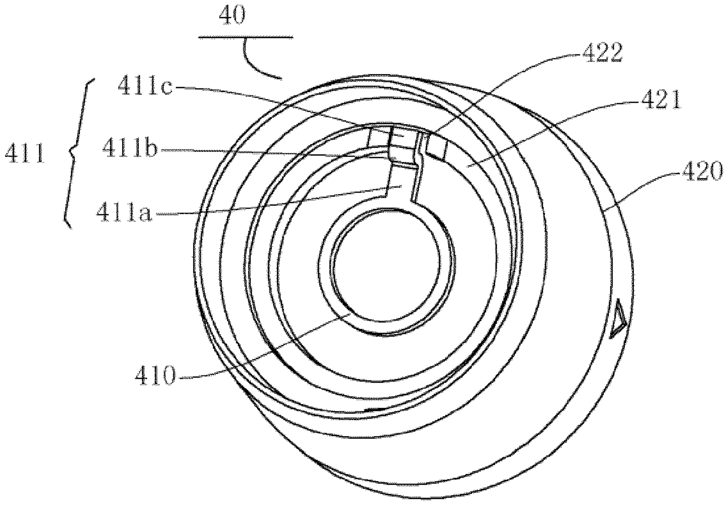
40
411
411c
411b
411a
422
421
420
410

FIG. 3

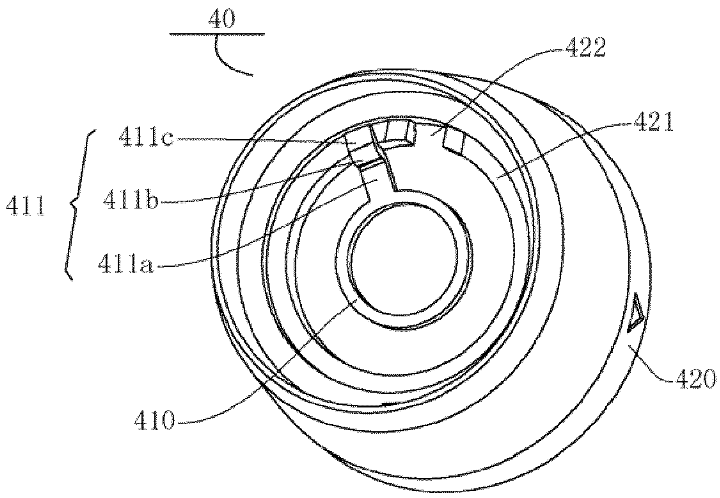
40
411
411c
411b
411a
422
421
420
410

FIG. 4

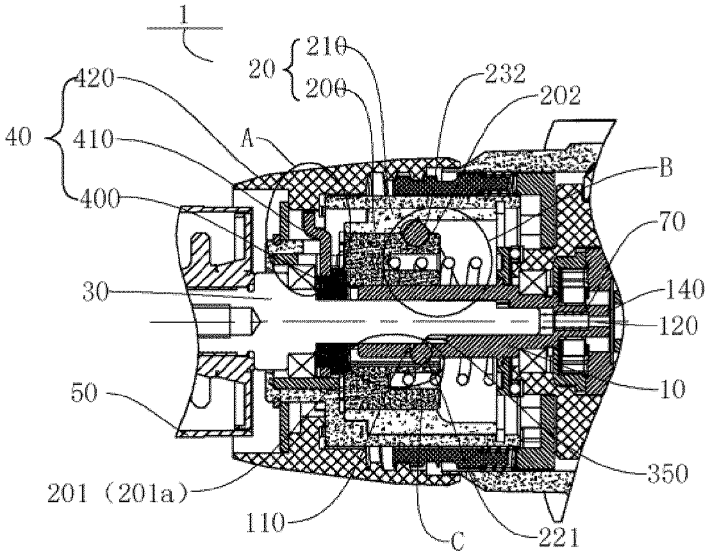
1
20
210
200
232
202
40
420
410
400
A
B
70
140
30
120
10
50
350
201 (201a)
110
C
221

FIG. 5

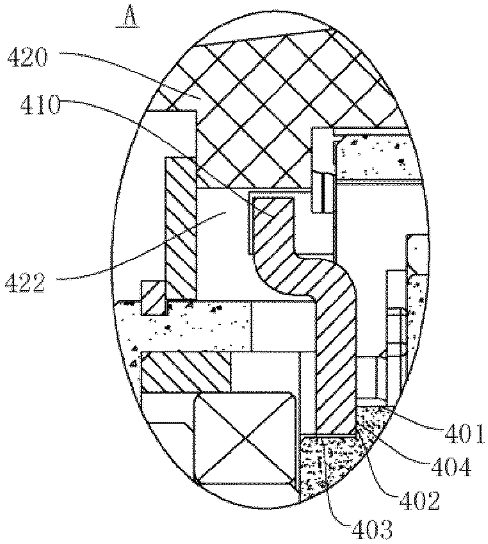
A
420
410
422
401
404
402
403

FIG. 6

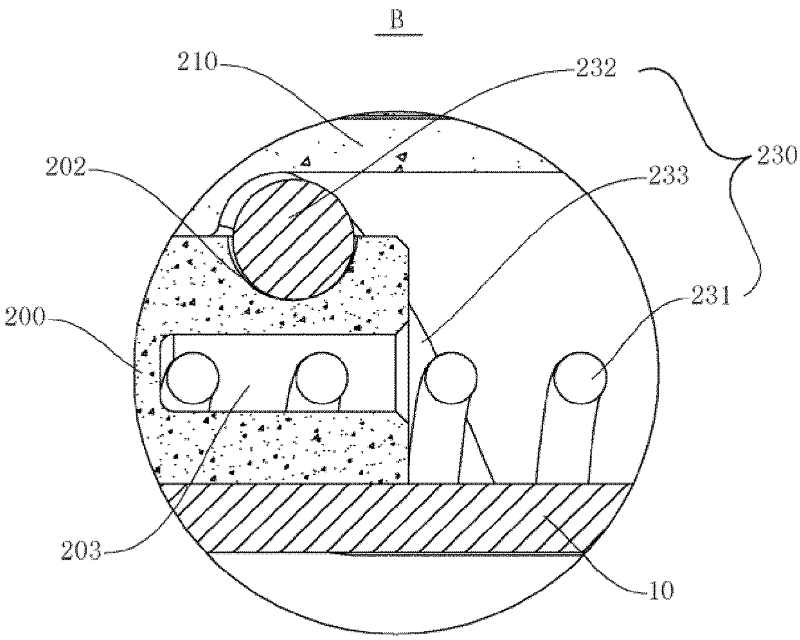
B
210
232
230
202
233
231
200
203
10

FIG. 7

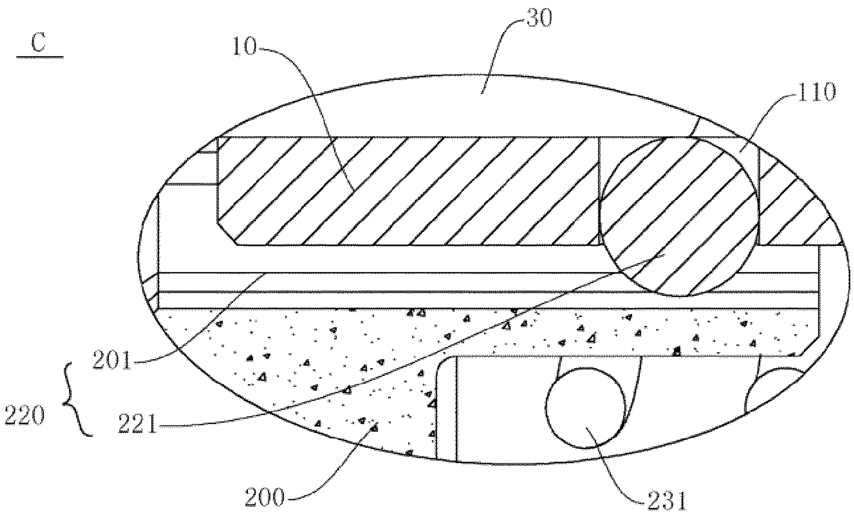
C
30
10
110
201
220
221
200
231

FIG. 8

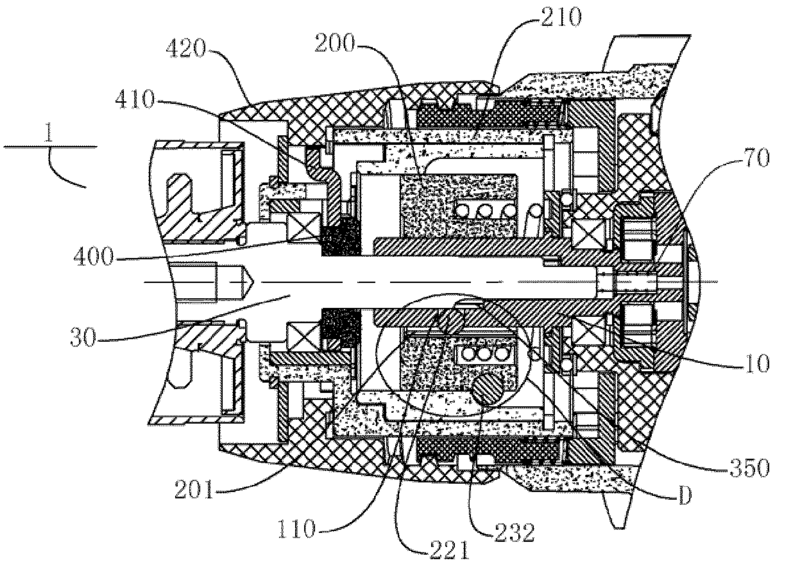
210
420
200
410
1
70
400
30
10
350
D
201
110
232
221

FIG. 9

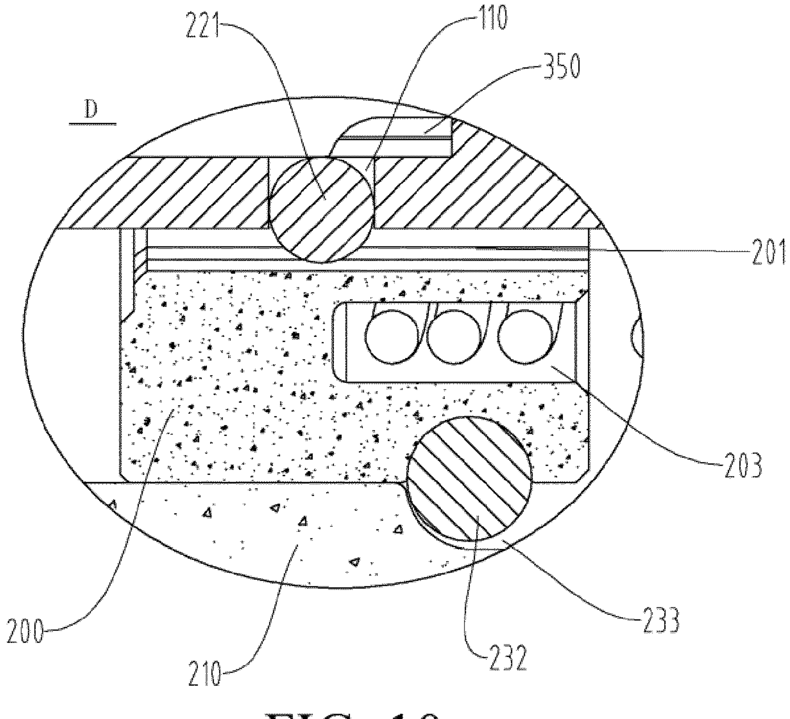
221
110
350
D
201
203
233
200
210
232

FIG. 10

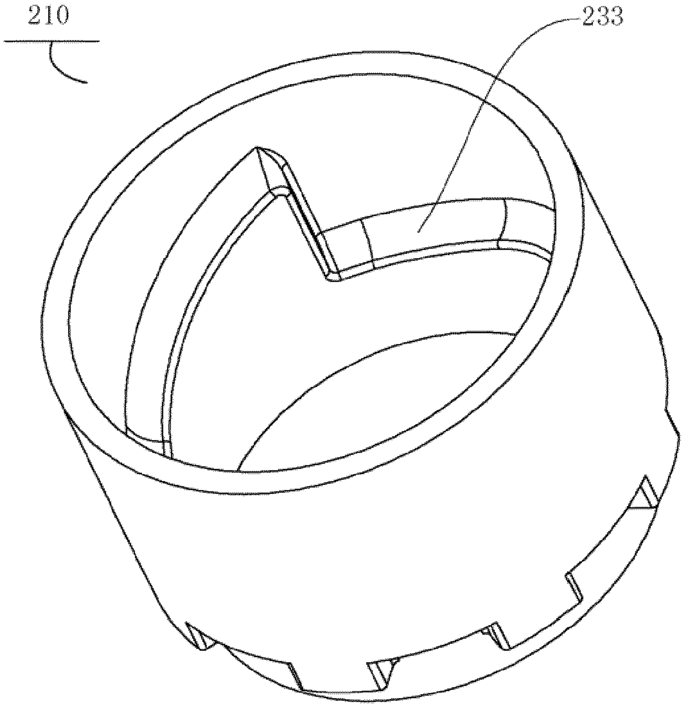

FIG. 11

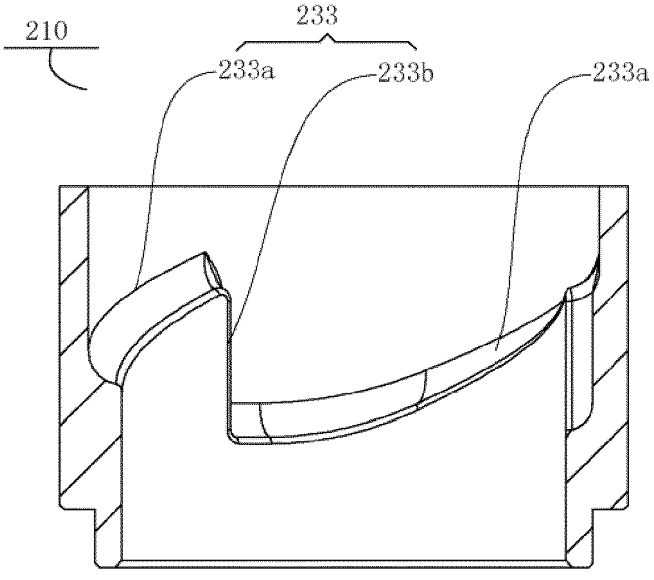

FIG. 12

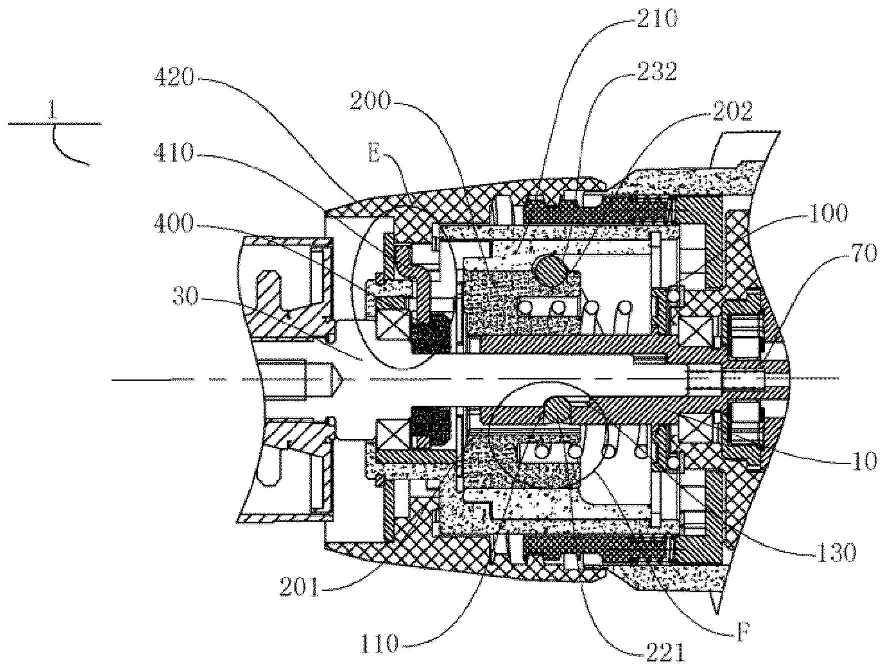

FIG. 13

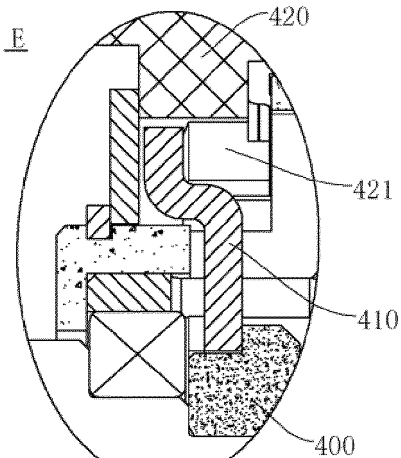

FIG. 14

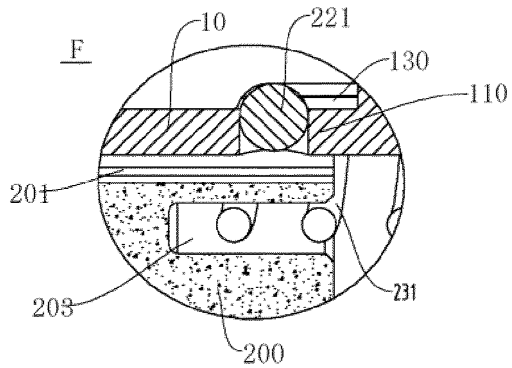

FIG. 15

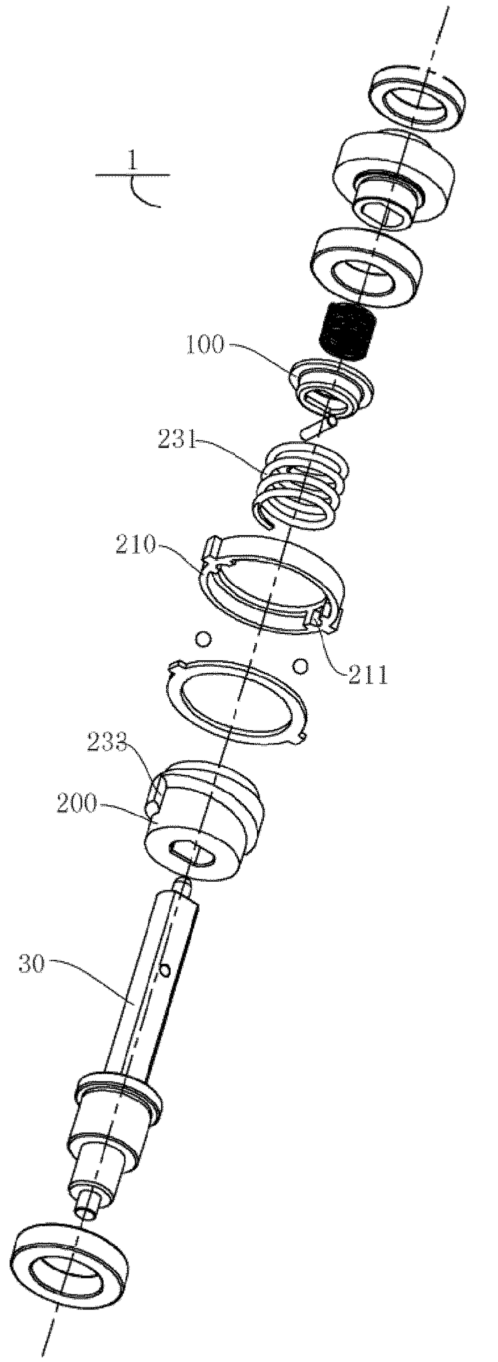

FIG. 16

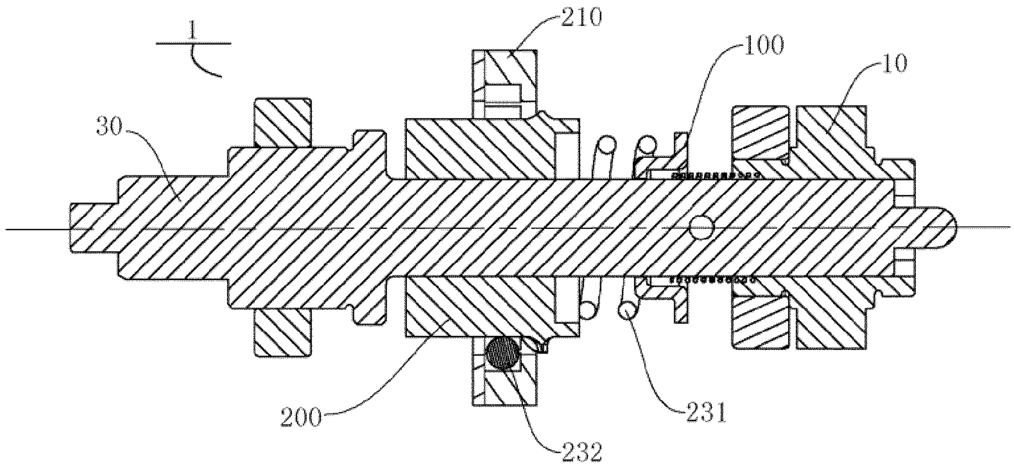

FIG. 17

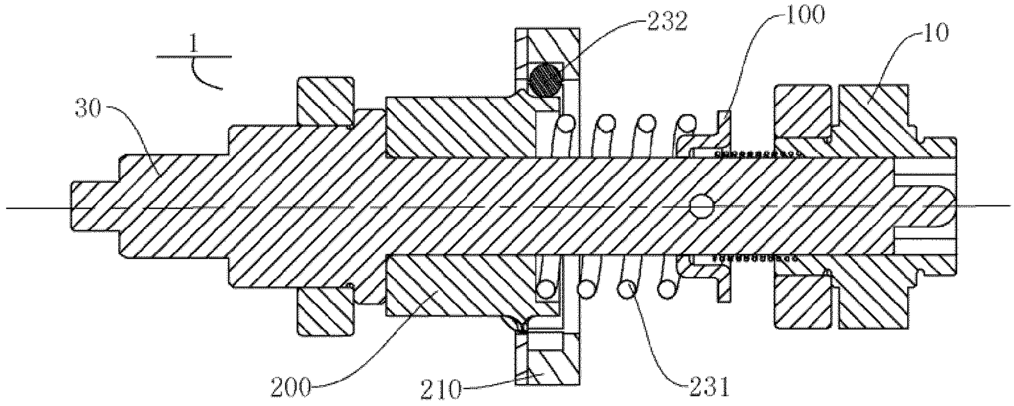

FIG. 18

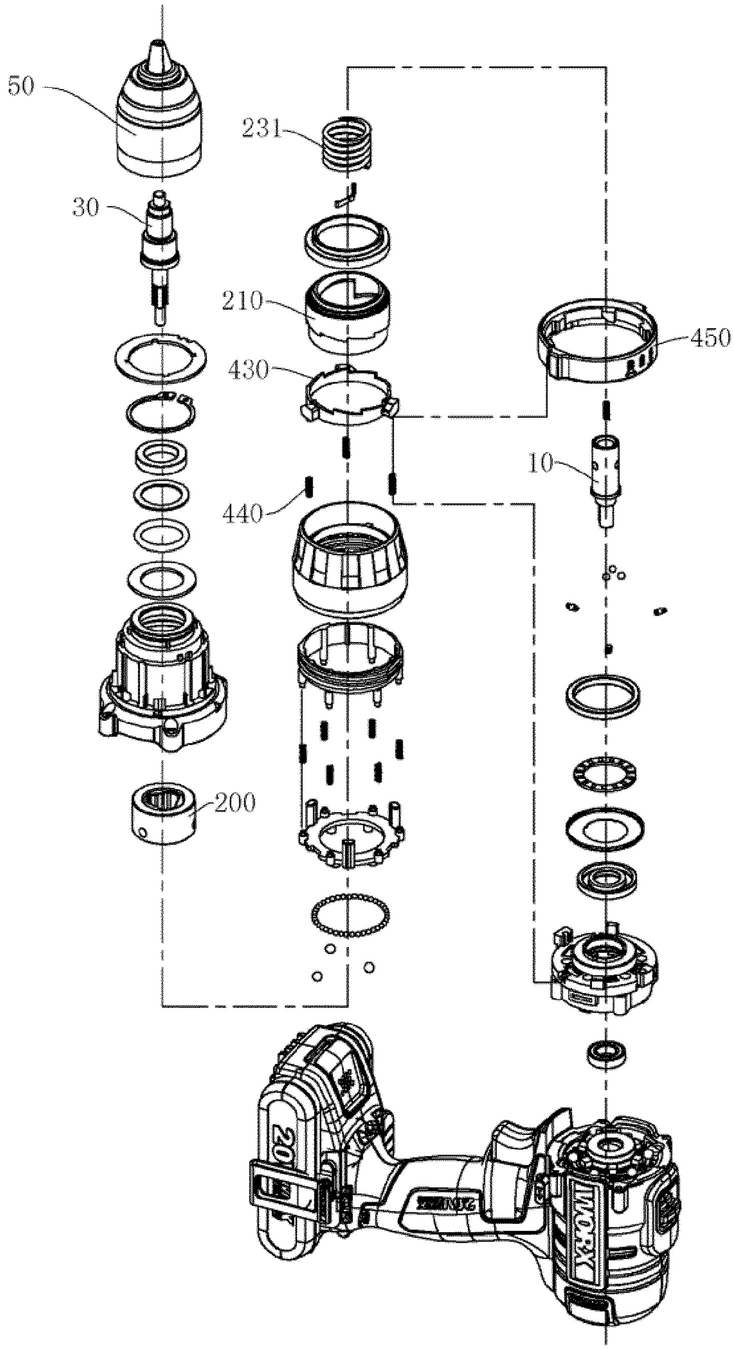

FIG. 19

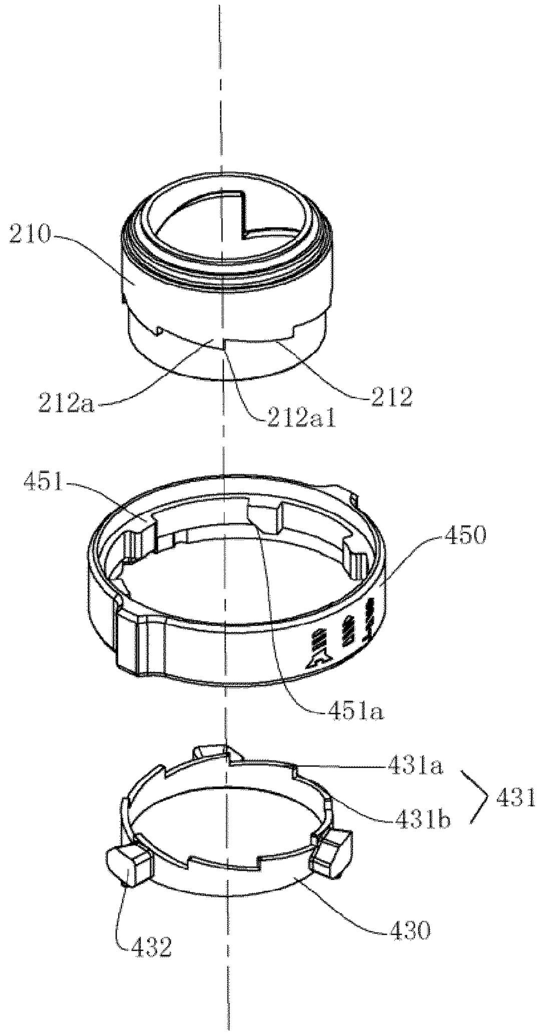

FIG. 20

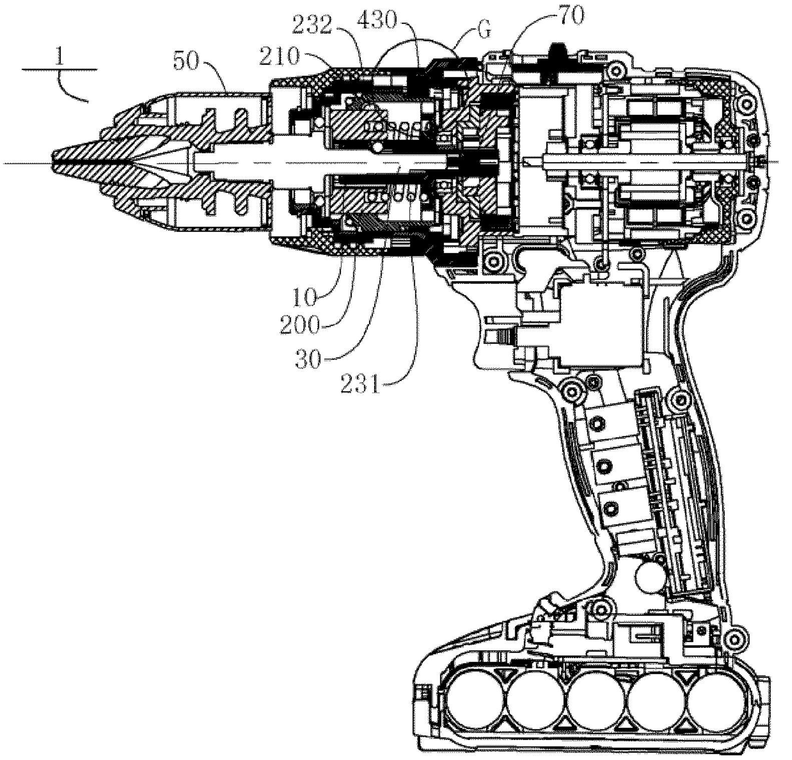

FIG. 21

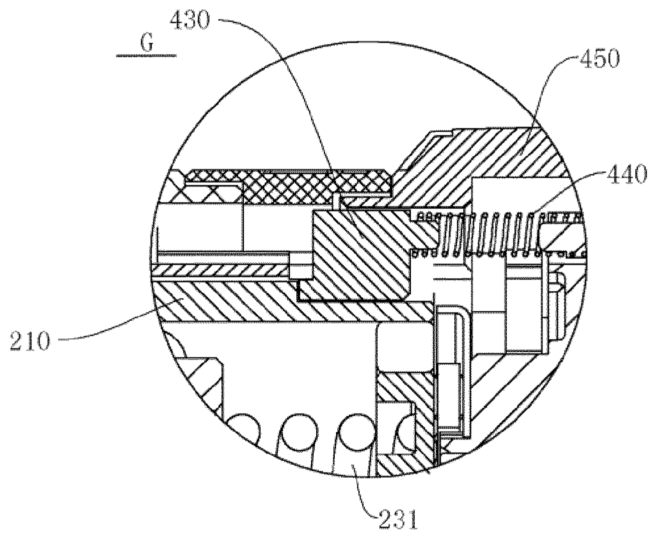

FIG. 22

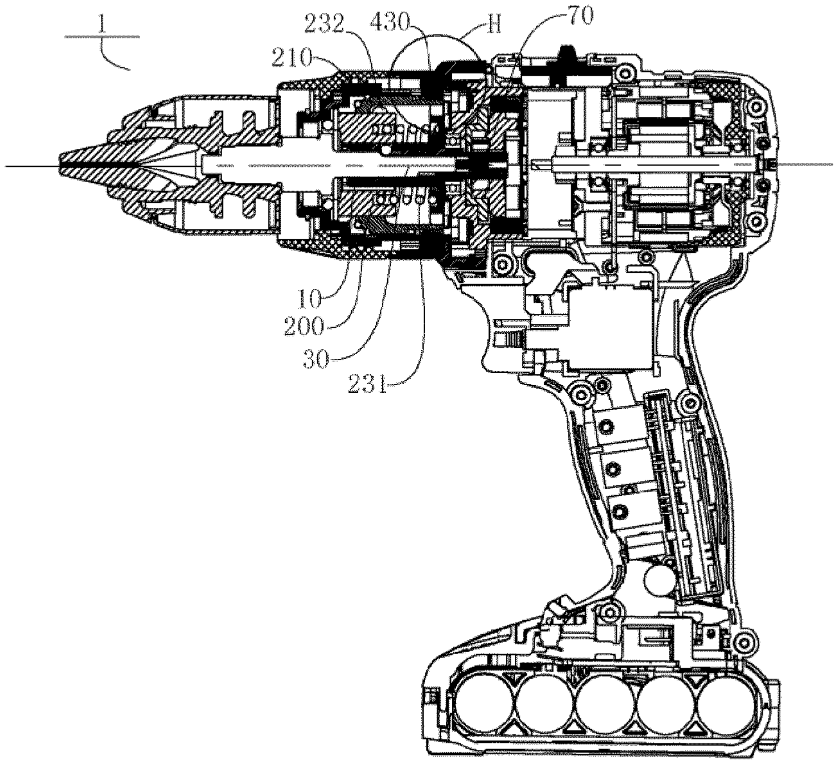

FIG. 23

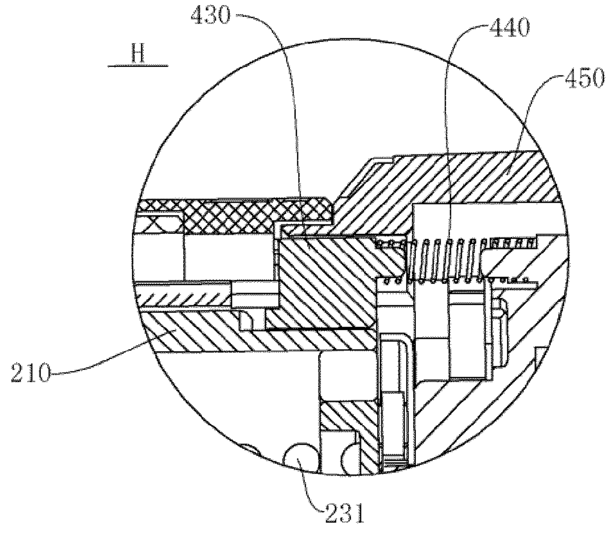

FIG. 24

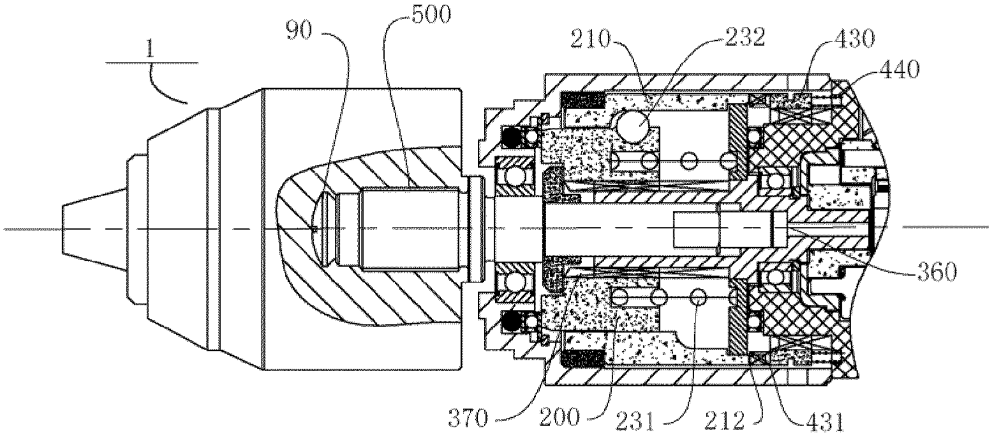
1
90
500
210
232
430
440
360
370
200
231
212
431

FIG. 25

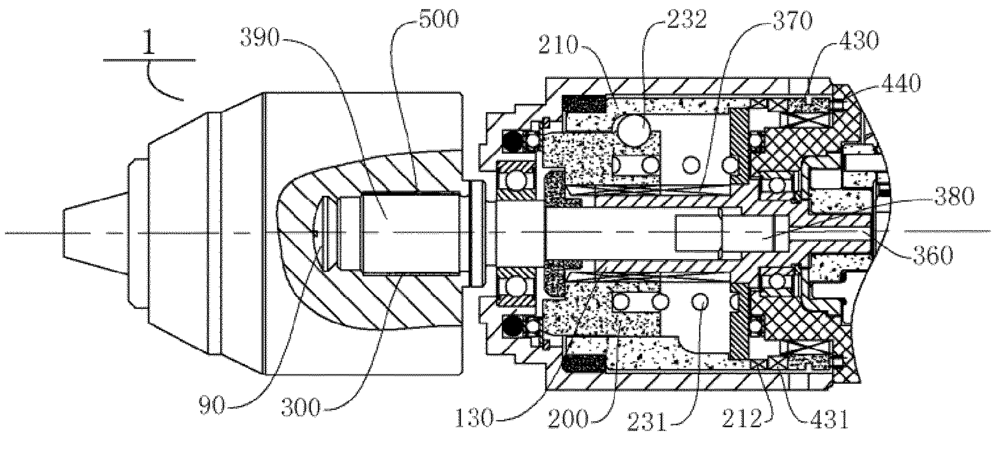
1
390
500
210
232
370
430
440
380
360
90
300
130
200
231
212
431

FIG. 26

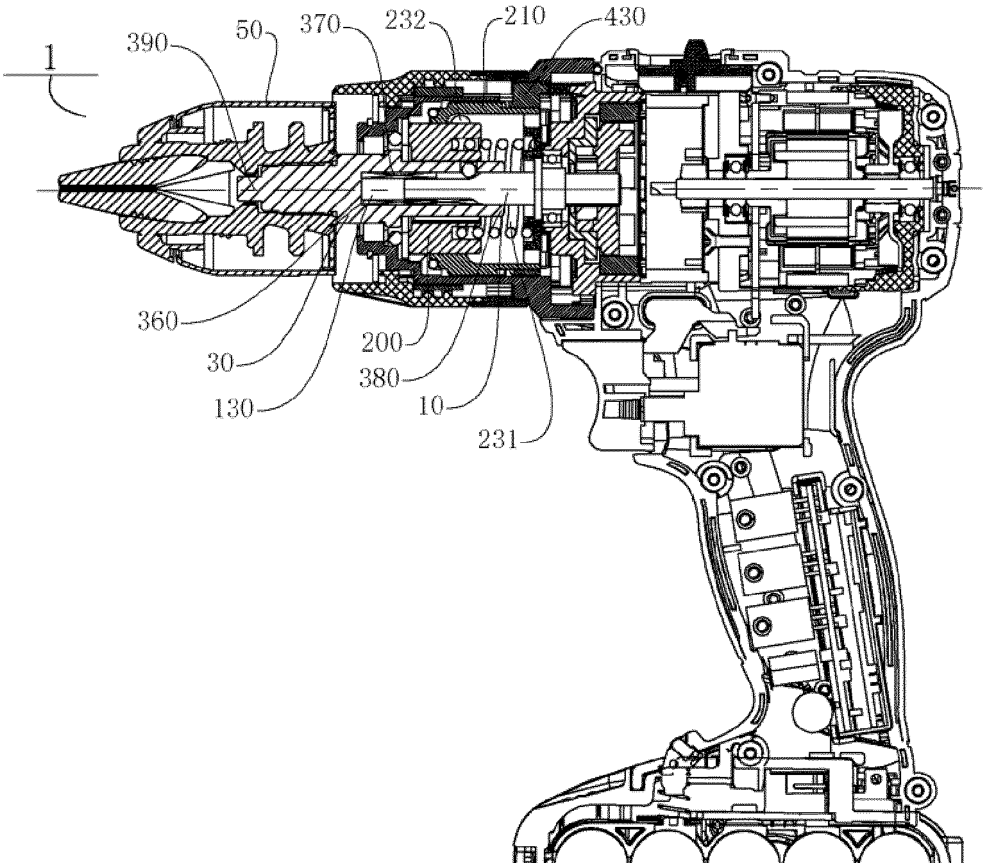

FIG. 27

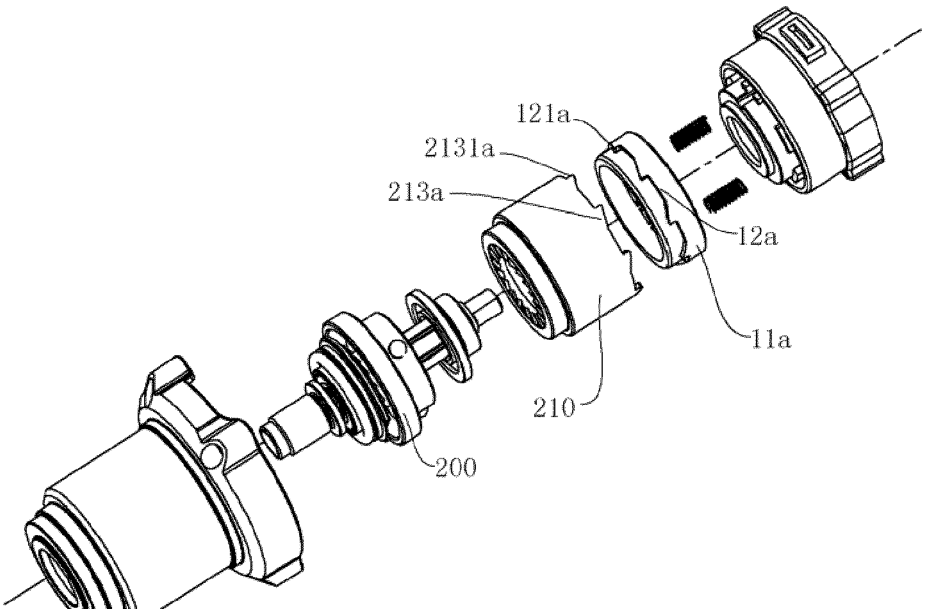

FIG. 28

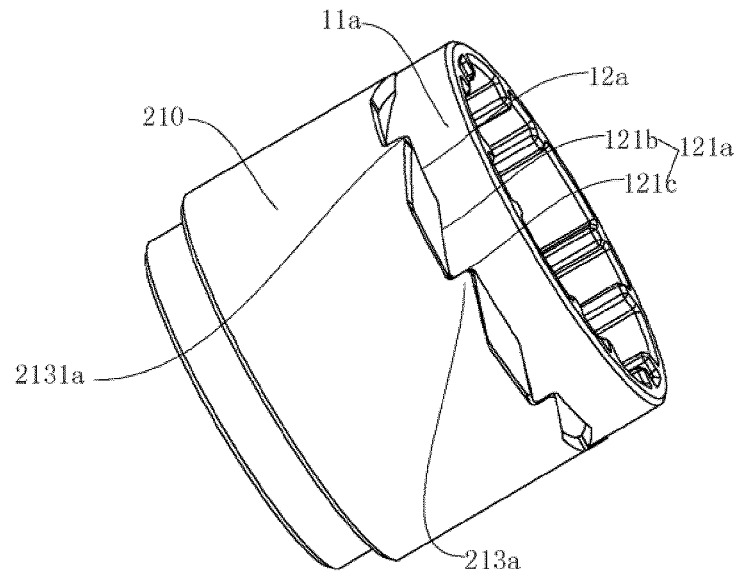
11a
12a
210
121b
121a
121c
2131a
213a

FIG. 29

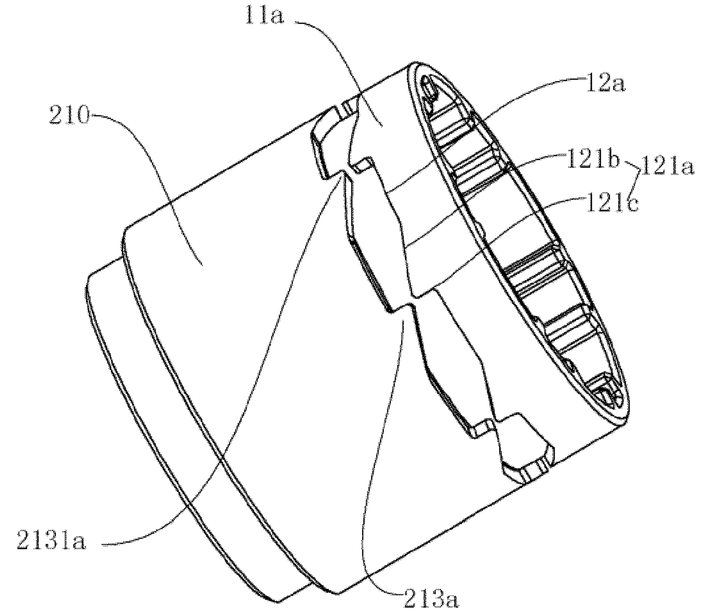
11a
12a
210
121b
121a
121c
2131a
213a

FIG. 30

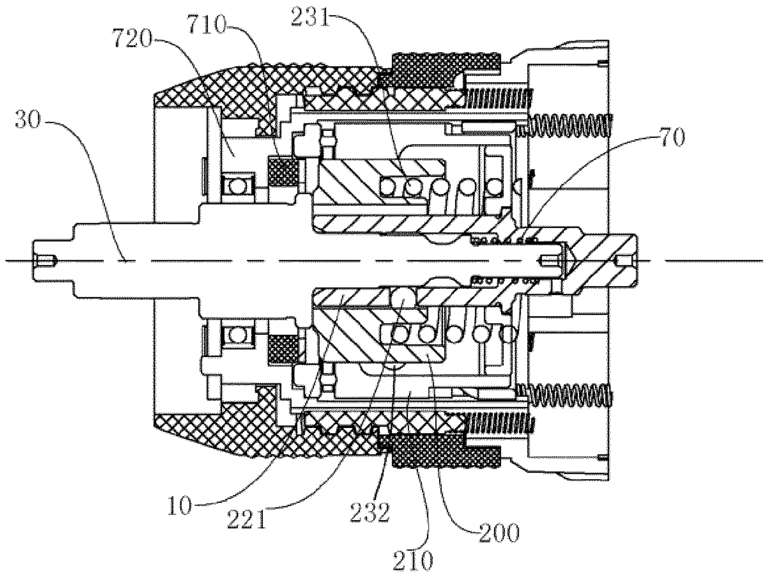
720
710
231
30
70
10
221
232
210
200

FIG. 31

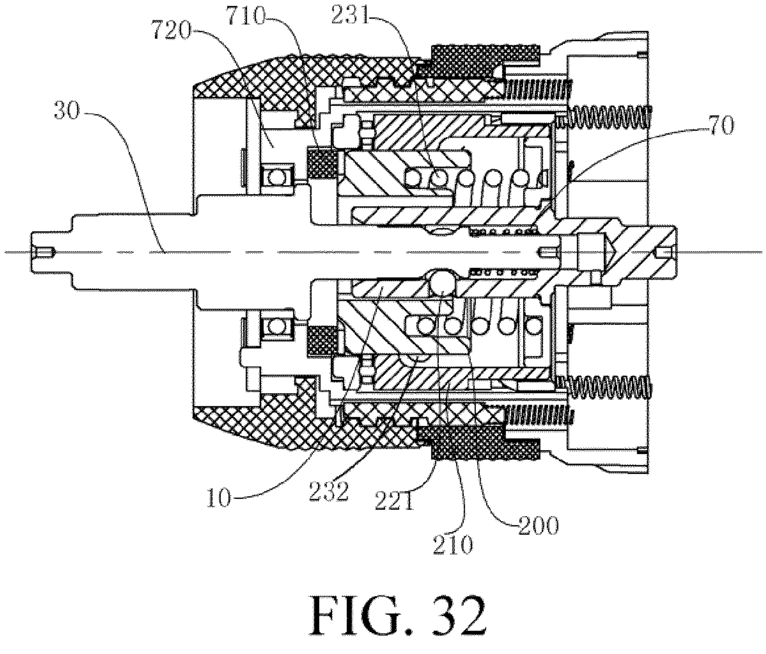
720
710
231
30
70
10
232
221
210
200

FIG. 32

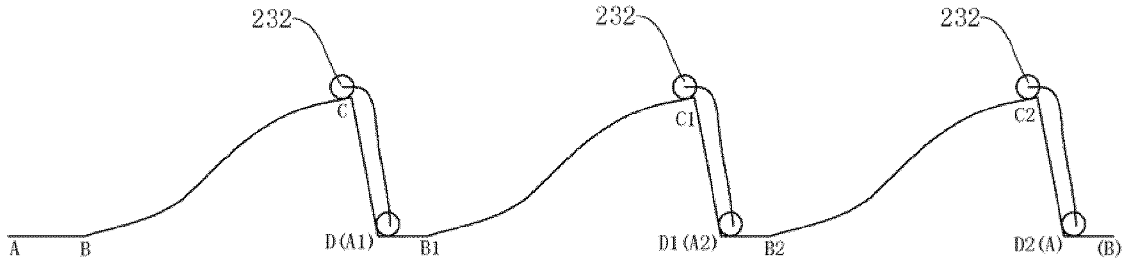
232
232
232
C
C1
C2
A
B
D(A1)
B1
D1(A2)
B2
D2(A)
(B)

FIG. 33

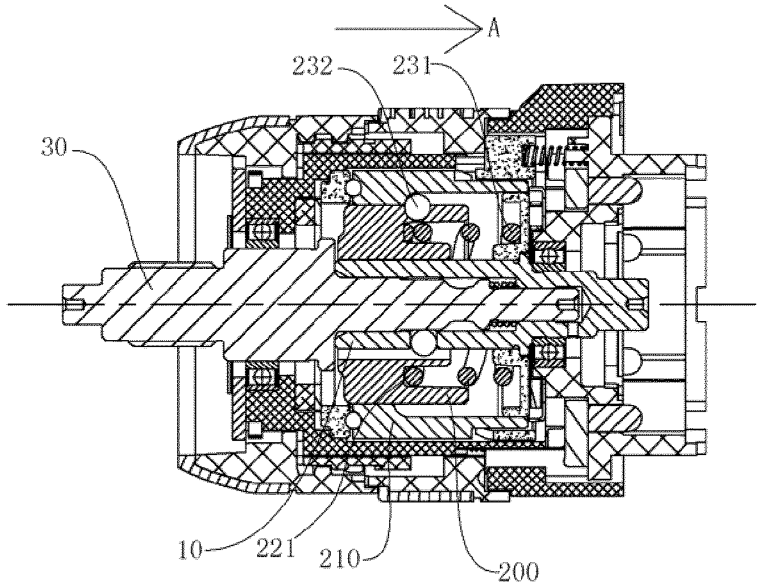
A
232
231
30
10
221
210
200

FIG. 34

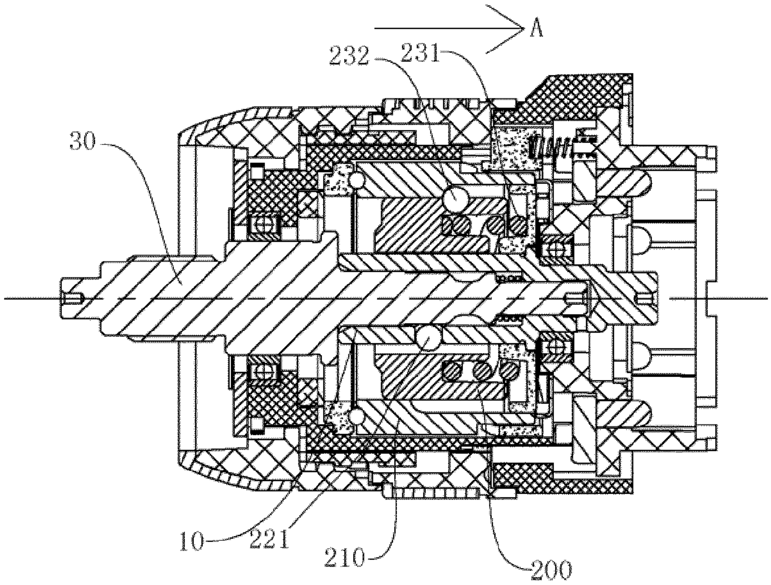

FIG. 35

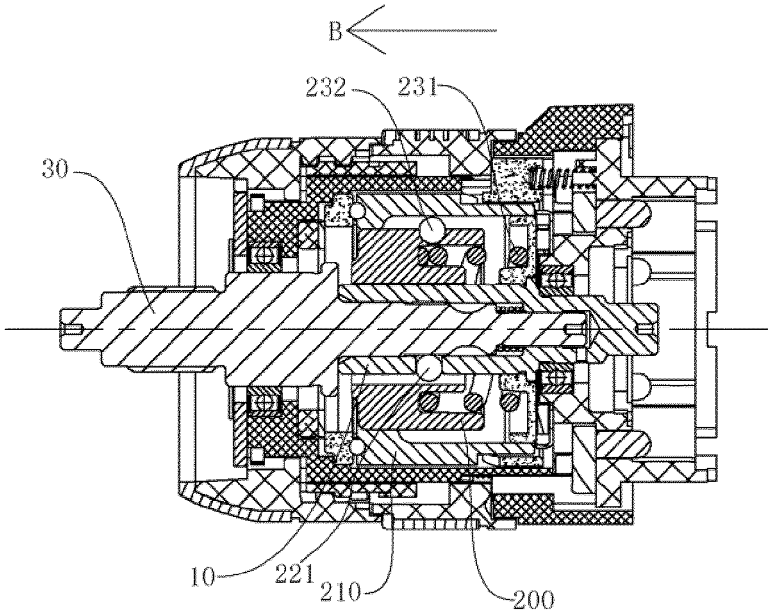

FIG. 36

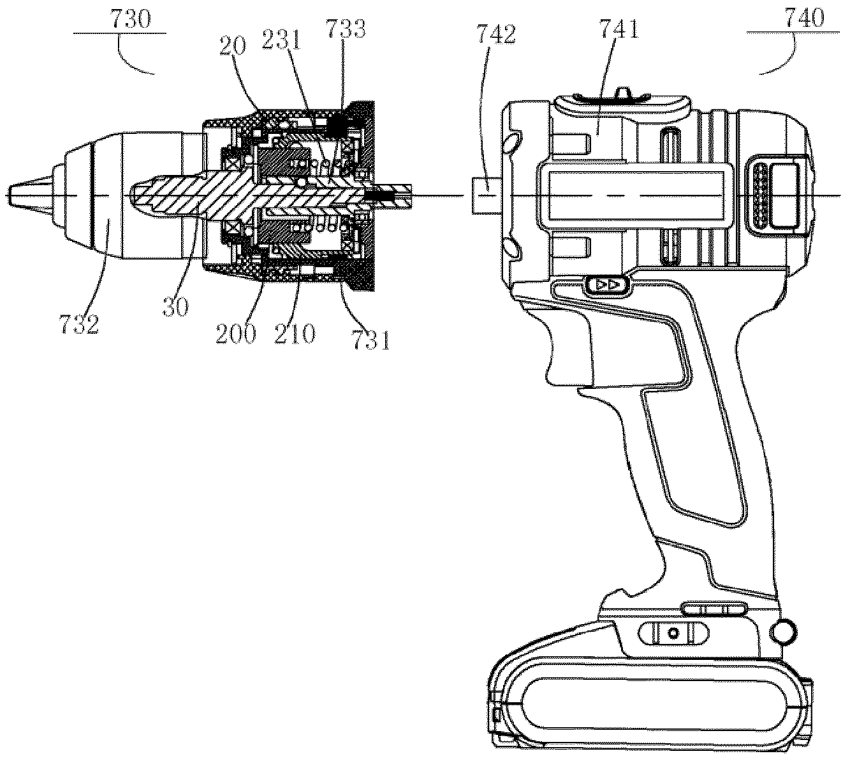

FIG. 37

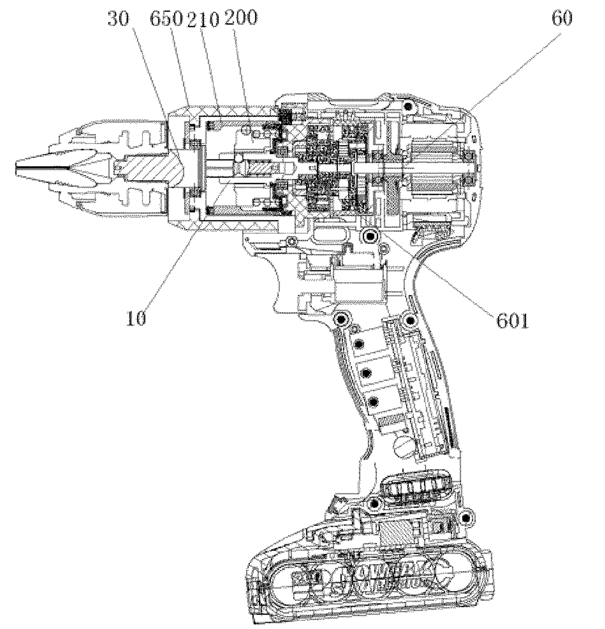

FIG. 38

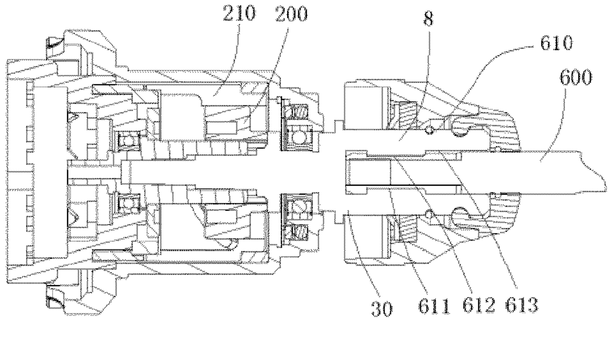

FIG. 39

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2014020921 A1 **[0003]**