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(54) POWER HEAD OF ROTARY DRILLING RIG AND ROTARY DRILLING RIG

(57) The present invention has disclosed a power head of a rotary drilling rig and a rotary drilling rig. The power head comprises a driving device, and a transmission device including an input shaft operatively connected with the driving device, a first output shaft operatively connected with a drilling rod of said rotary drilling rig and a second output shaft operatively connected with a casing driver of said rotary drilling rig, wherein the second output shaft has a first state, in which an output torque that of said second output shaft is greater than that of said first output shaft when said driving device drives said input shaft to rotate. When it is necessary to perform a full casing embedment, the power head may be manipulated to make the second output shaft be in the first state to output an output torque for driving the casing driver greater than an output torque for driving a drilling rod, so that a casing may be smoothly embedded by utilizing a built-in function of the rotary drilling rig, and a high construction efficiency can be achieved.

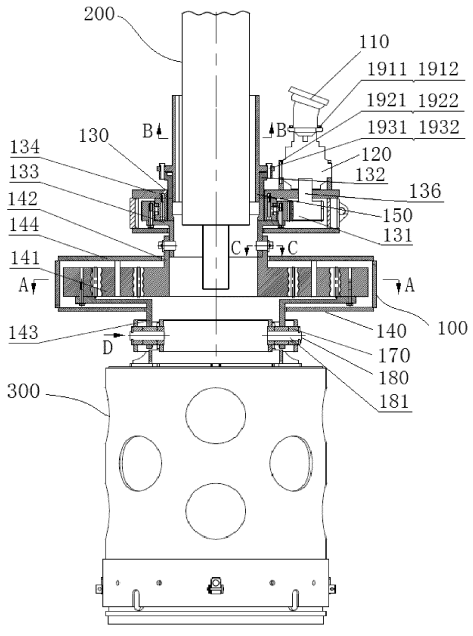

Fig. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to the field of drilling machinery, and in particular relates to a power head of a rotary drilling rig and a rotary drilling rig.

BACKGROUND ART

[0002] The rotary drilling rig with its efficient, fast, environmentally friendly, high-quality boring advantages attained rapid promotion and application. By cooperating with different drills, the rotary drilling rig may be adapted to construction of soil stratum as well as soft and hard stratums in most areas. The drilling manner of the rotary drilling rig generally adopts the wet-type rotary excavation construction method of a static slurry dado and the dry rotary excavation construction method without a stable liquid. For regional soft soil, marine silt stratum and several special strata, it is necessary to perform construction by a full casing rotary excavation construction method.

[0003] The construction by the full casing rotary excavation construction method is beneficial for the rotary drilling rig to improve the drilling efficiency and ensure the drilling quality, and the pile after concrete casting is not prone to such quality problems as necking, reinforcement exposure, and pile concrete segregation. With the gradual maturity of the full casing rotary excavation construction method, the full casing rotary excavation construction method continually gets promoted, in particular several European markets, almost all of which use the full casing rotary excavation construction method to perform rotary excavation construction. The differences between the full casing rotary excavation construction method and the wet-type rotary excavation construction method/dry rotary excavation construction method lie in that the dado uses a steel casing or a combination of a steel casing and a static slurry dado, and thus improves the adaptability of the rotary drilling rig for strata.

[0004] The full casing embedment is the core content of the full casing rotary excavation construction method. At present, the method for embedding a full casing mainly comprises three kinds, which are respectively embedment by a built-in function of a rotary drilling rig, embedment by utilizing a casing oscillator and embedment by utilizing a crawler crane cooperating with a vibration hammer.

[0005] The embedment by utilizing a built-in function of a rotary drilling rig is to pressurize the oil cylinder by utilizing an output torque of a power head of a rotary drilling rig to control the ascending and descending a casing so as to achieve full casing embedment. The process of embedding a full casing by utilizing a built-in function of a rotary drilling rig, which requires less auxiliary equipment and presents a high construction efficiency, is the most economic and the most convenient full casing embedment method at present.

[0006] However, the embedding a casing by utilizing a built-in function of a rotary drilling rig requires a power head to present an output torque that is large enough. For small rotary drilling rigs and large-bore drilling, when a casing is embedded by using an output torque of a power head of a rotary drilling rig itself, there are present with the problems that the construction efficiency is undesirable, the device is damaged in a large extent, and it is even impossible to effectuate driving the casing.

CONTENT OF THE INVENTION

[0007] The object of the present invention is to provide a power head of a rotary drilling rig and a rotary drilling rig, wherein the power head may output an output torque that is greater than an output torque when a drilling rod is driven so that a casing may be smoothly embedded by utilizing a built-in function of the rotary drilling rig, and a high construction efficiency can be achieved.

[0008] According to a first aspect of the present invention, there is provided a power head of a rotary drilling rig, comprising: a driving device, and a transmission device including an input shaft operatively connected with the driving device, a first output shaft operatively connected with a drilling rod of said rotary drilling rig and a second output shaft operatively connected with a casing driver of said rotary drilling rig; and wherein the second output shaft has a first state, in which an output torque of said second output shaft is greater than that of said first output shaft when said driving device drives said input shaft to rotate.

[0009] Further, said second output shaft has a second state, in which an output torque of said second output shaft is zero when said driving device drives said input shaft to rotate.

[0010] Further, said transmission device includes a first stage transmission portion including said input shaft, said first output shaft and an intermediate output shaft operatively connected with said input shaft, and a second stage transmission portion including an intermediate input shaft and said second output shaft operatively connected with said intermediate input shaft; and wherein in said first state said intermediate input shaft is connected to said intermediate output shaft; in said second state said intermediate input shaft is disengaged from said intermediate output shaft.

[0011] Further, said first stage transmission portion further includes a first gear transmission train for converting an input torque of said input shaft into an output torque of said first output shaft and an output torque of said intermediate output shaft.

[0012] Further, said first stage transmission portion further includes a transmission shaft, said input shaft is operatively connected to said transmission shaft by means of said first gear transmission train, and said first output shaft and said intermediate output shaft are connected to said transmission shaft.

[0013] Further, said first stage transmission portion further includes a first transmission case within which said first gear transmission train is located, and said input shaft, said first output shaft and said intermediate output shaft extend from the inside of said first transmission case.

[0014] Further, said first gear transmission train includes a first drive gear connected to said input shaft and a swiveling support including an inner ring and an outer ring having external teeth; and wherein said inner ring is fixed to said first transmission case, and said outer ring is engaged to said first drive gear and connected to said transmission shaft.

[0015] Further, said swiveling support further includes a rolling element disposed between said inner ring and said outer ring.

[0016] Further, said second stage transmission portion further includes a second gear transmission train for converting an input torque of said intermediate input shaft into an output torque of said second output shaft.

[0017] Further, said second stage transmission portion further includes a second transmission case within which said second gear transmission train is located, and said intermediate input shaft and said second output shaft extend from the inside of said second transmission case.

[0018] Further, said second gear transmission train includes a second drive gear, a planet gear and a ring gear having internal teeth, wherein said ring gear is sleeved on the outside of said second drive gear and said planet gear, a central axis of said planet gear is fixed relative to said second transmission case, and said planet gear is engaged to said second drive gear and said ring gear, said intermediate input shaft is connected to said second drive gear, and said second output shaft is connected to said ring gear.

[0019] Further, said power head further includes a first connection assembly, by means of which said intermediate input shaft and said intermediate output shaft are detachably connected.

[0020] Further, said power head further includes a casing driver connection device, by means of which said second output shaft and said casing driver are detachably connected.

[0021] Further, said casing driver connection device includes a transition body including a first connection portion for connection with said second output shaft and a second connection portion for connection with said casing driver, and a plurality of second connection assemblies, by means of one part of which said second output shaft and said first connection portion are detachably connected, and by means of the other part of which said second connection portion and said casing driver are detachably connected.

[0022] According to a second aspect of the present invention, there is provided a rotary drilling rig comprising a power head, wherein the power head is the power head according to any one of the first aspect of the present invention.

[0023] On the basis of the power head of a rotary drilling rig and the rotary drilling rig provided by the present invention, the power head comprises a driving device, and a transmission device including an input shaft operatively connected with the driving device, a first output shaft operatively connected with a drilling rod of said rotary drilling rig and a second output shaft operatively connected with a casing driver of said rotary drilling rig; the second output shaft has a first state, in which an output torque of said second output shaft is greater than that of said first output shaft when said driving device drives said input shaft to rotate. When it is necessary to perform a full casing embedment, the power head may be manipulated to make the second output shaft be in the first state to output an output torque for driving the casing driver greater than an output torque for driving a drilling rod, so that a casing may be smoothly embedded by utilizing a built-in function of the rotary drilling rig, and a high construction efficiency can be achieved.

[0024] Other features of the present invention and advantages thereof will become explicit by means of the following detailed descriptions of exemplary embodiments of the present invention with reference to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The drawings described herein are used to provide a further understanding of the present invention and constitute a part of the present application. The illustrative embodiments of the present invention as well as the descriptions thereof, which are used for explaining the present invention, do not constitute improper definitions on the present invention. In the drawings:

Fig. 1 is a schematic view of a sectional structure of a power head for a rotary drilling rig as well as a drilling rod and a casing driver operatively connected with the power head according to the embodiments of the present invention.

Fig. 2 is a schematic view of a local sectional structure of the power head according to the embodiment shown in Fig. 1.

Fig. 3 is a schematic view of a sectional structure of the power head in an A-A direction according to the embodiment shown in Fig. 1.

Fig. 4 is a schematic view of a sectional structure of the power head in a B-B direction according to the embodiment shown in Fig. 1.

Fig. 5 is a schematic view of a sectional structure of the power head in a C-C direction according to the embodiment shown in Fig. 1.

Fig. 6 is a schematic view of a sectional structure of a second output shaft of the power head according to the embodiment shown in Fig. 1.

Fig. 7 is a schematic view of a top-view structure with a local sectional structure of a transition body of the power head according to the embodiment shown in

Fig. 1.

Fig. 8 is a schematic view of a local structure of the power head in a D direction according to the embodiment shown in Fig. 1.

Fig. 9 is a schematic view of a structure of a casing driver connected to the power head according to the embodiment shown in Fig. 1.

[0026] In Fig. 1 to Fig. 9, various reference signs represent:

100, Power head; 110, Driving device; 120, Speed reducer; 130, First stage transmission portion; 131, First gear transmission train; 1311, First drive gear; 1312, Swiveling support; 1312A, Inner ring; 1312B, Outer ring; 1312C, Rolling element; 132, First output shaft; 133, Intermediate output shaft; 134, First transmission case; 135, Transmission shaft; 136, Input shaft; 1391, Bolt; 1392, Washer; 1393, Bolt; 1394, Washer; 140, Second stage transmission portion; 141, Second gear transmission train; 1411, Second drive gear; 1412, Planet gear; 1413, ring gear; 142, Intermediate input shaft; 143, Second output shaft; 1431, First bush; 144, Second transmission case; 1491, Bolt; 1492, Washer; 150, Drive sleeve; 151, Power head drive key; 160, First connection assembly; 161, First pin shaft; 162, Pin; 163, Cotter pin; 170, Transition body; 171, First bush mounting hole; 172, Second bush mounting hole; 173, Inside bush; 174, Outside bush; 180, Second connection assembly; 181, Second pin shaft; 182, Bolt; 183, Washer; 184, Collar; 1911, Bolt; 1912, Washer; 1921, Bolt; 1922, Washer; 1931, Bolt; 1932, Washer; 200, Drilling rod; 210, Drilling rod drive key; 300, Casing driver; 310, Second bush; 320, Casing connection part.

EMBODIMENTS

[0027] Next, the technical solution in the embodiments of the present invention will be explicitly and completely described in combination with the drawings in the embodiments of the present invention. Apparently, the described embodiments are merely part of the embodiments of the present invention, rather than all the embodiments. The following descriptions of at least one exemplary embodiment which are in fact merely descriptive, by no means serve as any delimitation on the present invention as well as its application or use. On the basis of the embodiments of the present invention, all the other embodiments acquired by a person skilled in the art on the premise that no inventive effort is involved fall into the protection scope of the present invention.

[0028] Unless additionally specified, the relative arrangements of the components and steps, numerical expressions and numerical values expounded in these examples do not limit the scope of the present invention. At the same time, it should be understood that, in order to facilitate the description, the dimensions of various parts shown in the drawings are not delineated according to actual proportional relations. Techniques, methods, and apparatuses known to a common technical person in the relevant art may not be discussed in detail, but where appropriate, techniques, methods, and apparatuses should be considered as part of the granted description. Among all the examples shown and discussed here, any specific value should be construed as being merely illustrative, rather than as a delimitation. Thus, other examples of exemplary embodiments may have different values. It should be noted that similar reference signs and letters present similar items in the following drawings, and therefore, once an item is defined in a drawing, there is no need for further discussion in the subsequent drawings.

[0029] In order to facilitate the description, spatial relative terms such as "on...", "above...", "at an upper surface of..." and "upper" may be used here, for describing spatial position relations of one device or feature with other devices or features as shown in the drawings. It should be understood that the spatial relative terms are intended to contain different orientations in use or operation other than the orientations of the devices described in the Figs. For example, if the device in the drawings is inverted, it is described in a way such that a device that is "above a further device or configuration" or "on a further device or configuration" will be afterwards positioned to be "below a further device or configuration" or "inferior to a further device or configuration". Thus, the exemplary term "above..." may include such two orientations as "above..." and "below...". The device may also be positioned and rotated 90 degrees in other ways or situated in other orientations, and the spatial relative descriptions used here are explained accordingly.

[0030] As shown in Fig. 1 to Fig. 9, the power head 100 provided by the present invention comprises a driving device 110 and a transmission device. The transmission device includes an input shaft 136 operatively connected with the driving device 110, a first output shaft 132 operatively connected with a drilling rod 200 of a rotary drilling rig and a second output shaft 143 operatively connected with a casing driver 300 of said rotary drilling rig. The second output shaft 143 has a first state, in which an output torque of said second output shaft 143 is greater than that of said first output shaft 132 when said driving device 110 drives said input shaft 136 to rotate.

[0031] When it is necessary to perform a full casing embedment, the power head 100 may be manipulated to make the second output shaft 143 be in the first state to output an output torque for driving the casing driver 300 greater than an output torque for driving a drilling rod 200, so that a casing may be smoothly embedded by utilizing a built-in function of the rotary drilling rig, and a high construction efficiency can be achieved.

[0032] The first stage transmission portion and the second stage transmission portion may be provided in series

in the transmission device, to effectuate that an output torque of the second output shaft is greater than that of the first output shaft by the second stage transmission portion increasing a torque relative to an output torque of the first stage transmission portion. It may also be effectuated that an output torque of the second output shaft is greater than that of the first output shaft in other manners, for example two transmission trains of different transmission ratios and output shafts corresponding to the two transmission trains are provided within the same transmission case to output different output torques.

[0033] Preferably, said second output shaft 143 has an second state, in which an output torque of second output shaft 143 is zero when said driving device 110 drives said input shaft 136 to rotate. By setting a second state, it may not affect normal rotary excavation construction of the rotary drilling rig when there is no need to drive the casing driver, and it is possible to reduce unnecessary power consumption of the power head 100.

[0034] The shift between the first state and the second state may be achieved in such a manner as to connect or disengage the first stage transmission portion and the second stage transmission portion. The shift between the first state and the second state may also be achieved in other manners, for example, in the case where the input shaft and the second output shaft are driven by a plurality of gears, the shift between the first state and the second state may be achieved in such a manner as to control engagement or disengagement of all or partial gears in the plurality of gears.

[0035] The power head of a rotary drilling rig and the rotary drilling rig according to the embodiments of the invention will be explained below in combination with Fig. 1 to Fig. 9.

[0036] Fig. 1 is a schematic view of a sectional structure of a power head 100 for a rotary drilling rig as well as a drilling rod 200 and a casing driver 300 operatively connected with the power head 100 according to the embodiments of the present invention.

[0037] As shown in Fig. 1, the power head 100 of the rotary drilling rig of the present embodiment includes a driving device 110, a speed reducer 120, a transmission device, a drive sleeve 150, a first connection assembly 160, and a casing driver connection device.

[0038] As shown in Fig. 1, the driving device 110 is a power source of the power head 100. In the present embodiment, the driving device 110 is a hydraulic motor.

[0039] The input shaft of the speed reducer 120 is connected to the output shaft of the hydraulic motor. Since the output shaft of the hydraulic motor has a high rotation speed, after one-stage speed reduction is realized by the speed reducer 120, the speed of the output shaft of the speed reducer 120 is reduced with respect to the speed of the input shaft of the speed reducer 120, and the torque is increased.

[0040] In the present embodiment, the housing of the hydraulic motor is fixed to the housing of the speed reducer 120 by means of bolts 1911 and washers 1912.

[0041] Fig. 2 is a schematic view of a local sectional structure of the power head 100 according to the embodiment shown in Fig. 1, in which the structure of the transmission device is shown. The transmission device is used for converting an output torque of the speed reducer 120 into an output torque of the power head 100 for driving the drilling rod 200 and for driving the casing driver 300.

[0042] As shown in Fig. 1 and Fig. 2, the transmission device includes a first stage transmission portion 130 and a second stage transmission portion 140.

[0043] The first stage transmission portion 130 includes a first gear transmission train 131, a first output shaft 132, an intermediate output shaft 133, a first transmission case 134, a transmission shaft 135, and an input shaft 136. The first gear transmission train 131 is located within the first transmission case 134. The input shaft 136, the first output shaft 132, and the intermediate output shaft 133 respectively extend from the inside of the first transmission case 134.

[0044] The speed reducer 120 is fixed to the first transmission case 134 by bolts 1921 and washers 1922. The input shaft 136 is connected to the output shaft of the speed reducer 120 so as to be operatively connected with the driving device 110.

[0045] The first output shaft 132 is operatively connected with a drilling rod 200 of said rotary drilling rig. The intermediate output shaft 133 is used for providing power to the second gear transmission train 140 when the power head 100 drives the casing driver 300.

[0046] The first gear transmission train 131 is used for converting an input torque of said input shaft 136 into an output torque of said first output shaft 132 and an output torque of said intermediate output shaft 133. The first gear transmission train 131 is operatively connected to the transmission shaft 135, and the first output shaft 132 and the intermediate output shaft 133 are connected to the transmission shaft 135.

[0047] The first gear transmission train 131 includes a first drive gear 1311 and a swiveling support 1312. The swiveling support 1312 includes an inner ring 1312A, an outer ring 1312B having external teeth, and a rolling element 1312C.

[0048] The first drive gear 1311 is connected to a lower end of the input shaft 136. In the present embodiment, the first drive gear 1311 and the input shaft 136 are integrally structured. The upper end of the input shaft 136 is provided with splines and driven by the lower end of the output shaft of the speed reducer 120 by depending on spline engagement.

[0049] The inner ring 1312A is fixed to the first transmission case 134 by bolts 1393 and washers 1394. The outer ring 1312B is engaged with the first drive gear 1311, and the outer ring 1312B is fixed to the transmission shaft 135.

[0050] The rolling element 1312C is provided between the inner ring 1312A and the outer ring 1312B. The rolling element 1312C may be a ball, a roller or a needle roller. The outer ring 1312B and the transmission shaft 135 are

born on the inner ring 1312A and the first transmission case 134, and the rolling element 1312C can reduce a frictional force between the inner ring 1312A and the outer ring 1312B.

[0051] The first output shaft 132 has a first flange, and the first flange of the first output shaft 132 and the outer ring 1312B of the swiveling support 1312 are fixed by bolts 1391 and washers 1392. The upper end of the transmission shaft 135 on the swiveling support 1312 is fixed to the lower end of the first output shaft 132 in a welded manner, and the lower end of the transmission shaft 135 on the swiveling support 1312 is fixed to the lower end of the intermediate output shaft 133 in a welded manner. Thus, in the present embodiment, the rotational speeds and the output torques of the transmission shaft 135, the first output shaft 132, and the intermediate output shaft 133 are the same.

[0052] Fig. 3 is a schematic view of a sectional structure of the power head 100 in an A-A direction according to the embodiment shown in Fig. 1, in which the structure of the second stage transmission portion 140 is shown. The second stage transmission portion 140 is used for effectuating that an output torque of the second output shaft 143 is greater than that of the first output shaft 132.

[0053] As shown in Fig. 1 to Fig. 3, the second stage transmission portion 140 includes a second gear transmission train 141, an intermediate input shaft 142, a second output shaft 143, and a second transmission case 144. The second gear transmission train 141 is located within the second transmission case 144. The intermediate input shaft 142 and the second output shaft 143 extend from the inside of the second transmission case 144.

[0054] The intermediate input shaft 142 is connected with the intermediate output shaft 133 to receive power from the intermediate output shaft 133. In the present embodiment, a detachable connection between the intermediate input shaft 142 and the intermediate output shaft 133 is realized by the first connection assembly 160.

[0055] The second output shaft 143 is operatively connected with a casing driver 300 of said rotary drilling rig. In Fig. 1, the second output shaft 143 is in a connected state with the casing driver 300. The second output shaft 143 is connected to the casing driver 300 by means of a casing driver connection device.

[0056] The second gear transmission train 141 is used for converting an input torque of the intermediate input shaft 142 to an output torque of the second output shaft 143.

[0057] The second gear train 141 includes a second drive gear 1411, planet gears 1412, and a ring gear 1413.

[0058] The ring gear 1413 has internal teeth. The ring gear 1413 is sleeved on the outside of the second drive gear 1411 and the planet gears 1412, the second drive gear 1411 has external teeth, a central axis of the planet gear 1412 is fixed relative to the second transmission case 144, and the planet gears 1412 are respectively engaged to the second drive gear 1411 and the ring gear 1413.

[0059] The intermediate input shaft 142 is connected to the second drive gear 1411. In the present embodiment, the intermediate input shaft 142 is integrally formed with the second drive gear 1411.

[0060] The second output shaft 143 is connected to the ring gear 1413. In the present embodiment, the second output shaft 143 has a second flange, the ring gear 1413 is provided with a threaded hole, and the second flange is fixed to the ring gear 1413 by bolts 1491 and washers 1492.

[0061] In the present embodiment, the first output shaft 132 and the intermediate output shaft 133 are in synchronous rotation, and when the intermediate output shaft 133 is connected to the intermediate input shaft 142, the input torque of the intermediate input shaft 142 in synchronous rotation with the intermediate output shaft 133 is converted by the second gear transmission train 141 into the output torque of the second output shaft 143 greater than the output torque of the first output shaft 132. A desired output torque of the second output shaft 143 may be acquired by providing a proper transmission ratio of the second gear transmission train 141. For example, the output torque of the second output shaft 143 may be made to reach twice or more the output torque of the first output shaft 132, so that the output torque of the power head 100 is multiplied to meet the power demand at the time of a full casing embedment.

[0062] Fig. 4 is a schematic view of a sectional structure of the power head 100 in a B-B direction according to the embodiment shown in Fig. 1, in which the structures of the drive sleeve 150 and the drilling rod 200 are shown. The drive sleeve 150 is used for driving the drilling rod 200 of the rotary drilling rig to rotate.

[0063] As shown in Fig. 1, the upper end of the drive sleeve 150 is fixed to the lower end of the first output shaft 132 by bolts 1931 and washers 1932.

[0064] As shown in Fig. 1 and Fig. 4, the inner wall of the drive sleeve 150 is fixed with a plurality of power head drive keys 151 axially provided along the drive sleeve 150. Correspondingly, the shank of the drilling rod 200 is fixed with a plurality of drilling rod drive keys 210 axially provided along the drilling rod 200. After the drilling rod 200 is assembled with the power head 100, the plurality of power head drive keys 151 and the plurality of drilling rod drive keys 210 are alternately arranged in a circumferential direction. Thus, the rotation of the first output shaft 132 may drive the drive sleeve 150 to rotate, and rotation of the drilling rod may be driven by engaging the plurality of power head drive keys 151 with the plurality of drilling rod drive keys 210 when the drive sleeve 150 rotates.

[0065] Fig. 5 is a schematic view of a sectional structure of the power head 100 in a C-C direction according to the embodiment shown in Fig. 1, in which the structure of the first connection assembly 160 is shown. The first connection assembly 160 is used for realizing a detachable connection between the intermediate input shaft 142

and the intermediate output shaft 133.

[0066] As shown in Fig. 1 and Fig. 5, the first connection assembly 160 includes a first pin shaft 161, a pin 162, and a cotter pin 163.

[0067] The lateral face of an end of the first pin shaft 61 has a stopper protrusion. When the intermediate output shaft 133 and the intermediate input shaft 142 are connected, the intermediate input shaft 142 is sleeved on the outside of the intermediate output shaft 133. Then, an end of the first pin shaft 61 which is not provided with the stopper protrusion is sequentially passed through the intermediate input shaft 142 and the intermediate output shaft 133. The intermediate input shaft 142 is provided with a pin holder at both sides of the pin shaft hole thereof. After the first pin shaft 61 is inserted, the pin 162 is inserted onto the pin holder so that the pin 162 is exactly stopped axially outside one end of the first pin shaft which is provided with the stopper protrusion, so as to prevent disengagement of the first pin shaft 61. Finally, a cotter pin 163 is inserted at a tail of the pin 162 to prevent that the pin 162 is disengaged from the pin holder.

[0068] With the first connection assembly 160, it is possible to effectuate quick connection and quick disengagement of the intermediate output shaft 133 and the intermediate input shaft 142, and improve the operational efficiency.

[0069] Fig. 6 is a schematic view of a sectional structure of a second output shaft 143 of the power head 100 according to the embodiment shown in Fig. 1. Fig. 7 is a schematic view of a top-view structure with a local sectional structure of a transition body 170 of the power head 100 according to the embodiment shown in Fig. 1. Fig. 8 is a schematic view of a local structure of the power head 100 in a D direction according to the embodiment shown in Fig. 1. Fig. 8 shows a mounting structure of the second connection assembly 180. Fig. 9 is a schematic view of a structure of a casing driver 300 connected to the power head 100 according to the embodiment shown in Fig. 1.

[0070] Fig. 6 to Fig. 9 show the structures of the second output shaft 143, the casing driver connection device, and the casing driver 300, as well as the connection relations therebetween. The casing driver connection device is used for connecting the second output shaft 143 and the casing driver 300.

[0071] As shown in Fig. 1, Fig. 6 to Fig. 9, the casing driver connection device comprises a transition body 170 and a second connection assembly 180.

[0072] The transition body 170 includes a first connection portion for connection with said second output shaft 143 and a second connection portion for connection with said casing driver 300, and said second output shaft 143 and said first connection portion are connected by means of a plurality of second connection assemblies 180, and said second connection portion and said casing driver 300 are connected by means of a plurality of second connection assemblies 180.

[0073] As shown in Fig. 1 and Fig. 6, the second output shaft 143 is a hollow shaft, the second output shaft includes two first bushes 1431 disposed on a shaft wall of the hollow shaft at an interval of 180 degrees, and the two first bushes 1431 are radially provided along the second output shaft 143.

[0074] As shown in Fig. 1 and Fig. 7, in the present embodiment, the transition body 170 presents an annular structure having an "H" cross-sectional shape substantially. The annular structure comprises an inner cylinder, an outer cylinder and an annular plate. The inner cylinder and the outer cylinder are arranged concentrically and respectively provided with a short cylinder shape; the annular plate connected between an outer wall of the inner cylinder and an inner wall of the outer cylinder.

[0075] The first connection portion comprises two first bush mounting holes 171 disposed on the annular plate at an interval of 180 degrees, two inside bushes 173 disposed on the inner cylinder at an interval of 180 degrees and two outside bushes 174 disposed on the outer cylinder at an interval of 180 degrees. Each inside bush 173 is provided inside a first bush mounting hole 171, each outside bush 174 is provided outside a first bush mounting hole 171. The inside bush 173 and the outside bush 174 located inside and outside same first bush mounting hole 171 are coaxial and radially provided along the annular structure.

[0076] When the second output shaft 143 is connected to the transition body 170, the two first bushes 1431 bearing the second output shaft 143 are correspondingly fitted into the two first bush mounting holes 171 of the transition body 170, respectively, so that the inside bush 173 and the outside bush 174 at both sides of each of the bush mounting holes 171 are aligned with a corresponding first bush 1431. Then, the second output shaft 143 and the transition body 170 may be connected together by the second connection assembly 180 connecting the outside bush 174, the first bush 1431 and the inside bush 173 after alignment.

[0077] As shown in Fig. 1 and Fig. 8, each second connection assembly 180 includes a second pin shaft 181, a bolt 182, a washer 183, and a collar 184. A collar mounting slot is provided at radial outside at an end of the second pin shaft 181. The collar 184 consists of two half rings, each of which is provided with two through holes. Four threaded holes corresponding to four through holes on the two half rings are provided at a radial outer end of each outside bush 174 on the outer cylinder of the transition body 170.

[0078] When the outside bush 174 outside the first bush mounting hole 171, the first bush 1431 and the corresponding inside bush 173 are connected by the second connection assembly 180, an end of the second pin shaft 181 which is not provided with the collar mounting slot is sequentially inserted into first the outside bush 174, the first bush 1431 and the inside bush 173, then two half rings of the collar 184 are clamped into the collar mounting slot, and the two half rings are respectively connected to the outside bush 174 by means of four groups of bolts

182 and washers 183.

[0079] The second connection portion comprises two second bush mounting holes 172 disposed on the annular plate at an interval of 180 degrees, two inside bushes 173 disposed on the inner cylinder at an interval of 180 degrees and two outside bushes 174 disposed on the outer cylinder at an interval of 180 degrees. The two first bush mounting holes 171 are alternately arranged with the two second bush mounting holes 172, and the adjacent first bush mounting holes 171 and second bush mounting holes 172 are at an interval of 90 degrees therebetween. Each inside bush 173 is provided inside a second bush mounting hole 172, each outside bush 174 is provided outside a first bush mounting hole 172. The inside bush 173 and the outside bush 174 located inside and outside the same second bush mounting hole 172 are coaxially and radially provided along the annular structure.

[0080] As shown in Fig. 9, the top end of the casing driver 300 is provided with two second bushes 310 at an interval of 180 degrees, and the two second bushes 310 are radially provided along the casing driver 300. A casing connection part 320 for connecting a casing onto the casing driver 300 is provided at the bottom of the casing driver 300.

[0081] When the casing driver 300 is connected to the transition body 170, as long as the two second bushes 310 are correspondingly fitted into the two second bush mounting holes 172 of the transition body 170, respectively, so that the inside bush 173 and the outside bush 174 at both sides of each of the bush mounting holes 172 are aligned with a corresponding second bush 310, the transition body 170 and the casing driver 300 may be connected together by second connection assembly 180 connecting the outside bush 174, the second bush 310 and the inside bush 173 after alignment so as to effectuate connection of the second output shaft 143 and the casing driver 300.

[0082] The process of connecting the outside bush 174 outside the second bush mounting hole 172, the second bush 310 and the corresponding inside bush 173 by means of the second connection assembly 180 is the same as the process of connecting the outside bush 174 outside the first bush mounting hole 171, the first bush 1431 and the corresponding inside bush 173 by means of the second connection assembly 180, and thus will be not be repeated here.

[0083] In addition, the present embodiment also provides a rotary drilling rig including the power head 100 described above.

[0084] When the rotary drilling rig applies a common construction method for construction, the transmission device only uses the first transmission portion 130, within which the first gear transmission train 131 may reduce an output speed and increase an output torque, to achieve the parameter design requirements needed when the rotary drilling rig performs a common drilling. Among them, the first gear transmission train 131 is operatively connected to the first output shaft 132 and the intermediate output shaft 133, and the first output shaft 132 is rigidly connected to the drive sleeve 150 so that the output torque and speed of the drive sleeve 150 respectively keep consistent with the output torque and speed of the first output shaft 132. In other words, the hydraulic motor drives the first gear transmission train 131 by means of the speed reducer 120 and transmits a torque and speed through the first output shaft 132 and the drive sleeve 150 to the drilling rod 200 so as to drive the drilling rod 200 to rotate and realize a common drilling function of the rotary drilling rig. At this time, the rotary drilling rig performs construction with its own standard torque.

[0085] When it is necessary to perform full casing embedment, the intermediate output shaft 133 of the first gear transmission train 131 is connected to the intermediate input shaft 142 to thereby add the second stage transmission portion 140 to the transmission device. The second gear transmission train 141 of the second stage transmission portion 140 may further reduce a speed output by the first gear transmission train 131, and at the same time increase an output torque to achieve the requirement of increasing a torque of the rotary drilling rig. The hydraulic motor drives two sets of gears of the first gear transmission train 131 and the second gear transmission train 141 by means of the speed reducer 120, to transmit a torque and speed through the second output shaft 143 to the casing driver 300. At this time, the rotary drilling rig performs construction with an increased construction torque on the basis of own standard torque.

[0086] Since the first stage transmission portion 130 and the second stage transmission portion 140 may be completely disengaged, normal rotary excavation construction of the rotary drilling rig may not be affected when the power head 100 is not required to drive the casing driver 300 to perform a full casing embedment.

[0087] Finally, it should be explained that: the aforementioned embodiments are only used to describe the technical solution of the present invention rather than limiting the same; although detailed explanations are made to the present invention by referring to preferred embodiments, a common technical person in the art should understand that: it is still possible to make amendments to the embodiments of the present invention or make equivalent replacements to part of the technical features; without departing from the spirit and scope of the present invention, they should all be covered in the scope of the technical solution for which protection is sought in the present invention.

Claims

1. A power head of a rotary drilling rig, comprising:

a driving device (110), and
a transmission device including an input shaft

(136) operatively connected with the driving device (110), a first output shaft (132) operatively connected with a drilling rod (200) of said rotary drilling rig and a second output shaft (143) operatively connected with a casing driver (300) of said rotary drilling rig; and
wherein the second output shaft (143) having a first state, in which an output torque of said second output shaft (143) is greater than that of said first output shaft (132) when said driving device (110) drives said input shaft (136) to rotate.

2. The power head according to claim 1, wherein said second output shaft (143) having a second state, in which an output torque of said second output shaft (143) is zero when said driving device (110) drives said input shaft (136) to rotate.

3. The power head according to claim 2, wherein said transmission device includes:

a first stage transmission portion (130) including said input shaft (136), said first output shaft (132) and an intermediate output shaft (133) operatively connected with said input shaft (136), and a second stage transmission portion (140) including an intermediate input shaft (142) and said second output shaft (143) operatively connected with said intermediate input shaft (142); and
wherein in said first state, said intermediate input shaft (142) is connected to said intermediate output shaft (133); in said second state, said intermediate input shaft (142) is disengaged from said intermediate output shaft (133).

4. The power head according to claim 3, wherein said first stage transmission portion (130) further includes a first gear transmission train (131) for converting an input torque of said input shaft (136) into an output torque of said first output shaft (132) and an output torque of said intermediate output shaft (133).

5. The power head according to claim 4, wherein said first stage transmission portion (130) further includes a transmission shaft (135), said input shaft (136) is operatively connected to said transmission shaft (135) by means of said first gear transmission train (131), and said first output shaft (132) and said intermediate output shaft (133) are connected to said transmission shaft (135).

6. The power head according to claim 5, wherein said first stage transmission portion (130) further includes a first transmission case (134) within which said first gear transmission train (131) is located, and said input shaft (136), said first output shaft (132) and said intermediate output shaft (133) extend from the inside of the said first transmission case (134).

7. The power head according to claim 6, wherein said first gear transmission train (131) includes:

a first drive gear (1311) connected to said input shaft (136), and
a swiveling support (1312) including an inner ring (1312A) and an outer ring (1312B) having external teeth; and
wherein said inner ring (1312A) is fixed to said first transmission case (134), and said outer ring (1312B) is engaged to said first drive gear (1311) and connected to said transmission shaft (135).

8. The power head according to claim 7, wherein said swiveling support (1312) further includes a rolling element (1312C) disposed between said inner ring (1312A) and said outer ring (1312B).

9. The power head according to claim 3, wherein said second stage transmission portion (140) further includes a second gear transmission train (141) for converting an input torque of said intermediate input shaft (142) into an output torque of said second output shaft (143).

10. The power head according to claim 9, wherein said second stage transmission portion (140) further includes a second transmission case (144) within which said second gear transmission train (141) is located, and said intermediate input shaft (142) and said second output shaft (143) extend from the inside of said second transmission case (144).

11. The power head according to claim 10, wherein said second gear transmission train (141) includes a second drive gear (1411), a planet gear (1412) and a ring gear (1413) having internal teeth, wherein said ring gear (1413) is sleeved on the outside of said second drive gear (1411) and said planet gear (1412), a central axis of said planet gear (1412) is fixed relative to said second transmission case (144), and said planet gear (1412) is engaged to said second drive gear (1411) and said ring gear (1413), said intermediate input shaft (142) is connected to said second drive gear (1411), and said second output shaft (143) is connected to said ring gear (1413).

12. The power head according to claim 3, wherein said power head further includes a first connection assembly (160), by means of which said intermediate input shaft (142) and said intermediate output shaft (133) are detachably connected.

13. The power head according to claim 1, wherein said power head further includes a casing driver connection device, by means of which said second output

shaft (143) and said casing driver (300) are detachably connected.

14. The power head according to claim 13, wherein said casing driver connection device includes:

a transition body (170) including a first connection portion for connection with said second output shaft (143) and a second connection portion for connection with said casing driver (300), and a plurality of second connection assemblies (180), by means of one part of which said second output shaft (143) and said first connection portion are detachably connected, and by means of the other part of which said second connection portion and said casing driver (300) are detachably connected.

15. A rotary drilling rig comprising a power head, wherein the power head is the power head according to claim 1.

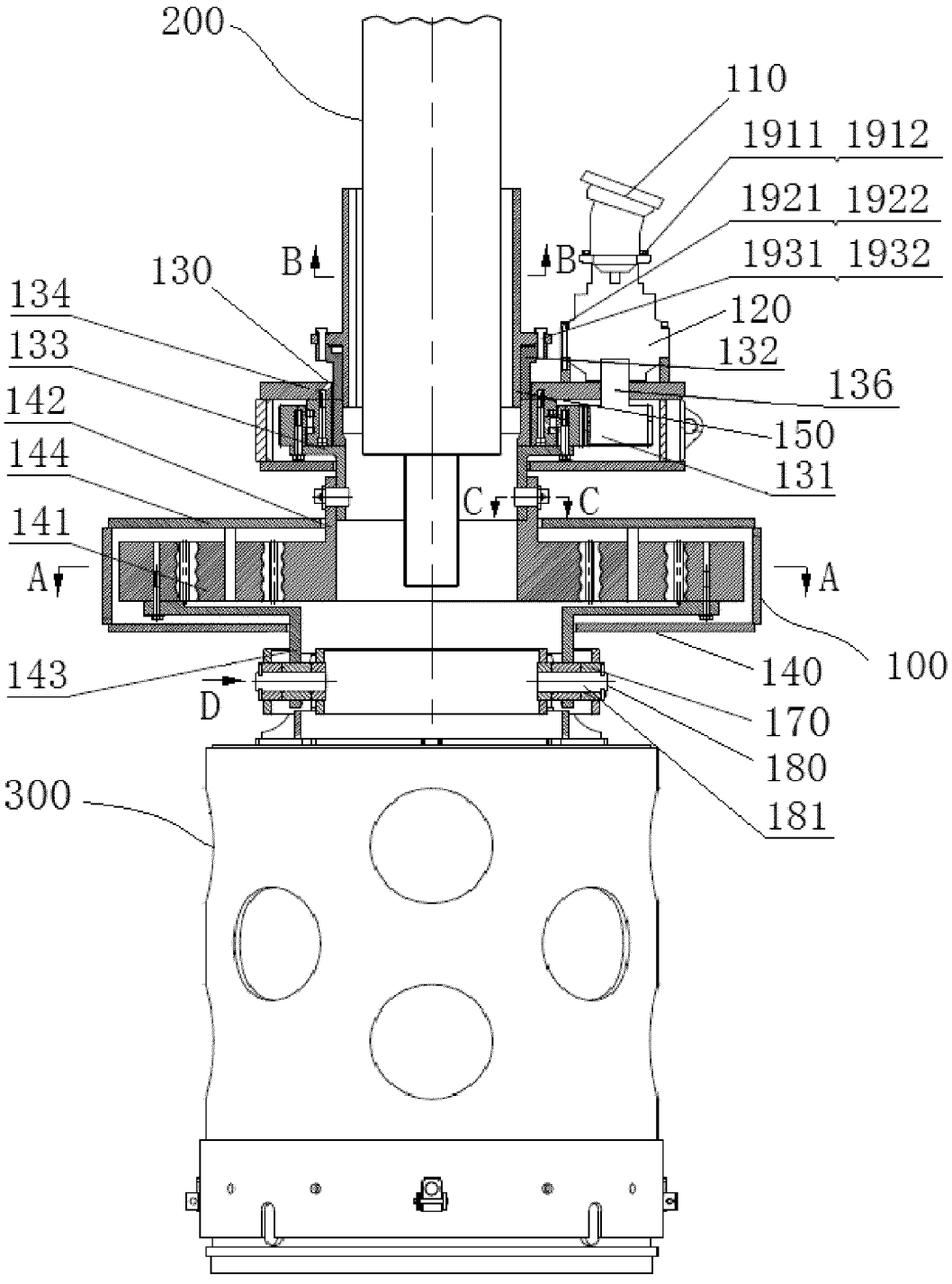
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Fig. 1

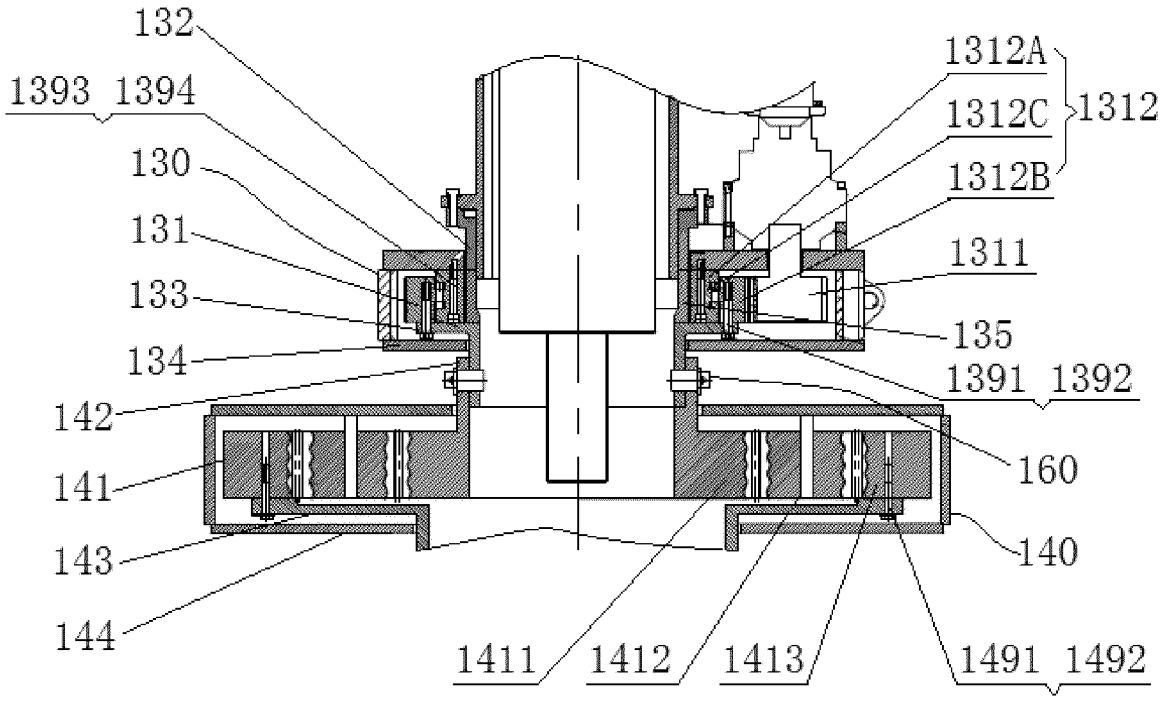
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Fig. 2

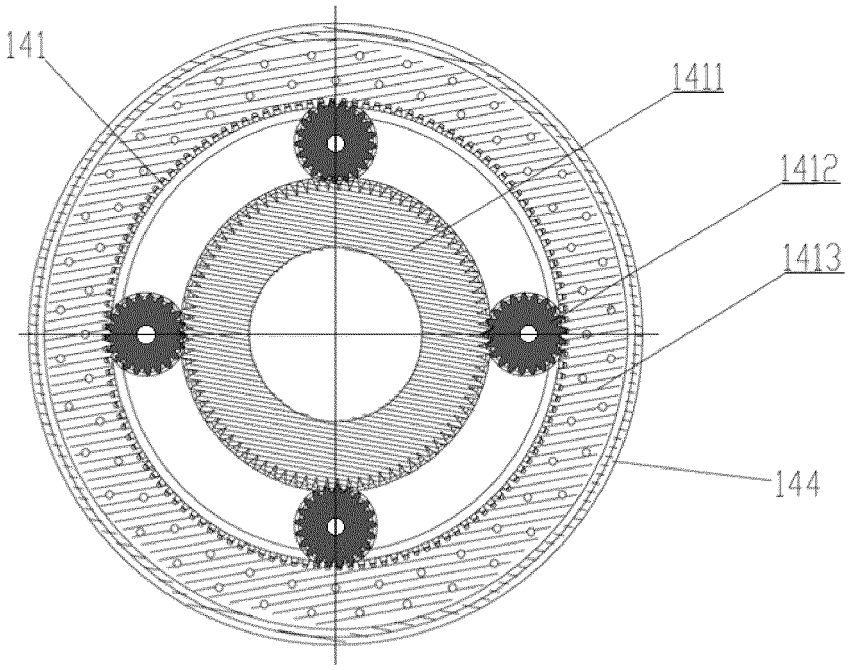
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Fig. 3

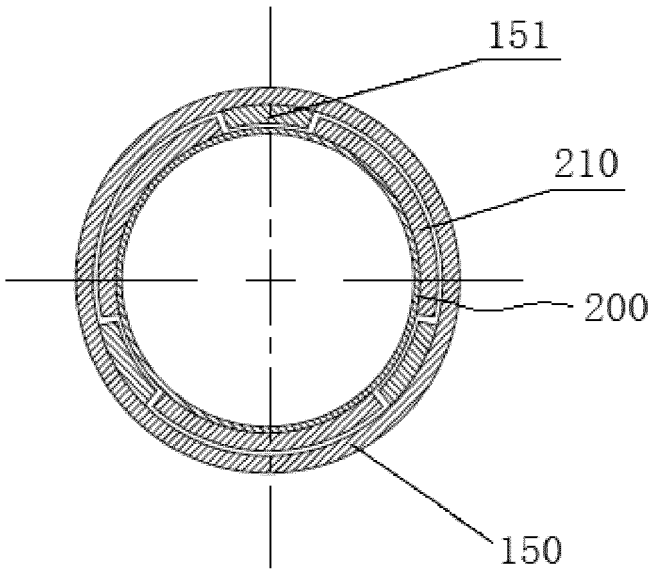

Fig. 4

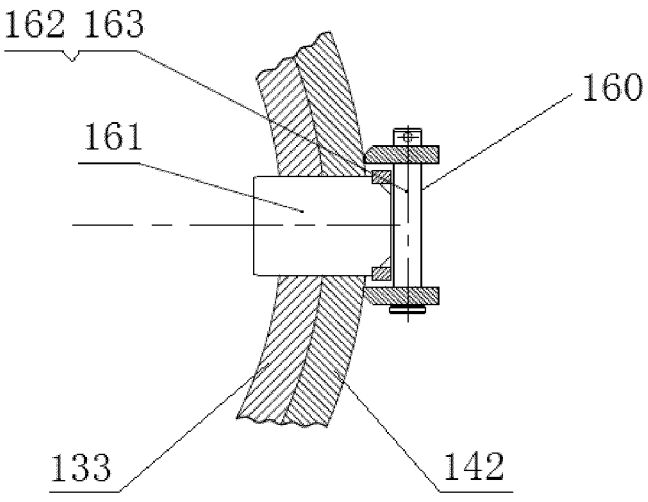

Fig. 5

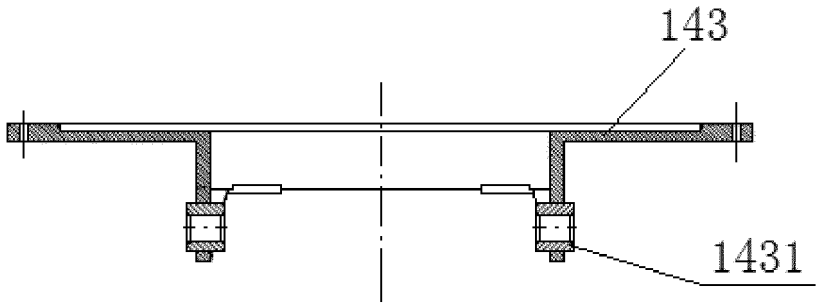

Fig. 6

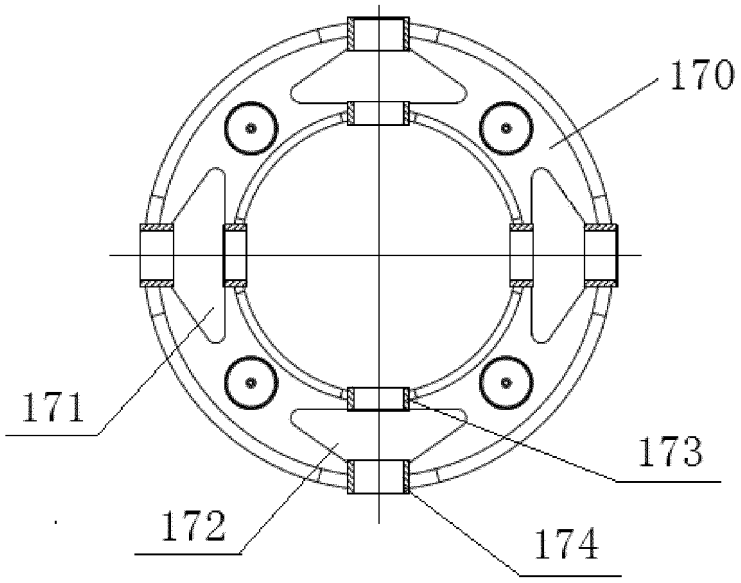

Fig. 7

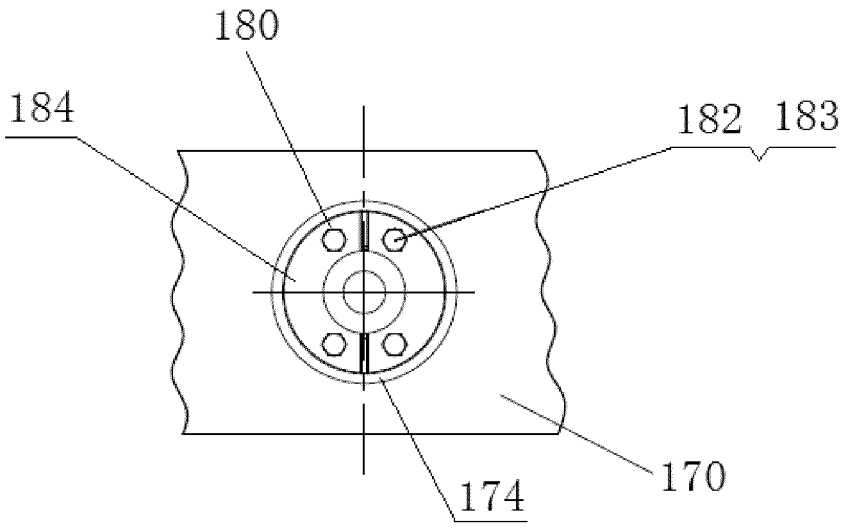

Fig. 8

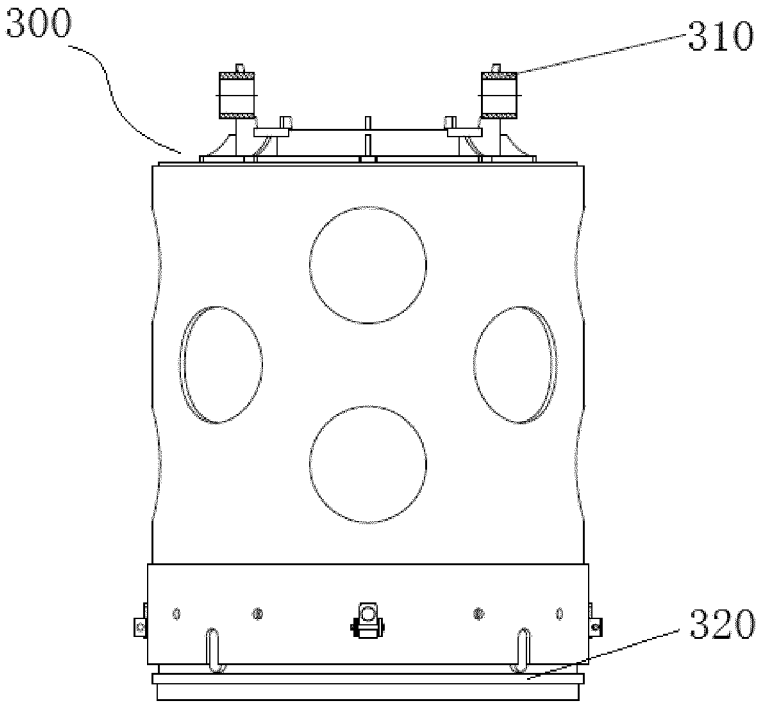

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2015/078648

A. CLASSIFICATION OF SUBJECT MATTER

E21B 7/20 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E21B; E02D

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

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

EPODOC, WPI, CNPAT, CNKI: Xuzhou Construction Machinery, SANY; rotary pile, drill pipe, power, rotary, drill???, sleeve?, driv???, shaft, axis, axes, increas+, enhanc+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 203463005 U (QIN, Bingde), 05 March 2014 (05.03.2014), description, paragraphs 33-36, and figures 1-4	1-15
A	CN 204098784 U (BEIJING SANY HEAVY MACHINERY CO., LTD.), 14 January 2015 (14.01.2015), the whole document	1-15
A	CN 203145004 U (KONG, Chao et al.), 21 August 2013 (21.08.2013), the whole document	1-15
A	CN 101086160 A (XU, Changyun), 12 December 2007 (12.12.2007), the whole document	1-15
A	CN 203808822 U (ZHENGZHOU YUTONG HEAVY INDUSTRIES CO., LTD.), 03 September 2014 (03.09.2014), the whole document	1-15
A	CN 104141455 A (SHANGHAI ZOOMLION PILE FOUNDATION MACHINERY CO., LTD. et al.), 12 November 2014 (12.11.2014), the whole document	1-15
A	CN 203742442 U (HUBEI WILLPOWER MACHINERY CO., LTD. et al.), 30 July 2014 (30.07.2014), the whole document	1-15

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

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"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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

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

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

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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 January 2016 (13.01.2016)	**25 January 2016 (25.01.2016)**
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer **FENG, Junhua** Telephone No.: (86-10) **010-61648170**

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2015/078648

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2008/121004 A1 (FLEXIDRILL LTD. Et al.), 09 October 2008 (09.10.2008), the whole document	1-15

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2015/078648

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 203463005 U	05 March 2014	None	
CN 204098784 U	14 January 2015	None	
CN 203145004 U	21 August 2013	None	
CN 101086160 A	12 December 2007	None	
CN 203808822 U	03 September 2014	None	
CN 104141455 A	12 November 2014	None	
CN 203742442 U	30 July 2014	None	
WO 2008/121004 A1	09 October 2008	CA 2676263 A1	09 October 2008
		NZ 554256 A	27 November 2009
		US 2010/0139984 A1	10 June 2010

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