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Benævnelse: Fremgangsmåde og anordning til transport af en vinge til en vindmølle

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Description

The present invention relates to a method and a device for transporting a rotor blade of a wind turbine, for example to the installation site of the wind turbine. The transport of a rotor blade often takes place initially with the help of a land vehicle, for example a specialized goods vehicle designed for large loads, to a first transfer location, at which the rotor blade is loaded onto a watercraft, for example a cargo vessel. The rotor blade is then transported on the watercraft by sea to a second transfer location, which either lies directly at the installation site of the wind turbine or at which the rotor blade is loaded onto a land vehicle once more, in order to be transported from there by road to the installation site of the wind turbine. However, the invention also relates to a method, in which transport of the rotor blade initially takes place by sea, followed by transhipment onto a land vehicle.

In the case of transport of the rotor blade by land vehicle, the rotor blade must be transported in a position which is aligned so that the overall height of the transport train does not exceed a maximum height. Furthermore, the transport train must also not be too wide. Both are essential to ensure that the transport train is also able to negotiate underpasses, tunnels and bridges etc. The result of this requirement is a favourable position of the rotor blade for road transport. On the other hand, the rotor blade must be aligned in another position for transport on a watercraft, that is to say in a favourable position for sea transport. Said favourable position is subject to constraints other than those that are applicable to land transport and results from the fact that multiple rotor blades are transported at the same time on the watercraft, and the rotor blades require to be aligned in the most space-saving manner possible for this purpose. Said favourable space-saving alignment differs from the favourable alignment of the land transport. The alignment of the rotor blade at the transfer location must accordingly be rotated.
from the favourable alignment for land transport into the favourable alignment for sea transport. The same applies if the transport route has been completed by sea and the rotor blade has subsequently been reloaded onto a land vehicle. In this case, the rotor blade must be rotated once again into the favourable alignment for land transport.

The transport of the rotor blade generally takes place in a rigid rack, in which the rotor blade is arranged in the favourable alignment for the forthcoming transport leg, wherein the rack can also be configured in such a way that multiple rotor blades are capable of being arranged therein. Different racks are used as a rule for land transport and for sea transport.

The disadvantage of the transport method involving the use of different racks for land transport and sea transport is that the rotor blade must be removed from the rack for land transport with the help of cranes, in order for it to be capable of being rotated into the favourable alignment for sea transport, and in order to arrange the rotor blade in the other rack for sea transport. Said rotating and reloading process is very time-consuming, in particular in view of the need to reposition multiple rotor blades. In addition, the realignment/repositioning of the rotor blades takes place as a rule on the port area. This means that the realignment/repositioning is very cost-intensive, since port operations are expensive. A further disadvantage of this realignment/repositioning is the associated risk of damage to the rotor blades, for example caused by lifting tackle or as a result of collision with the racks.

Already previously disclosed in WO 03/057528 A1 is a transport vehicle for a rotor blade of a wind turbine, comprising a tractor unit and a trailer, which are connected to one another by the rotor blade during transport of the rotor blade, and which in each case have a receiving rack/holding rack, which are configured in such a way that the rotor blade is capable
of rotation therein. The possibility of rotation is intended to permit the transport height of the rotor blade to be changed, in particular when travelling under an underpass, a tunnel or a bridge. Accordingly, the ability of the rotor blade to be supported in two racks so as to be rotatable is also previously disclosed in WO 03/057528 A1. However, the disadvantage of the racks that are previously disclosed in WO 03/057528 A1 is that they are not suitable for supporting the rotor blades for sea transport. Accordingly, rotor blades which are transported by the previously disclosed transport vehicle to a transfer location, as in the previously discussed prior art, must be loaded from the transport vehicle into other racks using two cranes, which gives rise to the previously discussed problems of the risk of damage to the rotor blades in the course of their repositioning as well as the high costs.

Previously disclosed in WO 2008/0044195 A2 are a method and a device which address the problem of the realignment/repositioning of rotor blades during the transition from land transport to sea transport described by way of introduction. A two-part transporting device with a blade root rack and a blade tip rack is proposed for this purpose, which hold the rotor blade on the one hand in a favourable position for land transport and on the other hand in a favourable position for sea transport. The favourable position for land transport in this case should be that in which the maximum rotor blade width extends in a horizontal direction. On the other hand, the favourable position for ship transport should be rotated through 90°, so that the maximum rotor blade width extends in a vertical direction. The realignment/repositioning, that is to say the rotation through 90°, should take place with the help of a crane, which engages on a lifting rack attached to the rotor blade at the centre of gravity thereof. It is considered to be detrimental for three racks to be provided for the handling of the rotor blade, and for the realignment/repositioning of the rotor blade to play a demanding role in the handling, since the tip rack and the
root rack must be rotated through 90°. In addition, the realignment/handling requires the use of a crane. Finally, the proposed alignments for land transport and sea transport cannot be considered to be entirely favourable.

Document US 2011/031292 discloses a method and a device according to the preamble to Claims 1 and 10.

The object of the present invention is thus to facilitate the transport of rotor blades by land and by sea, which is simple in respect of handling and cost-effective, and which in addition exposes the rotor blades to the lowest possible risk of damage.

The object is accomplished by a method according to Claim 1 and by a device according to Claim 10. Further advantageous embodiments of the method and the device are indicated in the dependent claims.

The method according to the invention is characterized in that the same transporting device is used for land transport and sea transport. The rotor blade continues to held in said transporting device during the entire transport operation and during reloading onto the watercraft or from the watercraft. The transporting device does not require to be rotated for the realignment/repositioning of the rotor blade, but the rotor blade is arranged therein so as to be rotatable and is accordingly capable of being rotated inside the transporting device. The transporting device is of at least two-part configuration and consists at least of a root rack arranged on the blade root side and a tip rack arranged on the blade tip side. A rotary unit is proposed, which, for example, can be arranged on the root rack in order to perform the rotation of the rotor blade required for the realignment/repositioning.

The present device according to the invention has the advantage that the rotor blades are transported to the transfer location and can be loaded there into a ship or onto
a land vehicle by means of cranes without the expenditure of
excessive time, depending on the sequence in which the land
transport and the sea transport take place, since the use of
the same transporting device means that no repositioning of
the rotor blades from a first transporting device into a
second transporting device is necessary. As a result, the risk
of possible damage to the rotor blades is also reduced at the
same time. Since the rotor blade inside the transporting
device is capable of being rotated, handling of the rotor
blade during reloading or during realignment/repositioning is
also simplified considerably.

During reloading of the rotor blade, it would be possible to
engage on the rotor blade itself, for example, or a lifting
device could be mounted on the rotor blade, for example at the
centre of gravity of the rotor blade, in order to engage
thereon. For loading of the rotor blade on the watercraft or
on the land vehicle, however, it is advantageous to engage on
the transporting device, for example, which has special
lifting tackle for this purpose. This avoids stresses on the
rotor blade, which could arise in the case of engagement on
the rotor blade. This also reduces the time input which could
be required for the installation of a lifting device, for
example.

There is very little likelihood, as a rule, of height or width
restrictions during sea transport. As a result, at least two
rotor blades arranged in transporting devices are arranged
advantageously above and/or next to one another on the
watercraft, and the transporting devices that are arranged
adjacent to one another are connected to one another. The
transporting devices can have connecting elements for this
purpose, of the kind that are already familiar in shipping
containers, for example.

The rotary unit can comprise motor drives, for example. The
rotary unit will be more cost-effective and more robust,
however, if it is of hand-operated configuration. Since the
rotor blade exhibits higher stability on the blade root side because of the blade root flange, the rotary unit is preferably executed on the rack on the blade root side.

A simple construction of the rotary unit consists of a lever arm, for example, which is caused to rotate by a lifting device. The lever arm could be moved, for example, by a crane. The lifting device is preferably a chain hoist, however, which acts on the free end of the lever arm for rotating the rotor blade by actuating the chain hoist.

It is not necessary, as a rule, to rotate the rotor blade through 90°, as proposed in the prior art, since a favourable position for road transport does not necessarily require the maximum rotor blade width to extend in the horizontal direction. The maximum rotor blade width can extend, for example, between the horizontal alignment and the vertical alignment, for example in the 45° direction. The rotor blade can then be rotated by less than 45°, in particular by less than 30°, and in particular by 10°-20°, in order to move from said favourable position for road transport to a favourable position for sea transport. Contrary to what is stated in the prior art, a favourable position for sea transport does not exist if the maximum rotor blade width is situated in the vertical direction.

The rotor blade is locked advantageously in the favourable position for road transport and/or for sea transport, in order to prevent unintentional rotation. Locking of the rotor blade in this case is effected advantageously by locking the rotary unit. An additional locking device on the blade root rack can be dispensed with as a result.

The root rack and the tip rack preferably each have a frame, which is capable of being arranged releasably on a land vehicle and which in each case has hitching points for hitching a crane. Said hitching points are preferably configured as container corners, furthermore, so that the
frames can be arranged easily on top of one another and next to one another and, if required, can be connected to one another.

The tip rack engages on the rotor blade in an area between the centre of gravity of the rotor blade and the rotor blade end on the tip side. It consists advantageously of a frame construction and receiving means for the rotor blade tip arranged therein so as to be rotatable. The frame is configured advantageously to be upwardly open on one side, in order to be able to introduce the rotor blade into the receiving means through said opening.

Said receiving means advantageously have a bearing shell for positively receiving the rotor blade tip, which bearing shell is fastened to the frame via a broad strap, wherein the bearing shell is arranged movably on the broad strap by means of rollers. The bearing shell can be changed in respect of its position and situation in this way, and can follow a rotating movement induced on the blade root side, for example. The bearing shell can be secured by suitable tensioning means, for example by tensioning belts/tensioning ropes or by lashing chains, which run from the bearing shell to the frame.

The bearing shell in this case bears positively against the rotor blade preferably via a sufficiently large area of the periphery of the rotor blade to ensure that the rotor blade is secured positively against slipping out of the bearing shell, both in the favourable position for road transport and also in the favourable position for sea transport. This is achieved in a simple manner, if the bearing shell positively encloses the rotor blade by more than 180°, preferably by more than 210°, more preferably by more than 240°. In both preferred transport positions, the rotor blade then rests over a large area on the bearing shell and is secured safely against slipping out in the gravitational direction or in the direction of rotation.

For the introduction of the rotor blade into the bearing shell
it is advantageous for the bearing shell to consist of a first bearing plate and a second bearing plate pivotably articulated thereon. Easy introduction of the rotor blade is possible by causing the second bearing plate to pivot into an open position, and, after the introduction is complete, the second bearing plate can be caused to pivot into the closed position, in which it comes to rest against the rotor blade, preferably positively.

10 The invention is now described below in more detail on the basis of illustrative embodiments depicted in the figures. In the figures:

Fig. 1a depicts a rotor blade held in a transporting device in a favourable position for land transport;

Fig. 1b depicts a rotor blade held in a transporting device in a favourable position for water transport;

20 Fig. 1c depicts multiple rotor blades held in transporting devices in a favourable position and arrangement for sea transport;

Fig. 2a, 2b depict a blade root rack of a transporting device in two perspective views;

Fig. 3 depicts a tip rack of a transporting device in a perspective view;

30 Fig. 4a depicts a blade root rack with a rotor blade held thereby in the land transport position in a front view;

Fig. 4b depicts a tip rack with a rotor blade held thereby in the land transport position in a front view;

35 Fig. 5a depicts the blade root rack in Fig. 4a after rotation into the water transport position; and
Fig. 5b depicts the tip rack in Fig. 4b after rotation into the water transport position.

Figs. 1a, 1b and 1c respectively depict in a perspective view transporting devices 10 according to the invention with rotor blades 5 held thereby. The transporting device 10 in this case consists respectively of a rack, which holds the rotor blade 5 at its blade root 5a, and which is accordingly referred to below as the blade root rack 10a, and of a rack, which holds the rotor blade 5 in its blade tip area 5b and which is accordingly referred to below as the tip rack 10b. The arrangement of the tip rack 10b takes place in an area of the rotor blade 5, which lies in the longitudinal direction (in the z-direction) of the rotor blade between the centre of gravity of the rotor blade and the rotor blade tip end 5c. Details in respect of the configuration and the functionality of the racks 10a and 10b are discussed in detail later.

The rotor blade 5 in Fig. 1a is held in a different position from the rotor blades 5 in Figs. 1b and 1c. Whereas the rotor blade 5 in Fig. 1a is held oriented in such a way that the direction of the maximum rotor blade width lies substantially horizontally, in Figs. 1b and 1c said direction of the maximum rotor blade width is unscrewed from the horizontal by about 10° to 20° in the counter clockwise direction. The rotor blade position in Fig. 1a is favourable for land transport or road transport, because a specific maximum height, which is most easily achievable in the depicted rotor blade position, must be maintained for this transport route. The rotor blade position depicted in Figure 1b is more favourable for sea transport, on the other hand, because no height requirements are critical here, but the interest of achieving the most space-saving arrangement possible is of primary importance. The maintenance of the position depicted in Fig. 1a would not be favourable for sea transport, because the distance between rotor blades 5 arranged next to one another would then be determined by the maximum rotor blade width. By rotation of the rotor blade 5 into a position as depicted in Fig. 1b, the
rotor blades 5 can be arranged in such a way that they are positioned closer together, but without leading to contact between the rotor blades 5. Even stronger rotation is not advantageous, because the stacking of the transporting devices 10 one on top of the other would then be hampered, as depicted in Fig. 1c by way of example on the basis of three rows each having three transporting devices 10 arranged stacked one on top of the other with rotor blades 5 held therein.

Further details of the configuration of a typical blade root rack 10a are depicted in Figs. 2a and 2b. The rack 10a consists of a rectangular double frame 12, which is constructed from square steel tubes. A first rectangular frame 12a is connected in this case to a second rectangular frame 12b via horizontal square struts 14, so that the resulting double frame 12 encloses a box volume 16 in its interior. Additional diagonal struts 18 are provided in the lateral side surfaces for the further strengthening and reinforcement of the double frame 12. The lower side surface on the bottom side and the upper side surface on the top side can also be stiffened as appropriate with struts 20, wherein the main load, which must be handled by the double frame 12, is the weight force of the rotor blade 5, which must be carried by the double frame 12.

The side of the double frame 12 facing away from the observer has two horizontal struts 22 at a distance from one another and oriented essentially horizontally. Said side has two vertical struts 24 oriented in the vertical direction, furthermore, which are likewise arranged at a distance from one another. Said four struts 22, 24 on the side facing away from the observer intersect at four points 26, which constitute the corner points of a central square surrounded by the struts 22, 24. Positioned in said square is a carrier plate 28 with a central rotary lead through, through which there runs a pivot shaft that is supported so as to be rotatable. On the rotor blade side or on the side facing away from the observer, the pivot shaft carries a four-armed spider
30, to which the blade root 5a of the rotor blade 5 can be attached. Present on the free ends of the arms of the spider 30 for this purpose are bolt receivers 32 for the blade root flange bolts 34 of the rotor blade 5. These bolts 34 pass through the bolt receivers 32, so that nuts can be screwed onto the ends of the bolts.

The side of the pivot shaft facing towards the observer carries a lever arm 36, on the free end of which a lifting device 38 can be suspended in order to cause the lever arm 36 to rotate about the pivot shaft. The root rack 10a has a chain hoist as the lifting device 38, which can be stretched between the free end of the lever arm 36 and the frame top side of the double frame 12 in order to pull the lever arm 36 upwards by actuation of the chain hoist 38. If the chain hoist 38 is stretched between the frame under side of the double frame 12 and the free end of the lever arm 36, the lever arm 36 can be pulled downwards by actuation of the chain hoist 38. Fig. 2 depicts two chain blocks 38, of which one runs between the frame top side and the lever arm 36 and the other runs between the lever arm 36 and the frame under side. Depending on the direction in which the lever arm 36 is to be moved, the bottom chain hoist or the top chain hoist 38 would require to be actuated, and the other chain hoist 38 would require to be relaxed, as appropriate. The lever arm can be locked, for example, by the actuation of the two chain blocks 38 with an identical pulling force. For locking, however, the lever arm has locking holes 40 on its end on the pivot shaft side, through which locking bolts can be inserted and brought into engagement with the carrier plate 28, which has corresponding locking holes.

Further details of the typical configuration of a tip rack 10b are shown in Fig. 3. The tip rack 10b consists of a rectangular double frame 42, which is open towards the top, however. The front and the rear frame 42a, 42b of the double frame also consist respectively of only two vertical square tubes 44 and a single horizontal square tube 46, which extends
between the bottom ends of the vertical square tubes 44. The front and the rear frame 42a, 42b are connected to the frame corners with horizontal square struts 48 to form the double frame 42. The frame stability is further improved by horizontal reinforcement struts 50, which run in the end surface of the front double frame and the rear double frame below half of the height of the frame 42 between the vertical tubes 44, and which is additionally stabilized and stiffened by diagonal struts 52, which run from the frame corners to the centre of the horizontal reinforcement strut. Ladders 54 are arranged in the lateral side surfaces, whereas the side surface on the bottom side is equipped with two square floor struts 56 for further strengthening of the frame 42. The square floor struts 56 can be used in an appropriate execution as forklift pockets, whereby simple transport of the rack is facilitated.

Said double frame construction 42 carries the rotor blade receiving means 60, which is formed by a broad strap 62, the strap ends of which are suspended on the upper open double frame end, and by a rotor blade bearing shell 64, which is capable of sliding along the broad strap 62. The rotor blade bearing shell 64 has rollers for this purpose (not depicted here) on its under side. The rollers can be embodied as pairs of rollers, for example, via which the broad strap 62 is guided and via the rotor blade bearing shell 64 is then prevented by the broad strap 62 from slipping off. The rotor blade bearing shell 64 consists of a base plate 66, the supporting surface 68 of which is moulded to imitate the outer contour of the rotor blade 5 in its area that is intended to be received, in order to ensure contact over a large area. A pivoting support element 70 is pivotally hinged on said base plate 66. Said pivoting support element 70 can be pivoted into a close position, as depicted in Fig. 3, and then bears against the rotor blade 5 over a large area and positively. The support element 70 can be pivoted into an open position and then permits free access to the supporting surface 68 of the base plate 66. On the rotor blade side, the rotor blade
bearing shell 64 is provided with a mat 72 made of an elastic material, whereas the base plate 66 and the pivoting support element 70 are formed from a dimensionally stable material. The base plate 66 and the support element 70 can consist of sheet steel, for example, and the mat 72 can consist of cellular rubber or some other elastomer, for example.

For the purpose of fixing the rotor blade bearing shell 64, four tensioning straps 74 are stretched between the bottom side of the rotor blade bearing shell and the double frame 42, which secure the rotor blade bearing shell 64 against sliding on the broad strap 62. The tensioning straps 74 are released in the event of the rotation of the rotor blade 5, and the rotor blade bearing shell 64 is able to move on the broad strap 62. On completion of the rotation of the rotor blade 5, the position of the rotor blade bearing shell 64 is once more secured by tensioning straps 74.

Figs. 4a and 4b depict in a front view the root rack 10a (Fig. 4a) and the tip rack 10b (Fig. 4b), in each case in the transport position for land transport. The double frame 12 of the root rack 10a in Fig. 4a is depicted partially broken away, in order to make clear the attachment of the rotor blade flange 5a to the spider 30. In the area identified with the letter C, it can be appreciated that the spider 30 is screwed to the rotor blade flange 5a, so that the rotor blade 5 accompanies the spider 30 as it rotates.

In Figs. 5a and 5b, the root rack 10a in Fig. 4a and the tip rack 10b in Fig. 4b are depicted in the arrangement for sea transport. The lever arm 36 in Fig. 5a and also the spider 30 are unscrewed by about 20° in the counter clockwise direction compared with the position in Fig. 4a. The rotor blade 5 screwed to the spider 30 accompanies it as it rotates through this angle. Because of the moving mounting, the rotor blade bearing shell 64 on the blade tip side can reproduce the rotating movement of the rotor blade 5 induced on the blade root side and reaches the changed position depicted in Fig.
5b, which differs from the position depicted in Fig. 4b, by the rotor blade bearing shell 64 now having an incline.

The position depicted in Figs. 4a and 4b corresponds to the favourable position of the rotor blade 5 for land transport. The rotor blade 5 can be held fixed in this position, on the one hand by the lever arm 36 being locked by placing the chain blocks 38 under tension, as a result of which at the same time also the spider 30 and thus also the rotor blade root 5a are fixed, and on the other hand by the insertion of the locking bolts, by means of which the pivot shaft is locked. The rotor blade bearing plate 66 depicted in Fig. 4b can also be held fixed in the double frame 42 by tightening the belts 74. The belts that are wrapped around the rotor blade 5 can also be tightened, in order to prevent slipping of the rotor blade 5 from the rotor blade bearing shell 64. Fixing also takes place in the favourable position of the rotor blade 5 for sea transport depicted in Figs. 5a and 5b, by the lever arm 36 and the rotor blade bearing shell 64 being locked, as explained in Figures 4a and 4b.

Rotation of the rotor blade 5 from the position in Fig. 4a and 4b into the position in Fig. 5a and 5b is effected via the lever arm 36. For this purpose, the free end of the lever arm 36 has two attachment elements 78, to which corresponding attachment elements 80 are allocated on the double frame 12 on the bottom side and on the top side. A chain hoist 38 can be installed between the pairs of associated attachment elements 78, 80, so that, by actuating the chain hoist 38, rotation of the lever arm 36 can take place in the clockwise direction or in the counter clockwise direction. The chain blocks 38 can also be kept under tension during transport and as such are additionally capable of producing locking of the rotor blade 5.

A root rack 10a and a tip rack 10b are provided for the transport of a rotor blade 5. Both racks 10a, 10b are mounted on the rotor blade 5, and the rotor blade 5 can then be lifted
onto a land vehicle by the engagement of a crane on the root rack 10a and on the tip rack 10b. In this case, the tip rack 10b can be attached to a trailer, for example, while the root rack 10a is attached to a tractor unit. The rotor blade 5 is present for this purpose in a favourable position for road transport, which corresponds to that depicted in Fig. 4a, for example. The rotor blade 5 is fixed in this position by locking together the lever arm 36 or the spider 30 and the rotor blade bearing shell 64.

After reaching the transfer location, the root rack 10a and the tip rack 10b can be released from the trailer and from the tractor unit. A crane can engage once more on said two racks 10a, 10b, and can load the rotor blade 5 together with the transporting device 10 consisting of the two racks 10a, 10b onto the watercraft which is to undertake the sea transport. For sea transport, the rotor blade 5 is rotated into a different position, which is indicated in Fig. 5a, for example, by the changed position of the lever arm 36 and the rotor blade bearing plate 66 (Fig. 5b). Rotation of the rotor blade 5 can take place, for example, while the transporting device 10 is still attached to the land vehicle. Rotation cannot take place, however, until the rotor blade 5 together with the transporting device 10 has already been set down on the ship. Rotation can also be effected in the intervening period, for example if the rotor blade 5 has already been attached to the crane or has already been raised, or while it is in interim storage.

The root rack 10a and the tip rack 10b each have stabilized areas in the corners of the double frame 12, 42, which are embodied as container corners 82. A crane can engage or can be attached in said stabilized areas. Said container corners 82 additionally ensure that the transporting device 10 is stackable, and that neighbouring transporting devices 10 can be attached to one another.

As soon as the watercraft has arrived at its destination, the
rotor blade 5 can be loaded from the watercraft onto a land vehicle once again with the transporting device 10. For land transport, the rotor blade 5 can be rotated back once again into the favourable position for land transport.
Patentkrav

1. Fremgangsmåde til transport af en vinge (5) til en vindmølle med et landtransportmiddel og med et vandtransportmiddel, idet vingen (5) med landtransportmidlet transporteres på veje eller til eller fra et indladsningssted, hvor det læses af vandtransportmidlet eller læses på vandtransportmidlet til videre transport, idet vingen (5) til transporten bliver anbragt i en transportanordning (10), som har i det mindste to dele, og som består af i det mindste et vingerodsstel (10a), som er anbragt på den side, der vender mod vingeroden, og et spidsstel (106), som er anbragt på den side, der vender mod vingspidsen, idet fremgangsmåden har følgende trin: Placering af vingen (5) i en til vejtransporten gunstig position i transportanordningen (10), placering af transportanordningen (10) på landtransportmidlet, transport af vingen (5) til eller fra indladsningsstedet, læsning af den i transportanordningen (10) hvilende vinge (5) fra landtransportmidlet til vandtransportmidlet eller fra vandtransportmidlet til landtransportmidlet, idet vingen (5) til søtransporten placeres i transportanordningen (10) i en hertil gunstig position, som afviger fra positionen til vejtransporten, transport af vingen (5) med vandtransportmidlet, kendtegnet ved, at vingen (5) er placeret drejeligt omkring sin vingelængdeaxse i transportanordningen (10), idet rodstellet (10a) og spidsstellet (10b) på transportanordningen (10) hver især er udformet på en sådan måde, at en drejning af den deri holdte vinge (5) omkring dennes vingelængdeaxse er mulig, og idet transportanordningen (10) har en drejeanordning, idet vingen (5), når den har nået indladsningsstedet og før den videre transport med vandtransportmidlet eller med landtransportmidlet, i transportanordningen (10) ved hjælp af drejeanordningen drejes fra den til vejtransporten gunstige position til den for søtransporten gunstige position eller fra den til søtransporten gunstige position til den til landtransporten gunstige position.
2. Fremgangsmåde ifølge krav 1, kendtegnet ved, at der til læsning af vingen (5) til vandtransportmidlet eller fra vandtransportmidlet indvirkes på transportanordningen (10).

3. Fremgangsmåde ifølge krav 1 eller 2, kendtegnet ved, at i det mindste to i transportanordningen (10) placerede vinger (5) er placeret over og/eller ved siden af hinanden på vandtransportmidlet, og de ved siden af hinanden placerede transportanordninger (10) forbindes med hinanden.

4. Fremgangsmåde ifølge et af de foregående krav, kendtegnet ved, at drejeanordningen betjenes manuelt og/eller er udformet på rodstellet (10a).

5. Fremgangsmåde ifølge et af de foregående krav, kendtegnet ved, at drejeanordningen har en vippearm (36), på hvilken et hejseværk (38) indvirker.

6. Fremgangsmåde ifølge krav 5, kendtegnet ved, at hejseværket (38) er et kædetræk, som indvirker på den frie ende på vippearmen (36) til at dreje vingen (5) ved aktivering af kædetrækket.

7. Fremgangsmåde ifølge et af de foregående krav, kendtegnet ved, at vingen (5) drejes mindre end 45 °, navnlig mindre end 30°, navnlig 10°-20°.


10. Transportanordning (10) til optag af en vinge (5) til en vindmølle til transport ad land- og/eller søvejen, idet transportanordningen (10) er opbygget af i det mindste to dele.
og i det mindste består af et rodstel (10a), som skal placeres på vingerodssiden, og et spidsstel (10b), som skal placeres på vingspidsssiden, idet disse to stel er udformet således, at vingen (5) holdes deri drejeligt omkring sin længdeakse, idet transportanordningen (10) har en drejeanordning til drenjning af vingen (5) omkring dennes længdeakse fra en til vejtransporten gunstig position til en til søtransporten gunstig position eller omvendt, idet disse to positioner ikke er ens, kendetegnet ved, at rodstellet (10a) og spidsstellet (10b) på transportanordningen (10) hver især er udformet således, at det er muligt at dreje den heri holdte vinge (5) omkring dennes vingelængdeakse, og idet rod- (10a) og spidsstellet (10b) hver især har en ramme (12, 42), som kan placeres aftageligt på et landtransportmiddel, og som hver især har fastgøringspunkter (82) til brug for en kran.

11. Transportanordning (10) ifølge krav 10, kendetegnet ved, at fastgøringspunkterne (82) er udformet som containerhjørner.

12. Transportanordning (10) ifølge et af de foregående krav 10 eller 11, kendetegnet ved, at drejeanordningen er manuelt betjent og/eller er udformet på rodstellet (10a).

13. Transportanordning (10) ifølge et af de foregående anordningskrav, kendetegnet ved, at drejeanordningen har en vippearm (36) og et hejseværk (38), idet hejseværket (38) til drenjning af vingen (5) indvirker på den frie ende af vippearmen (36).

14. Transportanordning (10) ifølge krav 13, kendetegnet ved, at hejseværket (38) er et kædetræk til drenjning af vingen (5) ved aktivering af kædetrækket.

15. Transportanordning (10) ifølge et af de foregående anordningskrav, kendetegnet ved, at spidsstellet (10b) består af en ramme (42) og deri drejeligt placerede optagsmidler (60) til vingspidsen.
16. Transportanordning (10) ifølge krav 15, kendetegnet ved, at optagsmidlerne (60) har en støtteskål (64) til effektivt optag af vingespidsen, som er fastgjort til rammen (42) via et bredt bælte (62), idet støtteskålen (64) er placeret bevægeligt på det brede bælte (62).

17. Transportanordning (10) ifølge krav 16, kendetegnet ved, at støtteskålen (64) ligger fast op mod vingen (5) over et så stort omfangsområde på vingen (5), at vingen (5) holdes effektivt fast både i den til vejtransporten og til søtransporten gunstige position og således sikres mod at rutsje ud af støtteskålen (64).

18. Transportanordning (10) ifølge krav 17, kendetegnet ved, at støtteskålen (64) omslutter vingen (5) effektivt med mere end 180°, fortrinsvis mere end 210°, yderligere foretrukket mere end 240°.

19. Transportanordning (10) ifølge krav 18, kendetegnet ved, at støtteskålen (64) består af en første støtteplade (66) og en svingbart hertil forbundet anden støtteplade (70).

20. Transportanordning (10) ifølge et af de foregående anordningskrav, kendetegnet ved, at rod- (10a) og/eller spidsstellet (10b) hver især har fastlåsningsmidler til henholdsvis vingerodssiden og vingespidssiden til fastlåsning af vingen (5) i den til søtransporten og/eller i den til vejtransporten gunstige position.

21. Transportanordning (10) ifølge krav 20, kendetegnet ved, at fastlåsningsmidlerne på vingerodssiden er midler, som fastlåser drejeanordningen, og/eller fastlåsningsmidlerne på vingespidssiden er midler, som fastlåser optagsmidlerne (60) ifølge et af kravene 15 til 20, navnlig fastsurringskæder (74).