US 20060000185A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2006/0000185 A1**

Wobben (43) **Pub. Date: Jan. 5, 2006**

(54) **FLANGE CONNECTION**

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(21) Appl. No.: **10/515,932**

(22) PCT Filed: **May 16, 2003**

(86) PCT No.: **PCT/EP03/05146**

(30) **Foreign Application Priority Data**

May 25, 2002 (DE)..... 102 23 429.9

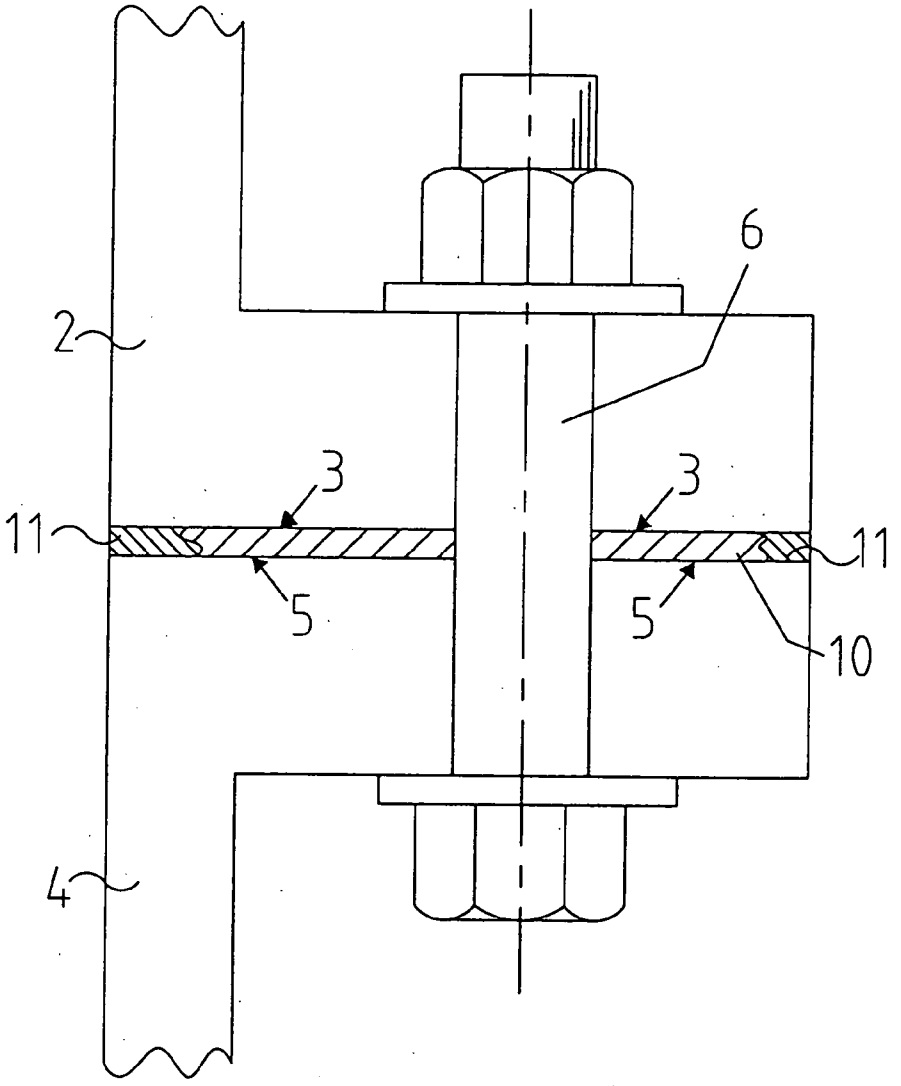
Publication Classification

(51) **Int. Cl.**
E04B 1/00 (2006.01)

(52) **U.S. Cl.** **52/745.15**

(57) **ABSTRACT**

A method of connecting two flanges, in particular such flanges which are mounted to segments (rings) of a pylon of, for example, a wind power installation and connect said segments to each other, wherein the flanges are connected together in force-locking relationship. In one aspect, the method of connecting two flanges, wherein to connect the two flanges provided in the connecting region is a layer which in a first period of time prior to the connection and in a third period of time after the connection is less deformable than in a second period of time, wherein the second period of time is between the first and third periods of time.



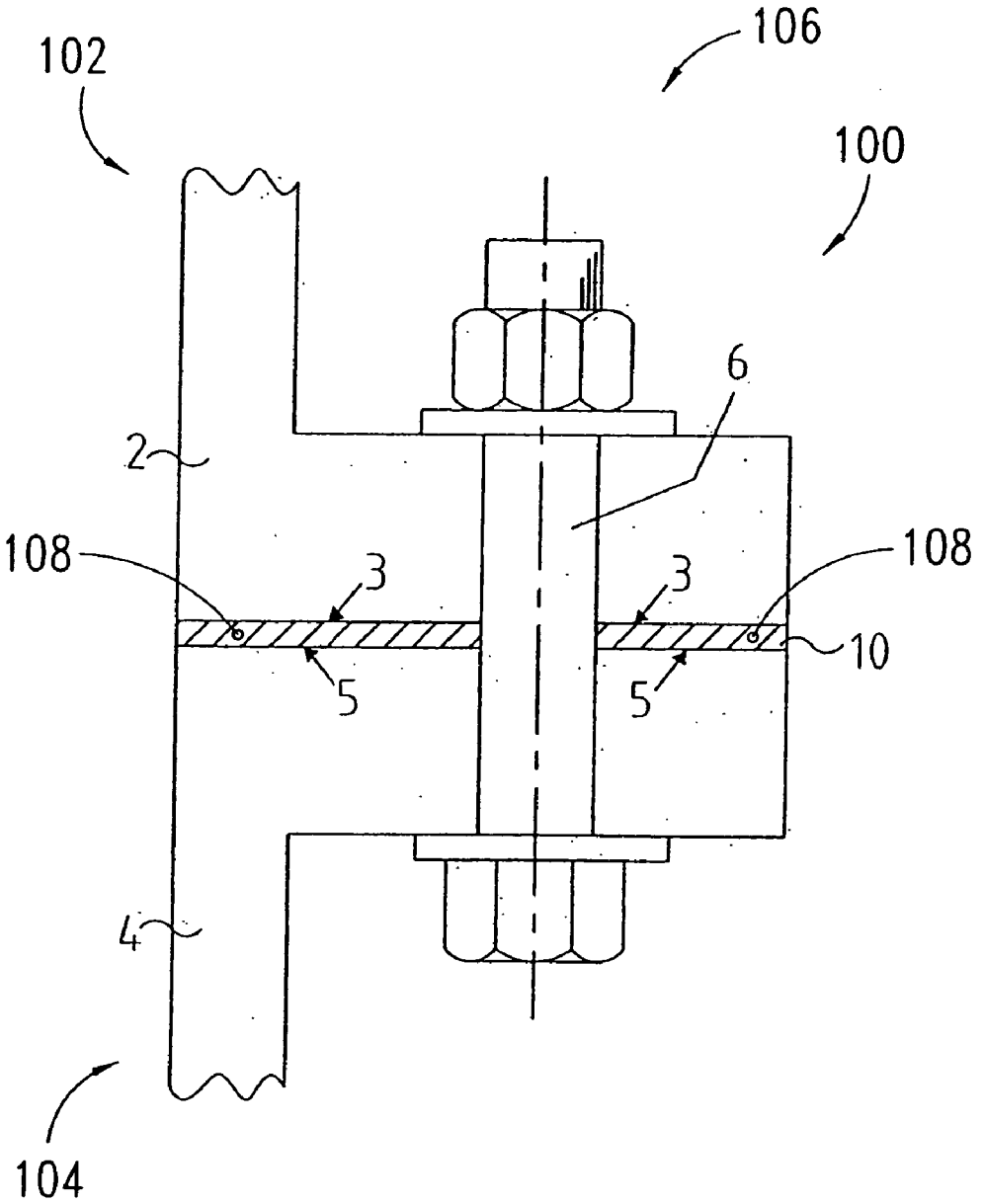


FIG. 1

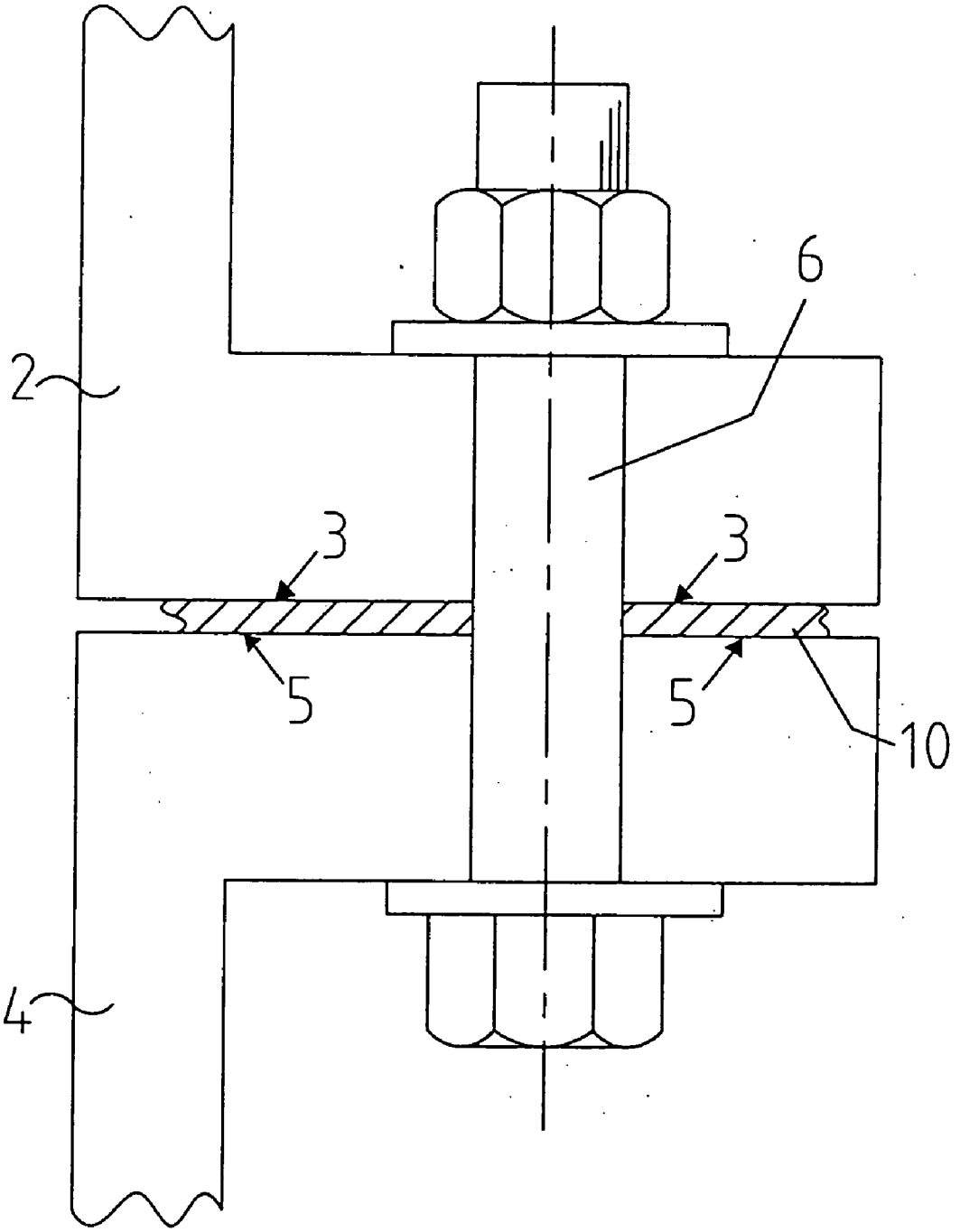


Fig. 2

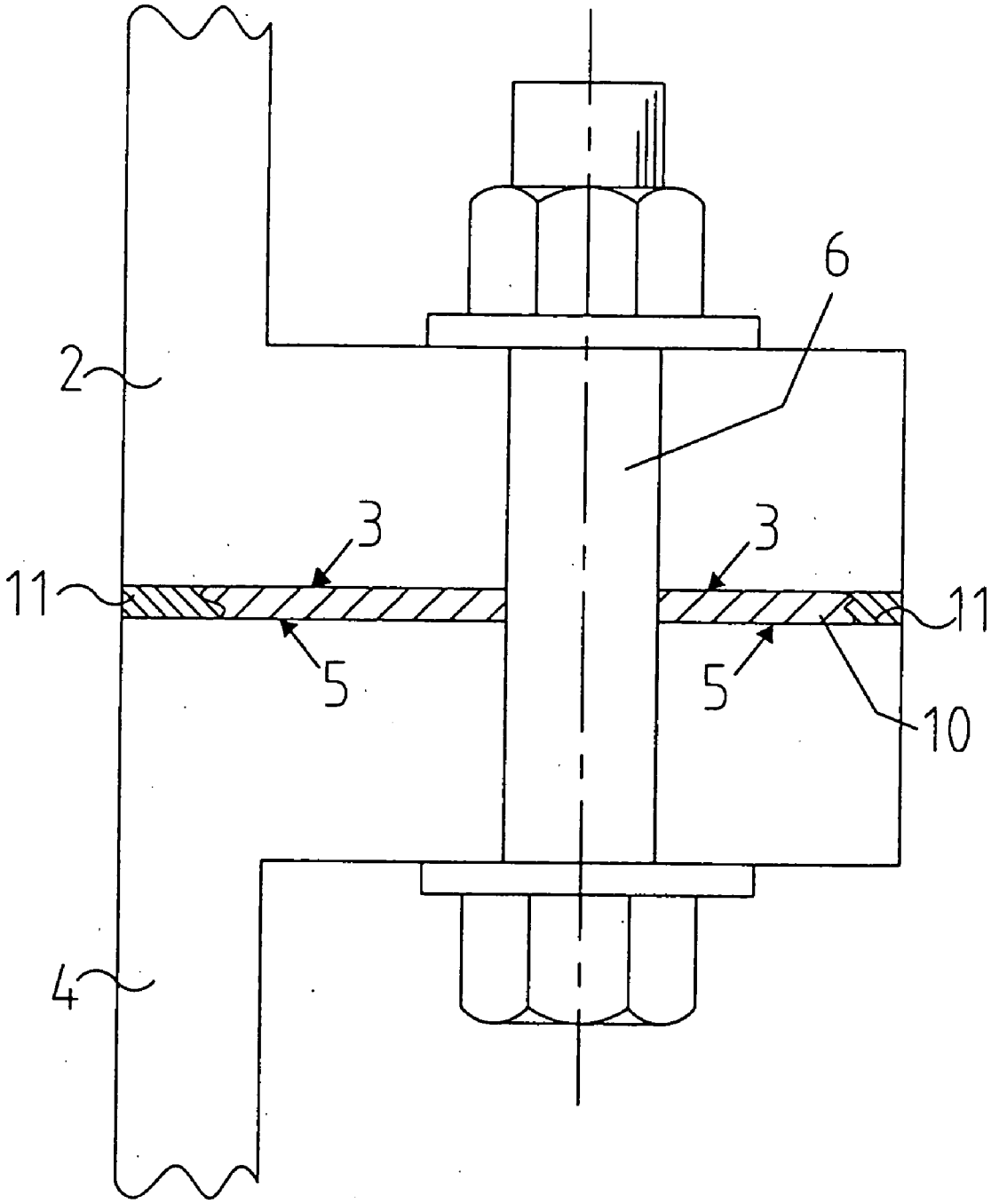
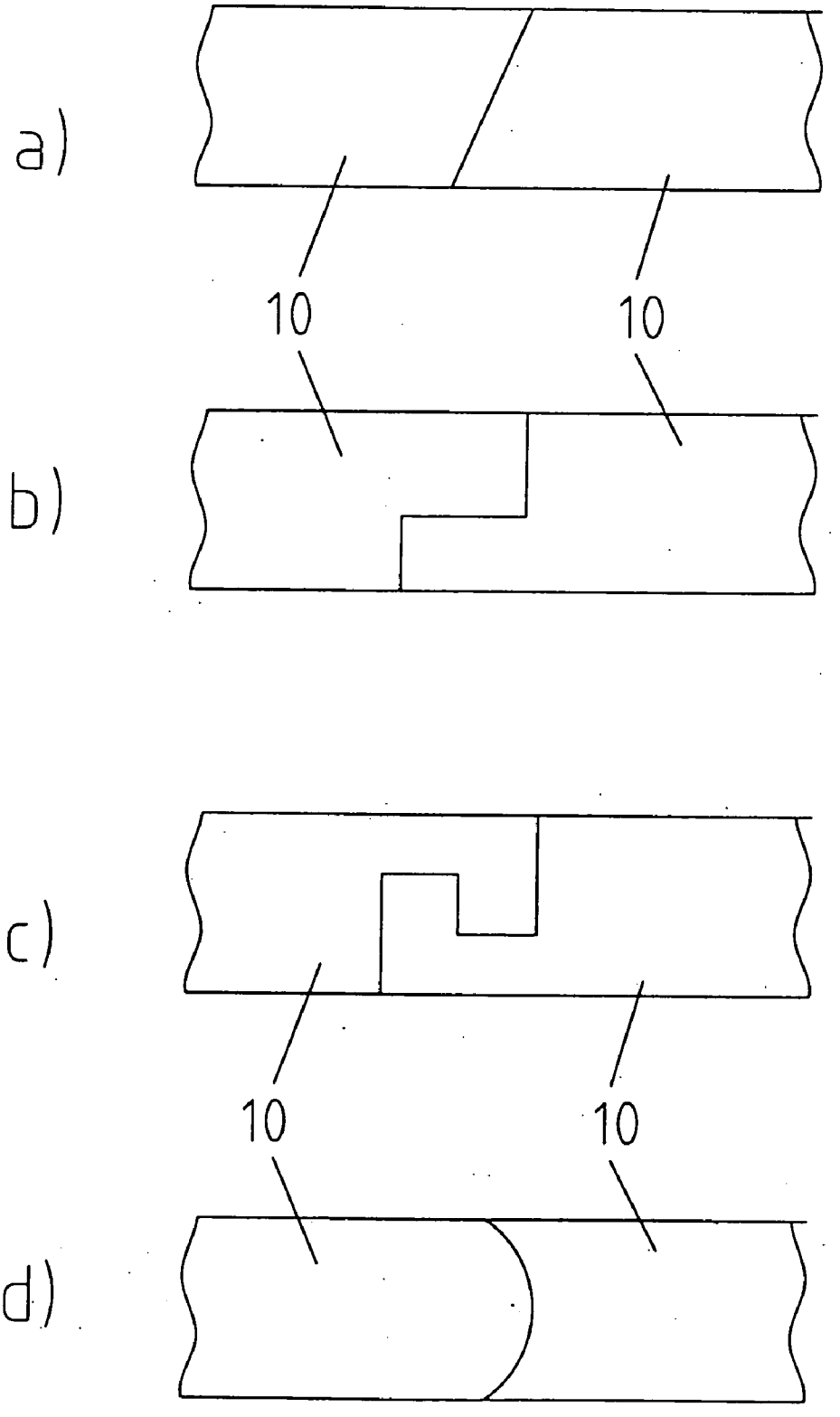


Fig. 3

Fig. 4



FLANGE CONNECTION

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention concerns a method of connecting two flanges mounted to segments (rings) of a pylon of a wind power installation together in force-locking relationship.

[0003] 2. Description of the Related Art

[0004] Flange connections have long been known in the state of the art and are universally employed. In that respect screws are frequently used as connecting means between the flanges, the screws providing a force-locking connection between the co-operating connecting portions.

[0005] In that respect the quality of such a flange connection, besides being dependent on a careful choice of material and faultless implementation of the assembly procedure, is also dependent on the surface of the abutment faces. They have to be machined in a particularly complicated and expensive fashion and precisely in order to achieve a sufficiently large and flat contact face.

[0006] In that respect in particular the expenditure involved for machining the surface is high and increases over-proportionally with an increasing size of the components to be machined.

[0007] When erecting buildings mortar is introduced between the abutment faces of the individual bricks. That mortar serves to connect the bricks together but also compensates for unevenness of the surface. It will be noted however that it has to be either produced on site or transported to the site. There it is then worked manually. In that respect working with the mortar requires a certain degree of practice in order to apply a suitable amount of mortar.

[0008] It is known from DE 100 33 845 to use a polymer instead of the mortar. That polymer is applied in a pasty phase and then, optionally after the addition of a hardener, can harden. The operation of applying the polymer is also affected manually and is thus labor-intensive. In addition the polymer also has to be prepared by the addition of hardener in a suitable amount. Here too the preparation process requires some experience.

BRIEF SUMMARY OF THE INVENTION

[0009] In one aspect an embodiment provides a flange connection and a method of making a flange connection which can be produced at a lower level of expense with the quality of the connection remaining at least the same.

[0010] In another aspect, a method of connecting pylon segments of a wind power installation at the erection site of the wind power installation comprises: providing a flange on facing sides of two pylon segments; inserting a layer between the two flanges prior to connection of the segments; coupling the flanges together; decreasing a viscosity of the layer; and adjusting the coupling of the flanges; and increasing the viscosity of the layer.

[0011] An embodiment provides that, before the flanges are placed one upon the other, a connecting layer is provided on one of the connecting flanges. That connecting layer is of a markedly lower viscosity after the flanges are connected for a time in a second period of time than in the first period of time prior to connection of the flanges and in a third period of time after connection of the flanges.

[0012] A considerable time saving can be achieved if the layer no longer has to be applied to one of the co-operating flange portions on the building site itself, but that layer is already previously applied there. In addition that layer can comprise for example thermoplastic material (plastic material). That makes it possible to already ensure a uniform quality for the layer upon the manufacture thereof under controlled conditions and in that way the danger for example of inclusions of foreign material into the layer when working with it in the open air can be reliably eliminated. In addition either that layer can be laid on the abutment face prior to transport of the individual sections of a pylon or it can be removed on the building site from a transport packaging and laid on the abutment face in such a way as to save time.

[0013] In order not to detrimentally influence the strength of the flange connection and to permit the use of identical connecting means such as for example screws of a predetermined length, the layer may be of a predetermined layer thickness of between about 0.1 mm and 20 mm, preferably between about 0.1 mm and 10 mm. Such a layer thickness is sufficient as that layer is intended to compensate for surface roughness and unevenness of the abutment faces but it is generally not intended to influence the transmission of force.

[0014] In one embodiment there are provided means for influencing the viscosity of the layer. In that way the layer can be transported to the site in a solid condition and incorporated there. In the incorporation situation the viscosity of the layer can be so changed that it is adapted to the surfaces of the abutment faces. That can be accomplished, for example, by heating wires being integrated into a thermoplastic material. As soon as the preformed layer or layers is or are incorporated, the heating wires are supplied with a current. Due to the increase in temperature the viscosity of the material falls and it is adapted to the surfaces against which it bears. As soon as the current is switched off the heating wires cool down and thus also cool the thermoplastic material and the material solidifies again.

[0015] The possibility of reducing the viscosity of the material by heating it naturally also affords advantages in terms of dismantling if for example individual sections of a pylon are to be separated from each other again. After release of the screw connections which provide the force-locking connection, the material is heated again, its viscosity falls and the pylon sections can be separated without any problem.

[0016] In one embodiment, the layer or layer segments at least on one side are coated with an adhesive. In that way the layer segments can be fixed in a predetermined position. Therefore the layer or the layer segments can already be laid on the abutment face during the production for example of a pylon section and then adhere to that abutment face so that unintentional displacement during transporting and during assembly is prevented.

[0017] Even if the layer segments are only worked on the building site, the adhesive can naturally prevent unintentional displacement. In that case the sides of the layer or layer segments, which are coated with adhesive, can be

covered with a sheet or film in order to avoid unwanted soiling of the adhesive and thus impairment of its adhesion capability.

[0018] Further advantageous embodiments of the invention are set forth in the detailed description and the appendant claims.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0019] Embodiments of the invention are described in greater detail hereinafter with reference to the Figures in which:

[0020] **FIG. 1** shows a flange connection according to an embodiment,

[0021] **FIG. 2** shows a flange connection according to an embodiment of the invention with an intermediate space between the co-operating connecting portions,

[0022] **FIG. 3** shows a flange connection according to an embodiment of the invention with a post-worked intermediate space, and

[0023] **FIG. 4** shows a plan view of a transition between two segments.

DETAILED DESCRIPTION OF THE INVENTION

[0024] **FIG. 1** shows two co-operating connecting portions **2**, **4** of a flange connection **100** of two segments **102**, **104** of a pylon structure **106**. Those co-operating connecting portions **2**, **4** are oriented towards each other with the abutment faces **3**, **5** and are connected together by a screw connection **6** to form a force-locking connection. In order to compensate for surface roughnesses and unevenness of the abutment faces **3**, **5** there is provided a layer **10** (shown enlarged in the Figure). That layer **10** is arranged between the co-operating connecting portions **2**, **4** and is at least temporarily deformable. In that way the surface structure of the co-operating connecting portions **2**, **4** at the abutment faces **3**, **5** is exactly reproduced in the layer **10** so that it is certain to involve full-area contact.

[0025] As the layer **10** comprises a pressure-resistant material the transmission of force in that flange connection can now take place over the entire abutment faces **3**, **5**. In that case, the screw connection **6** is provided to make the force-locking connection between the two co-operating connecting portions **2**, **4**. The layer **10** does not generally serve to make that force-locking connection but serves to compensate for surface irregularities.

[0026] The layer **10** can be a pre-shaped, segmented or one-piece layer, for example comprising a thermoplastic material with incorporated heating wires **108**. After joining of the adjacent segments the thermoplastic material can be heated and thus made deformable. As a result it adapts itself to the surfaces of the flanges and retains that form after cooling, in which case it returns to its predetermined stiffness.

[0027] **FIG. 2** shows a flange connection according to an embodiment of the invention in which the layer **10** does not completely fill up the intermediate space between the co-operating connecting portions **2**, **4**. In a use in relation to pylons, for example for wind power installations however, moisture can penetrate into the open intermediate space and cause damage there. As however it is precisely in the case of pylons for wind power installations that such flange connections have to transmit high levels of load, it is important for that flange connection to be protected from that.

[0028] **FIG. 3** shows that for example in the course of a post-working operation a filling material **11** is incorporated into those remaining intermediate spaces. That filling material **11** can be for example silicone which is used for filling up the intermediate spaces. In that way no moisture (and also no foreign bodies) can penetrate thereinto and the flange connection is thus protected therefrom.

[0029] **FIG. 4** shows a plan view of a transition between two segments in a number of examples. In example a) the transition between the two layer segments **10** illustrated is a rectilinear transition. In example b) the transition is stepped. The layer segments can be securely positioned in a simple fashion by virtue of that configuration. In example c) the layer segments **10** engage hook-like into each other so that the segments are also prevented from unintentionally slipping out of each other. In the embodiment d) the transition between two layer segments is of an arcuate configuration. That permits correction of the segment orientation in a particularly simple manner without in that case giving rise to unwanted spacings and thus air inclusions in the layer. Therefore, particularly with transitions as shown in example d), with a predetermined, relatively small length in respect of each individual layer segment, with a standardized layer segment, it would be possible to produce a layer according to the invention on abutment faces involving different radii.

[0030] Electrical contacts can be provided at the mutually facing ends of the layer segments **10**, which contacts connect together heating wires which are incorporated into the layer segments **10** (See heating wires **108** illustrated in **FIG. 1**). In that way the operation of arranging the layer can be simplified and speeded up.

[0031] Based on the foregoing benefits of the present invention, it can be appreciated that the present invention is not limited to pylons for wind turbines.

[0032] From the foregoing it will be appreciated that, although specific embodiments of the invention have been described herein for purposes of illustration, various modifications may be made without deviating from the spirit and scope of the invention.

1. A method of connecting pylon segments of a wind power installation at an erection site of the wind power installation, wherein two pylon segments are provided at their facing sides with a flange, wherein provided between the two flanges is a layer which in a first period of time prior to the connection and in a third period of time after the connection is less deformable than in a second period of time, wherein the second period of time is between the first and third periods of time and wherein during the second period of time the viscosity of the layer is reduced and the flanges are already connected together in force-locking relationship during the first period of time by a screw connection and the layer is either applied there prior to the transport of a segment or at the erection site it is removed from a transport packaging and laid on to an abutment face of a flange.

2. A method as set forth in claim 1 wherein the layer thickness is approximately in a range of between 0.1 mm and 20 mm.

3. A method as set forth in claim 1 wherein the layer is applied prior to the connection at one side to a co-operating connecting portion of the flange connection.

4. A method as set forth in claim 1 wherein electric lines are laid within the layer and the viscosity of the layer is decreased after the operation of connecting the flanges by means of a flow of current in the electric lines.

5. A method according to claim 1 wherein a transmission of force between the two flanges is substantially not influenced by the layer.

6. A method as set forth in claim 1 wherein the layer comprises a thermoplastic material.

7. A method of connecting two pylon segments comprising:

applying a layer to a flange of a first pylon segment;

increasing a deformability of the layer; and

coupling the flange of the first pylon segment to a flange of a second pylon segment.

8. The method of claim 7 wherein increasing a deformability of the layer comprises applying an electrical current to a conductor in the layer.

9. The method of claim 7 wherein the layer comprises a thermoplastic material.

10. The method of claim 7 wherein a thickness of the layer is approximately 0.1 mm to 20 mm.

11. The method of claim 7, further comprising:

decreasing the deformability of the layer after coupling the flange of the first pylon segment to the flange of the second pylon segment.

12. A pylon segment, comprising:

a flange to couple the pylon segment to another pylon segment;

a layer adhered to the flange; and

means for adjusting a deformability of the layer.

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