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(71) Applicants:
- **Shanghai Marine Diesel Engine Research Institute**
  Shanghai 201108 (CN)
- **Shanghai Qiyao Screw Machinery Co. Ltd.**
  Shanghai 201108 (CN)

(72) Inventors:
- **DIAO, Anna**
  Shanghai 201108 (CN)
- **XU, Mingzhao**
  Shanghai 201108 (CN)
- **CUI, Youzhi**
  Shanghai 201108 (CN)
- **YU, Li**
  Shanghai 201108 (CN)
- **YUAN, Weiwei**
  Shanghai 201108 (CN)
- **WANG, Yuli**
  Shanghai 201108 (CN)
- **ZHANG, Zhen**
  Shanghai 201108 (CN)
- **CHEN, Jun**
  Shanghai 201108 (CN)
- **ZHANG, Yuan**
  Shanghai 201108 (CN)
- **WENG, Kai**
  Shanghai 201108 (CN)

(74) Representative: **Murgitroyd & Company**
165-169 Scotland Street
Glasgow G5 8PL (GB)

(54) **SCREW COMPRESSOR, APPARATUS HAVING SAME AND USE METHOD THEREFOR**

(57) This application discloses a screw compressor, a device with the screw compressor and us method, a cooling structure is disposed in the screw compressor, hollowed out portions are disposed on the chamber body of the cooling structure, the chamber body is provided with a solid structure between the hollowed out portions, therefore the structural strength of the chamber body is enhanced, at the same time, the chamber body is also divided into a plurality of interconnected independent hollowed out portions, contributes to increase the flow rate and uniformity of flow of the cooling medium, and enhances the cooling effect, and then effectively controls the deformation of the shell caused by temperature.

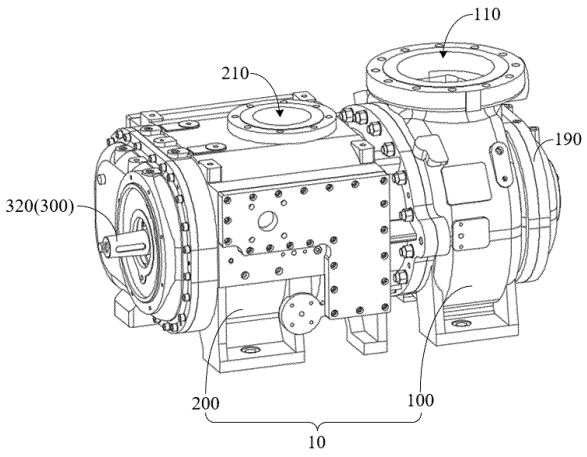

FIG. 1

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Description

[0001] This application claims the benefit of Chinese Patent Application No. 202310761261.4 filed on Jun. 26, 2023 and entitled "SCREW COMPRESSOR, DEVICE WITH SCREW COMPRESSOR AND USE METHOD", the disclosures of which are incorporated by reference herein in their entirety

TECHNICAL FIELD

[0002] The present disclosure relates to the technical field of compressor, and in particular, relates to a screw compressor, a device with screw compressor and use method.

BACKGROUND

[0003] Screw compressor is a type of positive displacement compressor, typically classified into two categories: oil-injected screw compressor and oil-free screw compressor. The oil-injected screw compressor is primarily used for gas boosting in the fields of air and refrigeration, the working media of the oil-injected screw compressor is friendly; the oil-free screw compressor is usually used for process gas boosting in the fields of petrochemical, natural gas, marine, electronic and food, the working media of the oil-free screw compressor is usually flammable and explosive gas, the application environment is special, and often requires customized design. Among them, the oil-free screw compressor is divided into two types: liquid spray and dry type, the liquid spray oil-free screw compressor is designed to meet the requirement of large-scale petrochemical equipment, by spraying water or diesel oil into the medium gas during the pressurization process for cooling, allowing for high pressure ratios in a single stage; the dry type oil-free screw compressor is to ensure the purity of the medium gas, without spraying any cooling liquid on the medium, the process of pressurization can realize high-purity compression of the gas, the dry type oil-free screw compressor has currently become the preferred compressor model in food, electronics , natural gas liquefaction and other fields.

[0004] In the dry type oil-free screw compressor, in order to ensure the medium gas is not polluted, there is no liquid cooling or sealing between the rotors, the leakage loss is relatively large, in order to ensure a certain volumetric efficiency, it is necessary to increase the rotational speed and reduce the leakage volume. Therefore, the most significant characteristic of the dry type oil-free screw compressor is high rotatioinal speed, the high rotational speed will result in high temperature of the medium gas, thus leads to the deformation of the shell.

[0005] It can be seen that although the dry type oil-free screw compressor unit has been broadly used in industry, in the field of the high-purity gas boosting, the existing structure cannot meet the application requirements, significant challenge still exists in terms of shell cooling and other aspects.

BRIEF SUMMARY OF THE INVENTION

[0006] The embodiment of the present application provides a screw compressor, a device with screw compressor and use method, to improve the cooling efficiency of the screw compressor.

[0007] The embodiment of the present application provides a screw compressor, comprises a main body, a screw and a cooling structure, the main body is provided with a screw working chamber; the screw has a helical section, the helical section is disposed in the screw working chamber; the cooling structure is disposed on the outer side of the main body, so as to form a cooling chamber between the main body and the cooling structure, the cooling chamber is configured to introduce cooling medium, and the projection of the cooling chamber in the radial direction of the screw covers at least a part of the helical section.

[0008] In some embodiments, the cooling structure comprises a chamber body and a sealing plate; the chamber body is disposed on the outer side of the main body, and a plurality of hollowed out portions are disposed at intervals on the chamber body, the hollowed out portion penetrate the chamber body along the radial direction of the screw, the cooling chamber comprises a space between the chamber body and the main body and a space inside the hollowed out portion; the sealing plate is disposed at one side of the chamber body away from the screw, and the sealing plate is installed on the chamber body to close one side of the hollowed out portion away from the screw.

[0009] In some embodiments, the chamber body comprises a bottom connection surface and a side connection surface, the bottom connection surface is disposed at the bottom of the main body, the side connection surface is disposed on the lateral side of the main body in the radial direction, the bottom connection surface and the side connection surface are both provided with the hollowed out portion.

[0010] In some embodiments, the screw compressor is further provided with a cooling liquid circulation pipeline, the sealing plate is provided with a first opening and a second opening, the first opening and the second opening communicate with the cooling chamber, and the cooling chamber is configured in the cooling liquid circulation pipeline through the first opening and the second opening.

[0011] In some embodiments, the main body is provided with an anchor, an anchor bolt hole is disposed on the anchor, the anchor bolt hole penetrates the anchor vertically, and the anchor bolt hole extends along the axial direction of the screw to have a first length in the axial direction.

[0012] In some embodiments, the main body com-

prises an inlet end seat and an exhaust end seat sequentially connected along the axial direction of the screw, the screw comprises a first screw and a second screw, the inlet end seat is provided with a first bearing chamber; the exhaust end seat is provided with a second bearing chamber, the screw working chamber is disposed in the exhaust end seat; one of the first screw and the second screw is provided with a female rotor, the other one is provided with a male rotor, the female rotor and the male rotor mesh with each other, and the position where the female rotor and the male rotor mesh with each other is the helical section, the two ends of the first screw and the second screw are rotatably fitted in the first bearing chamber and the second bearing chamber.

[0013] In some embodiments, the gear ratio between the female rotor and the male rotor ranges from 3:4 to 3:5, the single-stage compression ratio of the screw compressor does not exceed 4.

[0014] In some embodiments, the inlet end seat is provided with a first anchor bolt hole, the first anchor bolt hole penetrates the inlet end seat vertically, and the first ancho bolt hole extends along the axial direction of the screw; and/or, the exhaust end seat is provided with a second anchor bolt hole, the second anchor bolt hole penetrates the exhaust end seat vertically, and the second ancho bolt hole extends along the axial direction of the screw.

[0015] In some embodiments, a first connecting flange is disposed on the inlet end seat, the first connecting flange is provided with an inlet, the inlet faces the radial direction of the screw; a second connecting flange is disposed on the exhaust end seat, the second connecting flange is provided with an outlet, the outlet faces the radial direction of the screw.

[0016] In some embodiments, the screw compressor further comprises an exhaust end cover, the exhaust end cover is disposed on one end of the exhaust end seat away from the inlet end seat, a connecting end face is disposed on one side of the exhaust end cover away from the exhaust end seat, the connecting end face is configured to connect with a driving mechanism.

[0017] In some embodiments, the screw compressor further comprises a coupling and a coupling guard, the coupling is disposed in the coupling guard, the coupling guard comprises a first end and a second end opposite to each other, the connecting end face is further provided with a hole, the screw passes through the hole and is connected to the coupling, wherein, a first positioning step is disposed on the first end, the first positioning step is sleeved at the connecting end face; and/or, a second positioning step is disposed on the second end, and the second positioning step is sleeved at the driving mechanism.

[0018] Correspondingly, the embodiment of the present application further provides a device, the device comprises the above-mentioned screw compressor and a driving mechanism, the driving mechanism is connected to the screw of the screw compressor.

[0019] Correspondingly, the embodiment of the present application further provides a use method of the screw compressor mentioned above, the use method comprises, introducing the cooling medium into the cooling chamber, and allowing the cooling medium to flow between the hollowed out portions in the cooling chamber, so as to cool the main body of the screw compressor.

BENEFICIAL EFFECT

[0020] The embodiment of the present application provides a screw compressor, a device with the screw compressor and a use method of the screw compressor, a cooling structure is disposed in the screw compressor, hollowed out portions are disposed on the chamber body of the cooling structure, the chamber body is provided with a solid structure between the hollowed out portions, therefore the structural strength of the chamber body is enhanced, at the same time, the chamber body is also divided into a plurality of interconnected independent hollowed out portions, the cooling medium can pass through the independent hollowed out portions in sequent, ensures that the cooling medium can circulate to all portions of the chamber body, and contributes to increase the flow rate and uniformity of flow of the cooling medium, and enhances the cooling effect, and then effectively controls the deformation of the shell caused by temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] In order to more clearly illustrate the technical solutions of the embodiments of the present application, the accompanying drawings required in the description of the embodiments are briefly described below, obviously, the accompanying drawings in the following description are some embodiments of the present application, for those of ordinary skill in the art, other accompanying drawings can be obtained according to these accompanying drawings without exerting creative efforts.

FIG. 1 exemplarily illustrates a structural schematic diagram of a screw compressor;

FIG. 2 exemplarily illustrates a structural schematic diagram of a screw compressor from another perspective;

FIG. 3 exemplarily illustrates a structural schematic diagram of an inlet end seat;

FIG. 4 exemplarily illustrates a structural schematic diagram of an inlet end seat from another perspective;

FIG. 5 exemplarily illustrates a structural schematic diagram of an inlet end cover;

FIG. 6 exemplarily illustrates a structural schematic diagram of an exhaust end seat;

FIG. 7 exemplarily illustrates a structural schematic diagram of an exhaust end seat from another perspective;

FIG. 8 exemplarily illustrates a structural schematic diagram of a sealing plate disposed on the lateral side;

FIG. 9 exemplarily illustrates a structural schematic diagram of a sealing plate disposed on the bottom;

FIG. 10 exemplarily illustrates a structural schematic diagram of a screw compressor with a coupling guard;

FIG. 11 exemplarily illustrates a structural schematic diagram of an exhaust end cover;

FIG. 12 exemplarily illustrates a structural schematic diagram of a coupling guard;

FIG. 13 exemplarily illustrates a structural schematic diagram of a screw;

FIG. 14 exemplarily illustrates a structural schematic diagram of a synchronous gear.

[0022] Reference signs of main components in this application: main body-10, inlet end seat-100, air inlet port-110, first bearing chamber-120, balance air port-130, low-pressure sealing gas inlet-140, low-pressure end lubricating oil inlet-150, bearing oil return port-160, low-pressure end bearing temperature measuring port-170, first anchor bolt hole-180, inlet end cover-190, synchronous gear oil inlet-191, balance plate hole-192, tail cover-193, exhaust end seat-200, exhaust port-210, second bearing chamber-220, sealing balance chamber-230, high-pressure end sealing gas inlet-240, high-pressure end lubricating oil inlet-250, screw working chamber-260, high-pressure end bearing temperature measuring port-270, second anchor bolt hole-280, exhaust end cover-290, shaft hole-291, connecting end face-292, support point-293, oil return port-294, screw-300, first screw-310, second screw-320, chamber body-400, bottom connection surface-410, side connection surface-420, hollowed out portion-430, sealing plate-500, opening-510, coupling guard-600, first end-610, first positioning step-611, second end-620, second positioning step-621, synchronous gear-700, bull gear-710, pinion gear-720.

IMPLEMENTATIONS OF THIS APPLICATION

[0023] The following will clearly and completely describe the technical solutions in the embodiments of the application with reference to the drawings in the embodiments of the application. Apparently, the described embodiments are only some of the embodiments of the application, not all of them. Based on the embodiments in this application, all other embodiments obtained by those skilled in the art without making creative efforts belong to the scope of protection of this application. In addition, it should be understood that the specific implementations described here are only used to illustrate and explain the present application, and are not intended to limit the present application. In this application, unless stated otherwise, the used orientation words such as "up", "down", "left", and "right" usually refer to the upper, lower, and left sides in the actual use or working state of the device. and right, specifically the direction of the drawing in the attached drawing.

[0024] In addition, the terms "first" and "second" are used for descriptive purposes only, and cannot be interpreted as indicating or implying relative importance or implicitly specifying the quantity of indicated technical features. Thus, the features defined as "first" and "second" may explicitly or implicitly include at least one of these features.

[0025] The present application provides a screw compressor, a device with the screw compressor and use method, which will be described in detail below. It should be noted that the description order of the following embodiments is not intended to limit the preferred order of the embodiments of the present application. And in the following embodiments, the description of each embodiment has its own focus, and for the part not described in detail in a certain embodiment, the relevant descriptions of other embodiments can be referred to.

[0026] The embodiments of the present application provide a screw compressor, here, the screw compressor comprises a stationary component and a rotating component. Wherein, please refer to FIG. 1 and FIG. 2, the stationary component is the main body 10 of the screw compressor, the stationary component mainly comprises an inlet end seat 100 and an exhaust end seat 200, the rotating component mainly comprises a screw 300. Here, the main body 10 is a two-stage structure consisting of the inlet end seat 100 and the exhaust end seat 200, this structure helps ensure the concentricity of the screw compressor, reduces machining and assembly errors, and also helps simplify the assembly process. Certainly, in other embodiments, the structure of the main body 10 is not limited to this, and the example in this embodiment dores not constitute undue limitations to the structure of the main body 10.

[0027] In addition, in the embodiments of the present application, the screw compressor adapts two-stage structure, helps ensure the concentricity, reduces machining and assembly errors, and also helps simplify the assembly process.

[0028] The anchor bolt hole of the screw compressor can be designed as an oversized circular hole or an elongated hole, so as to release the displacement caused by thermal expansion in the screw compressor, helps to reduce the stress concentration, improve the reliability of the device.

[0029] A coupling guard and a connecting end face can be disposed on the exhaust end cover of the exhaust end seat, to achieve the safe protection of the high-speed coupling and ensure the alignment between the compressor and the driving structure.

[0030] Here, in order to facilitate the explanation of the positional relationship between various components, in the embodiments of the present application, the screw 300 is defined to have an axis, and with respect to the screw 300 and its axis are defined to have axial direction,

radial direction, and circumferential direction. Here, the axial direction refers to the direction along the extension of the axis, radial direction refers to the direction perpendicular to the axis, and circumferential direction refers to the direction along the circular line extending concentrically around the axis. In the embodiments comprising multiple screws 300, for example, the embodiment of the screw 300 comprising a first screw 310 and a second screw 320, the axes of each screw 300 are parallel, and one of the screws 300 can be configured to define the aforementioned directions, for example, the second screw 320, which is connected to the driving mechanism such as a motor, can be configured to define the aforementioned directions, therefore, the aforementioned axis can refer to the axis of the second screw 320, certainly, the examples provided in this embodiment do not constitute undue limitations to the present application.

[0031] Here, please refer to FIG. 3 and FIG. 4, the inlet end seat 100 is provided with an air inlet port 110, the air inlet port 110 is primarily configured to introduce the compressed gas into the screw compressor, ensuring smooth air inlet of the compressor. In some embodiments, the air inlet port 110 faces the radial direction, for example, the air inlet port 110 can be disposed above the inlet end seat 100, enables the beneficial effect of facilitating the pipeline connecting. It can be understood that, in the embodiments of the present application, unless otherwise specified, extending along a certain direction or facing a certain direction refers to extending in a direction that is parallel to or coincident with the direction or facing a direction parallel to or coincident with the direction. For example, the air inlet port 110 at here faces the radial direction, which refers to the air inlet port 110 faces a direction parallel to or coincident with the radial direction.

[0032] Meanwhile, the inlet end seat 100 is provided with a first bearing chamber 120, the first bearing chamber 120 is configured to rotatably connect to the aforementioned screw 300, for example, a bearing can be disposed in the first bearing chamber 120 to facilitate the connection with the screw 300. Please refer to FIG. 3, in the embodiments where the first screw 310 and the second screw 320 are disposed, correspondingly, the first bearing chamber 120 is two adjacent accommodating spaces, the two adjacent accommodating spaces can be connected or disconnected, it can also be understood that in other embodiments, the first bearing chamber 120 can be designed as a single integrated space to accommodate and assemble the screw 300, the example in this embodiment does not constitute undue limitations to the first bearing chamber 120.

[0033] In addition, in order to achieve corresponding function and technical effect, corresponding component and structure can be additionally disposed on the inlet end seat 100. For example, in some embodiments, a balance chamber can be disposed in the inlet end seat 100, the balance chamber is connected to the air inlet port 110, for example, the balance chamber is provided with a balance air port 130, the balance air port 130 is disposed at one side of the air inlet port 110 and connected to the air inlet port 110. The balance chamber here is configured to connect to the sealing balance chamber 230 disposed on the exhaust end seat 200 (please refer to FIG. 7), to reduce the pressure of the sealing balance chamber 230 disposed on the exhaust end seat 200, it can be understood that connecting to the sealing balance chamber 230 is not only limited here, in other embodiments, the balance chamber can be connected to other positions, the example in this embodiment does not constitute undue limitations to the present application.

[0034] In some embodiments, in order to achieve sealing effect, please refer to FIG. 3 and FIG. 4, a low-pressure sealing gas inlet 140 can be disposed on the two sides of the inlet end seat 100, to inject nitrogen or other gases into the inlet end seat 100 as sealing gas.

[0035] In some embodiments, in order to achieve lubrication effect, please refer to FIG. 3 and FIG. 4, a low-pressure end lubricating oil inlet 150 can be disposed on the two sides of the inlet end seat 100, the low-pressure end lubricating oil inlet 150 is connected to the bearing disposed in the inlet end seat 100, to supply oil to the bearing. Optionally, a bearing oil return port 160 can also be disposed below the inlet end seat 100 for the outflow of lubricating oil, and the bearing oil return port 160 may also be connected to the low-pressure end lubricating oil inlet 150 through a pipeline to form a circulation circuit and realize the reuse of lubricating oil.

[0036] In some embodiments, in order to monitor the running state of the bearing in real time, a low-pressure end bearing temperature measuring port 170 can be disposed on the inlet end seat 100, the temperature measuring component can be extended into the position in the inlet end seat 100 where the bearing is disposed through the low-pressure end bearing temperature measuring port 170, to perform temperature detection.

[0037] In some embodiments, please refer to FIG. 3, a first anchor is disposed on the inlet end seat 100, a first anchor bolt hole 180 is disposed on the first anchor, the first anchor bolt hole 180 is usually disposed on the anchor at the bottom of the inlet end seat 100, the first anchor bolt hole 180 penetrates the first anchor vertically, and the first anchor bolt hole 180 extends along the axial direction of the screw 300. That is to say, the first anchor bolt hole 180 has a first length on the axial direction, the first length is longer than the length of the anchor bolt, therefore, the first anchor bolt hole 180 can accommodate the potential slippage of the inlet end seat 100 under certain conditions due to thermal expansion and contraction. Exemplarily, the first anchor bolt hole 180 can be an oversized circular hole or an elongated hole or the like.

[0038] In some embodiments, please refer to FIG. 5, an inlet end cover 190 can also be disposed. Please refer to FIG. 1, the inlet end cover 190 can be disposed on one end of the inlet end seat 100 away from the exhaust end seat 200. Please continue to refer to FIG. 5, a synchronous gear oil inlet 191 can be disposed on the inlet end

cover 190, to facilitate lubrication and cooling of the inlet oil. A balance plate hole 192 can also be disposed on the inlet end cover 190, to facilitate the installation of the balance plate. In addition, the rotation direction of the rotor can also be marked on the inlet end cover 190, to facilitate the users to install and observe. And, please refer to FIG. 2, a tail cover 191 can also be disposed on one end of the inlet end cover 190 away from the inlet end seat 100, the tail cover 191 can shield and protect the first bearing chamber 120 and the surrounding components.

[0039] Please refer to FIG .1, the exhaust end seat 200 of the main body 10 is disposed on one side of the inlet end seat 100 along the axial direction, the exhaust end seat 200 is main structure for achieving supercharging. Here, please refer to FIG. 6 and FIG. 7, the exhaust end seat 200 is provided with an exhaust port 210. Wherein, the exhaust port 210 is primarily configured to send the compressed gas out of the screw compressor, ensuring smooth air outlet of the compressor. In some embodiments, the exhaust port 210 faces the radial direction, for example, the exhaust port 210 can be disposed above the exhaust end seat 200, thereby achieving the beneficial effect of facilitating pipeline connections.

[0040] Here, a second bearing chamber 220 is further disposed in the exhaust end seat 200, the second bearing chamber 220 is configured to rotatably connected the aforementioned screw 300, for example, a bearing can be disposed in the second bearing chamber 220 to facilitate the connection with the screw 300. Please refer to FIG. 6, in the embodiments where the first screw 310 and the second screw 320 are disposed, correspondingly, the second bearing chamber 220 is two adjacent accommodating spaces, the two adjacent accommodating spaces can be connected or disconnected, it can also be understood that in other embodiments, the second bearing chamber 220 can be designed as a single integrated space to accommodate and assemble the screw 300, the example in this embodiment does not constitute undue limitations to the second bearing chamber 220.

[0041] Moreover, here, the exhaust end seat 200 is further provided with a screw working chamber 260, the screw working chamber 260 is disposed between the first bearing chamber 120 and the second bearing chamber 220 and connected to the first bearing chamber 120 and the second bearing chamber 220, that is to say, the first bearing chamber 120, the screw working chamber 260 and the second bearing chamber 220 are disposed in sequence along the axial direction. Here, the screw working chamber 260 is disposed at one end of the exhaust end seat 200 closing to the inlet end seat 100, the second bearing chamber 220 is disposed at one end of the exhaust end seat 200 away from the inlet end seat 100.

[0042] The screw working chamber 260 is the position where the helical section of the screw 300 is disposed, at this position, the working medium such as air is compressed. The structure of the exhaust end seat 200 will be described continually at here, the specific structure of the screw 300 will be described later. Here, as the screw 300 works, the pressure and temperature of the working medium will rise, and then a large amount of heat will be transferred to the main body 10, especially transferred to the exhaust end seat 200 disposed at the position of the screw working chamber 260, which will cause deformation of the main body 10, especially the exhaust end seat 200, due to heating.

[0043] Therefore, in the embodiment of the present application, the screw compressor further comprises a cooling structure, the cooling structure is disposed on the outer side of the main body 10, to form a cooling chamber between the main body 10 and the cooling structure, the cooling chamber is configured to introduce cooling medium, the cooling medium can be liquid or gas, this embodiment does not does not constitute undue limitations to the cooling medium. And the projection of the cooling chamber in the radial direction of the screw 300 covers a part of the helical section of the screw 300, thus, by setting the cooling structure, the cooling medium in the cooling chamber can cool the main body 10 and take away the heat of the main body 10, to prevent the deformation of the main body 10. Certainly, it can be understood that, in other embodiments, the cooling chamber can be designed that the projection of the cooling chamber in the radial direction of the screw 300 completely covers the helical section of the screw 300, thereby the heat at the helical section can be taken away better.

[0044] Here, please refer to FIG. 6, the cooling structure comprises a chamber body 400, the chamber body 400 here comprises a bottom connection surface 410 and a side connection surface 420, the bottom connection surface 410 is disposed at the bottom of the main body 10, the number of the side connection surface 420 is two, respectively disposed on the lateral side of the main body 10 in the radial direction, the plane where the bottom connection surface 410 and the side connection surface 420 are disposed is approximately parallel to the axial direction. Here, the bottom connection surface 410 and the side connection surface 420 are integrally formed on the shell of the exhaust end seat 200, in other words, the bottom connection surface 410 and the side connection surface 420 can be a part integrated with the main body 10 in terms of solid structure, of course, in other embodiments, a bottom plate provided with a bottom connection surface and a side panel provided with a side connection surface can be disposed, and the bottom plate and the side panel are connected to the exhaust end seat 200 by welding or other methods, the examples in the embodiments do not constitute undue limitations thereto.

[0045] The bottom connection surface 410 and the side connection surface 420 are both provided with a hollowed out portion 430, wherein only one hollowed out portion 430 can be disposed on the bottom connection surface 410 and the side connection surface 420, or several hollowed out portions 430 arranged at intervals can be respectively disposed on the bottom connection surface 410 and the side connection surface 420, this embodiment does not constitute limitations thereto.

Here, the hollowed out portion 430 penetrates the chamber body 400 along the radial direction of the screw 300, the cooling chamber comprises a space between the chamber body 400 and the main body 10 and a space inside the hollowed out portion 430, wherein in this embodiment, the space between the chamber body 400 and the main body 10 is specifically the space between the outer wall of the exhaust end seat 200 and the inner wall of the chamber body 400. Certainly, it can be understood that in other embodiments, other numbers of the bottom connection surface 410 and the side connection surface 420 can be disposed, or the entire chamber body 400 can be an integral structure, or the chamber body 400 can not be plate-shaped, as long as the main body 400 is disposed on the outer side of the main body 10 to cooperate with the main body 10 and form a cooling chamber on the outer side of the main body 10, the example in this embodiment does not constitute undue limitations to the present application.

[0046] And, here, the cooling structure further comprises a sealing plate 500, the sealing plate 500 is disposed at one side of the chamber body 400 away from the screw 300, that is the position disposed on the outer side of the sealing plate 500 in the radial direction, so that the sealing plate 500 can be installed on the chamber body 400 to close one side of the hollowed out portion 430 away from the screw. Here, the sealing plate 500 is configured to fit on the aforementioned bottom connection surface 410 and the side connection surface 420 to close the outer side of the hollowed out portion 430.

[0047] In some embodiments, the number of the sealing plate 500 corresponds to the sum of the number of the bottom connection surface 410 and the side connection surface 420, exemplarily, in the embodiment where one bottom connection surface 410 and two side connection surfaces 420 are disposed, three sealing plates 500 are disposed correspondingly. Please refer to FIG. 8, wherein two sealing plates 500 are approximately L-shape, which are similar to the shape of the approximately L-shaped side connection surface 420, the L-shaped sealing plate 500 is configured to fit on the outer side of the side connection surface 420 to close the outer side of the hollowed out portion 430 of the side connection surface 420. Please refer to FIG. 9 again, another one sealing plate 500 is approximately similar to the shape of the bottom connection surface 410, the sealing plate 500 shown in FIG. 9 is configured to fit on the outer side of the bottom connection surface 410, that is, the bottom of the bottom connection surface 410, to close the outer side of the hollowed out portion 430 on the bottom connection surface 410.

[0048] It can be seen that, through the setting of the chamber body 400, a cooling chamber is formed on the outer side of the screw working chamber 260, the chamber body 400 of the cooling chamber is provided with hollowed out portions 430 at intervals, which allows for the the cooling medium to flow into the region inside the hollowed out portion 430 while ensuring the overall structural strength of the cooling chamber, and each of the hollowed out portions 430 are interconnected through the radial inner side space of the chamber body 400, thus the cooling medium can flow between each of the hollowed out portions 430. Since the hollowed out portions 430 are disposed at intervals on the outer side of the screw working chamber 260, the cooling medium in different hollowed out portions 430 can cool different parts of the screw working chamber 260, thereby achieving a good cooling effect.

[0049] It can be understood that, in other embodiments, the setting of the cooling structure is not limited to the above, as long as the cooling structure can form a cooling chamber for cooling the helical section. For example, the cooling chamber can only comprise the space inside the hollowed out portion 430, and/or other components can be disposed at one end of the hollowed out portion 430 closes to the main body 10 to connect each of the hollowed out portions 430, to form communication between the hollowed out portions 430, the example in this embodiment does not constitute undue limitations to the present application.

[0050] As can be seen from the above, the cooling chamber is formed by setting the cooling structure in the embodiment of the present application, and the main body 10, especially the screw working chamber 260 of the exhaust end seat 200 is cooled by the cooling medium in the cooling chamber, the heat of the main body 10 can be reduced efficiently, the main body 10 is prevented from being deformed by heat to affect the overall structure and working stability.

[0051] In optional embodiment, on the basis of the cooling structure is disposed, the screw compressor further comprises a cooling liquid circulation pipeline, the sealing plate 500 is provided with an opening 510, here please refer to FIG. 8, the two sealing plates 500 disposed on the side connection surface 420 correspondingly are both provided with the opening 510, thus the opening 510 on one sealing plate 500 is designated as the first opening 510, the opening 510 on the other sealing plate 500 is designated as the second opening 510, the first opening 510 and the second opening 510 communicate with the hollowed out portion 430, that is, communicate with the cooling chamber. Wherein the first opening 510 is designated as an inlet, the second opening 510 is designated as an outlet, the first opening 510 and the second opening are configured in the cooling liquid circulation pipeline through pipe, so that the cooling chamber can be configured in the cooling liquid circulation pipeline through the two openings 510. Certainly, those skilled in the art can understand that the cooling liquid circulation pipeline further comprises a power source such as a pump disposed therein, as well as structures such as valve that can be disposed, the example in this embodiment does not constitute undue limitations to the specific structure of the cooling liquid circulation pipeline.

[0052] In addition, in order to achieve corresponding

function and technical effect, corresponding component and structure can be additionally disposed on the inlet end seat 100. For example, in some embodiments, a sealing balance chamber 230 can be disposed in the inlet end seat 100, the sealing balance chamber 230 is connected to the aforementioned balance air port 130 and/or other low-pressure pipelines through an external pipeline, for example, the sealing balance chamber 230 is connected to other low-pressure pipeline of the screw compressor or connected to the low-pressure pipeline of other compressors, to reduce the pressure of the medium gas leaking into the sealing balance chamber 230.

[0053] In some embodiments, in order to achieve the sealing effect, the two sides of the exhaust end seat 200 can also be respectively provided with a high-pressure end sealing gas inlet 240 for injecting nitrogen or other gas into the exhaust end seat 200 as the sealing gas, and further prevents the medium gas leaking into the sealing balance chamber 230 from entering the second bearing chamber 220.

[0054] In some embodiments, in order to achieve lubricating effect, the two sides of the exhaust end seat 200 can be respectively provided with a high-pressure end lubricating oil inlet 250, the high-pressure end lubricating oil inlet 250 is connected with the bearing in the exhaust end seat 200 to supply oil to the bearing. Optionally, an oil return port can further be disposed below the exhaust end seat 200 for the outflow of the lubricating oil, and the oil return port can further be connected to the high-pressure end lubricating oil inlet 250 through the pipe to form a circulation circuit and realize the reuse of lubricating oil.

[0055] In some embodiments, in order to monitor the running state of the bearing in real time, a high-pressure end bearing temperature measuring port 270 can be disposed on the exhaust end seat 200, the temperature measuring component can be extended into the position in the exhaust end seat 200 where the bearing is disposed through the high-pressure end bearing temperature measuring port 270, to perform temperature detection.

[0056] In some embodiments, please refer to FIG. 6, a second anchor is disposed on the inlet end seat 100, a second anchor bolt hole 280 is disposed on the second anchor, the second anchor bolt hole 280 is usually disposed on the anchor at the bottom of the exhaust end seat 200, the second anchor bolt hole 280 penetrates the second anchor vertically, and the second anchor bolt hole 280 extends along the axial direction of the screw 300. That is to say, the second anchor bolt hole 280 has a first length on the axial direction, the first length is longer than the length of the anchor bolt, therefore, the second anchor bolt hole 280 can accommodate the potential slippage of the exhaust end seat 200 under certain conditions due to thermal expansion and contraction. Exemplarily, the second anchor bolt hole 280 can be an oversized circular hole or an elongated hole or the like. Here, in this embodiment, it is described that both the first anchor bolt hole 180 and the second anchor bolt hole 280 have a first length, but in other embodiments, the first anchor bolt hole 180 and the second anchor bolt hole 280 can have different lengths in the axial direction, the example in this embodiment does not contribute undue limitations thereto. And, in other embodiments, the above-mentioned configuration can be applied only to the second anchor bolt hole 280, or only to the first anchor bolt hole 180, as long as the aforementioned first anchor bolt hole 180 and/or the second anchor bolt hole 280 is disposed on the main body 10 as the anchor bolt hole.

[0057] In some embodiments, please refer to FIG. 10, an exhaust end cover 290 can also be disposed, the exhaust end cover 290 is disposed at one end of the exhaust end seat 200 away from the inlet end seat 100. Please refer to FIG. 11, an shaft hole 291 can be disposed on the exhaust end cover 290 for the screw 300 to pass through and to connect with an external driving mechanism.

[0058] Moreover, here, please continue to refer to FIG. 11, a connecting end face 292 is disposed at one side of the exhaust end cover 290 away from the exhaust end seat 200, the connecting end face 292 is used for connecting with the driving mechanism. Exemplarily, here, the screw compressor further comprises a coupling and a coupling guard 600, the coupling is disposed in the coupling guard 600. Please refer to FIG. 12, the coupling guard 600 comprises a first end 610 and a second end 620 opposite to each other, the first end 610 is adjacent to the exhaust end cover 290. The first end 610 protrudes radially to form a first positioning step 611, the first positioning step 611 is sleeved on the connecting end face 292. The second end 620 protrudes radially to from a second positioning step 621, and the second positioning step 621 is configured to be sleeved on the driving mechanism. The screw 300 passes through the hole and is connected to the coupling.

[0059] In addition, in some embodiments, please refer to FIG. 11, a support point 293 can also be disposed on the exhaust end cover 290 to facilitate the users to disassemble, assemble and place. Moreover, a rotation mark of the screw 300 can also be disposed on the exhaust end cover 290, to facilitate the users to observe. An oil return port 294 can also be disposed below the exhaust end cover 290 to facilitate the return of the lubricating oil at the high-pressure end.

[0060] As mentioned above, the screw compressor further comprises a screw 300, please refer to FIG. 13, the body of the screw 300 here comprises a first screw 310 and a second screw 320, the two ends of the first screw 310 and the second screw 320 can be rotatably fitted in the aforementioned first bearing chamber 120 and the second bearing chamber 220. Here, the first screw 310 is provided with a male rotor, the second screw 320 is provided with a female rotor, the female rotor and the male rotor mesh with each other, and the position where the female rotor and the male rotor mesh with each other is the helical section. It can be certainly understood that in other embodiments, the first screw 310 is provided

with the female rotor, the second screw 320 is provided with the male rotor, the example in this embodiment does not contribute undue limitations thereto. Here, the higher the efficiency of the oil-free screw compressor, the more controllable the outlet temperature, when the efficiency decreases, the outlet temperature rises obviously, under the condition that the rotor clearance is disposed unreasonably, the rotor is easily to be rubbed, therefore rotor type line is usually designed with the principle of low pressure ratio and high flow rate. In some embodiments of the present application, the gear ratio between the female rotor and the male rotor ranges from 3:4 to 3:5, and the single-stage compression ratio of the screw compressor does not exceed 4. For example, the gear ratio of the female rotor and male rotor can be set as 3:4, 3:5, 4:6, and so on. Thus, the temperature difference between the inlet and outlet of the screw compressor can be controlled within 200°C.

[0061] Here, a synchronous gear 700 can also be disposed, please refer to FIG. 12, the synchronous gear 700 comprises a pinion gear 720 and a bull gear 720 meshing with each other, the diameter of the pinion gear 720 is smaller than the diameter of the bull gear 710. The pinion gear 720 and the bull gear 710 are fixedly installed on the male rotor and the female rotor respectively, thus ensuring that the male rotor and the female rotor rotate synchronously at a fixed speed ratio. Here, the male rotor, the female rotor and the screw working chamber 260 jointly form a compression chamber.

EMBODIMENT

[0062] In one embodiment, the inlet end seat 100 and the exhaust end seat 200 are installed sequentially along the axial direction, the male rotor and the female rotor are both disposed in the screw working chamber 260 of the exhaust end seat 200, and the two ends of the first screw 310 provided with the male rotor and the second screw 320 provided with the female rotor respectively extend into the first bearing chamber 120 of the inlet end seat 100 and the second bearing chamber 220 of the exhaust end seat 200, bearings are respectively disposed in the first bearing chamber 120 and the second bearing chamber 220 to support the first screw 310 and the second screw 320. The air inlet port 110 is connected to the screw working chamber 260, that is, the medium gas introduced by the air inlet port 110 can be transported to the screw working chamber 260, compressed by the rotating male rotor and the female rotor, and then discharged from the exhaust port 210, thus the compression process of the medium gas is completed.

[0063] A cooling structure is disposed on the exhaust end seat 200, the chamber body 400 of the cooling structure is provided with hollowed out portions 430, the hollowed out portions 430 arranged at intervals ensure sufficient strength, and at the same time, the chamber body 400 is divided into a plurality of interconnected and independent hollowed out portions 430, the cooling chamber is formed after the two side connection surfaces 420 and one bottom connection surface 410 of the cooling structure are installed on the two lateral sides and the bottom surface of the exhaust end seat 200.

[0064] The inlet end cover 190 is fixedly connected to the inlet end seat 100 to form a sealed oil chamber with the inlet end seat 100, a synchronous gear oil inlet 191 is disposed on the inlet end cover 190 to supply oil to the synchronous gear 700. And a balance plate hole 192 is also disposed on the inlet end cover 190, the balance plate hole 192 is coaxial with the male rotor and the female rotor, a disc-shaped balance plate can be installed to reduce the axial force of the male rotor and the female rotor, the tail cover 191 is configured to fixedly connect to the inlet end cover 190 and seal the balance plate hole 192.

[0065] The exhaust end cover 290 is fixed connected to the exhaust end cover 200, the shaft hole 291 on the exhaust end cover 290 is coaxial with the first screw 310, the end of the first screw 310 extends out the shaft hole 291 and is connected with the driving mechanism (such as motor). The center of the connecting end face 292 is in the coaxial position with the shaft hole 291 and the first screw 310, the connecting end face 292 and the end face of the connecting end of the driving mechanism are fixedly connected through a hollow cylindrical coupling gurad 600, the two ends of the coupling guard 600 are respectively fixed to the connecting end face 292 on the exhaust end cover 290 and the end face at the connection position on the driving mechanism through bolts. Here, the first positioning step 611 and the second positioning step 621 at the two ends of the coupling guard 600 are respectively sleeved on the connecting end face 292 and the end face at the connection position on the driving mechanism, ensuring the concentricity requirement between the first screw 310 and the drive shaft of the driving mechanism, at the same time, the coupling guard 600 can also protect the coupling inside the coupling guard 600. An oil return port 294 can also be disposed on the exhaust end cover 290 for oil returning of the second bearing chamber 220 on the exhaust end seat 200 .

[0066] At the same time, the inlet end seat 100 and the exhaust end seat 200 are further provided with the first anchor bolt hole 180 and the second anchor bolt hole 280 respectively, the shape can be an oversized circular hole or an elongated hole, so as to accommodate the potential slippage of the machine under certain conditions due to thermal expansion and contraction.

[0067] It can be understood that the meanings of the nouns in the embodiments of the present application are the same, and for the content that is not described in detail in a certain embodiment, the specific implementation details can refer to the descriptions in other embodiments. The examples shown in the foregoing embodiments Both the description and the technical effect can be achieved correspondingly, and the repeated parts will not be repeated in this embodiment.

[0068] Correspondingly, in order to better realize the

technical effect of the embodiment of the present application, the embodiment of the present application also provides a device, the device includes the aforementioned screw compressor, and also includes a driving mechanism, the driving mechanism is connected to the screw 300 of the screw compressor. Here, the device can be a ship, a vehicle, a self-propelled device, a refrigeration device, a heating device, etc., and the examples in this embodiment do not constitute improper limitations to the device.

[0069] Correspondingly, in order to better realize the technical effects of the embodiments of the present application, the embodiments of the present application also provide a use method of a screw compressor. During use, the cooling medium can be introduced into the cooling chamber, and allows the cooling medium to flow between the hollowed out portions 430 disposed in the cooling chamber, so as to cool the main body 10 of the screw compressor. Of course, the steps included in the method are not limited to cooling, the detailed steps of cooling and other usage steps of the screw compressor can refer to the corresponding descriptions in the aforementioned structural embodiments, which will not be repeated in this embodiment of the present application.

[0070] The screw compressor, the device with the screw compressor and the use method provided by the present application have been introduced in detail above, In this paper, specific examples are used to illustrate the principle and implementation of this application. The description of the above embodiments is only used to help understand this application. The method of application and its core idea; at the same time, for those of ordinary skill in the art, according to the idea of this application, there will be changes in the specific implementation and scope of application. In summary, the content of this specification should not be understood For the limitation of this application.

Claims

1. A screw compressor, wherein the screw compressor comprises,

   a main body, the main body is provided with a screw working chamber;
   a screw, the screw has a helical section, the helical section is disposed in the screw working chamber; and
   a cooling structure, the cooling structure is disposed on the outer side of the main body, a cooling chamber is formed between the main body and the cooling structure, the cooling chamber is configured to introduce cooling medium, and the projection of the cooling chamber in the radial direction of the screw covers at least a part of the helical section.

2. The screw compressor according to claim 1, wherein,

   the cooling structure comprises a chamber body and a sealing plate;
   the chamber body is disposed on the outer side of the main body, and a plurality of hollowed out portions are disposed at intervals on the chamber body, the hollowed out portion penetrates the chamber body along the radial direction of the screw, the cooling chamber comprises a space between the chamber body and the main body and a space inside the hollowed out portion;
   the sealing plate is disposed at one side of the chamber body away from the screw, and the sealing plate is installed on the chamber body to close one side of the hollowed out portion away from the screw.

3. The screw compressor according to claim 2, wherein, the chamber body comprises a bottom connection surface and a side connection surface, the bottom connection surface is disposed at the bottom of the main body, the side connection surface is disposed on the lateral side of the main body in the radial direction, the bottom connection surface and the side connection surface are both provided with the hollowed out portion.

4. The screw compressor according to claim 2, wherein, the screw compressor is further provided with a cooling liquid circulation pipeline, the sealing plate is provided with a first opening and a second opening, the first opening and the second opening communicate with the cooling chamber, and the cooling chamber is configured in the cooling liquid circulation pipeline through the first opening and the second opening.

5. The screw compressor according to claim 1, wherein, the main body is provided with an anchor, an anchor bolt hole is disposed on the anchor, the anchor bolt hole penetrates the anchor vertically, and the anchor bolt hole extends along the axial direction of the screw to have a first length in the axial direction.

6. The screw compressor according to claim 1, wherein, the main body comprises an inlet end seat and an exhaust end seat sequentially connected along the axial direction of the screw, the screw comprises a first screw and a second screw, the inlet end seat is provided with a first bearing chamber;

   the exhaust end seat is provided with a second bearing chamber, the screw working chamber is disposed in the exhaust end seat;

one of the first screw and the second screw is provided with a female rotor, the other one is provided with a male rotor, the female rotor and the male rotor mesh with each other, and the position where the female rotor and the male rotor mesh with each other is the helical section, the two ends of the first screw and the second screw rotatably fitted in the first bearing chamberand the second bearing chamber.

7. The screw compressor according to claim 6, wherein, the gear ratio between the female rotor and the male rotor ranges from 3:4 to 3:5, the single-stage compression ratio of the screw compressor does not exceed 4.

8. The screw compressor according to claim 6, wherein, the inlet end seat is provided with a first anchor bolt hole, the first anchor bolt hole penetrates the inlet end seat vertically, and the first ancho bolt hole extends along the axial direction of the screw.

9. The screw compressor according to claim 6 or 8, wherein, the exhaust end seat is provided with a second anchor bolt hole, the second anchor bolt hole penetrates the exhaust end seat vertically, and the second ancho bolt hole extends along the axial direction of the screw.

10. The screw compressor according to claim 6, wherein,

a first connecting flange is disposed on the inlet end seat, the first connecting flange is provided with an inlet, the inlet faces the radial direction of the screw;
a second connecting flange is disposed on the exhaust end seat, the second connecting flange is provided with an outlet, the outlet faces the radial direction of the screw.

11. The screw compressor according to claim 6, wherein, further comprises an exhaust end cover, the exhaust end cover is disposed on one end of the exhaust end seat away from the inlet end seat, a connecting end face is disposed on one side of the exhaust end cover away from the exhaust end seat, the connecting end face is configured to connect with a driving mechanism.

12. The screw compressor according to claim 11, wherein, the screw compressor further comprises a coupling and a coupling guard, the coupling is disposed in the coupling guard, the coupling guard comprises a first end and a second end opposite to each other, the connecting end face is further provided with a hole, the screw passes through the hole and is connected to the coupling,
a first positioning step is disposed on the first end, and the first positioning step is sleeved at the connecting end face.

13. The screw compressor according to claim 11, wherein, the screw compressor further comprises a coupling and a coupling guard, the coupling is disposed in the coupling guard, the coupling guard comprises a first end and a second end opposite to each other, the connecting end face is further provided with a hole, the screw passes through the hole and is connected to the coupling,
a second positioning step is disposed on the second end, and the second positioning step is sleeved at the driving mechanism.

14. A device, wherein, the device comprises the screw compressor according to any one of claims 1 to 13 and a driving mechanism, the driving mechanism is connected to the screw of the screw compressor.

15. A use method of the screw compressor according to any one of claims 1 to 13, wherein, introducing the cooling medium into the cooling chamber, and allowing the cooling medium to flow between the hollowed out portions in the cooling chamber, so as to cool the main body of the screw compressor.

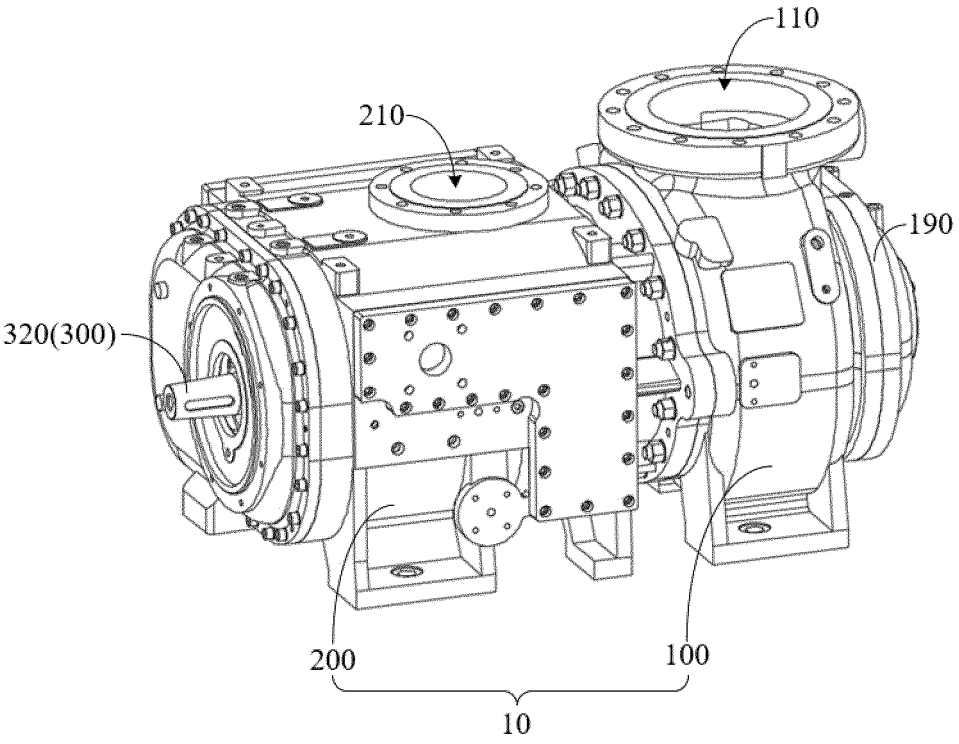


FIG. 1

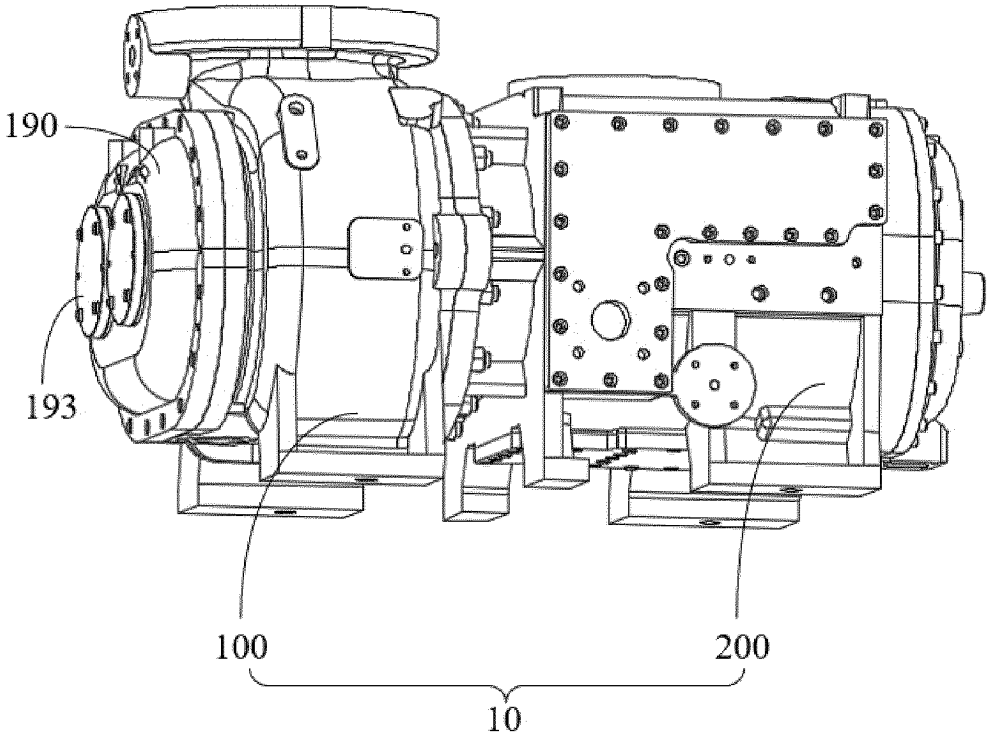


FIG. 2

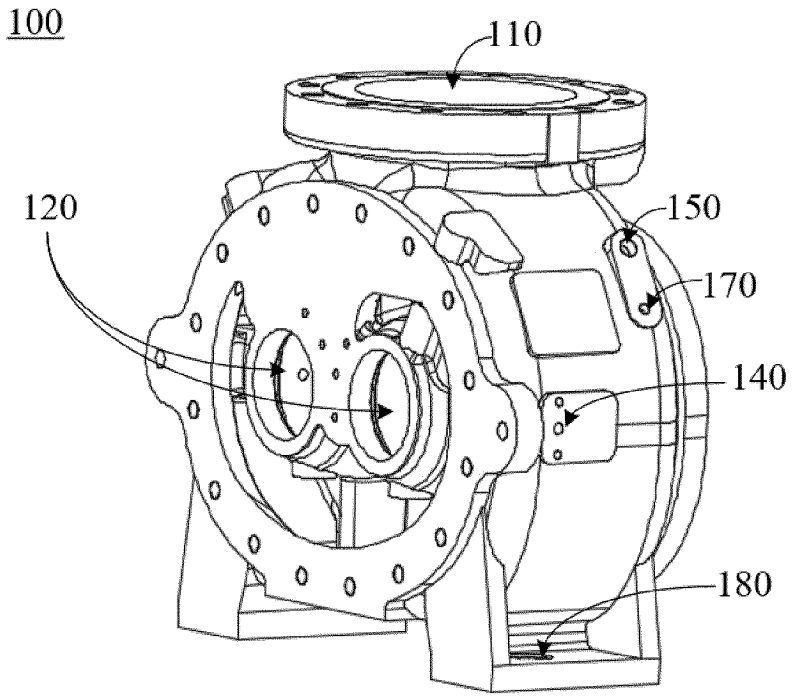


FIG. 3

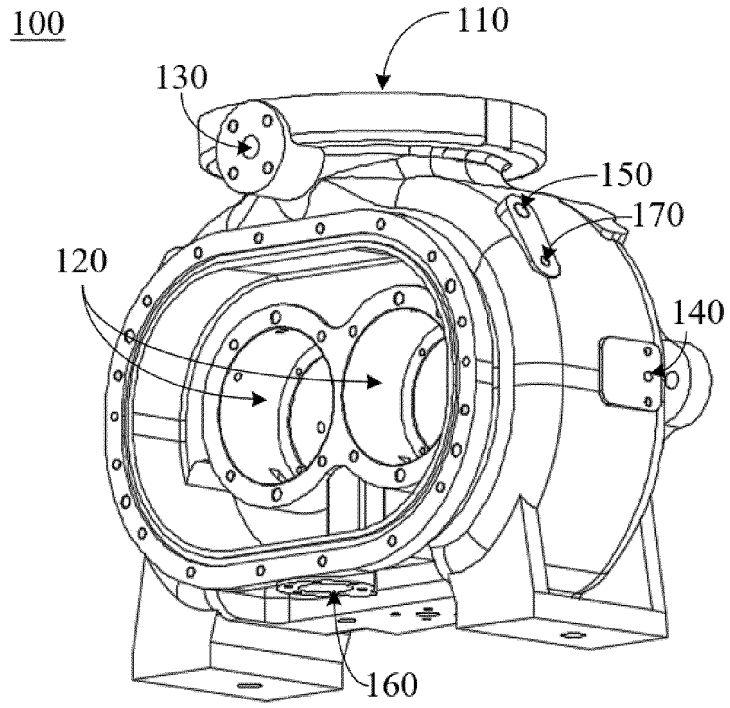


FIG. 4

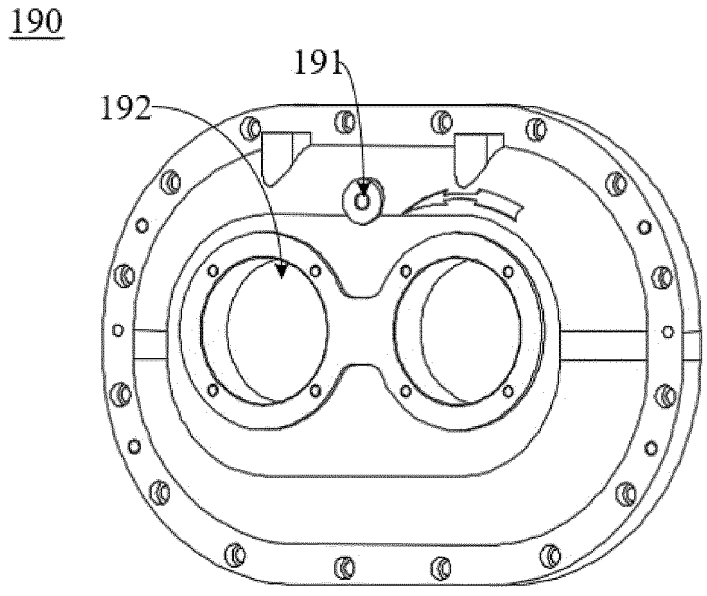
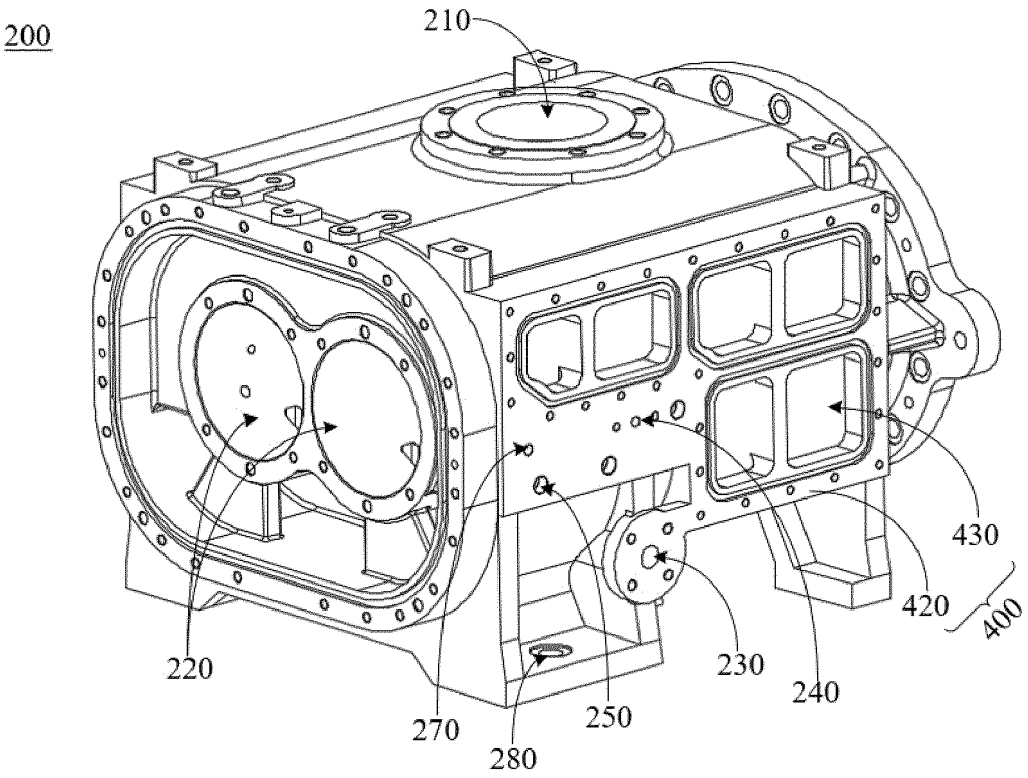


FIG. 5


200
210
220
270
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250
230
240
420
430
400

FIG. 6

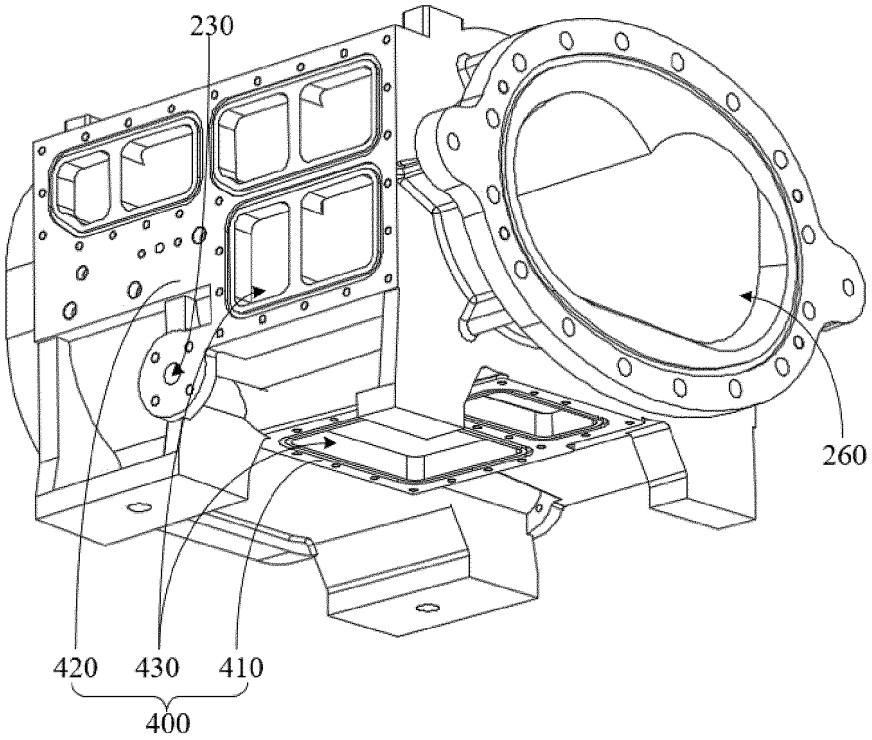
200
230
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FIG. 7

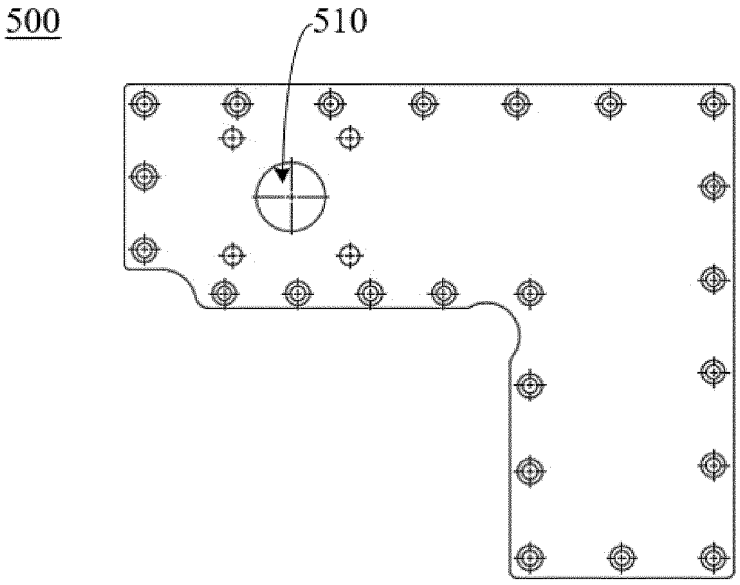

FIG. 8

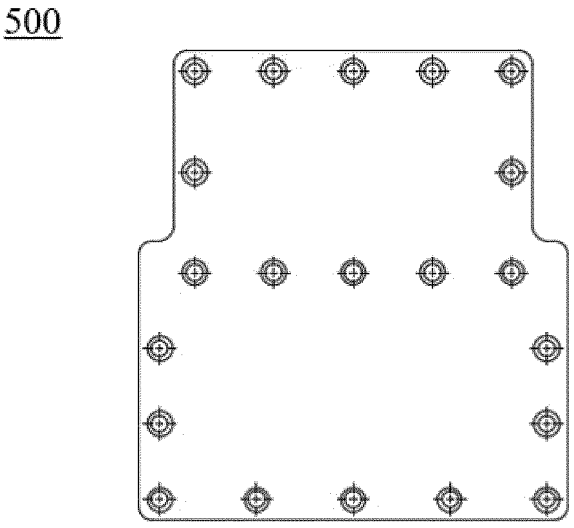

FIG. 9

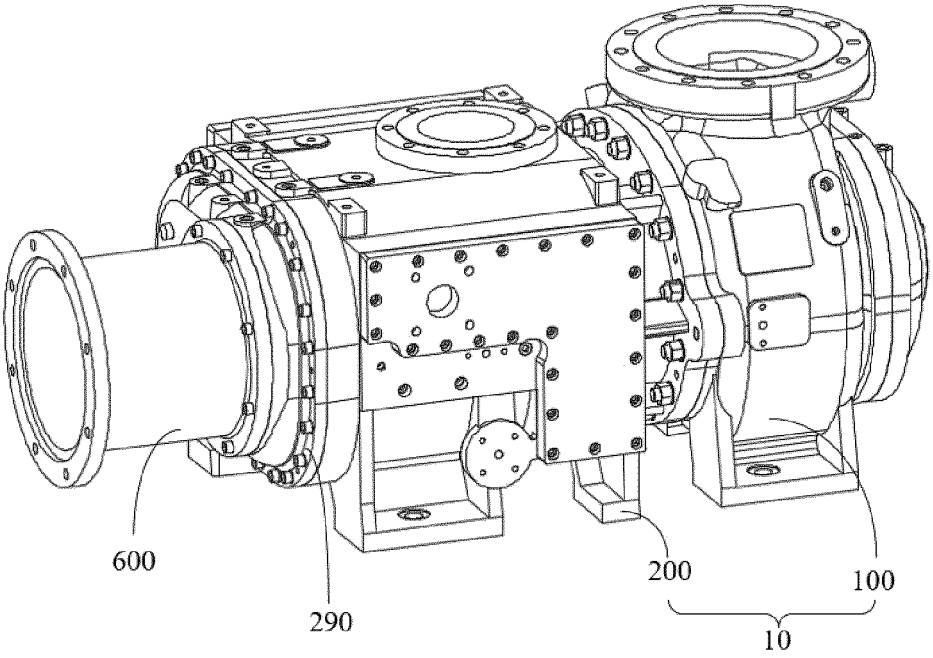

FIG. 10

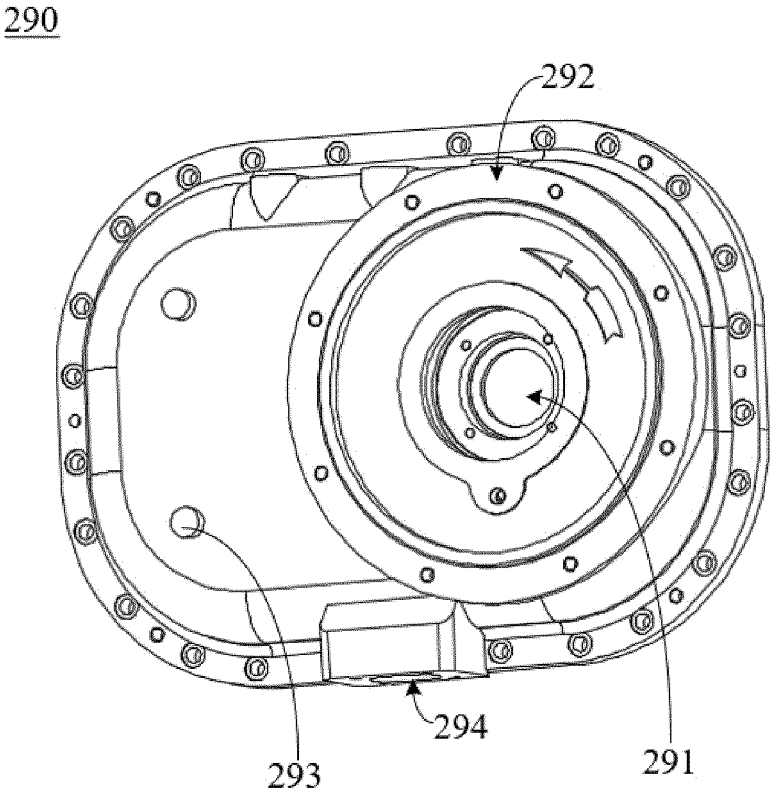

FIG. 11

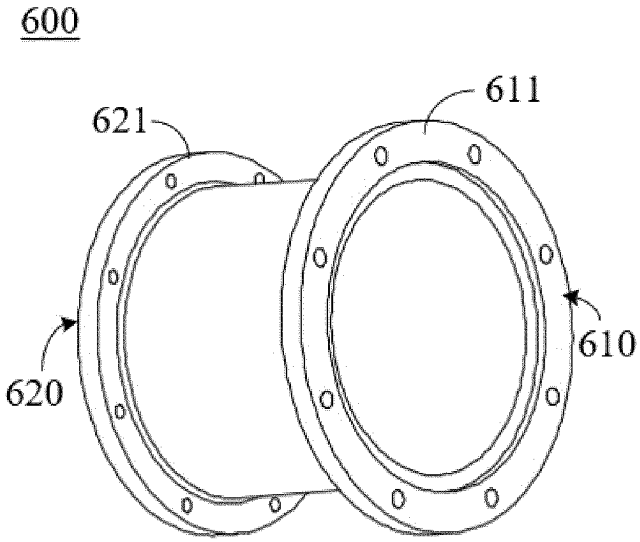

FIG. 12

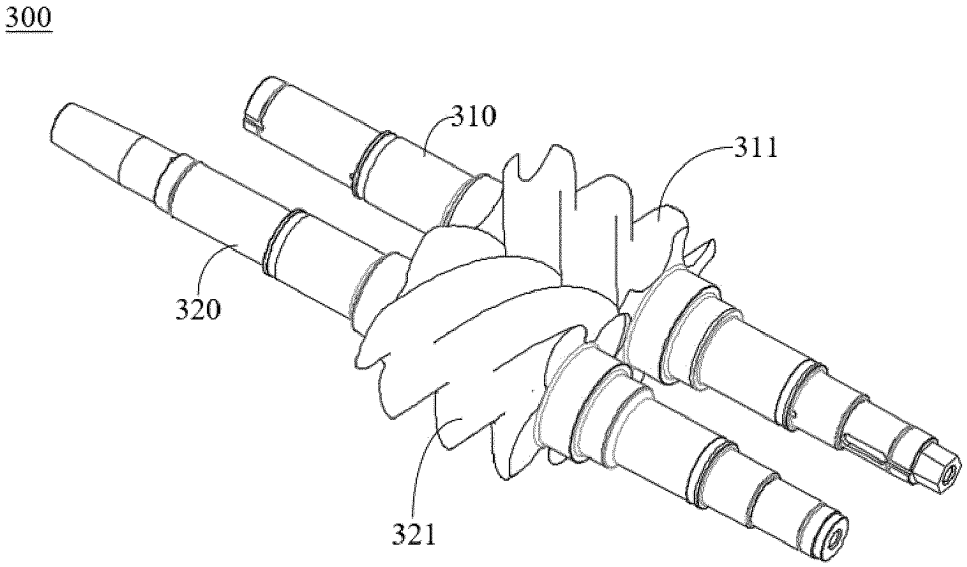

FIG. 13

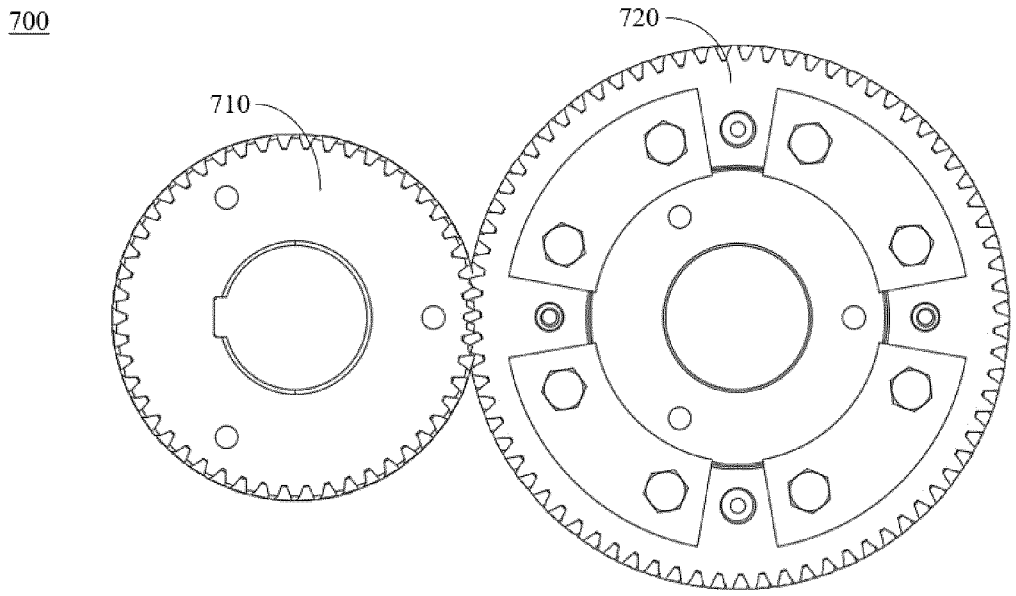

FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/082956

A. CLASSIFICATION OF SUBJECT MATTER

F04C 18/16(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)

IPC: F04C

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)

CNTXT, WPABS, ENTXTC, WPABS, DWPI, CJFD: 螺杆压缩机, 冷却, 镂空, 地脚螺栓, 锚螺栓, screw compressor, cool+, coolant, hollow out, cavity, anchor bolt

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X	CN 2718270 Y (XI'AN JIAOTONG UNIVERSITY) 17 August 2005 (2005-08-17) claims 1-5, description, paragraphs 4 and 13-15, and figures 1-3	1, 5-14
Y	CN 2718270 Y (XI'AN JIAOTONG UNIVERSITY) 17 August 2005 (2005-08-17) claims 1-5, description, paragraphs 4 and 13-15, and figures 1-3	2-4, 15
Y	CN 113153746 A (SONG YUEKUN) 23 July 2021 (2021-07-23) description, paragraphs 12-22 and 33-56, and figures 3-4	2-4
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☑ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"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
18 April 2024	**06 May 2024**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088**	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2024/082956

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Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2024/082956

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