(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 July 2020 (23.07.2020)

WIPO | PCT

(10) International Publication Number
WO 2020/148221 A1

(51) International Patent Classification:
H01R 39/14 (2006.01) *H01R 39/64* (2006.01)
H01R 39/08 (2006.01)

(21) International Application Number:
PCT/EP2020/050668

(22) International Filing Date:
13 January 2020 (13.01.2020)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
19152302.6 17 January 2019 (17.01.2019) EP

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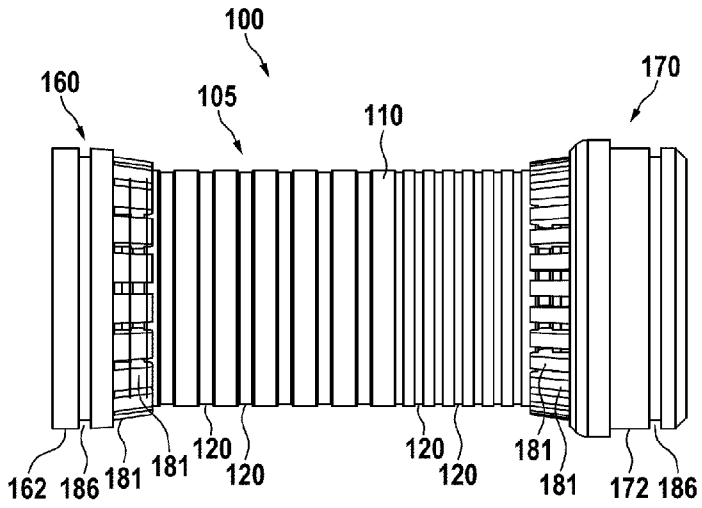
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*

(54) Title: SNAP-IN SLIPRING MODULE

Fig. 1



(57) **Abstract:** A slipring module assembly comprises a cylindrical slipring module and two holders at both ends of the module. The slipring module has a radial groove at both ends and each holder comprises a plurality of fingers reaching into the radial groove when attached to the slipring module, locking the holder to the module. The holders have support for ball bearings to provide a rotatable support in a housing.

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Snap-in Slipring Module

Field of the invention

The invention relates to a slipring module bearing sliding tracks of a slipring. Sliprings are used for transferring electrical signals and power between rotating parts.

Description of the related art

A slipring module held by cylindrical metal tube is disclosed in EP 1 320 155 A2. This assembly is comparatively stiff and solid. The disadvantage is a high weight and the expensive and complex manufacturing process. US 9,742,135 B2 discloses a slipring having sliding tracks mounted to a structured shaft. This is also complex and expensive. EP 1 482 604 A2 discloses a method of gluing multiple contact rings together with a flange. The flange is used as a chuck in a lathe and as mechanical reference. This method is also complex and expensive.

Summary of the invention

The problem to be solved by the invention is to provide a slipring module which is easy and inexpensive to manufacture and which can easily be exchanged in a slipring assembly. A further aspect is to provide a slipring assembly with free inner bore.

Solutions of the problem are described in the independent claims. The dependent claims relate to further improvements of the invention.

A slipring module comprises a body and at least one sliding track. There may be at least one of 2, 3, 4, 5, 6, 7, 8, 9, 10 sliding tracks. The maximum number of tracks is determined by the diameter of the module and the technology of con-

tacting the rings. Multiple slipring modules can e.g. be added from a modular construction kit.

The body has a circular cylindrical shape around a center axis and comprises an electrically insulating material. The body may have structural or structure enhancing metal components. It is preferred, if the body comprises insulating material only. The insulating material may be any suitable monomer or preferably polymer, for example epoxy or polyurethane. The insulating material may also comprise a preferably non-conductive filler, for example ceramic, aluminum oxide or others. The modules might also be strengthened by glass fiber mats or metal wire meshes incorporated into the insulating material. The modules may be hollow bodies with free inner bores.

The sliding tracks are on or at least partially embedded into the insulating material. The sliding tracks comprise an electrically conductive material. Preferably, at least two sliding tracks are insulated from each other. Preferably, they are solid conductive bodies. They may comprise any conductive metal or an alloy of metals.

For mounting the slipring module into a slipring device, at least one slip-ring holder is provided. Preferably, there are two slipring holders. The slip-ring holders are attached to one or both ends of the slipring module like end caps. Preferably, the slip-ring module has a groove at least at one end, preferably at both ends. The groove preferably is at the outside of the cylinder – shaped body, but it may also be at the inner side. The groove may have a distance from the end in a range of 2mm and 20mm, preferably between 3mm and 10mm, most preferably between 5mm and 8mm. The groove may have a depth in a range of 1mm to 10mm, preferably between 2mm and 6mm, most preferably between 3mm and 5mm. The slip-ring holders have a plurality of fingers reaching into the groove when mounted to the slipring module. Preferably, the holders have a circular

shape and the fingers are arranged circularly and preferably evenly spaced. The fingers provide together with the groove a snap – fit connection which may also be opened if necessary. Preferably, the fingers have at least a certain degree of elasticity to be deformed in such a way that they can reach over the rim of the groove. The fingers have an arm and at the end of the arm a protrusion, which fits into the groove. The protrusion and the groove may have rounded edges, such that the finger may be removed after assembly. There may also be an undercut at least at one of the protrusions and/or the groove to prevent removal of the holder after initial assembly. It may be sufficient to provide such an undercut at positions of only some of the fingers. The fingers and groove that connect holder and slipring module when mounted may also be located at the inside diameter of the module.

In an embodiment, a slipring module assembly may comprise a slipring module and a first holder and/or a second holder. The slipring module may have a cylindrical shape around a center axis which may also be a rotation axis. The module may have a first end and a second end opposing to the first end. The module may further include a slipring module body, the body including at least an electrically insulating material, which may be epoxy or any other resin or plastic. The module may further include at least one sliding track which may include a conductive material like a metal. The slipring module may have a first radial groove at the first end, and the first holder may be fitting to the first end of the slipring module. The first holder may include a plurality of fingers reaching into the first radial groove when attached to the slipring module, the fingers may lock the first holder to the module. Furthermore, as an alternative or in addition, a second slipring module may have a second radial groove at the second end and the second holder may be fitting to the second end of the slipring module. The second holder may comprise a plurality of fingers which may be reaching into the second radial groove when attached to the slipring module. The fingers may be locking the second holder to the module.

In another embodiment, a slipring module assembly may include a first slipring module, a second slipring module and one double holder. The first slipring module and the second slipring module may each have a cylindrical shape around a center axis. Each module may have a first end and a second end opposing to the first end. Each module may further include a slipring module body, the body comprising at least an electrically insulating material, at least one sliding track, the at least one sliding track including an electrically conductive material. The first slipring module may have a first radial groove at a first end, and the second slipring module may have a second radial groove at a second end. The double holder may have two axially opposing ends. They may include a plurality of fingers around a common center axis. A double holder may include a first end fitting to the first end of the first slipring module, the plurality of fingers on the double holder first end may be reaching into the first radial groove when attached to the first slipring module. A double holder second end may be fitting to the second end of the second slipring module, the plurality of fingers on the double holder second end may be reaching into the second radial groove when attached to the second slipring module. The fingers may be locking the double holder to the modules. By that way a larger number of modules may be stacked by including double holders between slipring modules. There may be a plurality of double holders between slipring modules, like an integer number of N double holders between N+1 slipring modules.

The embodiments disclosed herein may provide a free bore through the whole assembly, as the holding force by the holders is high enough to hold the modules in place. So, no shaft or supporting part is required within the modules and/or within the holders. The free bore may be used for cables, light wave conductors, pipes or even other slip rings or rotary joints which may be mounted coaxially.

Another embodiment includes the combination of the two embodiments described before. A double holder may be arranged between a second end of a first

slipring module and first end of a second slipring module. A first holder may be at a first end of the first slipring module and a second holder may be at a second end of the second slipring module. Thereby holders are at the ends and in between the slipring modules. By that way a larger number of modules may be stacked by including double holders between slipring modules.

In a further embodiment, one of the holders of the first embodiment is a double holder to connect two slipring modules.

The slipring module may be preassembled before mounting into a slip-ring housing by attaching at least one holder (if only one holder is used) or two holders to the ends of the slip-ring module. Such a preassembled slip-ring module may then be inserted into the housing from one side and along its center axis. This is the same way, as slip-ring modules known from prior art are mounted. If a slip-ring housing is already installed in an application, it may be difficult to access the housing from one side to insert the module along its center axis. Here, the slip-ring module may simply be displaced in a radial direction and the holders may be attached or removed, when they module is in place. Specifically, for assembling a module, first, the module may be moved laterally (in a radial direction) into its final position and then one or two holders are pushed on the ends of the slipring modules. For disassembly, one or two holders are removed sideward thus releasing the module which may be moved out of the housing laterally (in a radial direction).

It may be sufficient to hold the module with only one holder at one end. Normally, the module will be held with one holder at each end. It may also be possible to combine a holder at one end and a bearing fixation as known from prior art at the other end. The module may also be held only by a single holder at a first end while the second end is without mechanical support.

The at least one holder preferably comprises a plastic material, preferably made from thermosets or thermoplastics. Preferably, it is an injection molded part or a 3D printed part. Alternatively, it may be made of any metal or any other material as long as it provides enough flexibility to the fingers to snap into a groove of the module.

Preferably the at least one holder has a round outer shape. It may have a free inner bore. This inner bore may be used to guide wires to the module or to insert another rotary joint like another slipring, a RF joint, an optical joint or a media joint. Preferably, the at least one holder has a bearing seat for a ball bearing. Such a ball bearing may provide a rotatable support within a housing.

There may be a groove for holding a sealing ring (O-ring) in either at least one of the front sides of the module or in at least one of the holders such that a sealing ring contacts the module and the at least one holder at the same time. The at least one sealing ring preferably comprises an elastic material like a polymer or rubber. The at least one sealing ring may be compressed by the holding force generated by the fingers. The at least one sealing ring generates friction between the module and the holder, such that there is no movement and specifically no rotational movement between the at least one holder and the module. This increases mechanical stability. The sealing ring could also be realized by 3D printing a ring shaped or wavy structure into the groove of the module or onto the modules front side.

There may be a groove for holding a shaft lock ring in at least one of the holders. This shaft lock ring may be used to fix the holder and therefore the module assembly within a slipring housing. Instead of a shaft lock ring also a snap ring could be used.

Instead of an O-ring any other spring like a cup spring or+ wave spring could be used as separate part or as printed detail of the module.

A preferred embodiment is a contrarotating ribbon spring that locks into catch in case of rotation of the module (either during assembly or during operation). In this case a mechanical stop is of advantage to exactly define the axial position of the module.

In an embodiment, axial springs are provided at the holder. Preferably, the axial springs are one part with the body of the holder. In a further embodiment, springs, for example from spring steel may be inserted into gaps of the body of the holder. The axial springs assert a force to the holder in axial direction away from the module body. This helps fixing the fingers in the groove of the module and enhances stability, but allows assembly by firmly pressing the holder on the module in an axial direction. Axial springs may have different shapes.

In an embodiment, at least one catch (a snap tab , a hurtling nose) is provided for taking up torque, such that the holder cannot rotate relative to the module. There may also be a locking pin to lock the holder in a defined position relative to the module.

Another embodiment relates to a double holder with axial springs. This double holder basically has the same features and function as the holders described above, but they are double sided to connect two slipring modules together. There may also be an axial spring and/or a catch.

Another embodiment relates to a double slipring module assembly. Here, two modules are connected together by a double holder. The double holder has fingers on two axially opposing sides and around a common rotation axis. Double holders allow connecting two or more modules together. A double holder may comprise any of the features described herein.

In an embodiment, at least one end face of the module body has a catch to receive counterrotating springs of the at least one holder.

A slipring assembly comprising a module assembly which further comprises a slipring module and at least one, preferably two holders. The assembly may further comprise a stationary part holding a first holder by a first bearing and a rotating part holding a second holder by a second bearing.

The slipring holders may be coded by different pilot diameters lathed into the front side to prevent a wrong combination of slipring holder and module or a wrong orientation of the module. The interface between slipring module and slipring holder may have integrated teeth oriented axially or radially to transfer torque or to code different modules (e.g. for data, signal or power transmission) and ensure their correct orientation during assembly.

Description of Drawings

In the following the invention will be described by way of example, without limitation of the general inventive concept, on examples of embodiment with reference to the drawings.

Figure 1 shows a slip-ring module assembly.

Figure 2 shows a sectional view of a slip-ring assembly.

Figure 3 shows a detail of figure 2.

Figure 4 shows a finger in detail.

Figure 5 shows a modified finger in detail.

Figure 6 shows a second holder with axial springs.

Figure 7 shows a double holder with axial springs.

Figure 8 shows a double slipring module assembly.

Figure 9 shows a sectional view of a double slipring module assembly.

In figure 1 a slip-ring module assembly is shown. I slip-ring module 105 comprises a slip-ring module body 110 and a plurality of sliding tracks 120. It is preferred, if the slip-ring module body 110 is of an insulating material which may be epoxy, polyurethane or any other suitable material. The sliding tracks 120 preferably are of a conductive material which may be brass, copper, steel or any alloy. The conductive material may have a wear-resistant surface and/or a highly conductive surface, which may comprise gold or any other quantities material. This embodiment shows a first holder 160 and the left side of the slip-ring module 105 and a second holder 170 at the right side of the slip-ring module 105. The holders 160,

170 have a plurality of fingers 181 to fix the holders to the slip-ring module 105. Furthermore, it is preferred, if the at least one groove 186 which allows to insert a shaft lock ring to fix the holders in a slip-ring assembly.

In figure 2 a sectional view of a slip-ring assembly 200 is shown. The slip-ring assembly 200 comprises a stationary part 210 and a rotating part 220 forming a housing for the slip-ring module assembly 100 and holding the slip-ring module assembly 100. The slip-ring module assembly 100 comprises at least a slip-ring module body 105 and a plurality of sliding tracks 120. The slip-ring module assembly 100 preferably is cylindrical and rotational symmetrical about an axis of rotation 101. There may be minor deviations like the sliding track contact pins 122.

Preferably, for holding the slip-ring module assembly 100 within the housing, holders 160 and the 170 are provided, which are held rotatably by ball bearings 211 and 221. To hold the bearings, the holders may have bearing seats 162 and 172. To have a good friction and therefore to prevent any rotational movement between the holders 160, 170 and the slip-ring module 105, preferably at least one sealing ring 184 is placed between the holder and the slip-ring module. There may also be multiple sealing rings. The sealing ring preferably comprises an elastic material like a polymer or rubber. The sealing ring furthermore provides a pre-load to the fingers and results in a more stable connection and may provide dampening of vibrations. It is preferred, if there is a sealing ring groove 183 within one of the holders 160, 170 and/or within at least one of the ends of the slip-ring module 105.

The fingers 181 of the holders 160, 170 interact with a circular groove 182 at the outside of the slip-ring module 105. In an alternate embodiment, the groove may be at the inner side of the slip-ring module 105 and the fingers 181 may be arranged at the inner side.

This figure further shows connecting pins 122 of the sliding tracks 120.

In figure 3, a detail of figure 2 is shown. Here, the section comprising a finger 181 at the second holder 170 is shown enlarged.

In figure 4 a finger 181 is shown in detail. Preferably, a finger 181 has an arm 190 which further has a protrusion 192 at its end.

In figure 5 a modified finger 181 is shown. Here, the protrusion 192 has an undercut which may interface with a protrusion in groove 182 and which may lock the finger 181 within the module 105.

Figure 6 shows a second holder 310 with axial springs 311. In this embodiment, the axial springs are one part with the body of the holder 310. There may also be springs, for example from spring steel inserted into gaps of the body of the holder 310. The axial springs assert a force to the holder in axial direction away from the module body. This helps fixing the fingers 181 in the groove 182 of the module and enhances stability, but allows assembly by firmly pressing the holder on the module in an axial direction. Axial springs may have different shapes. For example, the spring 321 shown in the next figure may also be used here. In addition to the spring there may be at least one locking pin 313 for taking up torque, such that the holder cannot rotate relative to the module. There may also be a locking pin 313 to lock the holder in a defined position relative to the module. The axial stops 316 are shorter in axial direction compared to the locking pin 313 and define the axial position of the holder to a module.

Figure 7 shows a double holder with axial springs. This double holder basically has the same features and function as the holders described above, but they are double sided to connect two slipring modules together. There may also be an axial spring 321 combined with a counterrotating spring 324, or a spring 311 as shown in the previous figure. There may also be axial stops 322 to define the

axial position of the holder to a module. The function of the axial stop 322 and the spring interaction with a catch on the module end face is demonstrated in the figure 9.

Figure 8 shows a double slipring module assembly. Here, two modules 105, 315 are connected together by a double holder 320. The double holder has fingers 181 on two axially opposing sides and around a common rotation axis. In an embodiment, here may be holders 160, 170 (not shown) at the ends of the modules.

In figure 9 the double holder 320 of figure 6 is assembled with two modules 105 and 315 is shown in cross section. The axial spring 321 hooks into a catch 131 of the slipring module. The axial stop 323 of the double holder 320 defines the axial position of the modules 105, 315 against the double holder. In case of a reversed rotation of the module the axial spring 321 might slip out of the catch and the counterrotating axial spring 324 hooks into the catch 131 of the slipring module.

List of reference numerals

100	slipring module assembly
101	center axis
105	slipring module
110	slipring module body
120	sliding tracks
122	sliding track connecting pin
130	end face
131	catch
160	first holder
162	first bearing seat
170	second holder
172	second bearing seat
175a	first end
175b	second end
181	finger
182a	first radial groove
182b	second radial groove
183	sealing ring groove
184	sealing-ring
185	shaft lock ring
186	shaft lock ring groove
190	finger arm
192	finger protrusion
194	undercut
200	slipring assembly
210	stationary part
211	first bearing
220	rotating part

221	second bearing
310	second holder with axial spring
311	axial spring
312	catch
313	locking pin
315	slipring module
316	axial stop
320	double holder
321	axial spring
322	catch
323	axial stop
324	counterrotating axial spring
331	double holder first end
332	double holder second end

Claims

1. Slipring module assembly (100) comprising a slipring module (105) and a first holder (160) and/or a second holder (170),
the slipring module (105) having a cylindrical shape around a center axis (101) and having a first end (175a) and a second end (175b) opposing to the first end, and comprising:

- a slipring module body (110), the body comprising at least an electrically insulating material,
- at least one sliding track (120), the at least one sliding track (120) comprising an electrically conductive material,

characterized in, that
a) the slipring module (105) has a first radial groove (182a) at the first end (175a), and the first holder (160) is fitting to the first end (175a) of the slipring module (105), and the first holder (160) comprises a plurality of fingers (181) reaching into the first radial groove (182) when attached to the slipring module (105), the fingers (181) locking the first holder (160) to the module (105),
and/or
b) the slipring module (105) has a second radial groove (182) at the second end (175b) and the second holder (170) is fitting to the second end (175b) of the slipring module (105), and the second holder (170) comprises a plurality of fingers (181) reaching into the second radial groove (182) when attached to the slipring module (105), the fingers (181) locking the second holder (170) to the module (105).

2. Slipring module assembly (100) comprising a first slipring module (105), a second slipring module (315) and one double holder (320),
the first slipring module (105) and the second slipring module (315) each having a cylindrical shape around a center axis (101) and each having a first end (175a) and a second end (175b) opposing to the first end, and each further comprising:

- a slipring module body (110), the body comprising at least an electrically insulating material,
- at least one sliding track (120), the at least one sliding track (120) comprising an electrically conductive material,

characterized in, that
the first slipring module (105) has a first radial groove (182a) at the first end, and the second slipring module (315) has a second radial groove (182b) at the second end, and
the double holder (320) has two axially opposing ends (331, 332) comprising a plurality of fingers (181) around a common center axis (101), and
a double holder first (331) end is fitting to the first end of the first slipring module (105), the plurality of fingers on the double holder first end is reaching into the first radial groove (182) when attached to the first slipring module (105),
and a double holder second end (332) is fitting to the second end of the second slipring module (315), the plurality of fingers on the double holder second end is reaching into the second radial groove (182) when attached to the second slipring module (315), and
the fingers are locking the double holder (320) to the modules (105, 315).

3. Slipring module assembly (100) according to claim 1,
characterized in, that
either the first holder (160) and/or the second holder (170) is a double holder (320),
the slipring module assembly (100) further comprising a first slipring module (105) and a second slipring module (315),
the second slipring module (315) having a cylindrical shape around a center axis (101) and having a first end (175a) and a second end (175b) opposing to the first end, and the second slipring module (315) further comprising:

- a slipring module body (110), the body comprising at least an electrically insulating material,
- at least one sliding track (120), the at least one sliding track (120) comprising an electrically conductive material,

characterized in, that
the first slipring module (105) has a first radial groove (182a) at the first end, and the second slipring module (315) has a second radial groove (182b) at the second end, and
the double holder (320) has two axially opposing ends (331, 332) comprising a plurality of fingers (181) around a common center axis (101), and
a double holder first (331) end is fitting to the first end of the first slipring module (105), the plurality of fingers on the double holder first end is reaching into the first radial groove (182) when attached to the first slipring module (105),
and a double holder second end (332) is fitting to the second end of the second slipring module (315), the plurality of fingers on the double holder second end is reaching into the second radial groove (182) when attached to the second slipring module (315), and
the fingers are locking the double holder (320) to the modules (105, 315).

4. Slipring module assembly (100) according to claim 1 and 2 or claim 3 comprising a double holder (320) between a second end of a first slipring module (105) and first end of a second slipring module (315), and
a first holder (160) at a first end of the first slipring module (105) and a second holder (170) at a second end of the first slipring module (315).

5. Slipring module assembly (100) according to any of the previous claims, characterized in, that
the slipring module (105) comprises a plurality of sliding tracks (120) insulated from each other.

6. Slipring module assembly (100) according to any of the previous claims, characterized in, that
that at least one end face (130) of the module body (110) has a catch to receive counterrotating springs of the at least one holder (160).

7. Slipring module assembly (100) according to any of the previous claims, characterized in, that
the at least one end face (130) of the module body (110) has a groove for a sealing-ring (184).

8. Slipring module assembly (100) according to any of the previous claims, characterized in, that
at least one of the holders (160, 170) has a face matching to at least one end face (130) of the module body (110) comprising a groove for a sealing-ring (184).

9. Slipring module assembly (100) according to any of the previous claims, characterized in, that
at least one sealing ring (184) is located between at least one end face (130) of the module body (110) and at least one of the holders (160, 170).

10. Slipring module assembly (100) according to any of the previous claims, characterized in, that
at least one of the holders (160, 170) has a groove (186) for a shaft lock ring (185).

11. Slipring module assembly (100) according to any of the previous claims, characterized in, that
at least one of the holders (160, 170) has a bearing seat for a ball bearing (211, 221) or plain bearing.

12. Slipring module assembly (100) according to any of the previous claims, characterized in, that
at least one of the holders (160, 170, 310) has an axial spring (311, 321) for asserting an axial force between the at least one holder and the slipring module.

13. Slipring module assembly (100) according to any of the previous claims, characterized in, that
at least two slipring modules (105, 315) are connected together by a double holder comprising a plurality of fingers on two axially opposing sides and around a common center axis.

14. Slipring module assembly (100) according to any of the previous claims, characterized in, that
the Slipring module assembly (100) provides a free inner bore.

15. Slipring assembly (200) comprising a slipring module assembly (100) according to any of the previous claims,
characterized in, that
a stationary part (210) holding the first holder (160) by a first bearing (211) and a rotating part (220) holding the second holder (170) by a second bearing (221) are provided.

Fig. 1

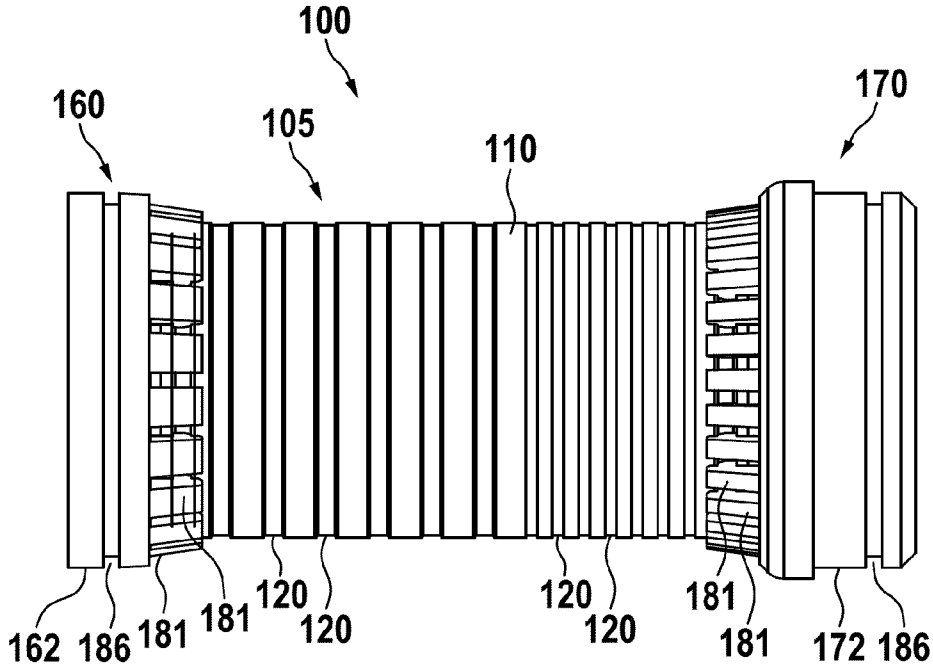

100
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172
186

Fig. 2

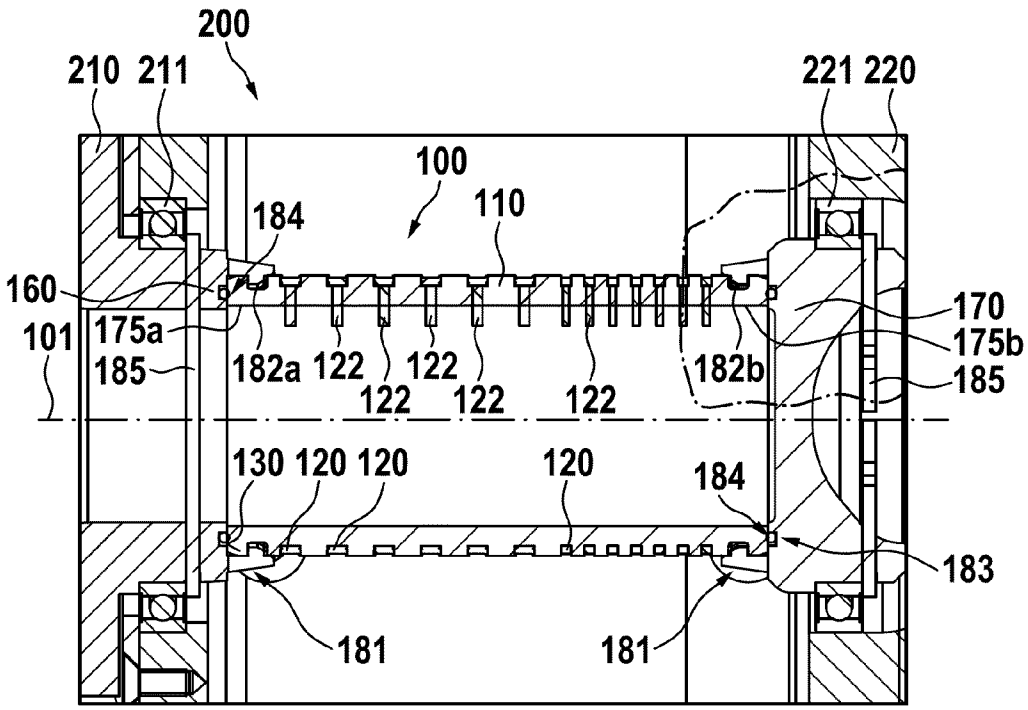

200
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211
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175b
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182b
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181

Fig. 3

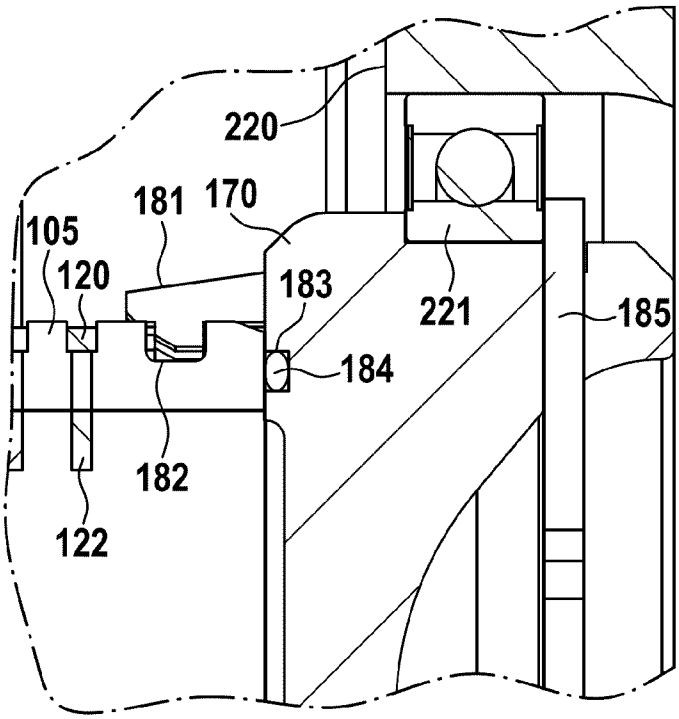


Fig. 4

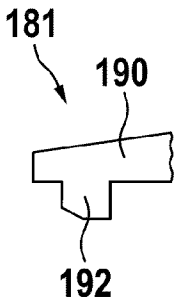


Fig. 5

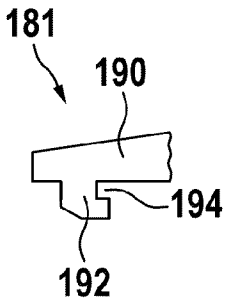


Fig. 6

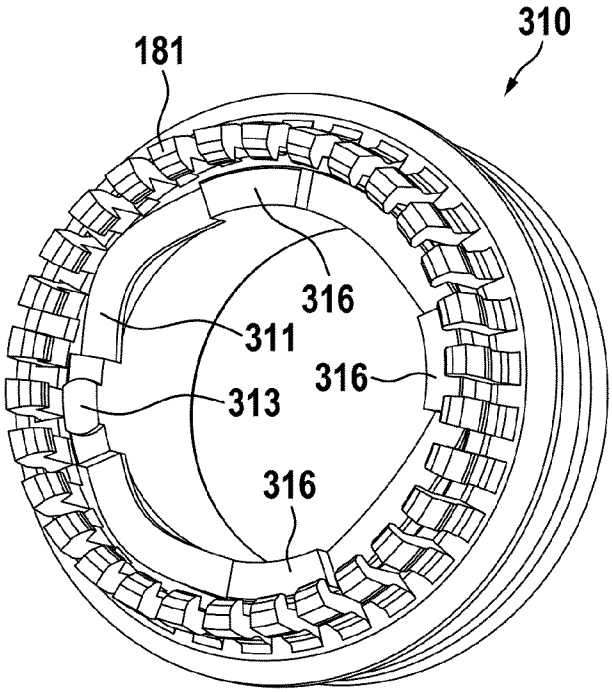


Fig. 7

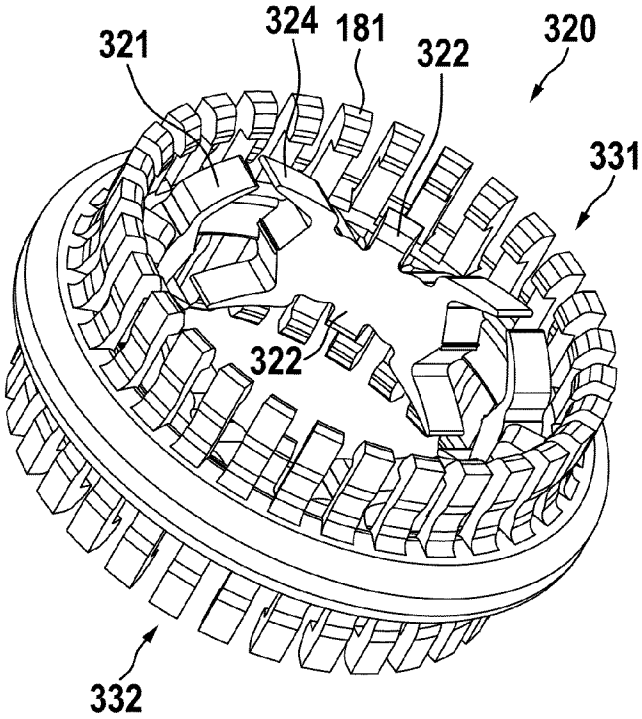


Fig. 8

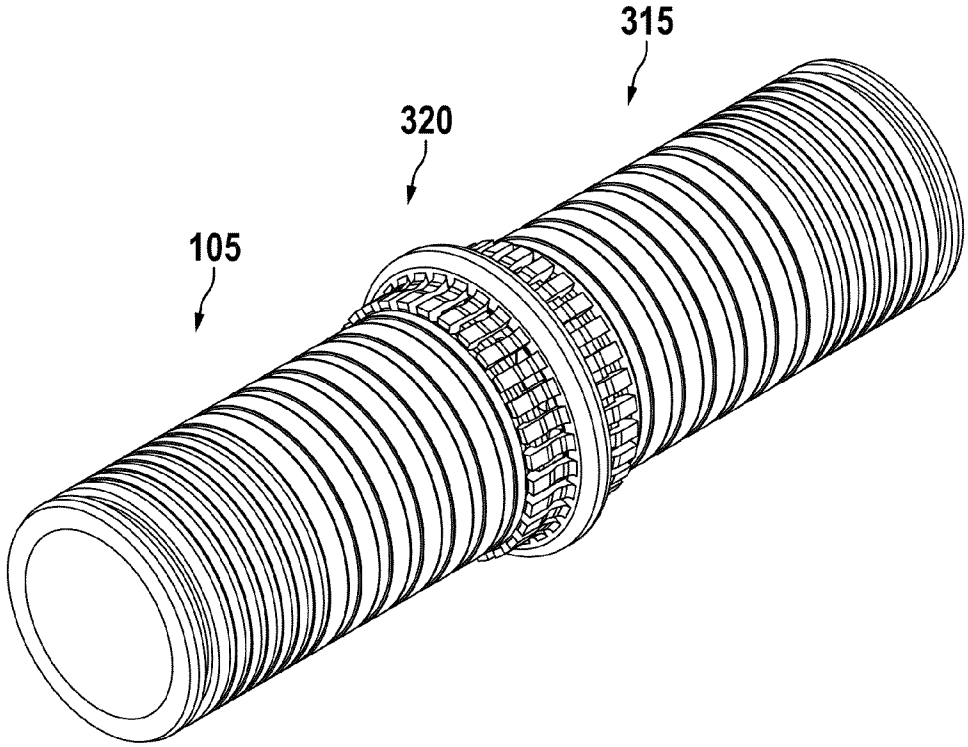
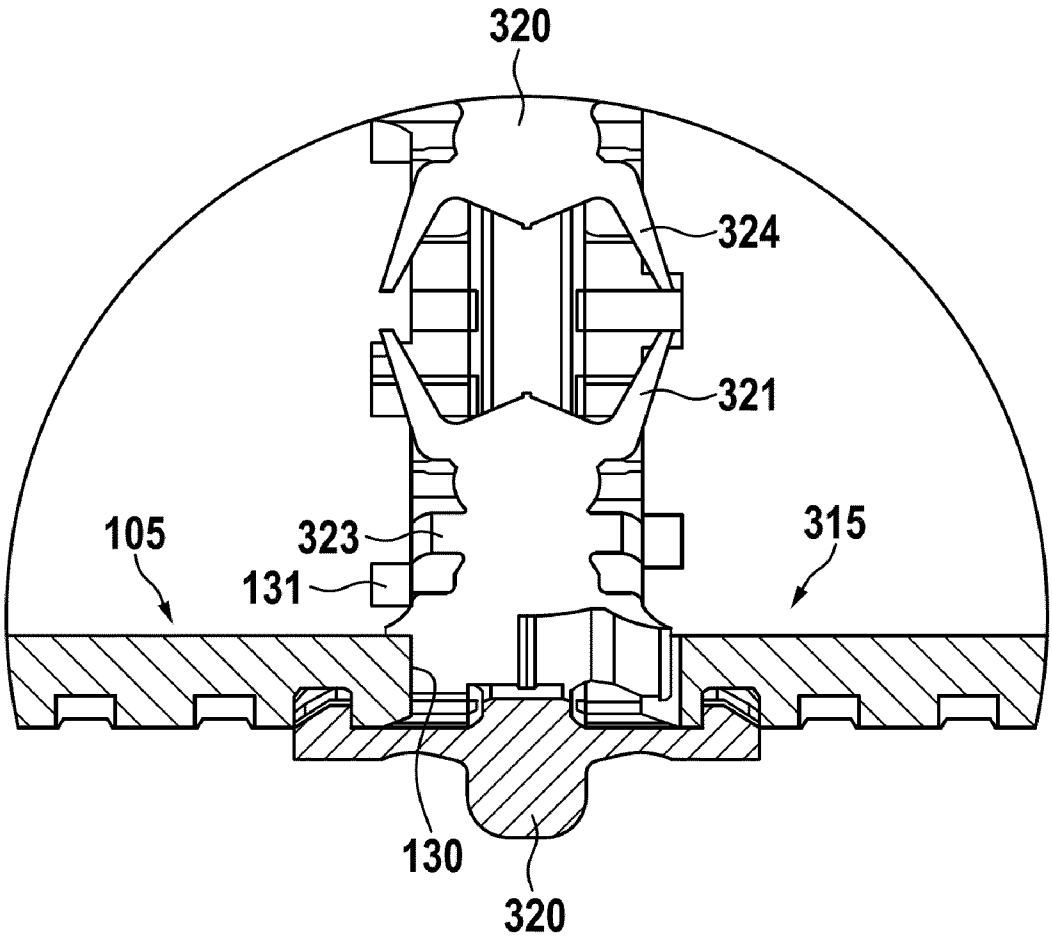


Fig. 9



INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/050668

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01R39/14
ADD. H01R39/08 H01R39/64

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)
H01R

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)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 90/05395 A1 (BOSCH GMBH ROBERT [DE]) 17 May 1990 (1990-05-17)	1,5-15
A	abstract; figures 1-12	2-4

A	US 4 469 972 A (RAMPIGNON MARC [FR] ET AL) 4 September 1984 (1984-09-04) abstract; figures 1-7	1-15

A	EP 0 967 696 A2 (JASUN ENGINEERING LIMITED [GB]) 29 December 1999 (1999-12-29) abstract; figures 1-6	1-15

A	WO 2010/048956 A1 (VESTAS WIND SYS AS [DK]; KROGH LARS [DK]; LAURIDSEN STEEN BJERG [DK]) 6 May 2010 (2010-05-06) abstract; figures 1-11	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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

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"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

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"&" 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 March 2020	27/03/2020

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Georgiadis, Ioannis

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2020/050668

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