(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 754 783 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
16.07.2014 Bulletin 2014/29

(51) Int Cl.:
E04H 12/08 *(2006.01)* ***E04H 12/34*** *(2006.01)*
B25B 5/14 *(2006.01)*

(21) Application number: **13151024.0**

(22) Date of filing: **11.01.2013**

(84) Designated Contracting States:
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
Designated Extension States:
BA ME

(71) Applicant: **Areva Wind GmbH**
27572 Bremerhaven (DE)

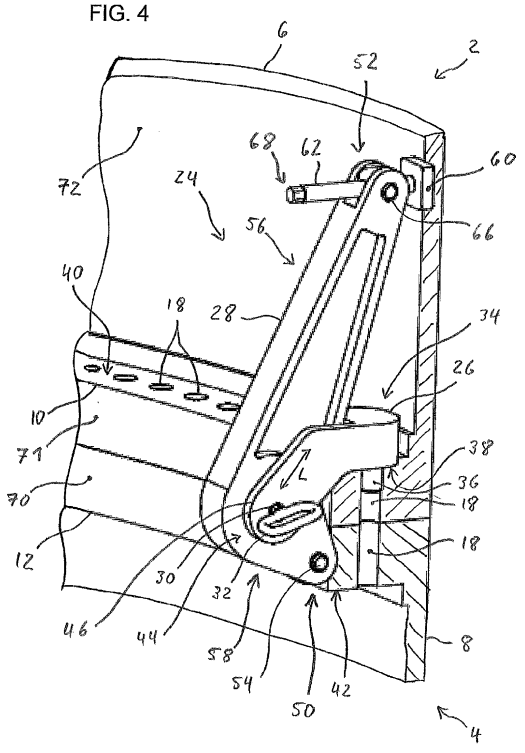
(72) Inventor: **Kramer, Thomas**
26919 Brake (DE)

(74) Representative: **Prinz & Partner**
Esplanade 31
20354 Hamburg (DE)

(54) A tool and a method for aligning a pair of flanges of a supporting structure of a wind generator

(57) A tool (24) and a method for aligning a pair of adjacent flanges (10,12) of adjacent segments of a supporting structure of a wind generator are provided. The tool (24) comprises a pulling member (26) having a first end (34) comprising a substantially flat contact surface (38) and a spigot (36) which projects from the contact surface (38) so as to engage a mounting aperture (18) of a first flange (71) of a pair of flanges (70,71) of adjacent segments (2,4) of the supporting structure. Furthermore, the tool (24) comprises a lever (28) which is pivotably coupled to the pulling member (26) at a joint (30) which is arranged at a second end (44) of the pulling member. The lever (28) comprises a first arm (56) and a second arm (58) having a first length and a second length, wherein the first length is greater than the second length. The lever (28) and the pulling member (26) are configured to define a distance between the contact surface (38) of the pulling member (26) and the second end (50) of the lever (28), when the spigot (36) resides in the mounting aperture (18) of the first flange (71). Said distance is arranged in that the second end (50) of the lever (28) contacts an inner surface of a second flange (70) of the pair of flanges (70,71).

FIG. 4



EP 2 754 783 A1

Description

FIELD OF THE INVENTION

[0001] The invention relates to a tool and to a method for aligning a pair of adjacent flanges of adjacent segments of a supporting structure of a wind generator.

BACKGROUND

[0002] A wind generator, which is also known as a wind turbine or a wind driven power plant, typically comprises a supporting structure having a plurality of vertical segments. A widespread type of supporting structure is a tower having vertically stacked annular tower segments which have a slightly conical shape. An annular flange is arranged at the upper and lower end of this tower segments. The flanges comprise a plurality of mounting apertures or through holes for receiving threaded fasteners or bolts for fixing adjacent tower segments with respect to each other. The tower segments are transported and handled separately to be fixed on each other at the tower erection site.

[0003] Ideally, the tower segments and their flanges are perfectly round or at least have a common shape to facilitate mating with each other. However, product spread and mechanical impact during transport and handling may lead to a deformation of the flanges which may be slightly ovalized. During assembly of the supporting structure of the wind generator, a mismatch between the flanges can prevent fasteners from being passed through the corresponding mounting apertures in adjacent flanges.

[0004] A common approach for aligning the adjacent flanges is to urge a conical bolt through the corresponding mounting apertures. However, this is a rather rough method and there may be a risk for damage of the anti-corrosion protection of the flanges.

[0005] Document DK 177 198 B1 discloses a tool for correcting ovality of flanges. Adjacent flanges are urged to perform a slight movement with respect to each other so as to align the corresponding mounting apertures. The tool is fixed on one of the tower segment flanges. A screw is applied for displacement of the opposite flange. However, a maximum force, which is available for displacement of the flanges, is limited since the generation of this force is merely due to a rotation of the screw in a corresponding threaded member.

SUMMARY

[0006] It is an object of the invention to provide an improved tool and an improved method for aligning adjacent flanges of a supporting structure of a wind generator.

[0007] In one aspect of the invention, a tool for aligning a pair of adjacent flanges of adjacent segments of a supporting structure of a wind generator is provided. The adjacent segments are configured to be mounted on each other by connecting the pair of flanges. The tool comprises a pulling member and a lever. The pulling member comprises a first end having a contact surface for contacting a flange surface of a first flange of the pair of flanges. The contact surface may be a substantially flat surface. This flange surface is averted from the contact surface which contacts an opposite contact surface of the adjacent segment, when the two segments are connected to each other. The pulling member further comprises a spigot which projects from the contact surface in a substantially perpendicular direction. The spigot is configured to engage a mounting aperture of the first flange. The lever and the pulling member are pivotably coupled at a joint which is arranged at a second end of the pulling member. Furthermore, the lever comprises a first arm and a second arm, wherein the two arms project in different directions from the joint. The first arm comprises a first end of the lever and the second arm comprises a second end of the lever. A first length of the first arm is a distance between the joint and the first end. This first length is greater than a second length of the second arm, which is a distance between the joint and the second end. The lever and the pulling member are configured to define a distance between the contact surface of the pulling member and the second end of the lever. This distance is considered when the spigot resides in the mounting aperture of the first flange. Furthermore, the distance is arranged in that the second end of the lever contacts an inner surface of a second flange of the pair of flanges.

[0008] Advantageously, the tool for aligning the pair of adjacent flanges according to aspects of the invention utilizes a lever action. A high force may be applied on the inner surface of the second flange, wherein this high force is generated by a comparably low driving force which is applied on the first end of the lever. In particular, the first length of the first arm is greater than the second length of the second arm, for example by a factor of two or greater. The length of the first and second arm may be arranged in that a desired force for displacement of the second flange may be provided at the second end of the lever using a predetermined force for displacement of the first end of the lever.

[0009] In another advantageous aspect of the invention, the pulling member is releasably coupled to the lever. According to an advantageous embodiment of the invention, the tool comprises at least one further pulling member for replacement of the (initially installed) pulling member. The further pulling member may be different when compared to the initially installed pulling member with respect to a load baring capability and / or with respect to a diameter of the spigot. According to another advantageous embodiment of the invention, the further pulling member is configured to define a further distance between the contact surface of the further pulling member and the second end of the lever, when the spigot resides in a mounting aperture of a first flange of a further pair of flanges.

[0010] This further pair of flanges may be of a different

type when compared to the type of the initial pair of flanges. For example, a first type of flanges has a different diameter in comparison to a second type of flanges. Furthermore, the flanges of the first type may have a greater thickness, which is considered in a direction of a length extension of the segment comprising the respective flange. The different thickness of the flanges may be due to a different load bearing capability of the segments and the flanges, respectively. The further distance, which is defined by the further pulling member, may be arranged in that the second end of the lever contacts the inner surface of a second flange of this further pair of flanges. For example, when a thickness of the second type of flanges is greater than a thickness of the first type of flanges, the further pulling member, which is adapted to the second type of flanges, is configured in that said further distance is greater than the distance which is defined by the initially installed pulling member.

[0011] Segments of a supporting structure which are arranged near to the foot of the supporting structure typically have a higher load baring capability. For example, when the supporting structure is a tower, the lower tower segments have a larger diameter when compared to higher tower segments which are arranged near the nacelle of the wind generator. Segments of different type are for example different with respect to their mechanical construction and with respect to their load baring capability. For connection of segments having a high load bearing capability, bolts of greater diameter are applied, when compared to the bolts which are applied for fixing segment having a lower load bearing capability. Accordingly, a diameter of the mounting apertures is different for different types of flanges. The pulling member, in particular the spigot, is adapted to fit in these different diameters. Since the pulling member of the tool is exchangeable, a variety of different pulling members which are adapted to different mounting aperture diameters may be provided. The tool comprises a single lever and a plurality of different pulling members. During erection of the supporting structure, advantageously, a single tool will be sufficient so as to conduct all the assembly works with respect to the alignment of the flanges.

[0012] According to another advantageous aspect of the invention, the pulling member is a forked member having a first leg and a second leg defining a clearance between the first leg and the second leg. The lever is coupled to the first leg and to the second leg of the pulling member by releasable axle which projects substantially perpendicular to a length extension of the legs. According to another advantageous embodiment of the invention, the first leg and the second leg of the pulling member each form a substantially identical angle with the contact surface. This angle is considered between a length extension of the legs and a plane which is defined by the substantially flat contact surface. In particular, the length extension of the legs is an extension of a segment of the legs comprising the joint with the axle projecting substantially perpendicular to this length extension. The legs of the pulling member may be bent towards the second flange; this is considered when the tool is mounted on the first flange. Furthermore, for a tool comprising more than one pulling member, the angle between the legs and the contact surface may be different for the variety of different pulling members. The angle may be selected according to the type of flange, to which the pulling member is adapted. If the pulling member is adapted for displacement of thick flanges having a high load bearing capability, the angle is selected to be smaller.

[0013] In another advantageous embodiment of the invention, an angle between the first length of the first arm and the second length of the second arm is between 50° and 80°, furthermore, the angle may be between 60° and 70°. These intervals revealed to be advantageous due to consideration of the mechanics of the tool and turned out to be advantageous in practical experiments.

[0014] According to another embodiment of the invention, a roll is mounted on the second end of the lever. The roll is configured to contact an inner surface of the second flange when the spigot resides in the mounting aperture of the first flange. When the lever of the tool is rotated with respect to the pulling member, which is mounted on the first flange, there is a vertical displacement of the second end with respect to the inner surface of the second flange. The roll prevents this inner surface from being scratched due to this movement of the second end and a risk for damage of the anti-corrosion protection is minimized.

[0015] In another advantageous aspect of the invention, a driving element is mounted on the first end of the lever. The driving element may be configured to drive or displace the lever with respect to the pulling member. According to an advantageous embodiment of the invention, the driving element comprises a contact pad which is configured to contact an inner surface of the first segment comprising the first flange. This is considered when the spigot resides in a mounting aperture of the first flange. The driving element may further comprise an actuation member for varying a distance between the contact pad and the first end of the lever. According to an advantageous embodiment of the invention, the actuation member is a spindle or a geared rod. Advantageously, for example a cordless screw driver may be applied for driving the actuation member. No hydraulics or other mechanical gear which always demands for a suitable infrastructure, for example electricity or a pressurized oil or air supply, is necessary.

[0016] In an advantageous embodiment of the invention, the tool including the pulling member and the lever is manufactured from steel or from high load aluminum alloy.

[0017] According to another advantageous aspect of the invention, a method for aligning a pair of adjacent sections of a supporting structure of a wind generator is provided. Advantageously, this method is applicable during assembly or erection of the supporting structure. The supporting structure comprises at least a first segment

having a first flange and a second segment having a second flange, wherein both, the first and the second flange comprise a plurality of mounting apertures.

[0018] The mounting apertures of the first flange and the second flange are aligned with respect to each other at a first lateral side of the supporting structure. A first set of fasteners is installed in corresponding mounting apertures of the first flange and the second flange for connecting the first flange with the second flange. Furthermore, a tool according to aspects of the invention is positioned on the first flange. The tool is arranged in that the spigot engages a mounting aperture of the first flange, wherein said mounting aperture is arranged at a second lateral side of the supporting structure. In particular, this second lateral side may be arranged opposite to the first lateral side of the supporting structure. The first end of the lever is displaced towards an interior of the supporting structure so as to generate a force which is applied to an inner surface of the second flange via the second end of the lever. Said force urges the second flange outwards, i.e. away from the first lateral side of the supporting structure. At a same time, the first flange is urged inwards, i. e. towards an interior of the supporting structure, in particular towards the first lateral side of the supporting structure. This displacement of the flanges is performed so as to align corresponding mounting apertures in the first flange and in the second flange.

[0019] According to an advantageous embodiment of the invention, a tool comprising a driving element having an actuation member, which may be a spindle or a geared rod, is positioned on the first flange. For displacement of the first end of the lever, the contact pad is arranged on the inner surface of the first segment of the supporting structure. The actuation member is swiveled using the actuation member of the driving element. A spreading force between the first end of the lever and the inner surface of the first segment is generated. The contact pad presses against the inner surface of the first segment and drives this first end of the lever in a direction towards an interior of the supporting structure.

[0020] Same or similar advantages which have been already mentioned with respect to the tool according to aspects of the invention apply to the method according to aspects of the invention in a same or similar way and are therefore not repeated.

BRIEF DESCRIPTION OF DRAWINGS

[0021] Further aspects and characteristics of the invention ensue from the following description of the preferred embodiments of the invention with reference to the accompanying drawings, wherein

FIG. 1 is a simplified perspective view showing a detail of a pair of adjacent segments of a supporting structure of a wind generator,

FIG. 2 is a simplified perspective view showing a pair of flanges, wherein one flange has an ovality condition,

FIG. 3 is a simplified perspective view showing a tool for aligning a pair of flanges of adjacent segments of a supporting structure of a wind generator, according to an embodiment of the invention,

FIG. 4 is a simplified perspective view showing a detail of adjacent segments of a supporting structure of a wind generator, wherein a tool according to an embodiment of the invention is mounted on one of the flanges and

FIG. 5 shows a simplified side view of a tool according to an embodiment of the invention which is mounted on a flange of a pair of flanges of adjacent segments which are shown in a simplified cross-sectional view.

DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

[0022] FIG. 1 is a simplified perspective view showing a first segment 2 and a second segment 4 of a supporting structure of a wind generator. By way of an example only, the segments 2, 4 are annular tower segments and reference is made to a wind generator having a tower as a supporting structure.

[0023] In the embodiment of FIG. 1, the first segment 2 comprises a first wall 6; the second segment 4 comprises a second wall 8. The walls 6, 8 may be manufactured using a steel sheet which is welded together so as to form a slightly conical segment 2, 4. A first flange 10 is welded on the first segment 2 and a second flange 12 is welded on the second segment 4. During assembly of the supporting structure, the pair of flanges 10, 12 is arranged in that a first contact surface 14 of the first segment 2 and a second contact surface 16 of the second segment 4 contact each other. Bolts may be inserted in corresponding mounting apertures 18 (FIG. 2) of the flanges 10, 12 so as to fix the first segment 2 on the second segment 4.

[0024] However, due to inevitable manufacturing spread and mechanical impact during transportation and handling of the segments 2, 4, their flanges 10, 12 are likely to have an ovality condition. This is illustrated in the simplified perspective view of FIG. 2. By way of an example only, the first flange 10 has the ovality condition. The two flanges 10, 12 are aligned and connected on a first lateral side 20 of the supporting structure. Due to the ovality of the first flange 10, there is a misalignment of the mounting apertures 18 on a second and opposite lateral side 22 of the supporting structure. In FIG. 2, this misalignment is greatly exaggerated. In practice, the misfits between the mounting apertures 18 are in a range of a few millimeters or centimeters.

[0025] For correcting this misalignment, in particular

for correcting the ovality of adjacent flanges 10, 12 of a supporting structure of a wind generator, a tool 24 is provided, which is shown in the simplified perspective view of FIG. 3.

[0026] The tool 24 according to an embodiment of the invention comprises a pulling member 26 and a lever 28. The pulling member 26 and the lever 28 are pivotably coupled at a joint 30, for example using a suitable bolt. The pulling member 26 may be exchanged by removing the bolt which is provided with a handle 32 so as to facilitate the removal. A first end 34 of the pulling member 26 comprises a spigot 36 that projects in a direction which is substantially perpendicular to a plane which is defined by a substantially flat contact surface 38. The spigot 36 is configured to engage a mounting aperture 18 of either the first flange 10 or the second flange 12.

[0027] The pulling member 26 according to the embodiment of FIG. 3 is a forked member comprising a first leg 46 and a second leg 48. The legs 46, 48 are arranged at a second end 44 of the pulling member 26. The legs 46, 48 define a clearance for accommodating the lever 28. The joint 30 between the pulling member 26 and the lever 28 is provided by an axle, i.e. a bolt, extending substantially perpendicular to a length extension L of the first leg 46 and the second leg 48. The legs 46, 48 may be L-shaped members. In other words, the legs 46, 48 form an angle with the contact surface 38. In particular, this angle is considered between the length extension L of the legs 46, 48 and the plane which is defined by the contact surface 38.

[0028] The pulling member 26 and the lever 28 may be manufactured from steel or from a high strength aluminum alloy.

[0029] At a first end 52 of the lever 28, there is a driving element which is configured for displacement of the lever 28 with respect to the pulling member 26 and with respect to the first or second flange 10, 12, when the tool 24 is mounted. An opposite second end 50 of the lever 28 may be configured to hold a roll 49. This roll 49 may be coupled to the second end 50 via a second axle 54, for example a bolt. The lever 28 comprises a first arm 56 and a second arm 58. The first end 52 of the lever 28 is arranged on the first arm 56; the second end 50 of the lever 28 is arranged on the second arm 58. The arms 56, 58 of the lever 28 project in different directions. According to a further embodiment of the invention, the roll 49 may be replaced by a pad.

[0030] The driving element comprises a contact pad 60 which is configured to contact an inner surface of the first segment 2. Furthermore, the driving element comprises an actuation member 62, for example a spindle, a geared rod, a hydraulic or pneumatic actuator, in particular a hydraulic or pneumatic impression cylinder, or any other suitable device. The actuation member 62 is screwed in a sleeve 64 which is pivotably coupled to the first end 52 via a first axle 66. The sleeve 64 is provided with an internal thread engaging an external thread of the actuation member 62. When the actuation member 62 is rotated in the sleeve 64, a distance between the contact pad 60 and the first end 52 of the lever 28 may be varied. The actuation member 62 may be rotated for example using a cordless screw driver. A rear end 68 of the actuation member 62 may be configured similar to a hexagon screw head. This head is configured to engage a hexagon socket which may be mounted on the cordless screw driver.

[0031] The surface of the contact pad 60 may be dimensioned to transmit the desired force to the second flange 12 without taking a risk for deformation of the wall 6 of the tower. In other words a deforming strain (P=F/S) for the tower wall 6 should not be reached at the contact pad 60. The calculation of this critical strain value is at the reach of the man skilled in the art.

[0032] For alignment of the pair of adjacent flanges 10, 12, the tool 24 is configured in that the spigot 36 engages a mounting aperture 18 of either the first flange 10 or the second flange 12. When the first flange 10 projects outwardly with respect to the second flange 12, this situation is illustrated in FIG. 2, the tool 24 is mounted on the first flange 10 and the contact surface 38 of the pulling member 26 directly contacts the first inner surface 40 of the first flange 10. An opposite ovality condition, i. e. when the second flange 12 projects outwardly with respect to the first flange 10, is corrected by mounting the tool 24 in opposite orientation. The tool 24 is rotated upside down with respect to the position which is shown in FIG. 3, and is subsequently mounted on the second flange 12. In this orientation of the tool 24, the spigot 36 engages one of the mounting apertures 18 of the second flange 12 from a lower side of this flange. The contact surface 38 of the pulling member 26 directly contacts the second flange surface 42 of the second flange 12. The second end 50 of the lever 28 engages an inner surface 71 of the first flange 10.

[0033] Misalignment correction is similar in both situations despite of the tool 24 is mounted either on the first flange 10 or on the second flange 12. When the tool 24 is mounted on the first flange 10, the second flange 12 is urged outwardly while the first flange 10 is pulled inwardly. Vice versa, for correcting an opposite misalignment of the two flanges 10, 12, the tool 24 is mounted on the second flange 12 and the first flange 10 is urged outwardly while the second flange 12 is pulled inwardly. For clarity reasons only, reference is made to a correction of the misalignment situation shown in FIG. 2.

[0034] For correction of this misalignment situation (see FIG. 2), a force is applied on the inner surface 70 of the second flange 12 via the second end 50 of the lever 28. FIG. 4 is a simplified perspective view showing the tool 24 which is mounted on the first flange 10. However, alignment of the flanges 10, 12 has been already performed. Correction of the misalignment commences by varying a distance between the inner surface 72 of the first wall 6 and the first end 52 of the lever 28. This distance may be increased or decreased by a rotation of the actuation member 62. For correction of the misalign-

ment situation which is shown in FIG. 2, the contact pad 60 presses against the inner surface 72 and moves the first end 52 in a direction towards an interior of the supporting structure. In other words, the first end 52 is moved inwards. A spreading force between the inner surface 72 and the first end 52 of the lever 28 is generated. The displacement of the first end 52 generates a lever action of the lever 28 and a force for displacement of the flanges 10, 12 is provided at the second end 50 of the lever 28 and at the pulling member 26. The second end 50 applies a force to the inner surface 70 of the second flange 12. This force urges the second flange 12 outwardly. The puling member 26, in particular the spigot 36 couples a force to the first flange 10. This force is directed inwardly. The terms inwardly and outwardly are considered with respect to the interior of the two flanges 10, 12. While the first end 52 of the lever 28 is displaced towards an interior of the flanges 10, 12, in particular towards a center of the pair of flanges 10, 12, the second end 50 of the lever 28 is displaced in opposite direction, which means the second flange 12 is urged towards and exterior of the flanges 10, 12. At the same time, the pulling member 26 urges the first flange 10 towards the interior of the flanges 10, 12.

[0035] For correction of the ovality condition between the adjacent flanges 10, 12, firstly, a first set of fasteners is mounted in corresponding mounting apertures 18 of the first flange 10 and the second flange 12 at a first lateral side 20 (FIG. 2). Secondly, the tool 24 is mounted and a correction of the misalignment between the flanges 10,12 is performed. When the adjacent flanges 10, 12 are aligned with respect to each other, bolts for fixing the two flanges 10, 12 may be inserted in corresponding mounting apertures 18 on the second lateral side 22.

[0036] FIG. 5 is a simplified side view showing the tool 24, which is mounted on the first flange 10. By way of an example only, the supporting structure is a tower having a diameter of 6 m. The tower segments 2, 4 are shown in a simplified cross-sectional view. A size and a dimensioning of the tool 24 depend on the size and type of the tower segments 2, 4 and their flanges 10, 12 which have to be aligned using the tool 24. In particular, the pulling member 26 may be tailored to the specific type and size of the flanges 10, 12. A load baring capability and a diameter of the spigot 36 of the pulling member 26 may be tailored to the specific requirements of the flanges 10, 12.

[0037] For example, a diameter of a tower segment 2, 4, which is arranged near the foot of the supporting structure, has a greater diameter when compared to a tower segment 2, 4 at the top of the supporting structure, near the nacelle. Larger bolts will be applied for connecting these tower segments 2, 4 near the foot of the tower. The bolts have a high load bearing capability in comparison to the bolts which are applied for connecting upper tower segments. In other words, a different type of segments is applied near the foot of the supporting structure when compared to the top of the tower. The mounting apertures 18 in the flanges 10, 12 of different types of segments 2, 4 will have a different diameter so as to accommodate either large bolts having a high load baring capability or smaller bolts having a comparably lower load baring capability. Furthermore, a thickness D of the flanges 10, 12 may vary according to the load bearing capability requirements. A higher thickness D may be found at flanges 10, 12 near the foot of the tower. For clarity reasons, in FIG. 5, a thickness D is illustrated for the first flange 10 only. The second flange 12 may have a similar thickness.

[0038] The lever 28 and the pulling member 26 are configured to define a distance LX between the contact surface 38 of the pulling member 26 and the second end 50 of the lever 28. In particular, this distance LX may be determined between the contact surface 38 and the second axle 54 holding the roll 49. Said distance LX may be adapted to the thickness D of the first and second flange 10, 12. Because this thickness D varies for different types of tower segments, in particular the pulling member 26 may be adapted in that it is safeguarded that the second end 50 of the lever 28 engages approximately the center of the inner surface 70 of the second flange 12.

[0039] According to an embodiment of the invention, the tool 24 may be configured to have a single lever 28 and a plurality of different pulling members 26, wherein each pulling member 26 is adapted to a specific type of flange 10, 12. The different pulling members 26 may be configured to defining different distances LX and furthermore, the spigot 36 of the pulling members 26 may be adapted to have a suitable diameter which fits in the corresponding mounting apertures 18 of the flange 10, 12 of that particular type of tower segment 2, 4 for which the pulling member 26 is designed.

[0040] The lever 28 of the tool 24 comprises a first arm 56 having a first length L1 which is greater than a second length L2 of the second arm 58. The first length L1 is a distance between the joint 30 and the first end 52. A second length L2 is a distance between the joint 30 and the second end 50. In particular, the first length L1 may be considered between the center of the first axle 66 (holding the sleeve 64) at the first end 52 and the joint 30. The second length L2 may be considered between a center of the second axle 54 (holding the roll 49) and the joint 30.

[0041] Furthermore, there is an angle α between the first arm 56 and the second arm 58 and this angle α is considered between the first length L1 and the second length L2. According to the particular embodiment of FIG. 5, the angle α is 66,8°. Preferable ranges for the angle α are between 50° and 80° and between 60° and 70°.

[0042] Although the invention has been described hereinabove with reference to specific embodiments, it is not limited to these embodiments and no doubt further alternatives will occur to the skilled person that lie within the scope of the invention as claimed.

Claims

1. A tool for aligning a pair of adjacent flanges of adja-

cent segments of a supporting structure of a wind generator, wherein the adjacent segments are configured to be mounted on each other by connecting the pair of flanges, **characterized in that**, the tool comprises a pulling member and a lever, wherein

a) the pulling member comprises a first end having a contact surface for contacting a flange surface of a first flange of the pair of flanges, wherein a spigot projects from the contact surface in a substantially perpendicular direction, the spigot being configured to engage a mounting aperture of the first flange,
b) the lever and the pulling member are pivotably coupled at a joint which is arranged at a second end of the pulling member and the lever comprises a first arm and a second arm, wherein the two arms project in different directions from the joint,
c) the first arm comprises a first end of the lever and the second arm comprises a second end of the lever, and a first length of the first arm is greater than a second length of the second arm,
d) the lever and the pulling member are configured to define a distance between the contact surface of the pulling member and the second end of the lever when the spigot resides in the mounting aperture of the first flange, wherein the distance is arranged **in that** the second end of the lever contacts an inner surface of a second flange of the pair of flanges.

2. The tool according to claim 1, wherein the pulling member is releasably coupled to the lever.

3. The tool according to claim 2, further comprising at least one further pulling member for replacement of the pulling member, wherein the further pulling member is different when compared to the pulling member with respect to a load bearing capability and / or with respect to a diameter of the spigot.

4. The tool according claim 2 or 3, wherein the pulling member is a forked member having a first leg and a second leg which are arranged at the second end of the pulling member and which define a clearance between the first leg and the second leg, wherein the lever is coupled to the first leg and to the second leg of the pulling member by a releasable axle which projects substantially perpendicular to a length extension of the legs.

5. The tool according to claim 4, wherein the first leg and the second leg of the pulling member each form a substantially identical angle with the contact surface, wherein this angle is considered between the length extension of the first leg and the second leg and a plane which is defined by the substantially flat contact surface.

6. The tool according to claim 5, wherein the further pulling member is different when compared to the pulling member with respect to said angle between the plane which is defined by the contact surface and the length extension of the first leg and the second leg.

7. The tool according to anyone of the preceding claims, wherein an angle between the first length of the first arm and the second length of the second arm is between 50° and 80°, in particular between 60° and 70°.

8. The tool according to anyone of the preceding claims, wherein a roll is mounted on the second end of the lever.

9. The tool according to anyone of the preceding claims, wherein a driving element is mounted on the first end of the lever.

10. The tool according to claim 9, wherein the driving element comprises a contact pad which is configured to contact an inner surface of a segment of the supporting structure comprising the first flange, when the spigot resides in a mounting aperture of the first flange, wherein the driving element further comprises an actuation member for varying a distance between the contact pad and the second end of the lever.

11. The tool according to claim 10, wherein the actuation member is a spindle, a geared rod, a hydraulic or pneumatic actuator and in particular a hydraulic or pneumatic impression cylinder.

12. A method for aligning a pair of adjacent flanges of adjacent segments of a supporting structure of a wind generator, wherein the supporting structure comprises at least a first segment having a first flange and a second segment having a second flange, the first flange and the second flange each comprising a plurality of mounting apertures, the method comprising the steps of:

a) aligning the mounting apertures of the first flange and the mounting apertures of the second flange at a first lateral side of the supporting structure and installing a first set of fasteners in corresponding mounting apertures for connecting the first flange and the second flange at the first lateral side,
b) positioning a tool according to anyone of claims 1 to 11 on the first flange, wherein the tool in arranged in that the spigot engages a mounting aperture of the first flange, wherein

said mounting aperture is arranged at a second lateral side of the supporting structure,

c) displacing the first end of the first arm of the lever of the tool towards an interior of the supporting structure so as to generate a force which is applied on an inner surface of the second flange, wherein said force urges the second flange outwards the supporting structure while the first flange is urged inwards the supporting structure so as to align corresponding mounting apertures in the first flange and in the second flange.

13. The method according to claim 12, wherein a tool according to anyone of claims 9 to 11 is positioned on the first flange, and the step of displacing the first end of the first arm of the lever further comprises the steps of:

a) arranging the contact pad of the tool so as to contact an inner surface of the first segment of the supporting structure, which comprises the first flange,

b) driving the actuation member of the driving element so as to generate a spreading force between the first end of the lever and contact pad which resides on the inner surface of the first segment, wherein the contact pad presses against the inner surface and drives the first end of the lever in a direction towards the interior of the supporting structure.

FIG. 1

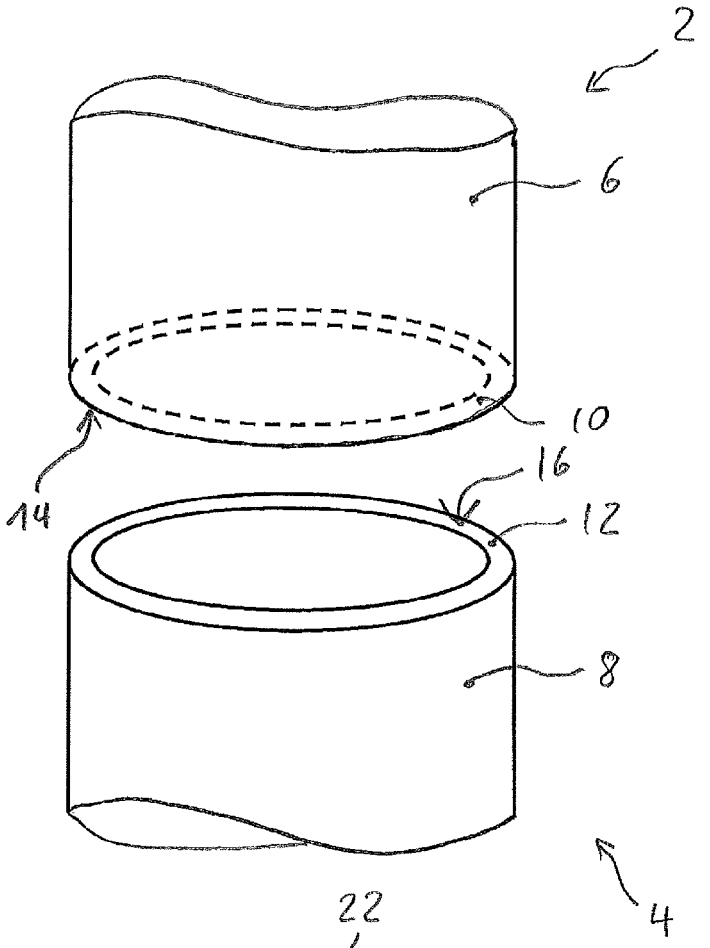


FIG. 2

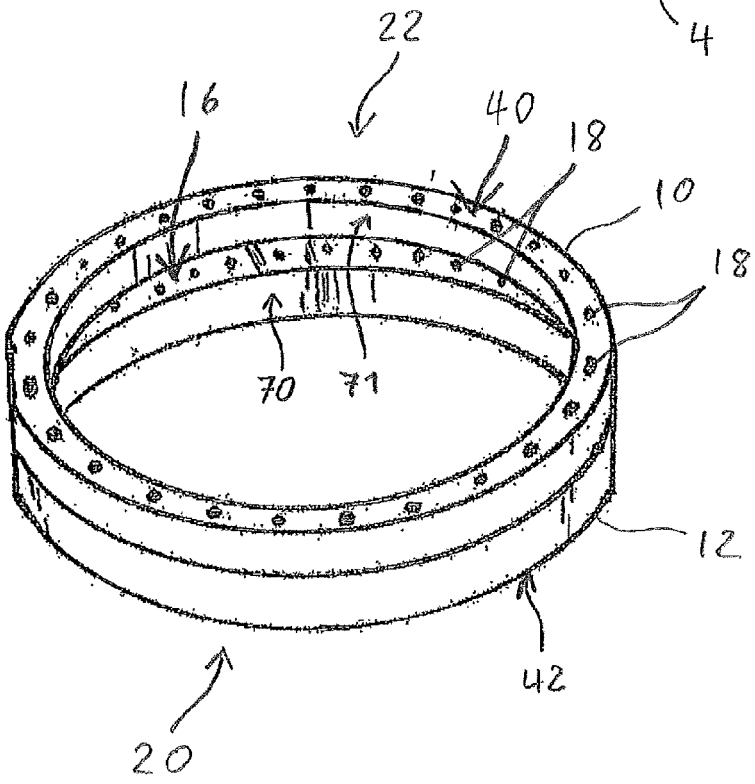


FIG. 3

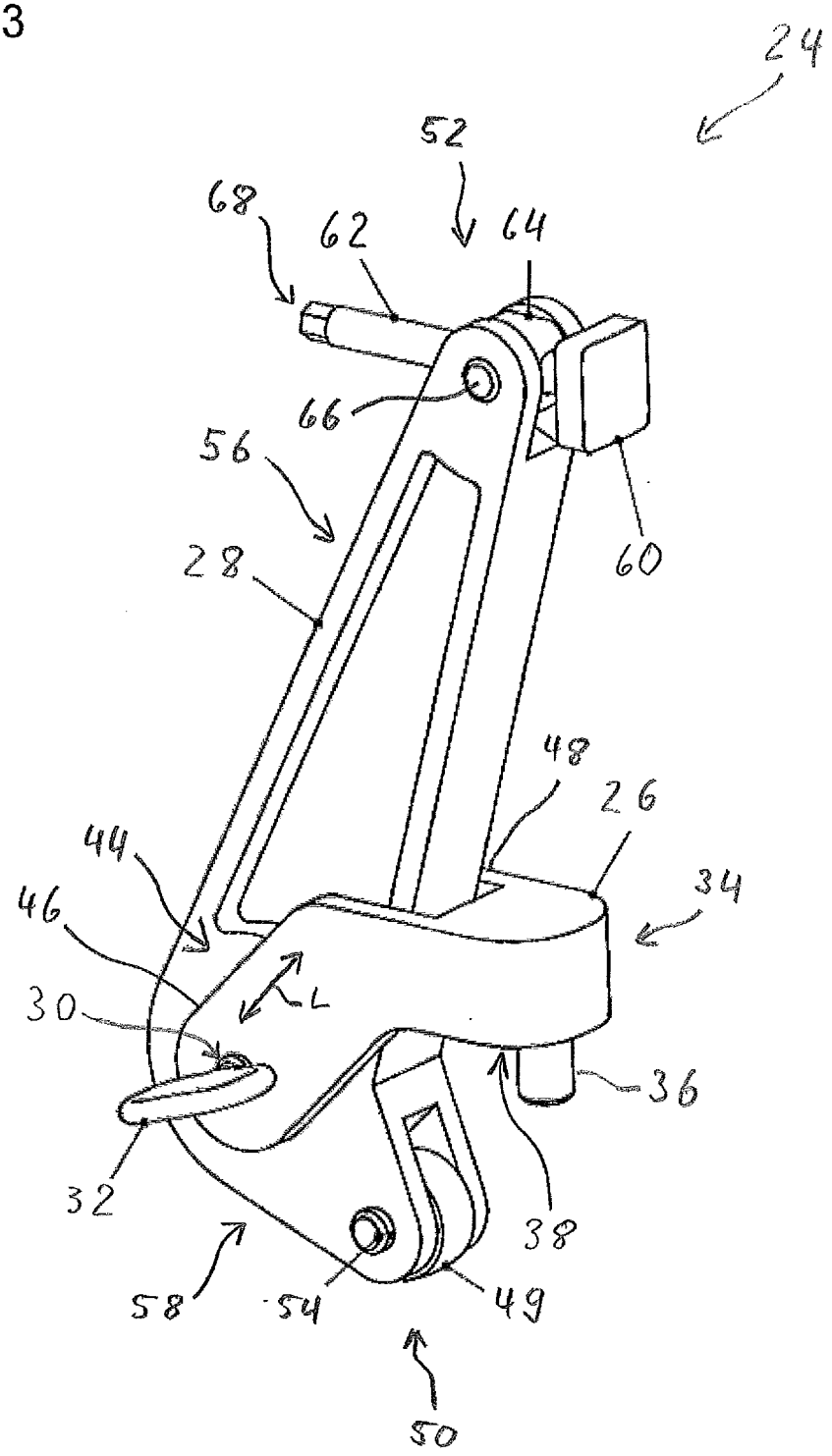


FIG. 4

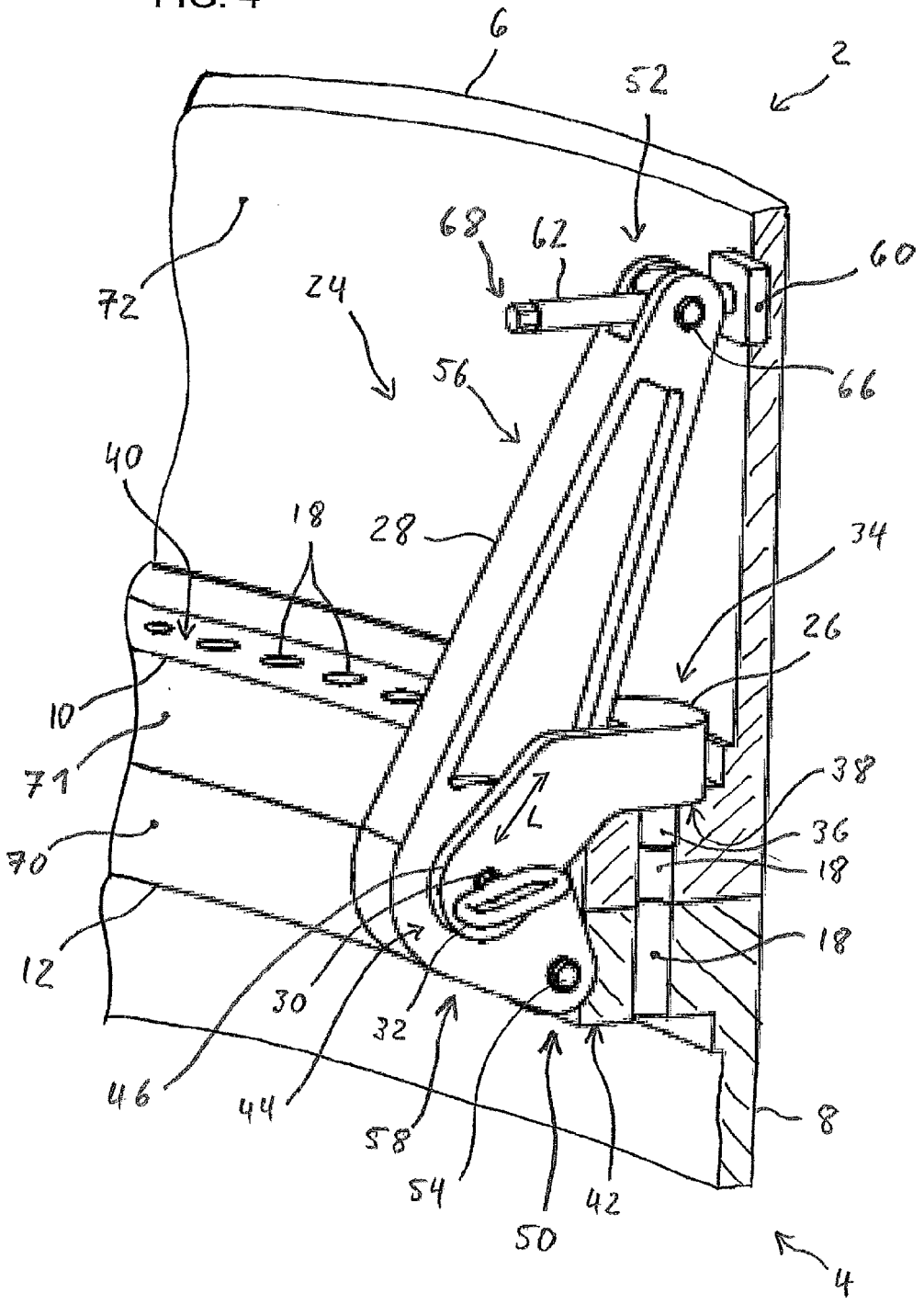
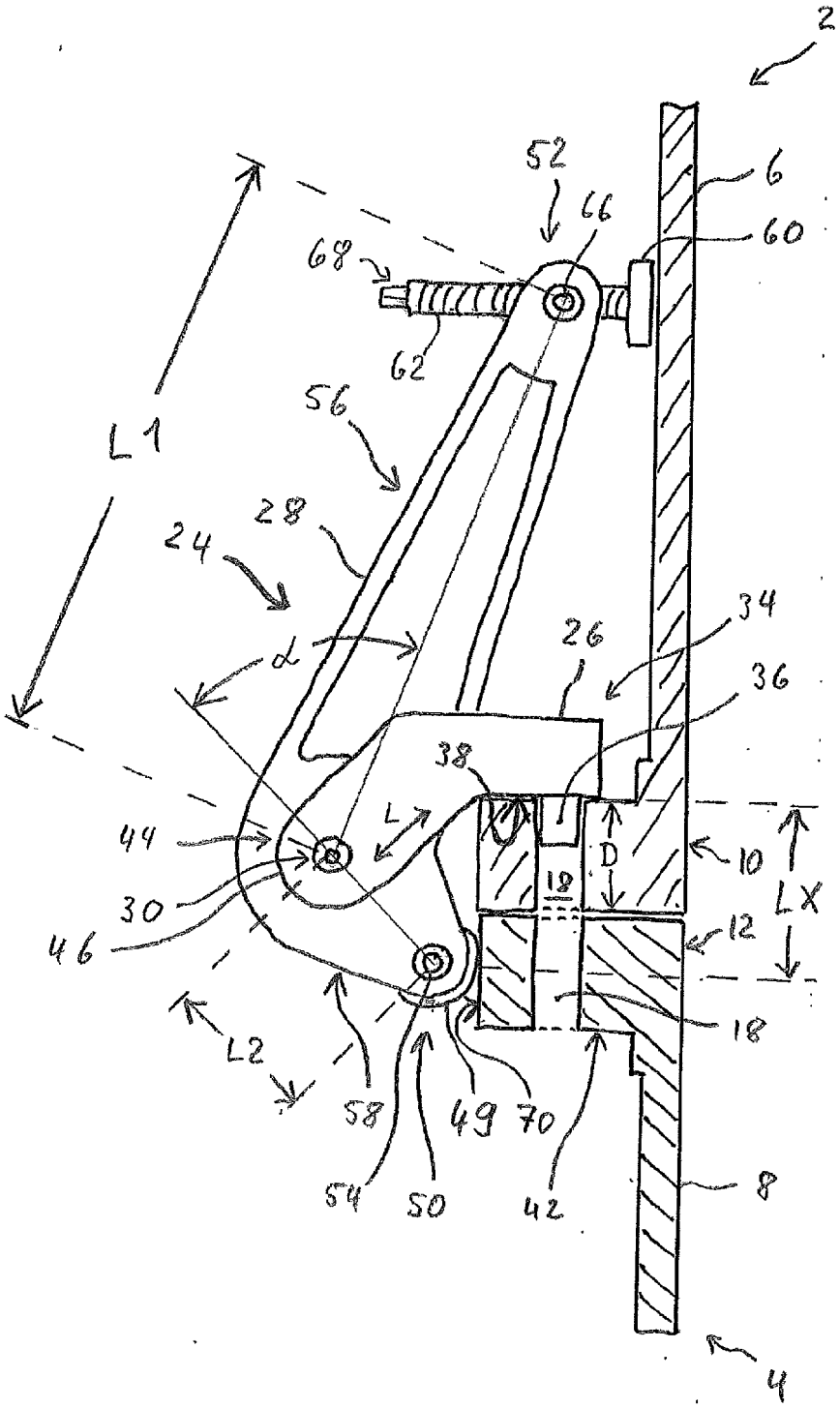

6
52
2
68
62
60
72
24
66
56
40
18
28
34
26
10
71
38
70
L
36
18
18
12
30
32
46
44
58
54
50
42
8
4

FIG. 5


2
52
66
6
60
68
62
56
L1
28
24
d
26
34
36
38
44
L
D
10
LX
30
12
46
18
L2
58
49
70
54
50
42
8
4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 13 15 1024

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	DK 177 198 B1 (.) 29 May 2012 (2012-05-29) * the whole document *	1-13	INV. E04H12/08 E04H12/34
A	US 2011/131898 A1 (NIES JACOB JOHANNES [NL] ET AL) 9 June 2011 (2011-06-09) * figures 2,3,7 *	12,13	B25B5/14
A	US 2010/307097 A1 (WORD III THOMAS NOTT [US] ET AL) 9 December 2010 (2010-12-09) * figures 4A,4B,5A,5B,6A,6B *	12,13	

TECHNICAL FIELDS SEARCHED (IPC)

E04H
B25B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	14 June 2013	Decker, Robert

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 15 1024

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-06-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DK 177198 B1	29-05-2012	DK 177198 B1	29-05-2012
		EP 2538000 A2	26-12-2012
US 2011131898 A1	09-06-2011	AU 2011201777 A1	17-11-2011
		CA 2738077 A1	29-10-2011
		CN 102235404 A	09-11-2011
		EP 2383476 A1	02-11-2011
		JP 2011231927 A	17-11-2011
		KR 20110120832 A	04-11-2011
		US 2011131898 A1	09-06-2011
US 2010307097 A1	09-12-2010	US 2010307097 A1	09-12-2010
		WO 2011146080 A1	24-11-2011

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- DK 177198 B1 **[0005]**