

(19) **DANMARK**

(10) **DK/EP 2930357 T3**



Patent- og
Varemærkestyrelsen

(12) Oversættelse af
europæisk patentskrift

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- (51) Int.Cl.: **F 03 D 80/30 (2016.01)** **F 03 D 1/06 (2006.01)** **H 02 G 13/00 (2006.01)**
- (45) Oversættelsen bekendtgjort den: **2018-10-01**
- (80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2018-06-27**
- (86) Europæisk ansøgning nr.: **14164232.2**
- (86) Europæisk indleveringsdag: **2014-04-10**
- (87) Den europæiske ansøgnings publiceringsdag: **2015-10-14**
- (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: **Rotorblad til vindenergianlæg og med en lynaflederbasis**
- (56) Fremdragne publikationer:
WO-A1-2011/080177
CN-U- 202 628 403
KR-A- 20100 115 139
US-A1- 2006 280 613
US-A1- 2007 081 900
US-A1- 2013 149 154

The invention relates to a wind turbine rotor blade having two lightning receptors, which are arranged on a suction side and a pressure side, and an integrally formed lightning receptor base, which is arranged in the wind turbine rotor blade and on which the two lightning receptors and a lightning protection conductor are fastened, and to a method for producing such a wind turbine rotor blade.

It is known to protect wind turbine rotor blades from damage by a stroke of lightning using a lightning protection device. For this purpose, a plurality of lightning receptors can be arranged on the rotor blade. The current from a flash of lightning striking such a lightning receptor is dissipated via a lightning protection conductor toward the blade root and from there via the nacelle and the tower of the wind turbine into the ground.

The lightning receptors and all other elements of the lightning protection device should be arranged in such a way that flashes of lightning only strike the lightning receptors. Each stroke of lightning at another location, whether it be another electrically conductive element of the wind turbine rotor blade such as, for example, a supporting structure consisting of a carbon fiber material, an electrical heating device or another electrical line, can under certain circumstances result in irreparable damage to the rotor blade. This also applies to flashes of lightning which strike a lightning receptor base or the lightning protection conductor itself at a distance from a lightning protection receptor.

The publication WO 2008/101506 A2 has disclosed a wind turbine rotor blade having two lightning receptors arranged opposite one another in the region of the blade tips. The lightning receptors are screwed to in each case one lightning receptor base. The two receptor bases are coupled to one another via a bolt and are connected separately from one another to a central lightning protection conductor via electrical lines.

The publication WO 2011/080177 A1 has disclosed a lightning protection device for a wind turbine rotor blade. A conductive surface coating acts as lightning receptor and is coupled electrically, via rods, to a lightning protection conductor in the interior of the rotor blade.

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The publication WO 2007/128314 A1 has disclosed a lightning protection device for a wind turbine rotor blade in which mutually opposite lightning receptors are coupled to a lightning protection conductor via a rod.

10 The publication EP 1 965 076 A1 has disclosed a wind turbine rotor blade in which two lightning receptors arranged on the pressure and suction sides are screwed to an integrally formed lightning receptor base in the region of the blade tip. The lightning receptor base is a solid, large-volume block consisting of an electrically conductive material.

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The publication US 2006/0280613 A1 shows a wind turbine rotor blade with several lightning receptors. These are each screwed to a metallic connecting element. An additional connector establishes an electrical connection between two lightning receptors and a lightning conductor.

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The publication US 2007/0081900 A1 shows a wind turbine rotor blade with an essentially box-shaped lightning receptor base.

Another wind turbine rotor blade is known from CN 202628403 U.

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Against this background, the object of the invention consists in providing a wind turbine rotor blade having two lightning receptors which are arranged on the pressure and suction sides and which are both fastened on an integrally formed lightning receptor base which is simpler and less expensive to produce and in which
30 the risk of a stroke of lightning in a region other than in the lightning receptors is reduced, as well as a method for producing such a wind turbine rotor blade.

This object is achieved by the wind turbine rotor blade having the features of claim 1. Advantageous configurations are specified in the following dependent claims.

- 5 The wind turbine rotor blade has a blade root, a lightning protection conductor for dissipating a lightning current toward the blade root, a suction side, a pressure side, a lightning receptor arranged on the suction side, a lightning receptor arranged on the pressure side, and an integrally formed lightning receptor base, which is arranged in the wind turbine rotor blade and on which the two lightning
10 receptors and the lightning protection conductor are fastened. The lightning receptor base includes two fastening rings, which each have an internal thread, into which one of the two lightning receptors is screwed, and an outer diameter, wherein the outer sides of the fastening rings are arranged with a spacing of less than one outer diameter from one another.

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- The wind turbine rotor blade can be intended for a wind turbine having a substantially horizontal axis. It can be produced from a fiber composite material, in particular from two half-shells connected to one another. It can have an aerodynamic shroud which is formed, for example, by the outer sides of the two half-shells,
20 and one or more spar caps, for example consisting of glass-fiber-reinforced or carbon-fiber-reinforced plastic. The two half-shells can be connected to one another via one or more webs, which can be arranged in particular between two mutually opposite main spar caps.

- 25 The lightning protection conductor can extend substantially over the entire length of the wind turbine rotor blade, in particular from a connection point in the region of the blade root up to the region of the blade tip. There, it can be connected to the lightning receptor base. The electrical connection between the lightning protection conductor and the two lightning receptors can be produced via the lightning
30 receptor base.

The two lightning receptors consist of an electrically conductive material, preferably of metal, and are arranged on the outer side of the wind turbine rotor blade

so that they terminate approximately flush with the suction side or with the pressure side. They can be arranged opposite one another in the region of the blade tip, but also spaced apart therefrom. It is also possible for a plurality of pairs of lightning receptors to be provided which are arranged with different spacings from the blade tip, with in each case a lightning receptor base being assigned to each pair. The lightning receptors and the lightning receptor base can be arranged in a longitudinal section or in a region close to the rear edge of the wind turbine rotor blade, in which the spacing between the suction side and the pressure side is so small that access to the interior of the rotor blade is not readily possible. For example, the spacing can be 30 cm or less or 20 cm or less.

An essential part of the lightning receptor base according to the invention are the two fastening rings, which are arranged closely adjacent to one another. The outer sides of the fastening rings are arranged with a spacing of less than an outer diameter of a fastening ring. Each fastening ring has an internal thread, into which one of the two lightning receptors has been screwed. For this purpose, the lightning receptor can have a bolt-shaped section with a corresponding external thread. In the simplest case, the lightning receptors consist of a threaded bolt with a disk-shaped head, for example. A multi-part embodiment of the lightning receptors is also possible, for example with a disk into which a threaded bolt is inserted. The threads are dimensioned such that a lightning stroke current of 200 kA, for example, can be dissipated without any damage via the screw connection.

The lightning receptor base according to the invention has very compact dimensions. At the same time, it enables secure fastening of the two lightning receptors and damage-free dissipation of the lightning stroke current. Owing to its compact configuration, it is particularly material-saving. A further advantage consists in that the lightning receptor base, owing to its compact shape, has a very low degree of attractiveness for flashes of lightning, as a result of which the probability of a lightning strike past a lightning receptor into the receptor base is substantially reduced. The fastening rings are each closed in the form of a ring around the internal thread. They can be in the form of a circular ring.

In one configuration, an edge radius at the outer circumferences of the two fastening rings is 3 mm or more. Such markedly rounded-off edges counteract local field intensity maxima and additionally reduce the attractiveness of the lightning receptor base for a lightning strike.

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In one configuration, the two fastening rings are arranged laterally next to one another. In this arrangement, the height of the entire lightning receptor base can be restricted substantially to the length of the internal thread, with the result that the lightning receptor base can also be used in regions of the wind turbine rotor blade with a very small profile thickness. In addition, the lightning receptors can be screwed deep into the internal thread or screwed through the fastening rings without the threaded bolts of the lightning receptors hitting one another.

In one configuration, the two fastening rings each have a longitudinal axis which passes through the center point of the fastening ring. The two longitudinal axes are arranged at an angle in the range of from 0° to 30° with respect to one another, with the result that one of the longitudinal axes perpendicularly intersects the suction side and the other of the longitudinal axes perpendicularly intersects the pressure side. In the case of an arrangement of the lightning receptors between a profile end edge and a position with a maximum profile thickness, the angle can be in particular in the range of from 3° to 20° . In this case, the configuration of the lightning receptor base already presets the correct angular arrangement of the two lightning receptors with respect to one another so that, when the lightning receptor base is fastened in the rotor blade in the intended position, the correct arrangement of the two lightning receptors is fixed.

In one configuration, the lightning receptor base has a fastening section, which is connected to the lightning protection conductor and is arranged between the two fastening rings. The fastening section can be in the form of a tube or bar, for example, and can be welded to the lightning protection conductor. The arrangement of the fastening section between the two fastening rings contributes to the compact design of the lightning receptor base. In particular, the lightning receptor

base can consist substantially or exclusively of the two fastening rings and the fastening section.

5 In one configuration, the two fastening rings are welded to one another and/or to the fastening section. In this case, in particular the fastening rings can be manufactured in a particularly inexpensive manner, for example as rotary parts. Alternatively, the lightning receptor base can be manufactured integrally, for example as a closed-die drop-forged part.

10 In one configuration, the two fastening rings have a smaller outer diameter than the lightning receptors. As a result, the lightning receptor base is even less attractive to a flash of lightning striking than the lightning receptors.

15 The abovementioned object is likewise achieved by the method having the features of claim 8. Advantageous configurations are specified in the following dependent claims.

The method serves to produce a wind turbine rotor blade and has the following steps:

- 20
- providing two rotor blade half-shells,
 - providing an integral lightning receptor base, which has a first fastening ring with a first internal thread and a second fastening ring with a second internal thread,
 - screwing a first screw into the first internal thread and a second screw into

25

 - the second internal thread,
 - fastening the lightning receptor base on an inner side of one of the rotor blade half-shells,
 - assembling the two rotor blade half-shells,
 - producing a first bore through a wall of one of the rotor blade half shells in

30

 - the region of the first screw and a second bore through a wall of the other rotor blade half-shell in the region of the second screw,
 - removing the two screws through the respective bore,

- screwing a first lightning receptor through the first bore into the first internal thread and a second lightning receptor through the second bore into the second internal thread.

5 In respect of the features and advantages of the method, reference is first made to the explanations above relating to the wind turbine rotor blade, which apply correspondingly. The method can be used in particular for producing a wind turbine rotor blade having the features of one of the claims directed thereto. The method is a simple and practicable possibility for producing such a wind turbine
10 rotor blade.

In the method according to the invention, the integral lightning receptor base is first fastened on an inner side of one of the rotor blade half-shells, for example with laminate layers and an adhesive, for example adhesive resin, which are ap-
15 plied in the region of the fastening section or of the lightning protection conductor connected thereto. The two screws screwed into the internal thread of the lightning receptor base reliably prevent the ingress of adhesive or other contaminants into the threaded bores in the lightning receptor base in this case and during as-
sembly of the two rotor blade half-shells, generally likewise using an adhesive. At
20 the same time, the two screws can be used as orientation in the production of the two bores through the walls of the two half-shells since their arrangement in the rotor blade assembled from the two rotor blade half-shells characterizes the position of the two internal threads into which the lightning receptors are screwed.

25 By virtue of the use of a prefabricated lightning receptor base, which already has the two threaded bores, and the production of the bores through the rotor blade walls only once the lightning receptor base has been fastened, particularly simple fitting of the entire lightning protection device which is not very susceptible to faults is achieved.

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In one configuration, the method has the following further step:

- identifying the position of one of the two screws optically from an outer side of the assembled half-shells.

As already mentioned, the arrangement of the screws can act as orientation for the production of the bores through the rotor blade walls. In principle, the position of the screws can be fixed as desired for this purpose, for example using magnets. When using sufficiently large screws, preferably with a characteristically structured screw head, in particular with a hexagon socket, it is in many cases possible, however, to identify the two screws through the rotor blade wall merely by eye. The production of the bores at the correct position is particularly simple as a result.

10 In one configuration, the lightning receptors screwed into the internal threads terminate flush with an outer side of the rotor blade half-shell in question without touching the bore surrounding them. In other words, the bore is so large that a free space remains around the screwed-in lightning receptors. The fastening of the lightning receptors is performed exclusively via the lightning receptor base, and a force effect on the lightning receptors, in particular in the case of an elastic deformation of the wind turbine rotor blade, does not occur. This contributes to a permanent fastening of the lightning protection device.

In one configuration, the method has the following further step:

- 20
- closing the gaps between the lightning receptors and the bores surrounding them once the two lightning receptors have been screwed in.

In particular, the gaps can be closed by a permanently elastic compound. As a result, sealing-off of the interior of the wind turbine rotor blade is achieved without the possibility of forces being exerted on the lightning protection device from the rotor blade wall.

In one configuration, the screws are screwed so far into the receptor base that the heads of the screws are each arranged with a spacing of less than 10 mm from the inner side of one of the rotor blade half-shells once the two rotor blade half-shells have been assembled. Preferably, an even smaller spacing of, for example, less than 5 mm can be selected. An arrangement of the screws as far as

possible directly below the inner side of the respective rotor blade half-shell simplifies the process of finding the screws from the outside.

In one configuration, a fastening plate is fastened on the lightning receptor base
5 with one of the screws and, in order to fasten the lightning receptor base on the inner side of one of the rotor blade half-shells, the fastening plate is adhesively bonded to the inner side of the rotor blade half-shell. The fastening plate enables simple adhesive bonding over a relatively large area to the rotor blade half-shell. In addition, the lightning receptor base itself can be adhesively bonded to the
10 inner side of the rotor blade half-shell or to the fastening plate. A particular advantage consists in that, once the fastening plate has been fastened on the inner side of the rotor blade half-shell, readjustment of the position of the lightning receptor base is still possible, at least by rotation. The lightning receptor base can therefore be oriented precisely simply before it is ultimately fixed. In addition, the
15 head of the screw used for fastening the fastening plate to the lightning receptor base can be recessed into the fastening plate so that it terminates flush with the surface thereof. After the adhesive bonding of the fastening plate to the rotor blade half-shell, it is then located directly on the inner side of the rotor blade half-shell so that it is particularly easily visible from the outside.

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The invention will be explained in more detail below with reference to an exemplary embodiment illustrated in the figures, in which:

figure 1 shows a wind turbine rotor blade according to the invention in a simplified,
25 perspective illustration,

figure 2a shows a lightning receptor base of the wind turbine rotor blade shown in figure 1 in a perspective illustration,

30 figure 2b shows the lightning receptor base in figure 2a in a plan view,

figure 3 shows a fastening ring of the lightning receptor base from figure 2a/b in three different views,

figure 4 shows the fastening section of the lightning receptor base from figure 2a/b in three different views,

figure 5 shows a detail illustration for the fastening of the lightning receptor base shown in figure 2 to a rotor blade half-shell in a sectioned and schematic illustration,

figure 6 shows a detail illustration of the lightning receptor base shown in figure 2 fastened between the two rotor blade half-shells prior to introduction of the bores,

figure 7 shows the arrangement shown in figure 6 after production of the bores,

figure 8 shows the arrangement shown in figure 7 with the lightning receptors screwed in.

The wind turbine rotor blade 10 shown in figure 1 has a blade tip 12, a blade root 14, a pressure side 16 and a suction side 18. A lightning protection conductor 20 leads from the blade root 14 into the region of the blade tip 12, where it is connected to a blade tip lightning receptor 22. In the region of the profile leading edge 24, an electrical heating device 26 is indicated as an additional option.

A lightning receptor 28 arranged on the pressure side 16 is spaced apart from the blade tip 12. On the suction side 18, a further lightning receptor 30 (see figure 8) is positioned approximately opposite said lightning receptor 28. The two lightning receptors 28, 30 are screwed to a lightning receptor base 32 (see, for example, figure 2) in the interior of the wind turbine rotor blade 10. The lightning receptor base 32 is connected to the lightning protection conductor 20.

Figures 2a and 2b show the lightning receptor base 32, which has two fastening rings 34, 36 and a fastening section 38 arranged therebetween. The two fastening rings 34, 36 are arranged closely adjacent to one another. They each have an outer diameter in the range of from 30 mm to 40 mm and have a spacing 47 in

the range of from 5 mm to 20 mm between their outer sides 43. Each of the two fastening rings 34, 36 has an M20 internal thread 40.

5 The two fastening rings 34, 36 are arranged laterally next to one another. As can clearly be seen in figure 2b, however, they do not lie precisely in one plane, but are tilted at an angle of approximately 15° relative to one another. All of the outer edges 42, in particular at the outer circumferences of the fastening rings 34, 36, are rounded off with a radius of approximately 4 mm.

10 The lightning receptor base 32 is assembled by welding the two fastening rings 34, 36 to the fastening section 38 arranged between the two fastening rings 34, 36.

15 Figure 3 shows a fastening ring 34 of the lightning receptor base 32 in cross section at the top left, in a plan view from above at the top right, and in a perspective illustration at the bottom. The rounded edges 42 at the outer circumferences and a lateral flattened portion 44 on the outer side 43, which forms a contact area for welding to the fastening section 38, can be seen particularly clearly in the cross-sectional illustration.

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Figure 4 shows the fastening section 38 in two plan views from different directions and additionally in a perspective illustration. The fastening section 38 has a circular-cylindrical basic shape with a diameter in the range of from 10 mm to 20 mm. At one end, which is arranged between the two fastening rings 34, 36, there are two mutually opposite flattened portions 46, which ensure contact with the flattened portions 44 on the fastening rings 34, 36 over a large area during welding.

30 Figure 5 shows schematically how the lightning receptor base 32 is fastened on the inner side 48 of a rotor blade half-shell 50. The two fastening rings 34, 36 of the lightning receptor base 32 are shown in the lower part of the figure. A first screw 52, namely a countersunk head screw, is screwed into the internal thread

40 of the fastening ring 34. This countersunk head screw is used to screw a fastening plate 54, which in the example consists of a glass fiber composite material, to the lightning receptor base 32. The upper side of the countersunk head of the first screw 52, which has a hexagon socket 56, terminates approximately flush
5 with the upper side of the fastening plate 54.

The fastening plate 54 is fastened with adhesive 58 on the inner side 48 of the rotor blade half-shell 50. The upper side of the screw 52 is therefore located in the direct vicinity of the inner side 48, with the result that the screw 52 is particularly easily visible from the outside.
10

Figure 6 shows another view of the lightning receptor base 32, in which the two fastening rings 34, 36 and additionally the fastening section 38 can be seen. In the illustration shown in figure 6, the fastening plate 54 is furthermore screwed to
15 the lightning receptor base 32 via the first screw 52, and the fastening plate 54 is adhesively bonded to the inner side 48 of the rotor blade half-shell 50. A second screw 60 is screwed into the fastening ring 36. Then, the rotor blade half-shell 50 has been assembled with a further rotor blade half-shell 62 so that the lightning receptor base 32 is arranged completely in the interior of the wind turbine rotor
20 blade 10.

The second screw 60 is likewise a countersunk head screw. It is screwed so far into the fastening ring 36 that its head has a spacing from the inner side 64 of the further rotor blade half-shell 62 of less than 10 mm.
25

The longitudinal axes 66, 68 of the two screws, which correspond to the longitudinal axes of the two threaded bores in the fastening rings 34, 36, are illustrated by dash-dotted lines in figure 6. It can be seen that the longitudinal axis 66 is arranged perpendicular to the rotor blade half-shell 50 and the other longitudinal
30 axis 68 is arranged perpendicular to the further rotor blade half-shell 62.

In the arrangement shown in figure 6, the two screws 52, 60 are visible from the outside through the walls of the rotor blade half-shells 50, 62 so that their position

can be identified visually. This enables production of the bores 70, 72 shown in figure 7 through the wall of the rotor blade half-shell 50 and the wall of the further rotor blade half-shell 62, respectively. The diameter of the bores 70, 72 is selected to be slightly greater than the diameter of the heads of the screws 52, 60
5 so that said screws can be unscrewed easily from the fastening rings 34, 36 and can be removed through the bores 70, 72.

Then, the two lightning receptors 28, 30 are screwed into the internal threads 49 of the fastening rings 34, 36 through the bores 70, 72, as is illustrated in figure 8.
10 The lightning receptors 28, 30 are in the form of countersunk head screws consisting of stainless steel and are screwed so far into the internal threads 40 of the fastening rings 34, 36 that their end sides terminate flush with the outer sides of the rotor blade half-shells 50, 62. The gaps remaining between the bores 70, 72 and the lightning receptors 28, 30 are filled with a permanently elastic compound.

List of reference symbols used:

	10	wind turbine rotor blade
	12	blade tip
	14	blade root
5	16	pressure side
	18	suction side
	20	lightning protection conductor
	22	blade tip lightning receptor
	24	profile leading edge
10	26	heating device
	28, 30	lightning receptor
	32	lightning receptor base
	34, 36	fastening ring
	38	fastening section
15	40	internal thread
	42	edge
	43	outer side
	44, 46	flattened portion
	47	spacing between outer sides
20	48	inner side
	50	rotor blade half-shell
	52	first screw
	54	fastening plate
	56	hexagon socket
25	58	adhesive
	60	second screw
	62	further rotor blade half-shell
	64	inner side
	66, 68	longitudinal axis
30	70, 72	bore

Patentkrav

1. Rotorblad (10) til et vindenergianlæg og med en bladrod (14), en lynafleder (20) til bortledning af en lyn-strøm til bladroden (14), en sugeside (18), en trykside (16), et ved sugesiden (18) indrettet lynmodtagerorgan (30), et ved tryksiden (16) indrettet lynmodtagerorgan (28) og et i vindenergianlæg-rotorbladet (10) indrettet og som en enkelt del fremstillet lynmodtagerorgan-basisdel (32), hvorpå de to lynmodtagerorganer (28, 30) og lynaflederen (20) er fastgjort, **kendetegnet ved**, at lynmodtagerorgan-basisdelen (32) omfatter to fastgørelsesringe (34, 36), som hver har et indvendigt gevind, (40), hvor et af de to lynmodtagerorganer (28, 30) er indskruet og har en yderdiameter og en yderside (43), og at ydersiderne (43) af fastgørelsesringene er indrettet i en afstand (47) fra hinanden, som er mindre end en yderdiameter.
2. Rotorblad (10) til et vindenergianlæg ifølge krav 1, **kendetegnet ved**, at en kantradius ved de ydre omkredse af de to fastgørelsesringe (34, 36) er 3 mm eller mere.
3. Rotorblad (10) til et vindenergianlæg ifølge krav 1 eller 2, **kendetegnet ved**, at de to fastgørelsesringe (34, 36) er anbragt sideværts ved siden af hinanden.
4. Rotorblad (10) til et vindenergianlæg ifølge et af kravene 1 til 3, **kendetegnet ved**, at de to fastgørelsesringe (34, 36) hver har en længdeakse (66, 68), og at de to længdeakser (66, 68) er anbragt i en vinkel i området fra 0° til 30° i forhold til hinanden, således at den ene længdeakse (66) rammer sugesiden (18) under en vinkel på 90°, og den anden længdeakse (68) rammer tryksiden (16) under dannelse af en vinkel på 90°.
5. Rotorblad (10) til et vindenergianlæg ifølge et af kravene 1 til 4, **kendetegnet ved**, at lynmodtagerorgan-basisdelen (32) har et fastgørelsesafsnit (38), som er forbundet med lynaflederen (20), og som er indrettet mellem de to fastgørelsesringe (34, 36).

6. Rotorblad (10) til et vindenergianlæg ifølge et af kravene 1 til 5, **kendetegnet ved**, at de to fastgørelsesringe (34, 36) er svejst til hinanden og/eller til et fastgørelsesafsnit (38).
- 5 7. Rotorblad (10) til et vindenergianlæg ifølge et af kravene 1 til 6, **kendetegnet ved**, at hver af de to fastgørelsesringe (34, 36) har en mindre yderdiameter end det tilforordnede lynmodtagerorgan (28, 30).
8. Fremgangsmåde til fremstilling af rotorblade (10) til vindenergianlæg, og
10 som omfatter følgende trin:
- at man klargør to rotorblads-halvskaller (50, 62),
 - at man klargør en af en enkelt del udformet lynmodtagerorgan-basisdel (32), som har en første fastgørelsesring (34) med et første indergevind (40),
15 og en anden fastgørelsesring (36) med et andet indergevind (40),
 - at man indskruer en første skrue (52) i det første indergevind (40) og en skrue (60) i det andet indergevind (40),
 - at man fastgør lynmodtagerorgan-basisdelen (32) på en inderside (48) af en af rotorblads-halvskallerne (50, 62),
 - 20 · at man sammenføjer de to rotorblads-halvskaller (50, 62),
 - at man fremstiller en første boring (70) gennem en væg i en af rotorblads-halvskallerne (50, 62) i et område for den første skrue (52) og en anden boring (72) gennem en væg i den anden rotorblads-halvskal (62) i et område for den anden skrue (60),
 - 25 · at man fjerner de to skruer (52, 60) gennem vedkommende boring (70, 72),
 - at man indskruer et første lynmodtagerorgan (28) gennem den første boring (70) i det første indergevind (40), og et andet lynmodtagerorgan (30) gennem den anden boring (72) i det andet indergevind (40).
- 30 9. Fremgangsmåde ifølge krav 8, **kendetegnet ved** de yderligere trin:
- at man identificerer stillingen af en af de to skruer (52, 60) på optisk måde fra ydersiden af de sammenføjede rotorblads-halvskaller (60, 62).

10. Fremgangsmåde ifølge krav 8 eller 9, **kendetegnet ved**, at lynmodtagerorganerne (28, 30), som er skruet ind i de indre gevind (40), ender flugtende med ydersiden af vedkommende rotorblad-halvskal (50, 62) uden at berøre den omgivende boring (70, 72).

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11. Fremgangsmåde ifølge krav 10, **kendetegnet ved** det yderligere trin:

· at man lukker spalten mellem lynmodtagerorganerne (28, 30) og de borede huller (70, 72), som omgiver lynmodtagerorganerne og dette så snart, at de
10 to lynmodtagerorganer (28, 30) er blevet indskruet.

12. Fremgangsmåde ifølge et af kravene 8 til 11, **kendetegnet ved**, at skruerne (52, 60) indskrues så langt i modtagerorgan-basisdelen (32), at hovedet på skruerne (52, 60), efter at de to rotorblads-halvskaller (50, 62) er blevet sammenføjet,
15 vil have en afstand på mindre end 10 mm fra indersiden (48) af en af rotorblads-halvskallerne (50).

13. Fremgangsmåde ifølge et af kravene 8 til 12, **kendetegnet ved**, at man ved hjælp af en af skruerne (52, 60) fastgør en fastgørelsesplade (54) på lynmodtagerorgan-basisdelen (32), og at man med henblik på fastgørelse af lynmodtagerorgan-basisdelen (32) på indersiden (48) af en af rotorblads-halvskallerne (50, 62) klæber fastgørelsespladen (54) sammen med en inderside (48) af rotorblads-halvskallen (50, 62).
20

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Fig. 1

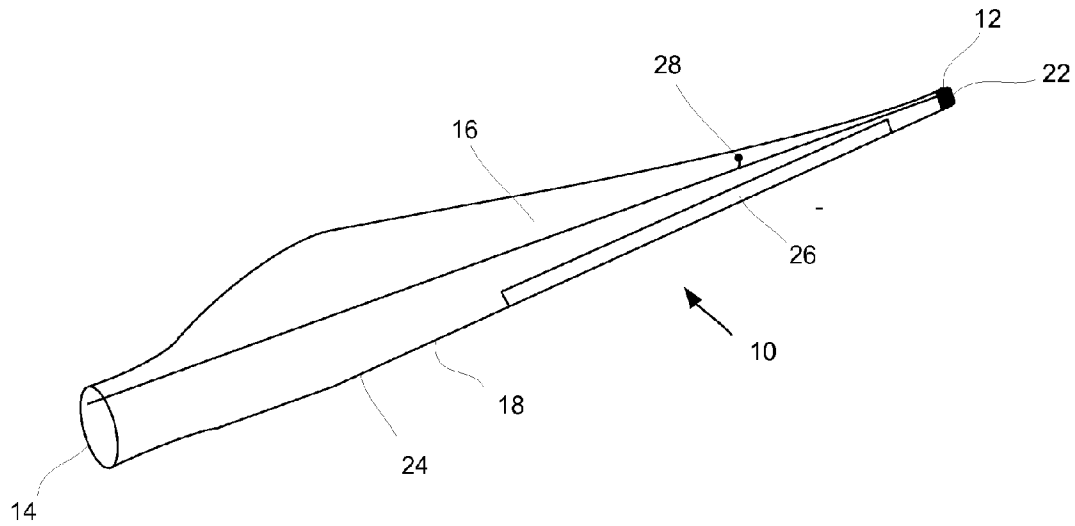


Fig. 2a

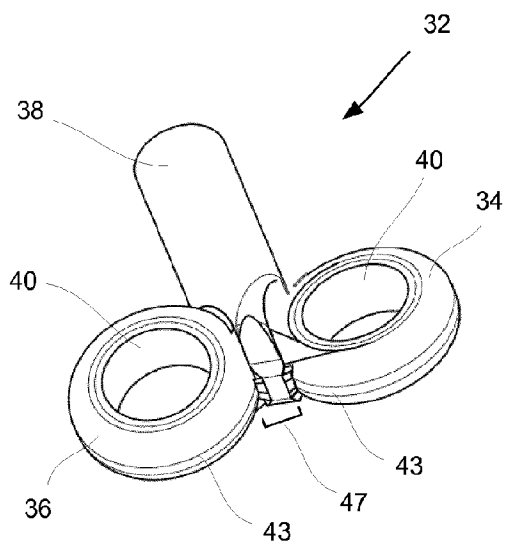
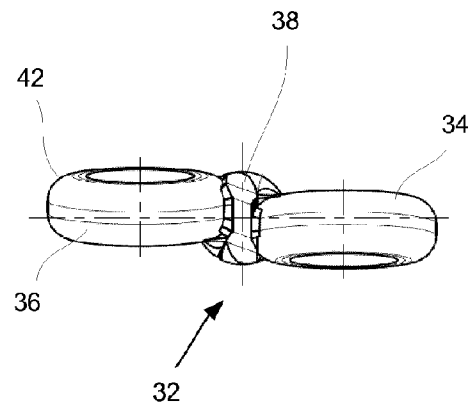


Fig. 2b



2

Fig. 3

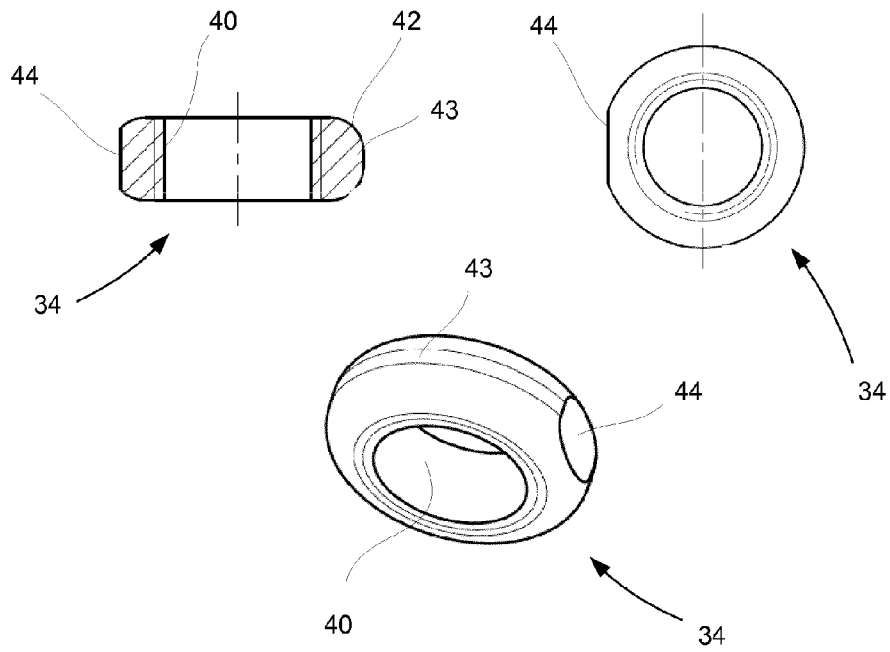
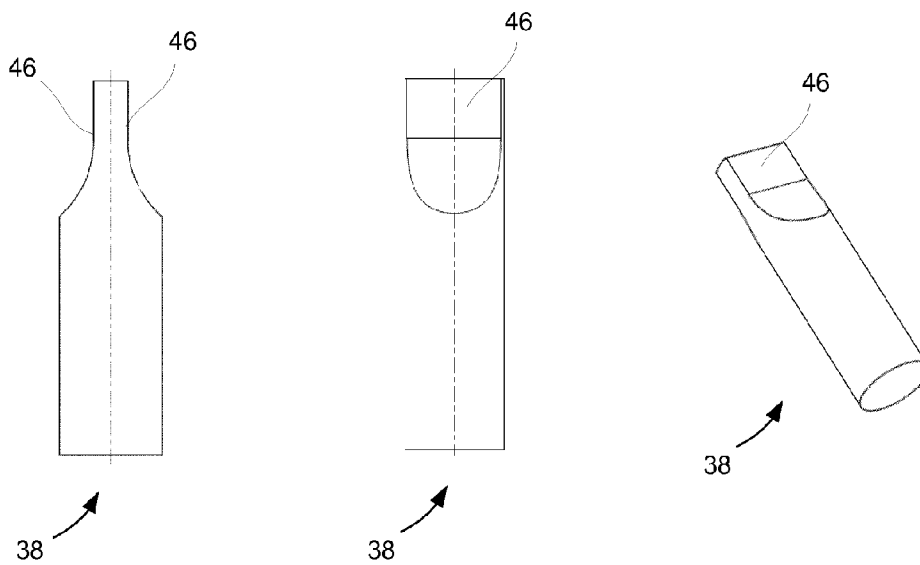


Fig. 4



3

Fig. 5

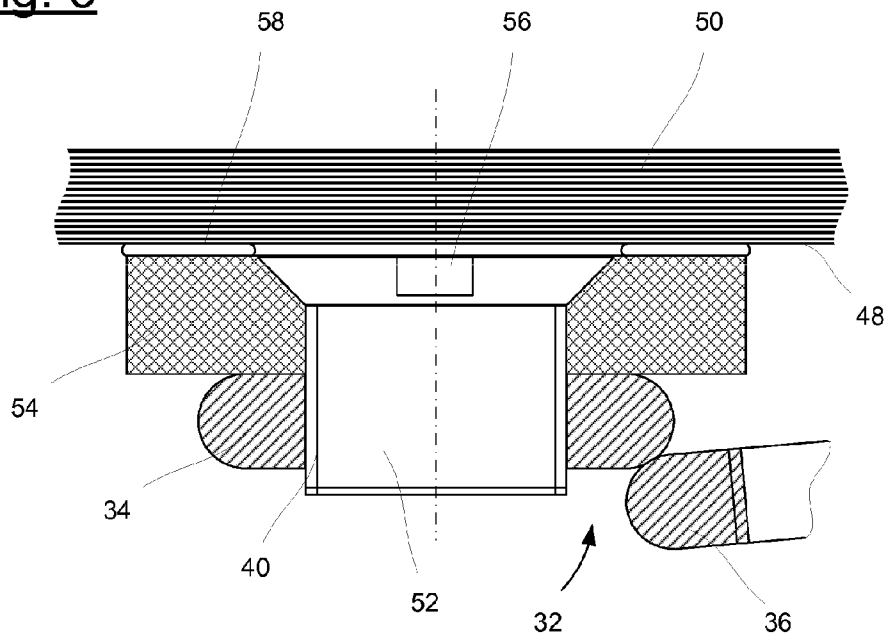


Fig. 6

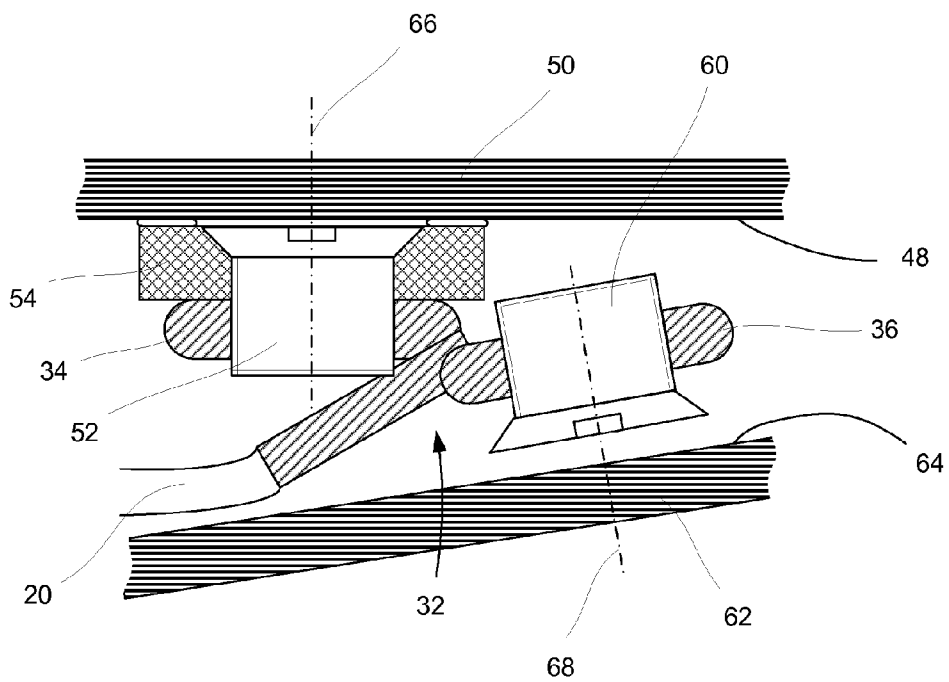
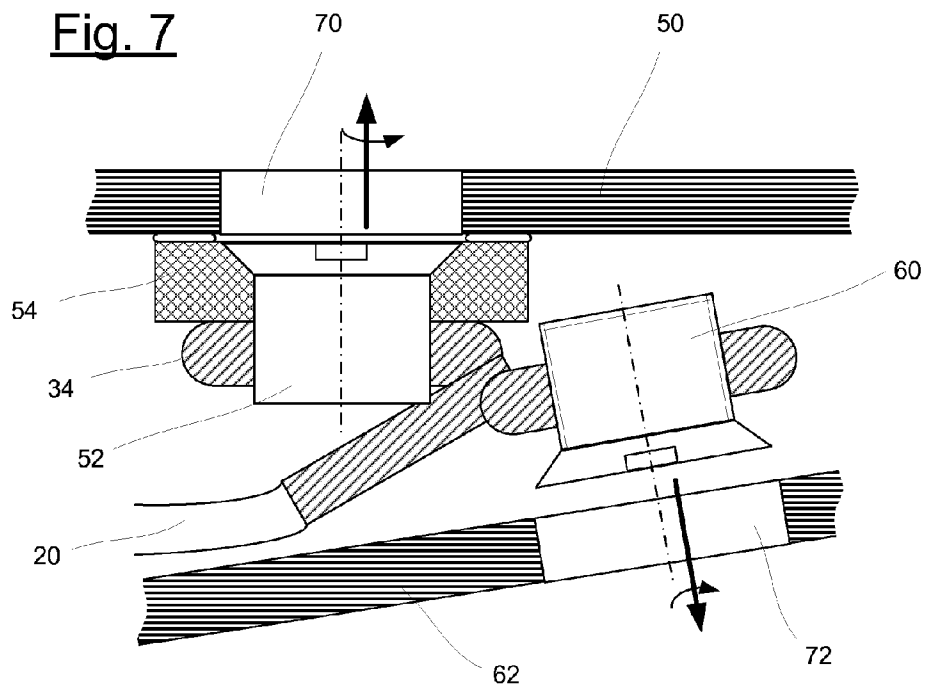


Fig. 7Fig. 8