(19) DANMARK

(10) DK/EP 2597301 T3

(12) Oversættelse af europæisk patentskrift

Patent- og Varemærkestyrelsen

(51) Int.Cl.: *F 03 D 80/00 (2016.01)*

(45) Oversættelsen bekendtgjort den: **2017-06-19**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2017-03-01**

(86) Europæisk ansøgning nr.: **12183965.8**

(86) Europæisk indleveringsdag: **2012-09-12**

(87) Den europæiske ansøgnings publiceringsdag: **2013-05-29**

(30) Prioritet: **2011-11-25 TW 100143430**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(54) Benævnelse: **Vindmølle og navtætningsapparat herpå**

(56) Fremdragne publikationer:
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DESCRIPTION

TECHNICAL FIELD

[0001] The present invention relates to a windmill and a hub sealing apparatus for windmills, and more particularly, to a sealing apparatus and a windmill with the sealing apparatus.

BACKGROUND

[0002] With increasing attention toward global environmental consciousness, especially in energy saving and carbon reduction, green energy (such as solar power, wind power, wave power, hydrogen energy or biomass energy) is becoming a focal point for industries all over the world, since it can be extracted, generated, and/or consumed without any significant negative impact to the environment. Among the variety of forms of green energy, wind power is the one most likely to become a major alternative energy source in the near future.

[0003] The harvesting of wind power is enabled through the use of windmills. Generally, a windmill is composed of: a tower, arranged at a specific location conforming to certain conditions; a gear box, mounted to an end of the tower; a generator, mounted at the end of the tower alongside the gear box to allow the same to be driven by the gear box so as to generate electricity; and a blade module, coupled to the gear box by a bearing for allowing the gear box to be driven by the blade module. The blade module is configured with a plurality of blades in a manner that each blade is coupled to the bearing while the bearing is further coupled to a hub. It is noted that there can be sealing components respectively arranged at a position between the blades and the bearing, and also at a position between the bearing and the hub.

[0004] Operationally, when the blades in the blade module are driven to rotate by wind power, the bearing will be brought along to rotate so as to drive the hub to rotate as well, and then the rotation of the hub is transmitted to the generator through the gear box to enable the generator to generate electricity. Simultaneously, the rotation of the plural blades can be adjusted and controlled by the use of a pitch motor for achieving maximum wind power harvesting, as the pitch motor is connected to an internal ring gear embedded in the bearing through the coupling of a small gear. However, if there is no sealing means arranged at the interface (or interval) between the inner ring of the bearing and the blades, and between the outer ring of the bearing and the hub, for preventing water or foreign objects from entering into the hub through those interfaces, the electric control equipment arranged inside the hub might be in danger of being damaged and thus beginning to malfunction. Consequently, the hub is usually sealed by a kind of sealing apparatus to be used for preventing water from entering and also for preventing leakage of internal lubricating oil. Ideally, the hub can be sealed satisfactorily by a conventional sealing apparatus. In reality, however, the sealing effect of the conventional seal apparatus can easily be devastated by material failure, inferior working conditions or a harsh environment.

[0005] Existing windmills with a water-proof seal design are inflexible because the conventional sealing apparatus cannot easily be detached or replaced. Nor can such conventional apparatus be adapted to many windmills available on the market today.

[0006] Document DE 10 2009 035 248 A1 discloses a housing for a wind turbine. The housing comprises a sealing device to cover the hub-blade interface. The sealing device consists of two envelope rings each being respectively formed on either the hub or the blade and both comprising skirt-like outward extensions that cover the hub-blade interface and thereby protect the interface, while still allowing, the blade to be rotated against the hub.

[0007] Document EP 2 375 092 A1 discloses a lubrication system for a bearing including a seal. Document WO 2007/061439 A2 refers to a pitch bearing with one or two seals provided at opposite faces of the pitch bearing. Document JP H08 82322 A discloses a rotor blade bearing seal device for a windmill generator, wherein the connection between a sealing plate and a cover of the bearing is accomplished by an engagement of protrusions and recesses respectively formed on both the sealing plate and the cover.

SUMMARY

[0008] The present disclosure describes a windmill, and a hub sealing apparatus for windmills, which is includes an assembly of

a multiple sealing rings or sealing ring parts that can be detached and replaced easily, and is designed with a flexible architecture for allowing the sealing apparatus to be adapted to any type of windmill and thus to achieve a better sealing effect.

[0009] Such a hub sealing apparatus may include a bottom sealing ring, mounted to an end of a hub; a middle sealing ring, coupled the bottom sealing ring while being arranged at a position neighboring to a bearing outer ring; and a top sealing ring, coupled to the middle ring while being arranged at a position neighboring to a blade; wherein the hub is coupled to the bearing outer ring, the bearing outer ring is coupled to a internal gear of a bearing inner ring, and the internal gear of the bearing ring is coupled to the blade.

[0010] In another embodiment, the a hub sealing apparatus includes a bottom sealing ring, mounted to an end of a hub; a middle sealing ring, coupled the bottom sealing ring while being arranged at a position neighboring to a bearing outer ring; and a top sealing ring, coupled to the middle ring while being arranged at a position neighboring to a blade; wherein, the middle sealing ring is composed of two or more middle ring segments that are capable of interconnecting to each other for forming a full ring; and the top sealing ring is composed of two or more top ring segments that are capable of interconnecting to each other for forming a full ring; wherein, the hub is coupled to the bearing outer ring, the bearing outer ring is coupled to an internal gear of a bearing inner ring, and the internal gear of the bearing ring is coupled to the blade.

[0011] In still another embodiment, a windmill includes a nacelle; a generating unit installed in the nacelle; a shaft installed in the nacelle and coupled to the generating unit; a hub, coupled to the shaft, having at least one bearing outer ring and at least one internal gear of a bearing inner ring, the bearing outer ring being coupled to the internal gear of the bearing inner ring; at least one blade coupled to the internal gear of the bearing inner ring; a tower coupled to the nacelle; and at least one hub sealing apparatus. Each hub sealing apparatus of this embodiment has: a bottom sealing ring mounted to an end of the hub; a middle sealing ring coupled the bottom sealing ring while being arranged at a position neighboring to the bearing outer ring; and a top sealing ring coupled to the middle ring while being arranged at a position neighboring to a blade.

[0012] Thus, the hub sealing apparatus described herein may have the following advantages:

1. (1) Since the hub sealing apparatus is constructed as an assembly of a plurality of sealing rings, i.e. it is of a multi-ring structure, the hub sealing apparatus can be detached from the hub more easily than can conventional sealing devices.
2. (2) The hub sealing apparatus is designed with a flexible architecture for allowing the sealing apparatus to be adapted to many if not all types of windmills available on the market today.
3. (3) By the multi-ring structure, the hub sealing apparatus disclosed herein can form multiple seals to the hub for achieving a better sealing effect.

[0013] Further scope of applicability of the present disclosure will become more apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating exemplary embodiments, are given by way of illustration only, since various changes and modifications within their spirit and scope will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present disclosure will become more fully understandable from the detailed description given herein below and the accompanying drawings which are given by way of illustration only, and thus are not limitative of the present disclosure and wherein:

FIG. 1A is a three-dimensional diagram showing a hub sealing apparatus for windmills according to a first embodiment that is cut open to reveal its cross section and the partial enlargements of different portions of the hub sealing apparatus.

FIG. 1B is a partial schematic diagram showing a top sealing ring and a middle sealing ring in an exploded view of the first embodiment.

FIG. 1C is a partial schematic diagram showing a blade and the top sealing ring in an exploded view.

FIG. 2 is a partial schematic diagram showing different portions of the hub sealing apparatus in an exploded view of the first embodiment.

FIG. 3 is a three-dimensional diagram showing a hub sealing apparatus for windmills according to a second embodiment.

FIG. 4 is a three-dimensional diagram showing a hub sealing apparatus for windmills according to a third embodiment.

FIG. 5 is a three-dimensional diagram showing a windmill and the partial enlargement of the windmill.

DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0015] To further understand and recognize the functions and structural characteristics of the windmill and sealing apparatus thereof, several exemplary embodiments cooperating with a detailed description are presented as follows.

[0016] FIG. 1A a three-dimensional diagram showing a hub sealing apparatus for windmills according to a first embodiment that is cut open to reveal its cross section. FIG. 1B is a partial schematic diagram showing a top sealing ring and a middle sealing ring in exploded view of the first embodiment. FIG. 1C is a partial schematic diagram showing a blade and the top sealing ring in an exploded view. FIG. 2 is a partial schematic diagram showing the different portions of the hub sealing apparatus in an exploded view of the first embodiment. In this embodiment, the hub sealing apparatus is adapted to be mounted on a hub 10 while the hub 10 is coupled to a bearing outer ring 101, where the bearing outer ring 10 is further coupled to an internal gear 11 of a bearing inner ring (not shown), and an internal gear 11 of the bearing inner ring is coupled to a blade 12. Moreover, the bearing outer ring 11 may be securely fixed to the hub 10 by a plurality of bolts 103, and similarly the blade 12 may be securely fixed to the internal gear 11 of the bearing inner ring by such bolts 103. The hub sealing apparatus is provided to address a conventional leaking problem that generally occurs at the interface (such as an interval) between the hub 10 and the bearing outer ring 101, and also at the interface (or an interval) between the internal gear 11 of the bearing inner ring and the blade 12. In this embodiment, the hub sealing apparatus comprises a bottom sealing ring 20, a middle sealing ring 30 and a top sealing ring 40.

[0017] As shown in FIG. 2, the cross section of the bottom sealing ring 20 is formed like the letter "L", whereas the bottom sealing ring 20 is mounted and fixed to the hub 10. In addition, the bottom sealing ring 20 may be configured with a bottom support 200 and an interface 201 in a manner that the bottom support 200 is mounted to an end of the hub 10, and the interface 201 may be disposed so as to correspond to the periphery of the hub 10 while allowing the bottom support 200 to couple with the interface 201. As shown in FIG. 2, one surface of the bottom support 200 is formed with a bottom ring groove 2000, a recess, e.g. a bottom slot 2001 and a plurality of bottom fixing holes (not shown) in a manner that the bottom ring groove 2000 and the bottom slot 2001 are arranged between the bottom fixing holes while allowing the bottom ring groove 2000 to be filled by a sealant 2002. In this embodiment, the sealant 2002 is an elastic sealing part (e.g. an elastic sealing ring).

[0018] Moreover, the middle sealing ring 30 may be formed in a double-L shape in cross section, whereas the middle sealing ring 30 is mounted on the bottom support 200 while being arranged neighboring to the bearing outer ring 101. In this embodiment, the middle sealing ring 30 is composed of multiple ring segments such as two middle half rings 300 that are capable of interconnecting to each other for forming a full ring. In the case of the two middle half ring halves, the two ends of each middle half ring 300 are formed respectively with a middle lug 301 to be used for coupling to the corresponding middle lug 301 formed on the other middle half ring so as to form the complete middle sealing ring 30. Moreover, each of the two middle half rings 300 is configured with half of a middle coupler 302, half of a middle extension part 303 and half of a middle support 304.

[0019] The middle coupler 302 is arranged to couple to an end of the middle extension part 303, whereas the middle coupler 302 has a middle shoulder part 305 formed on one end thereof for abutting against the interface 201 of the bottom sealing ring 20, and thus enabling the middle sealing ring 30 to engage exactly with the bottom sealing ring 20. As shown in FIG. 2, the middle coupler 302 may be further formed with a protrusion, e.g. a middle block 3020 at a position corresponding to the bottom slot 2001 for allowing the same to be inset into the bottom slot 2001, so as to fixedly secure the middle sealing ring 30 to the bottom sealing ring 20 and to simultaneously seal the bottom slot 2001. In addition, the middle coupler 302 is formed with a plurality of middle coupling holes (not shown) at positions corresponding to the plural bottom fixing holes, so that each middle coupling hole can be fitted to the bottom fixing hole corresponding thereto by a fixing element 3021, so as to lock the middle sealing ring 30 and the bottom sealing ring 20 together.

[0020] Moreover, the middle support 304 is coupled to an end of the middle extension part 303 other than the end coupling to the middle coupler 302, whereas one surface of the middle support 304 is formed with a middle ring groove 3040, a recess, e.g. a middle slot 3041, and a plurality of middle fixing holes (not shown), in such a manner that the middle ring groove 3040 and the middle slot 3041 are arranged between the middle fixing holes while allowing the middle ring groove 3040 to be filled by a sealant 3042. In this embodiment, the sealant 3042 is an elastic sealing part.

[0021] In addition, the cross section of the top sealing ring 40 is formed like the letter "L," whereas the top sealing ring 40 is mounted on the middle support 304 while allowing the same to be arranged neighboring to the blade 12. Similarly, the top sealing ring 40 composed of multiple top ring segments such as two top half rings 400 that are capable of interconnecting to each other for forming a full ring, and in the case of half rings the two ends of each top half ring 400 are formed respectively with a top lug 401 to be used for coupling to the corresponding top lug 401 formed on another top half ring 400 so as to form the complete top sealing ring 40. Moreover, each of the two top half rings 400 is configured with half of a top coupler 402 and half of a top neck 403.

[0022] Similarly, the top coupler 402 is arranged to couple to the top neck 403, whereas the top coupler 402 has a top shoulder part 4020 formed on an end thereof, for abutting against the middle extension part 303, and thus enabling the top sealing ring 40 to engage exactly with the middle sealing ring 30. As shown in FIG. 2, the top coupler 402 may be further formed with a protrusion, e.g. a top block 4021 at a position corresponding to the middle slot 3041 for allowing the same to inset into the middle slot 3041, so as to fixedly secure the top sealing ring 40 to the middle sealing ring 30, and simultaneously seal the middle slot 3041. In addition, the top coupler 402 is formed with a plurality of top coupling holes at positions corresponding to the plural middle fixing holes, so that each middle coupling hole can be fitted to the bottom fixing hole corresponding thereto by a fixing element 4022 (not shown), so as to lock the top sealing ring 40 and the middle sealing ring 30 together.

[0023] In addition, one surface of the top neck 403 that is orientated facing toward the blade 12 is formed with two top ring grooves 4030 while allowing each of the two top ring grooves 4030 to be filled with a sealant 4031 for sealing the gap formed between the blade 12 and the top sealing ring 40. In this embodiment, the sealant 4031 is an elastic sealing part.

[0024] FIG. 3 is a three-dimensional diagram showing a hub sealing apparatus for windmills according to a second embodiment. In this embodiment, rather than using sealing rings that are composed of multiple ring segments such as two half rings as disclosed in the first embodiment, the bottom sealing ring 20A, the middle sealing ring 30A and the top sealing ring 40A are all formed respectively as a complete ring. Other than that, all of the other components of the bottom sealing ring 20A, the middle sealing ring 30A and the top sealing ring 40A are exactly the same as in the first embodiment, and thus will not be described further herein.

[0025] Please refer to FIG. 4, which is a three-dimensional diagram showing a hub sealing apparatus for windmills according to a third embodiment. In the third embodiment, the middle sealing ring 30 and the top sealing ring 40 may be exactly the same as those disclosed in the first embodiment, but the bottom sealing ring 20B is also composed of multiple bottom ring segments such as two bottom half rings 200B, where the two ends of each bottom half ring 200B are formed respectively with a bottom lug 201B to be used for coupling to the corresponding bottom lug 201B of another middle half ring, so as to form the complete bottom sealing ring 20B. Other than that, the bottom sealing ring 20B may be structurally the same as those disclosed in the foregoing embodiments and thus will not be described further herein.

[0026] FIG. 5 shows a windmill and a partial enlargement of the windmill. As shown in FIG. 5, the windmill includes at least one blade 60, a shaft 61, a hub 62, a nacelle 63, a generating unit 64, a tower 65 and at least one hub sealing apparatus 5.

[0027] The generating unit 64 is installed in the nacelle 63. The nacelle 63 is coupled to the tower 65.

[0028] The shaft 61 is installed in the nacelle 63 and coupled to the generating unit 64.

[0029] The hub 62 is coupled to the shaft 61. The hub 62 has at least one bearing outer ring and at least one internal gear of a bearing inner ring. The bearing outer ring is coupled to the internal gear of the bearing inner ring. The internal gear of the bearing inner ring is coupled to the blade 60. The bearing outer ring and the internal gear of the bearing inner ring are structurally the same as those disclosed in the foregoing embodiments and thus will not be described further herein.

[0030] The hub sealing apparatus 5 is coupled to the blade 60 and the hub 62. The hub sealing apparatus 5 may be structurally the same as those disclosed in the foregoing embodiments and thus will not be described further herein.

[0031] When a wind force acts on the blade 60, the hub 62 is rotated by the blade 60. The shaft 61 is driven by the rotating hub 62. The generating unit 64 is driven by the shaft 61, so that the generating unit 64 is able to generate electricity.

[0032] As is apparent from the structures and the assembly of the hub sealing apparatus 5 as described above, the hub sealing apparatus 5 can be replaced easily if needed, and can achieve a superior sealing effect.

[0033] To sum up, the hub sealing apparatus for windmills disclosed herein is substantially an assembly of multiple sealing rings that can be detached and replaced easily, and is designed with a flexible architecture for allowing the sealing apparatus to be adapted to any type of windmills and thus achieving a good sealing effect.

[0034] In addition, by the mating of recesses (e.g. slots) and the corresponding protrusions (e.g. blocks), such as the bottom slot and the bottom block, the middle slot and the middle block, and the top slot and the top block illustrated herein, and also by the filling of the sealants into the ring grooves including the bottom ring groove, the middle ring groove and the top ring groove, the hub sealing apparatus can provide multiple seals to the hub to achieve a better sealing effect and also to prevent leakage or permeation.

[0035] With respect to the above descriptions, it is to be realized that the optimum dimensional relationships of parts, to include variations in size, materials, shape, form, function and manner of operation, assembly and use, are deemed readily apparent to those skilled in the art, and all equivalent relationships to those illustrated in the drawings and described in the specification are intended to be encompassed by the present disclosure.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE102009035248A1 **[0006]**
- EP2375092A1 **[0007]**
- WO2007061439A2 **[0007]**
- JPH0882322A **[0007]**

Patentkrav

1. Navtætningsapparat til tætning af et mellemrum imellem et nav (10) og et blad (12) på en vindmølle, omfattende:

navtætningsapparatet omfatter:

en nedre tætningsring (20), som er konfigureret til at være tætnende forbundet med navet (10),
en øvre tætningsring (40), som er konfigureret til at være roterbart tætnet forbundet med bladet (12), og
en midtertætningsring (30), som er konfigureret til at være tætnet forbundet med den øvre tætningsring (40) og den nedre tætningsring (20), således at den øvre og nedre tætningsring (20, 40) forbindes,

kendetegnet ved, at
den nedre tætningsring (20) har en nedre understøtning (200), og midtertætningsringen (30) har et midterkoblingsorgan (302), som er konfigureret til at være tætnende forbundet med den nedre understøtning (200), den ene af enten den nedre understøtning (200) eller midterkoblingsorganet (302) har en heri tildannet udsparing, og den anden af enten den nedre understøtning (200) eller midterkoblingsorganet (302) har et fremspring, som passer sammen med udsparingen, således at et interval imellem den nedre understøtning (200) og midterunderstøtningen (302) tætnes, når fremspringet placeres i udsparingen, midterkoblingsorganet (302) har en midterskulderdel (305), som er tildannet ved en ende heraf med henblik på at dække en søm, som er tildannet imellem den nedre understøtning (200) og midterkoblingsorganet (302).

2. Navtætningsapparat ifølge krav 1, hvorved et interval imellem den øvre tætningsring (40) og bladet (12) dannes imellem imod hinanden vendende overflader på den øvre tætningsring (40) og bladet (12), omfattende endvidere en ringrille (2000), som er tildannet i den øvre tætningsrings (40) overflade, og en elastisk

tætningsdel til anbringelse i ringrillen (2000), for derved at tætne intervallet imellem den øvre tætningsring (40) og bladet (12), et interval imellem den øvre tætningsring (40) og bladet (12) er tildannet imellem imod hinanden vendende overflader på den øvre tætningsring (40) og bladet (12), og som yderligere omfatter et antal ringriller (2000), som er tildannet på den øvre tætningsrings (40) overflade, og et antal elastiske tætningsdele, som hver svarer til en ud af antallet af ringriller (2000) til placering i den tilsvarende ringrille (2000), for derved at tætne intervallet imellem den øvre tætningsring (40) og bladet (12).

3. Navtætningsapparat ifølge krav 2, hvorved den nedre understøtning (200) har en rille og yderligere omfatter en elastisk tætningsdel til anbringelse i rillen for derved at tætne et interval imellem den nedre understøtning (200) og midterkoblingsorganet (302).

4. Navtætningsapparat ifølge krav 1, hvorved midtertætningsringen (30) omfatter en midterunderstøtning (304), og den øvre tætningsring (40) omfatter et øvre koblingsorgan (402), som er konfigureret til at være tætsluttende forbundet med midterunderstøtningen (304), som har en rille, som yderligere omfatter en elastisk tætningsdel til anbringelse i rillen for derved at tætne et interval imellem midterunderstøtningen (304) og det øvre koblingsorgan (402), den ene af enten midterunderstøtningen (304) eller det øvre koblingsorgan (402) har en udsparing, som er tildannet deri, og den anden af enten midterunderstøtningen (304) eller det øvre koblingsorgan (402) har et fremspring, som passer sammen med udsparingen, således at et interval imellem midterunderstøtningen (304) og det øvre koblingsorgan (402) tætnes, når fremspringet placeres i udsparingen, midterunderstøtningen (304) har en rille og yderligere omfatter en elastisk tætningsdel til anbringelse i rillen for derved at tætne et interval imellem midterunderstøtningen (304) og det øvre koblingsorgan (402), idet den ene af enten midterunderstøtningen (304) eller det øvre koblingsorgan (402) har en udsparing, som er tildannet heri, medens den anden af enten midterunderstøtningen (304) eller det øvre koblingsorgan (402) har et fremspring, som passer sammen hermed, således at et interval imellem midterunderstøtningen (304) og det øvre koblingsorgan (402) tætnes, når fremspringet placeres i udsparingen, det øvre koblingsorgan (402) har en

øvre skulderdel (4020), som er tildannet ved en ende heraf med henblik på at dække en søm, som dannes imellem midterunderstøtningen (304) og det øvre koblingsorgan (402).

5. Navtætningsapparat ifølge krav 1, hvorved i det mindste en af enten den øvre, den nedre eller den midterste tætningsring (40, 20, 30) har et antal ringsegmenter, som er konfigureret til at danne en hel ring, når de er samlet i tætningsapparatet.

6. Navtætningsapparat ifølge krav 5, hvorved antallet af ringsegmenter omfatter to halve ringe, hvor hver af antallet af ringsegmenter har to flige, som er anbragt ved hver sin af de to ender, og at den øvre, nedre og midterste tætningsring (40, 20, 30) har et antal ringsegmenter, som er konfigureret til at danne en hel ring, når de er samlet i tætningsapparatet.

7. Vindmølle med et navtætningsapparat ifølge ethvert af kravene 1 til 6, omfattende:

et nav (10),
i det mindste et blad (12), og
et navtætningsapparat, som tætner et interval imellem navet (10) og bladet (12), og som omfatter:

en nedre tætningsring (20), som aftageligt er tætnet forbundet med navet (10),
en øvre tætningsring (40), som er aftagelig og roterbart tætsluttende forbundet med bladet (12), og
en midterste tætningsring (30), som er aftageligt tætsluttende forbundet med den øvre tætningsring (40) og den nedre tætningsring (20), således at den øvre og nedre tætningsring (20) forbindes.

8. Vindmølle ifølge krav 7, hvorved et interval imellem den øvre tætningsring (40) og bladet (12) er tildannet imellem imod hinanden vendende overflader på

den øvre tætningsring (40) og bladet (12), og der endvidere er tilvejebragt en ringrille (2000), som er tildannet i en øvre tætningsrings (40) overflade, og en elastisk tætningsdel, som er aftageligt anbragt i ringrillen (2000), hvorved intervallet imellem tætningsringen (40) og bladet (12) tætnes, et interval imellem den øvre tætningsring (40) og bladet (12) er tildannet imellem imod hinanden vendende overflader på den øvre tætningsring (40) og bladet (12), og der endvidere findes et antal ringriller (2000), som er tildannet på overfladen af den øvre tætningsring (40), og et antal elastiske tætningsdele, som hver svarer til en ud af antallet af ringriller (2000) og er aftageligt anbragt i den tilsvarende ringrille (2000), hvorved intervallet imellem den øvre tætningsring (40) og bladet (12) tætnes.

9. Vindmølle ifølge krav 7, hvorved den nedre tætningsring (20) omfatter en nedre understøtning (200), og den midterste tætningsring (30) omfatter et midterste koblingsorgan (302), som er aftageligt tætnet forbundet med den nedre understøtning (200), den nedre understøtning (200) har en rille og endvidere omfatter en elastisk tætningsdel, som er aftageligt anbragt i rillen for derved at tætne et interval imellem den nedre understøtning (200) og det midterste koblingsorgan (302), den ene af enten den nedre understøtning (200) og det midterste koblingsorgan (302) har en udsparing, og den anden af enten den nedre understøtning (200) og midterkoblingsorganet (302) har et fremspring, idet fremspringet er aftageligt placeret i udsparingen for at tætne et interval imellem den nedre understøtning (200) og det midterste koblingsorgan (302), den nedre understøtning (200) har en rille, som endvidere omfatter en elastisk tætningsdel, som er aftageligt placeret i rillen for derved at tætne et interval imellem den nedre understøtning (200) og det midterste koblingsorgan (302), idet den ene af enten bunddelen (200) og det midterste koblingsorgan (302) har et fremspring, hvilket fremspring er aftageligt placeret i udsparingen for at tætne et interval imellem den nedre understøtning (200) og det midterste koblingsorgan (302), hvor det midterste koblingsorgan (302) har en midterste skulderdel (305), som er tildannet ved en ende heraf for at dække en søm, der er tildannet imellem den nedre understøtning (200) og det midterste koblingsorgan (302).

10. Vindmølle ifølge krav 7, hvorved den midterste tætningsring (30) har en midterste understøtning (302), og den øvre tætningsring (40) har et øvre koblingsorgan (402), som er aftageligt tætsluttende forbundet med den midterste understøtning (304), den midterste understøtning (304) har en rille og yderligere omfatter en elastisk tætningsdel, som er aftageligt anbragt i rillen for derved at tætne et interval imellem den midterste understøtning (304) og det øvre koblingsorgan (402), den ene af enten den midterste understøtning (304) eller det øvre koblingsorgan (402) har en udsparing, og den anden af enten den midterste understøtning (304) og det øvre koblingsorgan (402) har et fremspring, idet fremspringet er aftageligt placeret i udsparingen for at tætne et interval imellem den midterste understøtning (304) og det øvre koblingsorgan (402), den midterste understøtning (304) har en rille og endvidere omfatter en elastisk tætningsdel, som er aftageligt placeret i rillen, hvorved et interval imellem den midterste understøtning (304) og det øvre koblingsorgan (402) tætnes, idet den ene af enten den midterste understøtning (304) og det øvre koblingsorgan (402) har en udsparing, som er tildannet deri, idet den anden af enten den midterste understøtning (304) eller det øvre koblingsorgan (402) har et fremspring, idet fremspringet placeres aftageligt i udsparingen for at tætne et interval imellem den midterste understøtning (304) og det øvre koblingsorgan (402), hvilket øvre koblingsorgan (402) har en øvre skulderdel (4020), som er tildannet ved en ende heraf for at dække en søm, som er tildannet imellem den midterste understøtning (304) og det øvre koblingsorgan (402).

11. Vindmølle ifølge krav 10, hvorved i det mindste den øvre og/eller den nedre og/eller den midterste tætningsring (40, 20, 30) omfatter et antal ringsegmenter, hvor antallet af ringsegmenter omfatter to halve ringe, hvert af antallet af ringsegmenter har to flige, som er anbragt ved hver sin af de to ender, den øverste, den nederste og den midterste tætningsring (40, 20, 30) omfatter hver et antal ringsegmenter.

12. Fremgangsmåde til fremstilling af en vindmølle
omfattende:

tilvejebringelse af et nav (10) og i det mindste et blad (12),
tætning af den nedre tætningsring (20) til navet (10),
drejelig tætning af den øvre tætningsring (40) til bladet (12),
kendetegnet ved,
tætning af en midterste tætningsring (30) til den øvre tætningsring (40) og den nedre tætningsring (20), således at den øvre og nedre tætningsring (20) forbindes,
dannelse af en nedre understøtning (200) på den nedre tætningsring (20),
dannelse af et midterste koblingsorgan (302) på den midterste tætningsring (30), og
tætning af det midterste koblingsorgan (302) til den nedre understøtning (200),
dannelse af en rille i den nedre understøtning (200), og
anbringelse af en elastisk tætningsdel i rillen for derved at tætne et interval imellem den nedre understøtning (200) og det midterste koblingsorgan (302),
dannelse af en udsparing og et fremspring på henholdsvis den ene af enten den nedre understøtning (200) og det midterste koblingsorgan, og anbringelse af fremspringet i udsparingen for at tætne et interval imellem den nedre understøtning (200) og det midterste koblingsorgan (302),
dannelse af en rille i den nedre understøtning (200), og
anbringelse af en elastisk tætningsdel i rillen for derved at tætne et interval imellem den nedre understøtning (200) og det midterste koblingsorgan (302), og
dannelse af en udsparing og et fremspring henholdsvis på den ene af enten den nedre understøtning (200) og det midterste koblingsorgan (302) og anbringelse af fremspringet i udsparingen for at tætne et interval imellem den nedre understøtning (200) og det midterste koblingsorgan (302).

13. Fremgangsmåde ifølge krav 12, som yderligere omfatter:

dannelse af den øvre tætningsring (40) og bladet (12) imellem imod hinanden vendende overflader på den øvre tætningsring og bladet (12),

dannelse af en ringrille (2000) i den øvre tætningsrings (40) overflade, og anbringelse af en elastisk tætningsdel i ringrillen (2000) for derved at tætne intervallet imellem den øvre tætningsring (40) og bladet (12),

dannelse af et interval imellem den øvre tætningsring (40) og bladet (12) imellem imod hinanden vendende overflader på den øvre tætningsring (40) og bladet (12), dannelse af et antal ringriller (2000) på den øvre tætningsrings (40) overflade, og anbringelse af et antal elastiske tætningsdele, som hver svarer til en af antallet af ringriller (2000) i den tilsvarende ringrille (2000) for derved at tætne intervallet imellem den øvre tætningsring (40) og bladet (12).

14. Fremgangsmåde ifølge krav 12, og som yderligere omfatter:

dannelse af en midterste skulderdel (305) ved en ende af det midterste koblingsorgan (302) for at dække en søm, som er tildannet imellem den nedre understøtning (200) og det midterste koblingsorgan (302).

15. Fremgangsmåde ifølge krav 12, og som yderligere omfatter:

dannelse af en midterste understøtning (304) på den midterste tætningsring (30),
dannelse af et øvre koblingsorgan (402) på den øvre tætningsring (40), og tætning af det øvre koblingsorgan (402) til den midterste understøtning (304),

dannelse af en rille i den midterste understøtning (304), og
anbringelse af en elastisk tætningsdel i rillen for derved at tætne et interval imellem den midterste understøtning (304) og det øvre koblingsorgan (402),
dannelse af en udsparing og et fremspring på henholdsvis en af enten den midterste understøtning (304) eller det øvre koblingsorgan (402), og anbringelse af fremspringet i udsparingen for at tætne et interval imellem den midterste understøtning (304) og det øvre koblingsorgan (402),

dannelse af en rille i den midterste understøtning (304) og anbringelse af en elastisk tætningsdel i rillen for derved at tætne et interval imellem den midterste understøtning (304) og det øvre koblingsorgan (402), og

dannelse af en udsparing og et fremspring henholdsvis på den ene af enten den midterste understøtning (304) og det øvre koblingsorgan (402), og anbringelse af fremspringet i udsparingen for at tætne et interval imellem den midterste understøtning (304) og det øvre koblingsorgan (402),

dannelse af en øvre skulderdel (4020) ved en ende af det øvre koblingsorgan (402) for at dække en søm, som er tildannet imellem den midterste understøtning (304) og det øvre koblingsorgan (402).

16. Fremgangsmåde ifølge krav 15, hvorved den øvre tætningsring og/eller den nedre tætningsring og/eller den midterste tætningsring (40, 20, 30) omfatter et antal ringsegmenter og yderligere omfatter samling af antallet af ringsegmenter til dannelse af en hel ring, idet antallet af ringsegmenter omfatter to halve ringe, hvor hver af antallet af ringsegmenter har to flige tildannet ved hver sin af to ender heraf, idet den øvre og/eller den nedre og/eller den midterste tætningsring (40, 20, 30) omfatter et antal ringsegmenter.

DRAWINGS

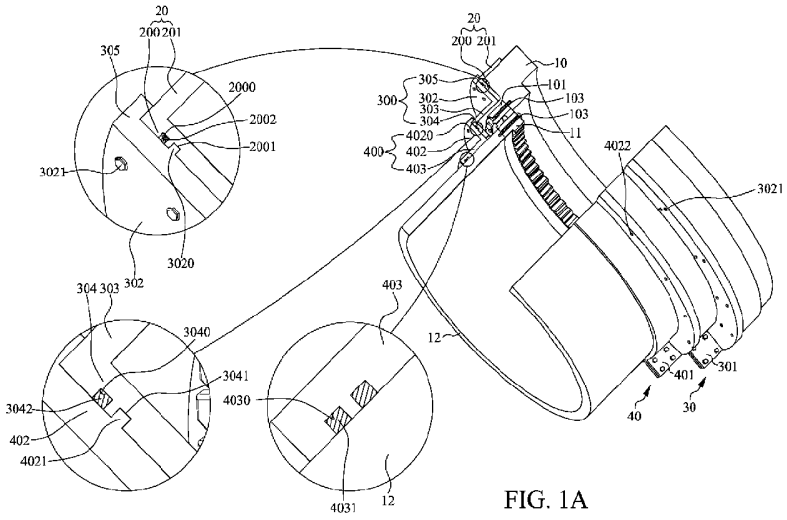


FIG. 1A

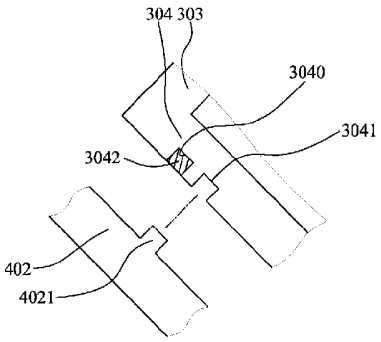


FIG. 1B

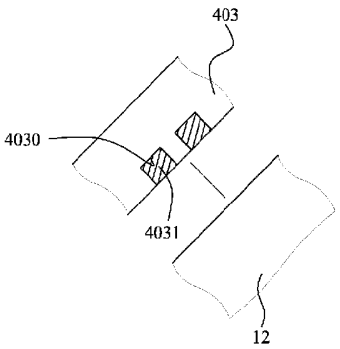


FIG. 1C

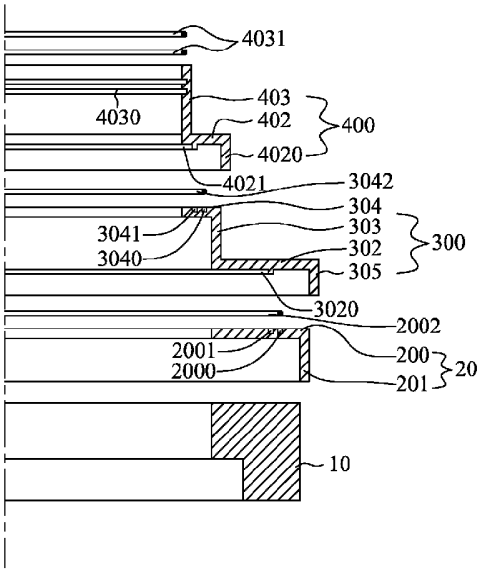

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FIG. 2

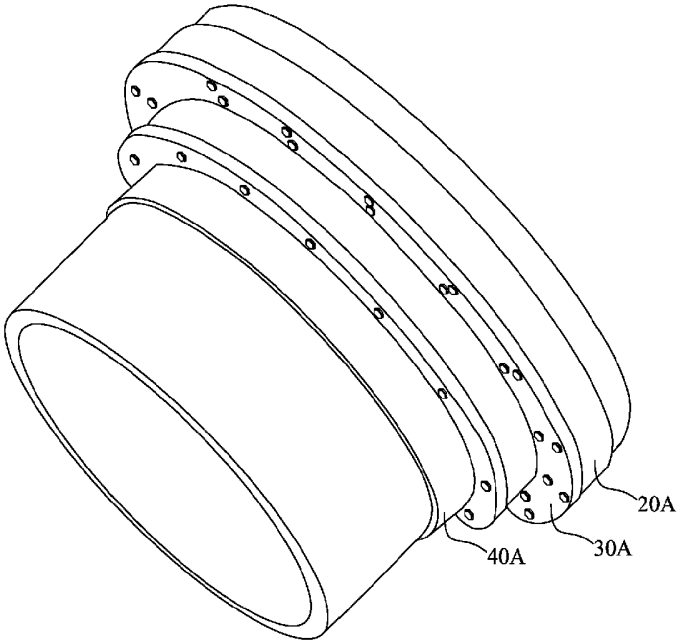


FIG. 3

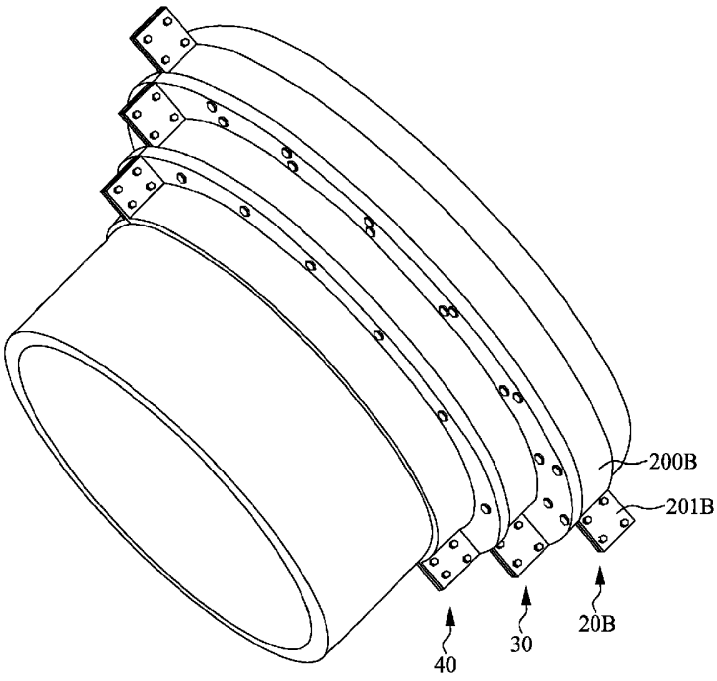


FIG. 4

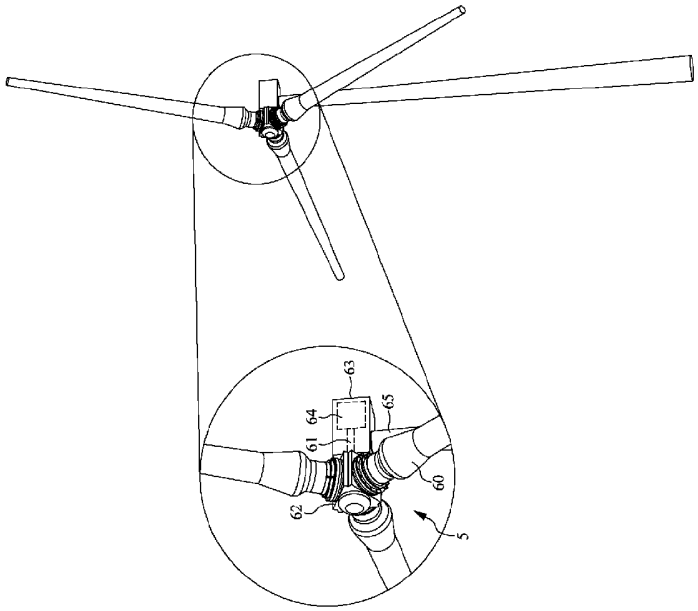


FIG. 5