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(54) **CONNECTING ROD STRUCTURE FOR ELECTRIC VACUUM PUMP, AND ELECTRIC VACUUM PUMP**

(57) The present application provides a connecting rod structure for an electric vacuum pump and an electric vacuum pump. The connecting rod structure for an electric vacuum pump includes: a connecting rod, a proximal end of the connecting rod being configured for a motor shaft to pass through, and a distal end of the connecting rod being configured for connection with a piston; a pin including a shank, a neck and a cap which are connected in sequence, the shank being connected to the distal end of the connecting rod; and a bushing sleeved around the

neck. The connecting rod structure for an electric vacuum pump according to the present application prevents, by means of the fitting between the pin and the bushing, jamming or wear due to impurities entering a clearance therebetween, and has advantages such as ease of manufacturing and assembly, capability of withstanding large axial forces, and rare chances for the pin to be detached during the swinging of the connecting rod. Further, the bushing may be a sintered copper bushing, prolonging the lifetime of the connecting rod structure.

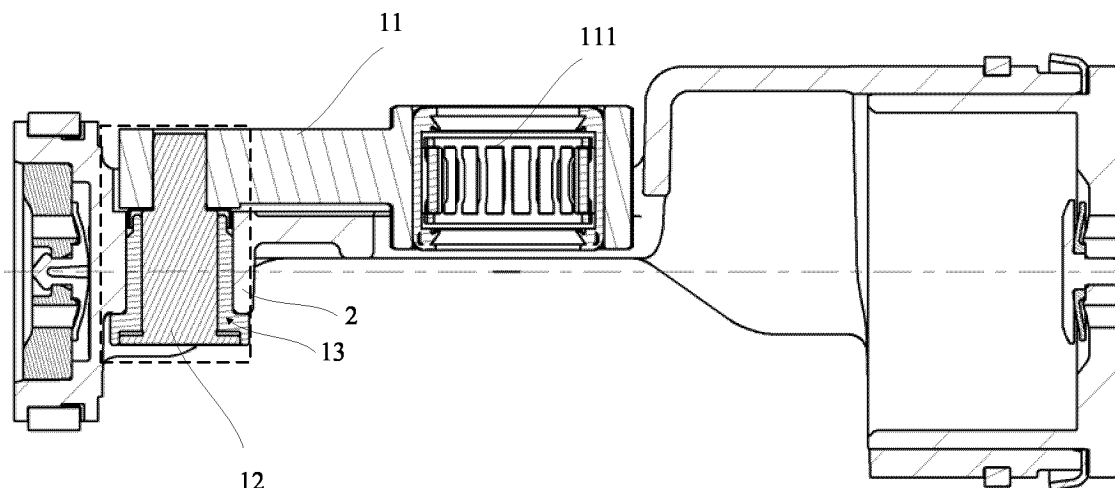


FIG. 1

Description

Technical Field

[0001] The present application relates to the technical field of electric vacuum pumps, and in particular to a connecting rod structure for an electric vacuum pump, and an electric vacuum pump.

Background Art

[0002] An electric vacuum pump of a vehicle generates vacuum by a motor and a motor shaft driving a piston to move, which can improve the braking performance of the whole vehicle. In a current electric vacuum pump, a motor shaft and a piston are connected via a connecting rod structure, the connection of the connecting rod structure with the piston suffers from disadvantages such as low strength, poor wear resistance and short lifetime, and an urgent problem to be addressed in the art is to develop a connecting rod structure that is easy to manufacture and assemble and can withstand a large axial forces.

[0003] It should be noted that information disclosed in the above background art section is only used to enhance the understanding of the background of the present application, and therefore may include information that does not constitute the prior art known to those skilled in the art.

Summary

[0004] For the problems in the prior art, an objective of the present application is to provide a connecting rod structure for an electric vacuum pump and an electric vacuum pump. The connecting rod structure for an electric vacuum pump according to the present application prevents, by means of the fitting between the pin and the bushing, jamming or wear due to impurities entering a clearance therebetween, and has advantages such as ease of manufacturing and assembly, and prolonged lifetime.

[0005] A first aspect of the present application provides a connecting rod structure for an electric vacuum pump, including:

a connecting rod, a proximal end of the connecting rod being configured for a motor shaft to pass through, and a distal end of the connecting rod being configured for connection with a piston;
a pin including a shank, a neck and a cap which are connected in sequence, the shank being connected to the distal end of the connecting rod;
and a bushing sleeved around the neck.

[0006] According to the first aspect of the present application, the bushing further includes an extension that extends to one side of the cap.

[0007] According to the first aspect of the present

application, the connecting rod structure further includes a sealing unit, the sealing unit being provided at an end of the neck close to the shank.

[0008] According to the first aspect of the present application, the sealing unit is a dust-proof sleeve;

the dust-proof sleeve includes a bottom face provided with a through hole and a side wall connected to the bottom face; and

the shank passes through the through hole, and the dust-proof sleeve is sleeved around the end of the neck close to the shank.

[0009] According to the first aspect of the present application, an outer peripheral wall of the bushing at the dust-proof sleeve is a recessed wall recessed toward a centre of the pin, the side wall of the dust-proof sleeve fitting with the recessed wall.

[0010] According to the first aspect of the present application, the sealing unit is a sealing groove provided in the distal end of the connecting rod, and one end of the bushing is in insertion fit with the sealing groove.

[0011] According to the first aspect of the present application, the shank is connected to the distal end of the connecting rod by means of interference fit; or the bushing is in clearance fit with the neck.

[0012] According to the first aspect of the present application, the bushing is a sintered copper bushing.

[0013] According to the first aspect of the present application, the bushing is a sintered copper bushing containing graphite.

[0014] A second aspect of the present application provides an electric vacuum pump, including at least one connecting rod structure for an electric vacuum pump as described.

[0015] According to the second aspect of the present invention, the electric vacuum pump further includes at least one piston; and

each of the bushings is connected to a piston rod of one of the pistons by means of interference fit.

[0016] The connecting rod structure for an electric vacuum pump according to the present application prevents, by means of the fitting between the pin and the bushing, jamming or wear due to impurities entering a clearance therebetween, and has advantages such as ease of manufacturing and assembly, capability of withstanding large axial forces, and rare chances for the pin to be detached during the swinging of the connecting rod. Further, the bushing may be a sintered copper bushing, prolonging the lifetime of the connecting rod structure.

Brief Description of the Drawings

[0017] Other features, objectives, and advantages of the present application will become more apparent from reading the detailed description of non-limiting embodiments with reference to the following accompanying drawing.

FIG. 1 is a schematic diagram of a connecting rod structure for an electric vacuum pump according to an embodiment of the present application;

FIG. 2 is an enlarged view of a part of FIG. 1 in a dashed box;

FIG. 3 is a sectional view of a dust-proof sleeve according to an embodiment of the present application;

FIG. 4 is a partial cutaway view of a connecting rod structure for an electric vacuum pump according to another embodiment of the present application; and FIG. 5 is a structural schematic diagram of an electric vacuum pump according to an embodiment of the present application.

Detailed Description of Embodiments

[0018] Now exemplary implementations will be described more fully with reference to the accompanying drawings. However, the exemplary implementations can be implemented in many forms and should not be construed as being limited to the implementations set forth herein. On the contrary, these implementations are provided to make the present application thorough and complete, and to fully convey the concept of the exemplary implementations to those skilled in the art. The embodiments described below with reference to the drawings are exemplary and are merely for the purpose of explaining the present application and should not be construed as limiting the present application. In the drawings, the same reference signs denote the same or similar structures, and thus the repeated description thereof will be omitted.

[0019] In the description of the present application, it is to be understood that the terms "first" and "second" are used only for the purpose of illustration, and are not to be construed as indicating or implying the relative importance or implicitly indicating the number of technical features indicated. Thus, a feature defined by "first" and "second" may explicitly or implicitly include one or more features. In the description of the present application, "a plurality of" means two or more, unless explicitly and specifically defined otherwise.

[0020] In the description of the present application, it should be noted that, unless otherwise explicitly specified and defined, the terms "mount", "connect", and "connection" should be understood in a broad sense, for example, they may be a fixed connection, a detachable connection, or an integrated connection; may be a mechanical connection, or an electrical connection or mutual communication; may be a direct connection or an indirect connection by means of an intermediate medium, or may be communication between interiors of two elements or interaction between the two elements. For those skilled in the art, the specific meanings of the above terms in the present application should be understood according to specific circumstances.

[0021] The disclosure below provides many different

embodiments or examples for implementing different structures of the present application. In order to simplify the disclosure of the present application, components and settings of specific examples are described below. Of course, they are merely examples and are not intended to limit the present application. In addition, reference numerals and/or reference letters may be repeated in different examples in the present application, such repetition being for the purpose of simplicity and clarity, and not by itself indicative of the relationships between the various embodiments and/or settings in discussion. In addition, the present application provides examples of various specific processes and materials, but those skilled in the art may recognize the application of other processes and/or the use of other materials.

[0022] For existing technical problems, the present application provides a connecting rod structure for an electric vacuum pump and an electric vacuum pump. The connecting rod structure for an electric vacuum pump includes: a connecting rod, a proximal end of the connecting rod being configured for a motor shaft to pass through, and a distal end of the connecting rod being configured for connection with a piston; a pin including a shank, a neck and a cap which are connected in sequence, the shank being connected to the distal end of the connecting rod; and a bushing sleeved around the neck. The connecting rod structure for an electric vacuum pump according to the present application prevents, by means of the fitting between the pin and the bushing, jamming or wear due to impurities entering a clearance therebetween, and has advantages such as ease of manufacturing and assembly, capability of withstanding large axial forces, and rare chances for the pin to be detached during the swinging of the connecting rod. Further, the bushing may be a sintered copper bushing, prolonging the lifetime of the connecting rod structure.

[0023] The connecting rod structure for an electric vacuum pump and the structure of the electric vacuum pump according to the present application are further set forth below with reference to the drawings and specific embodiments. It may be understood that the various specific embodiments are not to be construed as limitations on the scope of protection of the present application.

[0024] FIG. 1 is a schematic diagram of a connecting rod structure for an electric vacuum pump according to an embodiment of the present application. Specifically, the connecting rod structure for an electric vacuum pump includes a connecting rod 11, a pin 12, and a bushing 13.

[0025] A proximal end 111 of the connecting rod 11 is configured for a motor shaft to pass through, rotation of the motor shaft brings about rotation of the connecting rod, and a distal end of the connecting rod 11 is configured for connecting with a piston. Here, the proximal end represents an end of the connecting rod 11 close to the motor shaft, and the distal end represents an end of the connecting rod 11 relatively away from the motor shaft. Typically, the proximal end 111 of the connecting rod 11 is connected to the motor shaft by a stud which is coaxially

connected to the motor shaft. The motor shaft connected to the motor can drive the piston smoothly by the connecting rod 11, allowing the piston to run with less vibration.

[0026] FIG. 2 is an enlarged view of a part of FIG. 1 in a dashed box, the pin 12 includes a shank 121, a neck 122, and a cap 123 connected in sequence, and outer diameters of the shank 121, the neck 122 and the cap 123 increase in sequence. The shank 121 is connected to the distal end of the connecting rod 11. The connection between the shank 121 and the distal end of the connecting rod 11 may be implemented by means of interference fit, i.e., a hole adapted to the shank 121 may be provided at the distal end of the connecting rod 11, to which hole the shank 121 is then fitted. The bushing 13 is sleeved around the neck 122, the bushing 13 may be a sintered copper bushing which has a stronger wear resistance, thereby prolonging the lifetime of the connecting rod structure and of the electric vacuum pump using the connecting rod structure. Preferably, the bushing may be a sintered copper bushing containing graphite. During sintering, an appropriate amount of graphite is uniformly mixed into copper powder, and a sintered copper bushing containing graphite is obtained after the sintering. Since the graphite having a platelet-like crystal structure has good lubricating performance as well as good wear resistance, pressure resistance and temperature resistance, the sintered copper bushing containing graphite is more wear-resistant, and its self-lubricating action allows the electric vacuum pump to operate with less noise and better smoothness. The bushing 13 is in clearance-fit with the neck. During the fitting of the copper bushing, a mandrel may be used to press in the neck 122 of the pin 12, preventing excessive deformation.

[0027] In some embodiments, to reduce impurities entering a clearance between bushing 13 and the pin 12, the bushing 13 further includes an extension 131 that extends to one side of the cap 123. Further, the connecting rod structure further includes a sealing unit, and the sealing unit is arranged at an end of the neck 122 close to the shank 121. That is, the bushing according to the present application is sleeved on the middle (the neck 122) of the pin 12, impurities are prevented from entering the bushing 13 at the connection between the neck 122 and the cap 123 by means of the extension 131 of the bushing 13, and the sealing unit is provided at the end of the neck 122 connected to the shank 121 to implement sealing for this connection. The above structure prevents the impurities from entering the clearance between the bushing 13 and the pin 12, thereby preventing jamming or wear between the bushing 13 and the pin 12. In addition, the above connecting rod structure is simple in terms of structure and has the advantages such as ease of manufacturing and assembly, capability of withstanding large axial forces, and rare chances for the pin to be detached during the swinging of the connecting rod.

[0028] In an embodiment, the sealing unit is a dust-proof sleeve 14, i.e., the connecting rod structure further

includes the dust-proof sleeve 14. FIG. 3 is a sectional view of the dust-proof sleeve according to an embodiment of the present application. The dust-proof sleeve 14 is sleeved on the end of the neck 122 close to the shank 121. The dust-proof sleeve includes a bottom face 141 provided with a through hole h and a side wall 142 connected to the bottom face 141. The shank 121 passes through the through hole h, and the dust-proof sleeve 14 is sleeved around the end of the neck 22 close to the shank 121. As shown in FIG. 2, in this case, the bottom face 141 of the dust-proof sleeve 14 abuts against an end face of the connecting rod 11. In this embodiment, an outer peripheral wall of the bushing 13 at the dust-proof sleeve 14 is a recessed wall recessed toward a centre of the pin 12, and the side wall 142 of the dust-proof sleeve 14 fits with the recessed wall. By means of the recessed wall, the side wall 142 of the dust-proof sleeve 14 may be flush with the outer periphery of the rest of the dust-proof sleeve 14, thus avoiding affecting the connection between the bushing and the piston. The dust-proof sleeve may be a steel sleeve.

[0029] FIG. 4 is a partial cutaway view of a connecting rod structure for an electric vacuum pump according to another embodiment of the present application. In this embodiment, the sealing unit is a sealing groove 112 provided in the distal end of the connecting rod 11, and one end of the bushing 13' is in insertion fit with the sealing groove 112. The sealing groove 112 may also function to prevent impurities from entering the clearance between the neck 122 and the bushing 13 from the connection between the neck 122 and the shank 121. The sealing unit is not limited to the structure in the above embodiment.

[0030] A second aspect of the present application provides an electric vacuum pump, including at least one connecting rod structure for an electric vacuum pump as described. Of course, the electric vacuum pump further includes a motor, a motor shaft, and a plurality of pistons, and the number of pistons of the electric vacuum pump may be adjusted according to the actual conditions. FIG. 5 is a structural schematic diagram of an electric vacuum pump according to an embodiment of the present application, the electric vacuum pump including two connecting rod structures and two pistons 2. The motor shaft 3 of the electric vacuum pump is in transmission connection with the piston 2 by means of a connecting rod structure. More specifically, a proximal end of each connecting rod 11 is configured for the motor shaft 3 to passing through, and a distal end of the connecting rod 11 is connected to one piston 2, that is, by means of the shank 121 of the pin 12 being connected to the distal end of the connecting rod 11, the bushing 13 is sleeved on the neck 122 of the pin 12, and the piston rod of the piston 2 is sleeved on the bushing 13. Each of the bushings 13 may be connected to the piston rod of one of the pistons 2 by means of interference fit, thereby maintaining the strength of the connection therebetween, making the pin 12 and the bushing 13 less prone to detachment, and improving the structur-

al and operating stabilities of the electric vacuum pump.

[0031] Although the embodiments of the present application have been shown and described above, it can be understood that the above embodiments are exemplary and cannot be construed as limiting the present application, and changes, modifications, substitutions, and variations may be made by a person skilled in the art to the above embodiments within the scope of the present application.

[0032] The above contents are further detailed descriptions of the present application made with reference to the specific preferred embodiments, and it cannot be considered that the specific implementation of the present application is limited to these descriptions. For those skilled in the art of the present application, several simple deductions or substitutions can be made without departing from the spirit of the present application, and should be regarded as falling within the scope of protection of the present application.

Claims

1. A connecting rod structure for an electric vacuum pump, **characterized by** comprising:
 - a connecting rod, a proximal end of the connecting rod being configured for a motor shaft to pass through, and a distal end of the connecting rod being configured for connection with a piston;
 - a pin including a shank, a neck and a cap which are connected in sequence, the shank being connected to the distal end of the connecting rod;
 - and a bushing sleeved around the neck.
2. The connecting rod structure for an electric vacuum pump according to claim 1, **characterized in that** the bushing further comprises an extension that extends to one side of the cap.
3. The connecting rod structure for an electric vacuum pump according to claim 1 or 2, **characterized in that** the connecting rod structure further comprises a sealing unit, the sealing unit being arranged at an end of the neck close to the shank.
4. The connecting rod structure for an electric vacuum pump according to claim 3, **characterized in that** the sealing unit is a dust-proof sleeve;
 - the dust-proof sleeve comprises a bottom face provided with a through hole and a side wall connected to the bottom face; and
 - the shank passes through the through hole, and the dust-proof sleeve is sleeved around the end of the neck close to the shank.
5. The connecting rod structure for an electric vacuum pump according to claim 4, **characterized in that** an outer peripheral wall of the bushing at the dust-proof sleeve is a recessed wall recessed toward a centre of the pin, the side wall of the dust-proof sleeve fitting with the recessed wall.
6. The connecting rod structure for an electric vacuum pump according to claim 3, **characterized in that** the sealing unit is a sealing groove provided in the distal end of the connecting rod, and one end of the bushing is in insertion fit with the sealing groove.
7. The connecting rod structure for an electric vacuum pump according to any one of the preceding claims, **characterized in that** the shank is connected to the distal end of the connecting rod by means of interference fit; or the bushing is in clearance fit with the neck.
8. The connecting rod structure for an electric vacuum pump according to any one of the preceding claims, **characterized in that** the bushing is a sintered copper bushing.
9. The connecting rod structure for an electric vacuum pump according to any one of the preceding claims, **characterized in that** the bushing is a sintered copper bushing containing graphite.
10. An electric vacuum pump, **characterized by** comprising at least one connecting rod structure for an electric vacuum pump according to any one of claims 1 to 9.
11. The electric vacuum pump according to claim 10, **characterized by** further comprising at least one piston; wherein each of the bushings is connected to a piston rod of one of the pistons by means of interference fit.

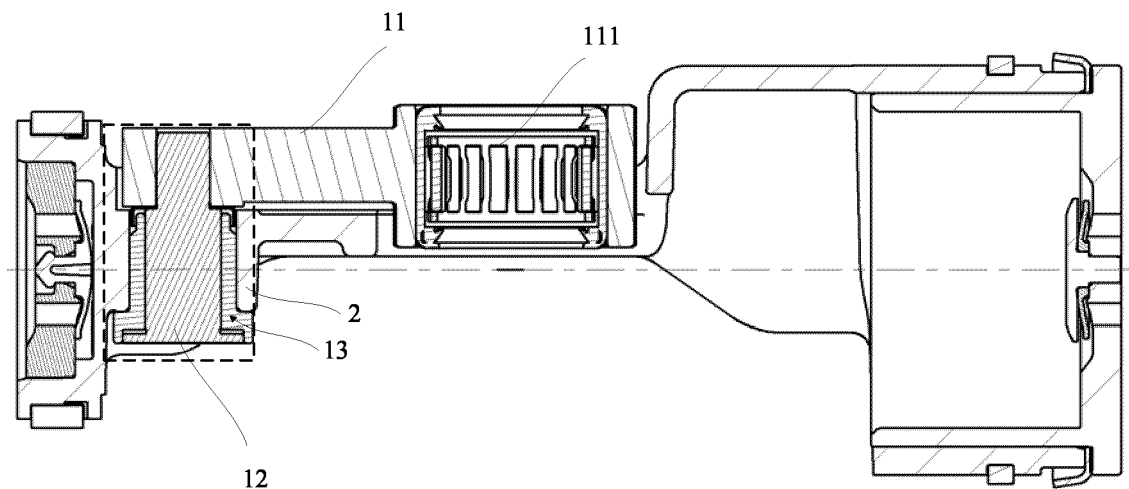


FIG. 1

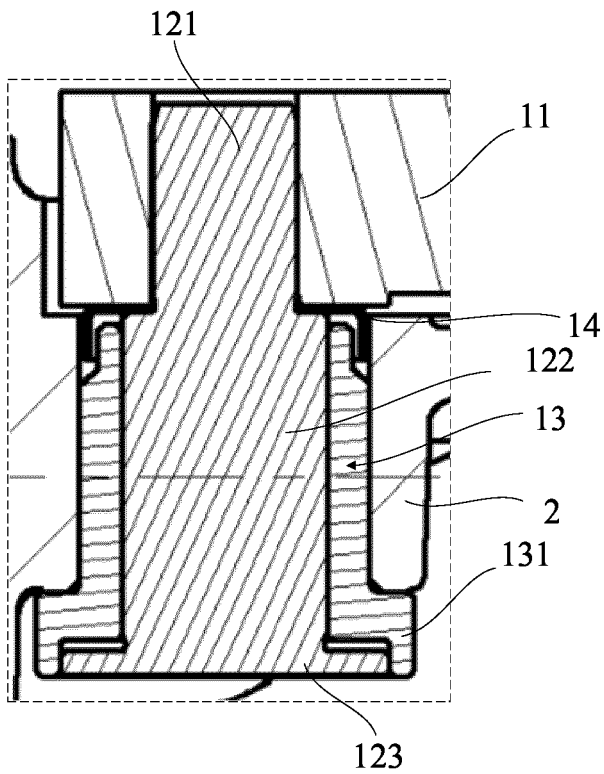


FIG. 2

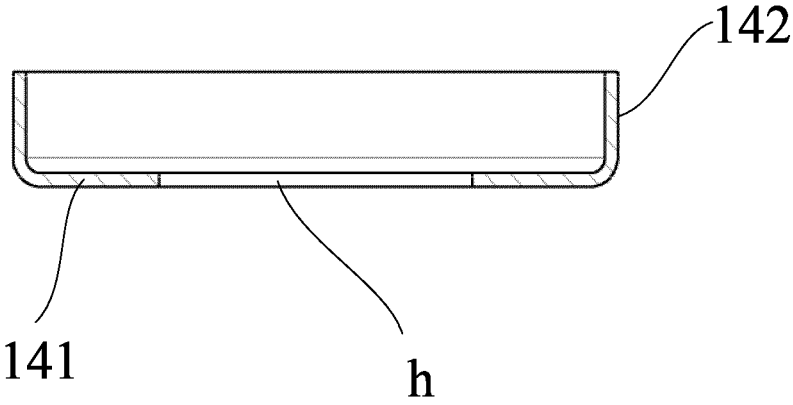


FIG. 3

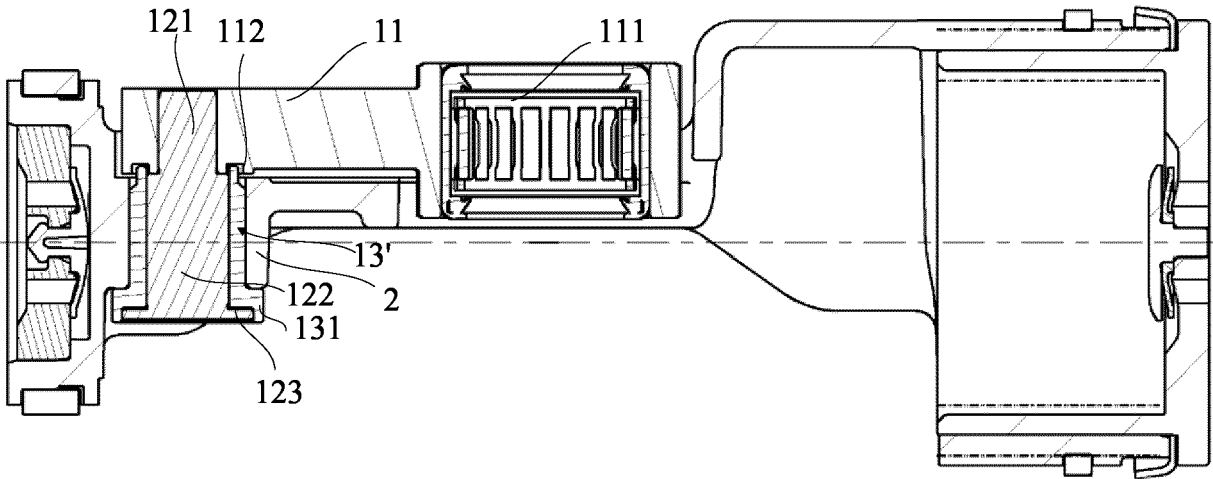


FIG. 4

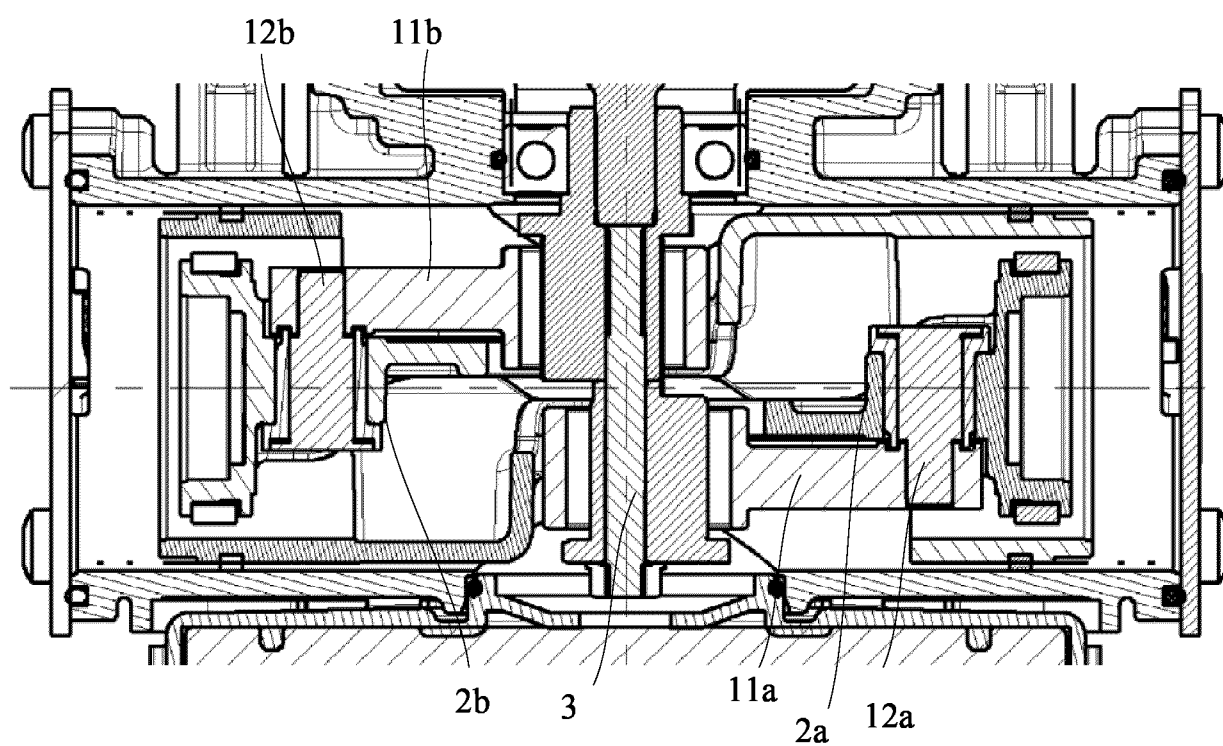


FIG. 5



EUROPEAN SEARCH REPORT

Application Number

EP 25 18 9791

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		2 September 2025	Pinna, Stefano
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