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(54) **Melegítő elrendezés**

Heating device

The present invention relates to a heating device for heating an impact region which extends in an annular manner between a tubular tower segment with a peripheral segment wall and a tower foundation of a wind turbine when the wind turbine is constructed according to the preamble of claim 1. Such a heating device is disclosed, for example, by WO2010/147459.

Methods for erecting a tower of a wind turbine, in particular a concrete tower, are known in principle. Firstly, a concrete tower is provided. A prefabricated concrete tower is composed of a plurality of tower segments. Such tower segments may be provided as tubular and consequently cylinder-like elements, that is to say, in contrast to a cylinder having a slightly conical shape. With larger tower diameters, a subdivision in the peripheral direction may also be considered so that, for example, two elements which are substantially semi-circular in cross-section or other pitch-circle-like segments are assembled.

Firstly, a tower segment or a plurality of tower segments is/are placed as the first, lowest tower plane on the foundation. It is important that this first plane is orientated very carefully, that is to say, levelled. To this end, this first segment or a plurality of segments is/are precisely levelled and in this levelled position at least provisionally fixed initially in order to then insert between the foundation and this lowest tower segment or these lowest tower segments a compensation mass which finally hardens and fixes this levelled orientation.

It is problematic in this instance that the hardening of the compensation mass requires a specific minimum temperature. At low external temperatures around freezing point, the hardening may be extended significantly or fail completely. This leads on the one hand to the risk of a poorly or incompletely hardened compensation mass. On the other hand, as a result of waiting for an extended hardening time, longer downtimes, for example, for a crane which is required for installation, may result. Such a crane which has already raised the first tower segment(s) onto the foundation remains unused for the duration of the hardening of this compensation mass. There are consequently additional costly downtimes for the crane.

Furthermore, the tower is successively constructed by additional tower segments being placed on the part-tower which has previously been constructed. The operations which are required for this are consequently carried out at an increasingly great height. In the region of the highest level of the completed tower portion, there is consequently regularly arranged a frame or operating platform on which workers of the construction team can monitor the placement of a new tower segment. In this instance, it must be monitored in particular that the respective new tower segment is arranged at precisely the correct provided position. Using a crane, each tower segment is thus successively raised approximately to its position and a crane driver carries out fine positioning of the respective tower segment. The precise positioning of each tower segment is then carried out by the workers of the construction team manually on the said operating platform, that is to say, using physical strength. In particular, the respective tower segment generally has to be rotated into the correct position. The construction operators hold the tower segment which is thus orientated by hand in the correct position and the crane driver then slowly lowers the tower segment whilst the construction team ensures that the orientated position is maintained. It should be taken into account in this instance that such a tower segment may weigh approximately from 5 to 120 tonnes. Consequently, in spite of the use of significant physical strength, a very fine positioning has to be carried out.

This method for placing an additional tower segment is consequently complex, time-intensive and labour-intensive and has a degree of susceptibility to error. In addition, there is the risk of injury for the operators in situ, in particular the risk of occurrences of crushing.

If the new tower segment is arranged on the tower which has previously been erected, the tower segment has to be separated from a cross-member by means of which the crane has lifted the tower segment. To this end, carrier loops, such as steel cables which have been formed into loops, may be secured to the tower segment. The cross-member is then released from these loops, such as, for example, unhooked, and the steel cable loops per se are then manually removed from the tower segment which has been placed by the workers on the operating platform. This is also complex and involves a very high level of complexity in terms of personnel including a corresponding working platform at the height of the previously completed tower.

Very generally, reference may be made to the documents US 3,074,564 A, DE 10 2009 023 538 A1 and DE 20 2010 000 868 U1.

An object of the present invention is consequently to configure the construction of a concrete tower of a wind turbine in a more efficient manner. At least an alternative solution is intended to be proposed.

According to the invention there is proposed a heating device for heating an impact region which extends in an annular manner between a tubular tower segment with a peripheral segment wall and a tower foundation of a wind turbine when the wind turbine is constructed according to claim 1. This heating device has one or more covering tarpaulins for covering the impact region. Furthermore, it has one or more annular carrier frames for carrying the or one of the covering tarpaulins. In this instance, the one or more carrier frames is/are constructed in such a manner that there is sufficient space for at least one adult person between the impact region and the covering tarpaulin which is placed on the carrier frame.

This heating device is based on the recognition that, in order to orientate a tower segment on a tower foundation, it is possible to arrange a compensation mass which in particular at freezing temperatures, that is to say, in particular temperatures around and in particular below freezing point, hardens poorly, slowly or not at all. The erection of towers of wind turbines in cold regions and/or at cold times of year is therefore problematic and may at least lead to delays in the erection of the wind turbine tower. Taking into consideration that a corresponding crane is already required to erect the first tower segment, a delay in the construction already means an idle time of the ordered crane with the connected costs. As a result of the use of the heating device, it is consequently intended to be made possible, in spite of low ambient temperatures, for the temperature in the region in which the levelling is carried out by means of a compensation mass, to be increased at least to the extent that the hardening of the compensation mass is not or is not significantly impaired.

The heating device which is proposed for this purpose substantially makes provision for the arrangement of a heating covering around the said region which is intended to be heated. To this end, there is proposed a retention device which is leaned against the tower or secured thereto and on which a corresponding covering tarpaulin is arranged. As a result of the use of the carrier frame or the carrier frames, the covering can in principle be kept away from the location which is intended to be heated to such an extent that there is produced sufficient space for one or more persons to work. The carrier frames are constructed in an annular manner for this purpose. This annular configuration not only includes an annular form in the mathematical sense of a circle, but also polygonal constructions which are adapted to the circular shape of a wind turbine tower or tower segment.

According to the invention, there is provided for arranging at the outer side around the tower segment an outer part-covering which itself has at least one covering tarpaulin and one carrier frame. Where applicable, it may thus be sufficient to manage with only an outer part-covering device if the outside temperature is not too low and the protected position of the space in the first tower segment can ensure a sufficiently high temperature at that location. Preferably, an inner part-covering device is provided for arrangement inside the tower segment which comprises an in particular independent construction comprising the carrier frame or carrier frames and covering tarpaulin or covering tarpaulins.

Preferably, the at least one carrier frame has an upper carrier portion which extends in an annular manner for securing to the tower segment. Based on this, the carrier frame can be further constructed, in particular spacing struts can be arranged to keep away the covering tarpaulin.

A covering tarpaulin may comprise a water-impermeable material in order at the same time to also provide protection from rain. On the other hand, a covering tarpaulin is not limited to this, but instead air and/or water-permeable materials may also be considered. A high insulating property of these tarpaulins may be provided. Depending on the outside temperature, a thin tarpaulin may be sufficient and substantially prevents or at least minimises a circulation of air and in particular the escape of hot air as a result of convection.

Preferably, a heating means, in particular a fan heater, is provided. This heats the air in the space between the impact region and the covering tarpaulin and the covering tarpaulin substantially prevents the escape of the air which has been heated in this manner. It should be repeated that heating to temperatures slightly above freezing point may often be sufficient to enable the hardening of the compensation mass.

Preferably, the covering tarpaulin has a light-absorbing surface. The sunlight can thereby additionally be used for heating. Depending on the outside temperature and the solar radiation, such heating may be sufficient or in addition a heating means, such as, for example, a fan heater, is used.

The invention is explained by way of example below with reference to embodiments and with reference to the appended Figures.

Figure 1 is a perspective view of a first tower segment with a heating device,

Figure 2 shows a portion of a substructure of a heating device inside a tower segment.

Figure 2 is a perspective view of a first tower segment 200 which is placed on a foundation and around which a heating device having an outer part-covering device 202 is illustrated. This outer part-covering device 202 surrounds the impact region which consequently cannot be seen between the tower segment 200 and the foundation 204. In this instance, this outer part-covering device 202 provides around the tower segment 200 a protected space which is readily accessible in terms of height and width for adult persons. For illustration, persons are schematically indicated.

The outer part-covering device 202 is secured to an upper peripheral rail 206 on the tower segment 200 and substantially seals against the first tower segment. In this instance, such a sealing is intended to substantially prevent heat from escaping as a result of convection. Furthermore, a frame is arranged below the outer part-covering device 202 and is also connected to this peripheral upper rail and substantially determines the outer form of the outer part-covering device 202.

Figure 2 shows a portion of a carrier frame 208 of an inner part-covering device which is yet to be completed. Accordingly, Figure 15 shows the inner space of the tower segment 200. The inner carrier frame 208 also has a peripheral rail, that is to say, inner peripheral rail 210. In the illustration of Figure 15, a person is also

indicated in order to illustrate the size of the carrier frame 208 and consequently the inner part-covering device which is intended to be provided. Furthermore, the carrier frame 208 which is provided substantially to brace a covering tarpaulin is connected to the carrier frame 208 in order to retain the carrier frame 208.

MELEGÍTŐ ELRENDEZÉS

Szabadalmi igénypontok

1. Melegítő elrendezés körbefutó szegmensfallal rendelkező cső alakú toronyszegmens (200) és szélturbinatorony-alapzat (204) között gyűrű alakban terjedő illesztési tartomány melegítésére a szélturbina építésénél, amely tartalmaz

– az illesztési tartomány fedésére egy vagy több fedőponyvát, valamint

– a fedőponyva vagy a fedőponyvák egyike tartására egy vagy több gyűrű alakú tartóvázat,

ahol az illesztési tartomány és a fedőponyva között legalább egy felnőtt személy számára elégséges tér van jelen, **azzal jellemezve**, hogy tartalmaz továbbá

– a toronyszegmens (200) körül kívül történő elrendezésre külső részlegesen fedő eszközt (202),

ahol a részlegesen fedő eszköz a fedőponyvák egyikét és a tartóvázak egyikét tartalmazza.

2. Az 1. igénypont szerinti melegítő elrendezés, ahol a toronyszegmens belsejében való elrendezésre belső részlegesen fedő eszköz van biztosítva, amely a fedőponyvák egyikét és a tartóvázak egyikét tartalmazza.

3. Az 1. vagy a 2. igénypont szerinti melegítő elrendezés, **azzal jellemezve**, hogy a toronyszegmenshez való hozzáerősítésre a vagy valamennyi tartóváznak gyűrű alakban terjedő felső tartórésze van.

4. Az 1-3. igénypontok bármelyike szerinti melegítő elrendezés, amely az illesztési tartomány és a fedőponyva közötti térben lévő levegő melegítéséhez legalább egy fűtőeszközzel, különösen fűtőventillátorral rendelkezik.

5. Eljárás szélturbina tornyának felállítására, melynek lépéseiben

– alapzaton első toronyszegmenst rendezünk el, valamint

– a toronyszegmensen egy az 1-4. igénypontok bármelyike szerinti melegítő elrendezést rendezünk el, továbbá egy a toronyszegmens és a toronyalapzat közötti gyűrű alakban terjedő illesztési tartományt fedéssel látunk el.

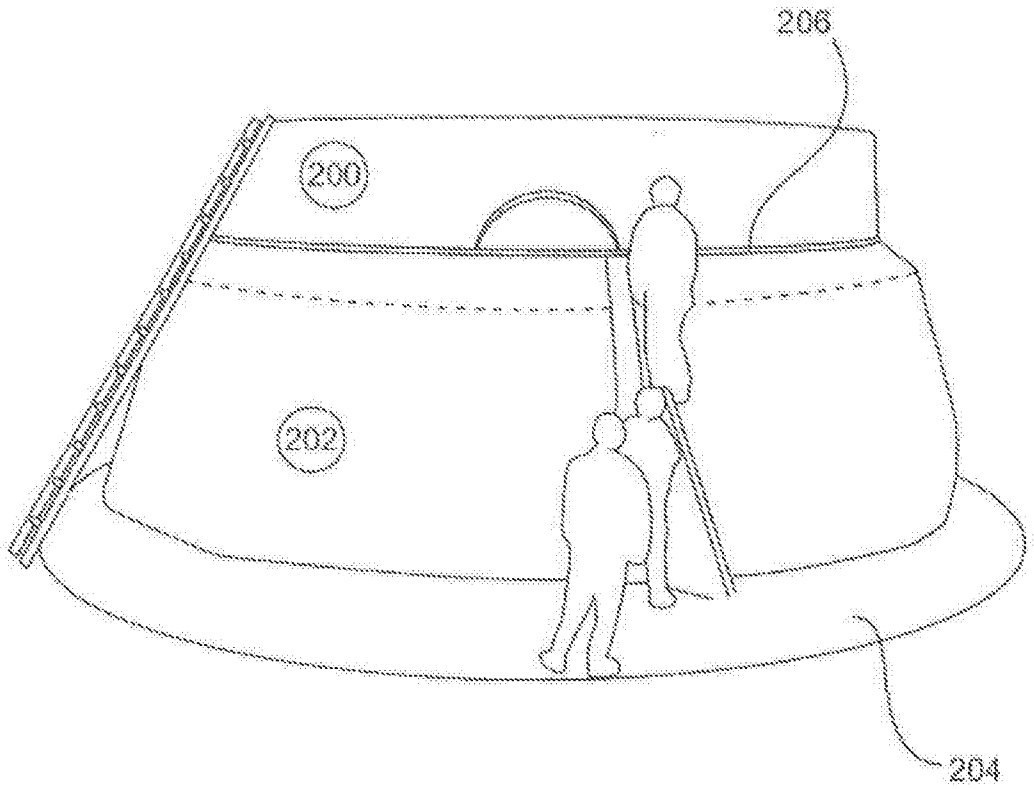

Fig. 1

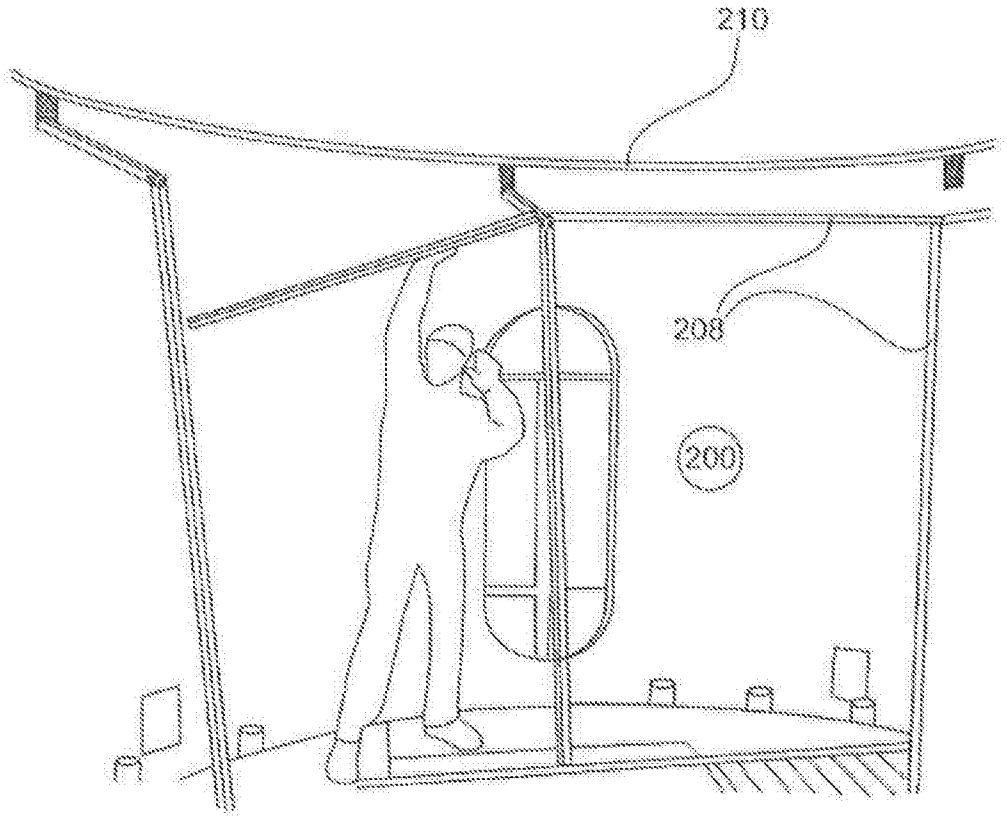

Fig. 2