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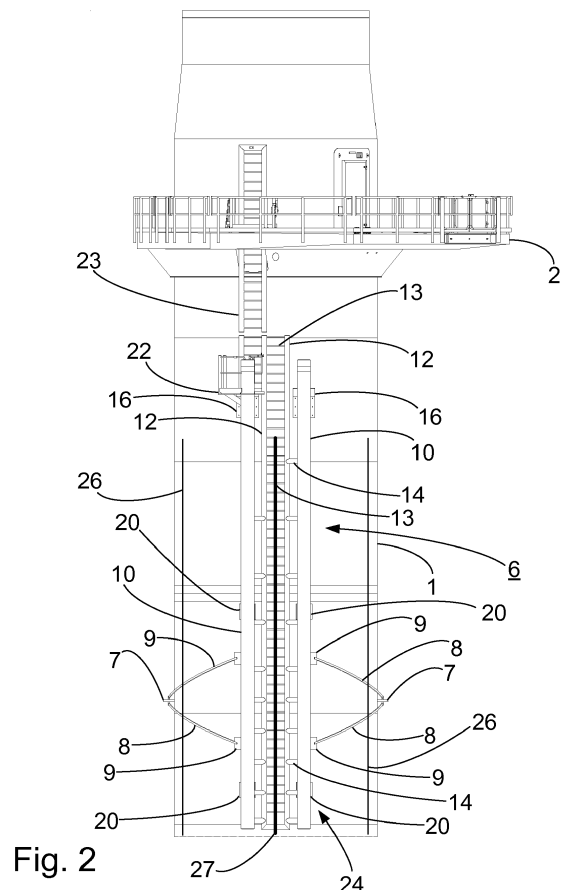
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### (54) A LANDING STRUCTURE FOR AN OFFSHORE STRUCTURE

(57) A landing structure (6) for an offshore structure (1). The landing structure (6) comprises a pair of parallel columns (10) interconnected by a ladder (11) where the stringers (12) of the ladder (11) extend in parallel with the columns. (10). The columns (10) comprise attachment means for releasable attachment to the offshore structure (1) allowing the landing structure (6) to be refitted on the offshore structure (1).



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## Description

**[0001]** The present invention relates to a landing structure for the docking of ships, in particular transfer vessels, against offshore, in particular but not exclusively monopiles of wind farm equipment.

**[0002]** When operating offshore wind farms, it is necessary to transport service personnel and equipment etc. to the wind farm for service, maintenance and the like. This is normally done via the sea using transfer vessels. These transfer vessels need to be able to dock at the various different types of equipment such as platforms, wind turbine foundations or even other vessels.

**[0003]** For the docking purposes at structures such as monopile wind turbine foundations, the vessel normally makes a landing by being pressed against a suitable landing structure of the equipment under its own engine power. For wind turbines located on monopiles the landing structure is normally a pair of vertical protective columns arranged with a suitable spacing to the monopile, thereby *inter alia* protecting the monopile from scratching or denting, the latter potentially compromising the structural integrity of the monopile.

**[0004]** Examples of such protective columns, protecting a monopile wind turbine foundation, may *inter alia* be found in the published patent applications GB2473490, GB2520094 and GB2489679.

**[0005]** Providing and maintaining the landing structure on a monopile at sea, however, involves additional costs and there is therefore at least an economic incentive to avoid the use of the landing structure.

**[0006]** However, if an infrastructure of offshore structures, in particular monopiles of offshore wind turbine generators, without landing structures is established, e. g. by using suitably equipped transfer vessels and transfer mechanisms allowing the docking and transfer to an offshore structure without a landing structure, there may still be situations where it may later turn out to be desirable to have a landing structure.

**[0007]** On this background it is the object to provide a landing structure which may be retrofitted on an already erected offshore structure.

**[0008]** According to a first aspect of the invention this object is achieved by a landing structure for an offshore structure, said landing structure comprising a pair of parallel columns interconnected by a ladder where the stringers of the ladder extend in parallel with the columns, wherein the columns comprise attachment means for releasable attachment to the offshore structure.

**[0009]** This allows the retrofitting of a landing structure to an existing or previously erected offshore structure, only in the event a landing structure turns out to be necessary. This, significantly reduces the overall costs, as the costs for the offshore structure is substantially reduced by not having to provide it in the first place.

**[0010]** According to a preferred embodiment according to the first aspect of the invention, the attachment means comprises at least one pair of mounting flanges arranged

one on each of a pair of spacers extending from each of the pair of columns, respectively. This, allows the landing structure to be attached to a corresponding flange or attachment point on the offshore structure.

**[0011]** According to a further preferred embodiment according to the first aspect of the invention, the mounting flanges comprise an alignment recess adapted to engage a corresponding flange or attachment point on the offshore structure. The alignment recess acts as an alignment means and as a hook for temporarily holding the landing structure on the corresponding flange or attachment point until permanently secured by other means such as bolts.

**[0012]** According to another preferred embodiment according to the first aspect of the invention, the attachment means comprises connection points for elongated supports. This allows the landing structure to be secured to the offshore structure using elongated supports such as straps, cables, rods, wires, or the like.

**[0013]** According to yet another preferred embodiment according to the first aspect of the invention, the landing structure further comprises at least one further pair of spacers, wherein the further pair of spacers comprise pads adapted for abutting said offshore structure. These further pairs of spacers work in conjunction with the elongated supports. When tensioned the supports pull the spacers into firm engagement with the offshore structure, thus securing the landing structure in position.

**[0014]** According to a further preferred embodiment according to the first aspect of the invention, the pads comprise a protective covering adapted to protect said offshore structure. The protective covering prevents the pads from wearing, scratching or other abrasive influence on the protective coating of the offshore structure, which needs to be kept in good condition to protect the offshore structure against the harsh offshore marine environment.

**[0015]** According to yet a further preferred embodiment, the protective covering comprises an elastomer and/or polymer material. Elastomers generally provides a good contact, while preventing lateral slipping and thus the above mentioned risk of wearing, scratching or other abrasive influence. Likewise, suitable polymer materials may have low friction and thus prevent the above mentioned risk of wearing, scratching or other abrasive influence.

**[0016]** According to a second aspect of the invention, the object is achieved by an offshore structure adapted for receiving a landing structure according to the first aspect of the invention and embodiments thereof. This allows the in-situ retrofitting of a landing structure on an already erected offshore structure.

**[0017]** According to a first preferred embodiment, the offshore structure comprises attachment points adapted to receive a landing structure according to any one of the preceding claims. By the provision of the attachment points on the offshore structure rather than a complete landing structure substantially reduces the initial costs for establishing the offshore structure, thus adding the

costs for the landing structure only in cases where it later turns out to be necessary or desirable to have.

**[0018]** According to a preferred embodiment of the second aspect of the invention, a removal protective cover adapted to be arranged on the attachment points. Such a protective cover may prevent entanglement of hoisting cables and damage to objects and personnel, which may bounce against them during hoisting onto the structure in the absence of the landing structure.

**[0019]** According to a third aspect of the invention the object is achieved by system comprising a landing structure according to the first aspect of the invention and embodiments thereof and an offshore structure according to the second aspect of the invention and embodiment thereof.

**[0020]** According to a fourth aspect of the invention, the object is achieved by a method for retrofitting a landing structure on an offshore structure, comprising the steps of erecting an offshore structure and attaching a landing structure according to the first aspect of the invention including any of the above mentioned embodiments thereof to the erected offshore structure.

**[0021]** In this way an economically advantageous offshore structure may be erected, and only if necessary may the landing structure be retrofitted, thereby cutting the overall costs.

**[0022]** The invention will now be described in greater detail based on nonlimiting exemplary embodiments and with reference to the schematic drawings, on which:

Fig. 1 shows a novel offshore structure without a landing structure but prepared for retrofitting a landing structure,

Fig. 2 shows the novel offshore structure with a landing system according to the invention retrofitted,

Fig. 3 shows a detail of a spacer with a flange attached to an attachment point on the offshore structure,

Fig. 4 shows a detail of a spacer with a pad in abutting engagement with the offshore structure,

Fig. 5 shows a horizontal cross-section of the offshore structure just above the attachments points,

Fig. 6 shows a horizontal cross-section of the offshore structure just above a pair of anchoring points for securing supports on the offshore structure, and

Fig. 7 shows a cross-section corresponding to that of Fig. 5 but with a pair of protective covers mounted on the attachment points.

**[0023]** Turning first to Fig. 1 a section of an offshore structure 1 is shown. In the following the offshore structure 1 is exemplified by a wind turbine generator, e.g. the steel tower or steel transition piece mounted on a monopile foundation rammed into the seabed. As will be noticed the offshore structure comprises a platform 2. The platform 2 is arranged quite a distance i.e. about 20 metres or more above sea level, depending of course on tide, waves etc. Traditionally, the platform has been ac-

cessed by climbing a ladder forming a part of a landing structure mounted on the offshore structure. This novel offshore structure 1 does not have a landing structure and ladder mounted, and the intention is to hoist or otherwise move personnel to the platform 2 from a crew transfer vehicle (not shown).

**[0024]** Instead the offshore structure 1 is prepared for retrofitting a landing structure only in the event it later turns out to be necessary, thus saving the initial costs for a landing structure. Instead, according to a preferred embodiment of the invention, the offshore structure 1 comprises a pair of attachment points 3. As can be seen in Fig. 3 the attachment points 3 are mounted at a distance from the offshore structure 1 on corresponding protrusions 4. The attachment points 3 are preferably a pair of flanges 5 with V-shaped cut-outs 18 in the top for alignment of a landing structure 6 according to the invention as shown in Figs. 2 to 4. As will be described below the landing structure 6 according to the invention is retrofittable in-situ to the already erected offshore structure 1. This can readily be done by the use of conventional existing equipment. Since the retrofitting of a landing structure is the exemption, the attachment points 3 will normally be covered by a pair of covers 21, so as to cover the edges and protrusion, as seen in Fig. 7 in comparison with the corresponding view in Fig. 5. Covering the attachment points 3 will prevent hoisting cables or the like to be caught on the unused attachment points 3 when transferring objects and personnel to the platform 2 under normal use. Likewise, it will reduce the risk of potential injuries to persons and objects directly hitting the attachment points 3 during hoisting or the like onto the platform 2 of the offshore structure 1. The covers 21 are preferably made of a suitable polymer material, such as e.g. HDPE or other material capable of withstanding the harsh marine offshore environment.

**[0025]** The offshore structure 1 further comprises a pair of anchoring points 7 adapted to receive a number of elongated supports 8 for securing the landing structure 6. As can be seen in Fig. 2 one end of an elongated support 8 is secured to the anchoring point 7 whereas the other end is secured to the landing structure 6 at a respective connection point 9. The elongated supports 8 comprise suitable tensioning means which are as such well known in the art. The elongated supports 8 are preferably steel bands, but other suitable elongated supports comprising cables, wires, rods, chains etc. may be employed. The elongated supports 8 are preferably attached to anchoring points 7 with some degree of freedom for pivotal or rotary motion. The same may apply to the attachment to the connection points 9. That is to say the connections are not necessarily bolted or in otherwise fixed engagement, but could be T- or ball-shaped heads interlocking with the anchoring points 7 or the connection points under tension only.

**[0026]** Turning now to the landing structure 6 as seen in Fig. 2, the landing structure 6 comprises a pair of columns 10. The columns 10 are sturdy enough to resist

impact and forces from a crew transfer vessel docking against them. The columns 10 are interconnected by means of a ladder 11. The stringers 12 of the ladder 11 extend generally in parallel with the columns 10, but is off-set with respect to the common plane of the columns 10. The stringers 12 are interconnected by the rungs 13 of the ladder 11, and the stringers in turn are connected to the columns 10 by means of a suitable number of struts 14.

**[0027]** At or close to the top of the columns 10 a pair of spacers 15, one for each column 10 is provided. The free end of the spacers 15 are provided with mounting flanges 16 adapted to engage the flanges 5 on the offshore structure 1. The top of the mounting flanges 16 each comprise an alignment recess 17 adapted to engage around the top of the corresponding flange 5 on the offshore structure 1. The bottom of the alignment recess is 17 preferably adapted to match the V-shaped cut-out 18 in the corresponding flanges 5 on the offshore structure 1. The alignment recess 17 furthermore serves as a hook to hold the landing structure 6 temporarily on the offshore structure 1, until the mounting flanges 16 are secured to the corresponding flanges 5. Typically, the mounting flanges 16 are secured to the corresponding flanges 5 by means of nuts and bolts, but other well-known means such as welding or riveting could be envisaged.

**[0028]** Having secured the upper part of the landing structure 6 to the offshore structure 1 by securing the mounting flanges 16 to the corresponding flanges 5, the lower part of the landing structure may be secured to the offshore structure 1 by attaching the elongated supports 8 to the respective connection points 9 and to the anchoring points 7. Tensioning the supports 8 will force a number of further spacers 19 into engagement with the offshore structure and thus secure the lower part of the landing structure 6 against the offshore structure 1.

**[0029]** As can best be seen in Fig. 4 the further spacers 19 are preferably provided with pads 20 adapted to engage the offshore structure 1. The pads 20 have a suitably large surface to decrease the pressure against the surface of the offshore structure 1 to a suitable level. The pads 20 are furthermore preferably covered in an elastomeric and or polymer material in order to reduce the risk of wearing, scratching or other abrasive influence on the protective coating of the offshore structure 1, which must be kept intact in order to protect properly against the corrosive influences of the salty maritime offshore environment. The coating could be any suitable polymer coating with low friction and suitable elastic properties to avoid such wearing, scratching or other abrasive influence. The polymer could also be an elastomer with good impact damping properties, and good friction properties to prevent abrasion from e.g. slipping and sliding of the pad along the surface of the offshore structure 1. Examples of suitable coatings could be neoprene, nylon or Teflon.

**[0030]** Preferably, the elongated supports 8 are coated

with similar or the same material as the pads, at least on the side facing the offshore structure 1, when installed. This will prevent the material of the elongated supports 8, e.g. steel, from wearing, scratching or otherwise damaging the coating of the offshore structure 1 by abrasive influence.

**[0031]** The landing structure 6 may include a landing 22 at the top for making a transition to an additional ladder 23 mounted directly on the platform 2 as a separate piece, when retrofitting the offshore structure 1 with the landing structure 6.

**[0032]** Since, however, the intention is to only exceptionally provide the landing structure 6, the offshore structure 1 is adapted to allow the docking of suitably equipped vessels directly at the offshore structure 1. For this the offshore structure preferably has a designated area 24, covering a predetermined angle, such as 160 degrees of the circumference of the offshore structure 1, as indicated by the dashed lines 25 in Fig 6. In this area the surface of the offshore structure 1 may be covered with a more robust heavy-duty coating than the remainder of the offshore structure. That is to say a coating not only able to withstand the harsh offshore marine environment, but also suitable for protecting the offshore structure 1 from scratching, abrasion, piercing by a docking vessel. Examples of such heavy-duty coatings could be Hempadur 45753, Teknos Teknopur 300 8-00, LINE-X XS-BK 100, or Hempadur Spray-Guard 35490.

**[0033]** To ensure that the vessels dock in the intended area, the offshore structure 1 is preferably provided with markings. As illustrated in Figs. 1 and 2, such markings could comprise a pair of vertical lines 26, preferably in a suitable colour, such as red, standing out from the colour of the coating of the structure, which is typically yellow. These vertical lines 26 coincide with the angle spanned by the dashed lines 25 and delimit the intended docking area 25 with the heavy duty coating. To further aid in docking the markings could also include a vertical centerline marking 27, midway between the vertical lines 26 and preferably in a different colour such as black, to avoid confusion.

## Claims

1. A landing structure for an offshore structure, said landing structure comprising a pair of parallel columns interconnected by a ladder where the stringers of the ladder extend in parallel with the columns, wherein the columns comprise attachment means for releasable attachment to the offshore structure.
2. A landing structure according to claim 1, wherein the attachment means comprises at least one pair of mounting flanges arranged one on each of a pair of spacers extending from each of the pair of columns, respectively.

3. A landing structure according to any one of claims 1 or 2, wherein the mounting flanges comprise an alignment recess adapted to engage a corresponding flange on the offshore structure. 5
4. A landing structure according to any one of the preceding claims, wherein the attachment means comprises connection points for elongated supports. 10
5. A landing structure according to any one of the preceding claims further comprising at least one further pair of spacers, wherein the further pair of spacers comprise pads adapted for abutting said offshore structure. 15
6. A landing structure according to claim 5, wherein said pads comprise a protective covering adapted to protect said offshore structure. 20
7. A landing structure according to claim 6, wherein said protective covering comprises an elastomer and/or polymer material. 25
8. An offshore structure adapted for receiving a landing structure according to any one of the preceding claims. 30
9. An offshore structure according to claim 8, wherein the offshore structure comprises attachment points adapted to receive a landing structure according to any one of the preceding claims. 35
10. An offshore structure according to any one of claims 8 to 9, further comprising a removal protective cover adapted to be arranged on the attachment points. 40
11. A system comprising a landing structure according to any one of claims 1 to 7 and an offshore structure according to any one of claims 8 to 10. 45
12. A method for retrofitting a landing structure on an offshore structure, comprising the steps of erecting an offshore structure according to any one of claims 8 to 10, and attaching a landing structure according to any one of claims 1 to 7 to the erected offshore structure. 50

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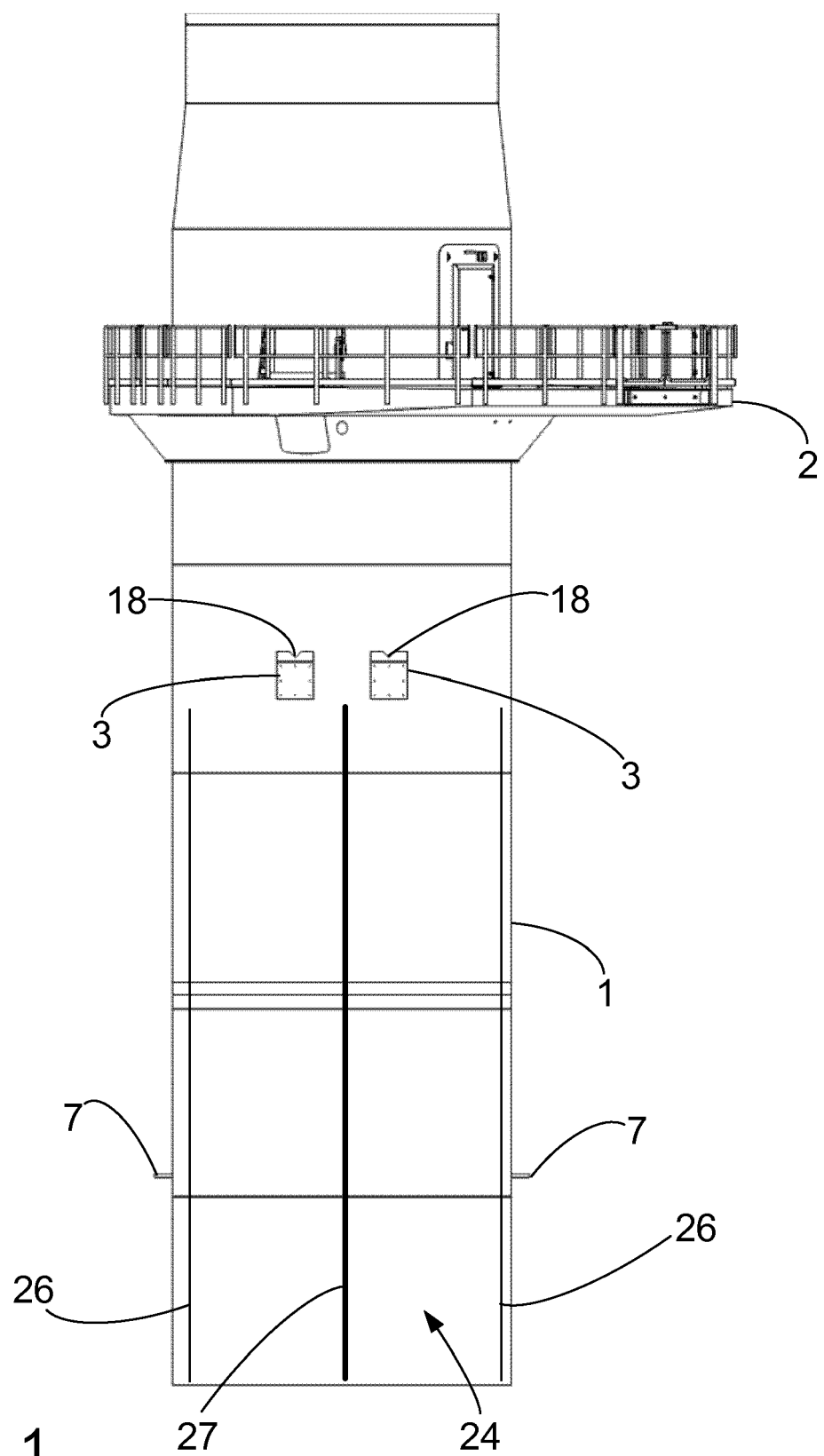


Fig. 1

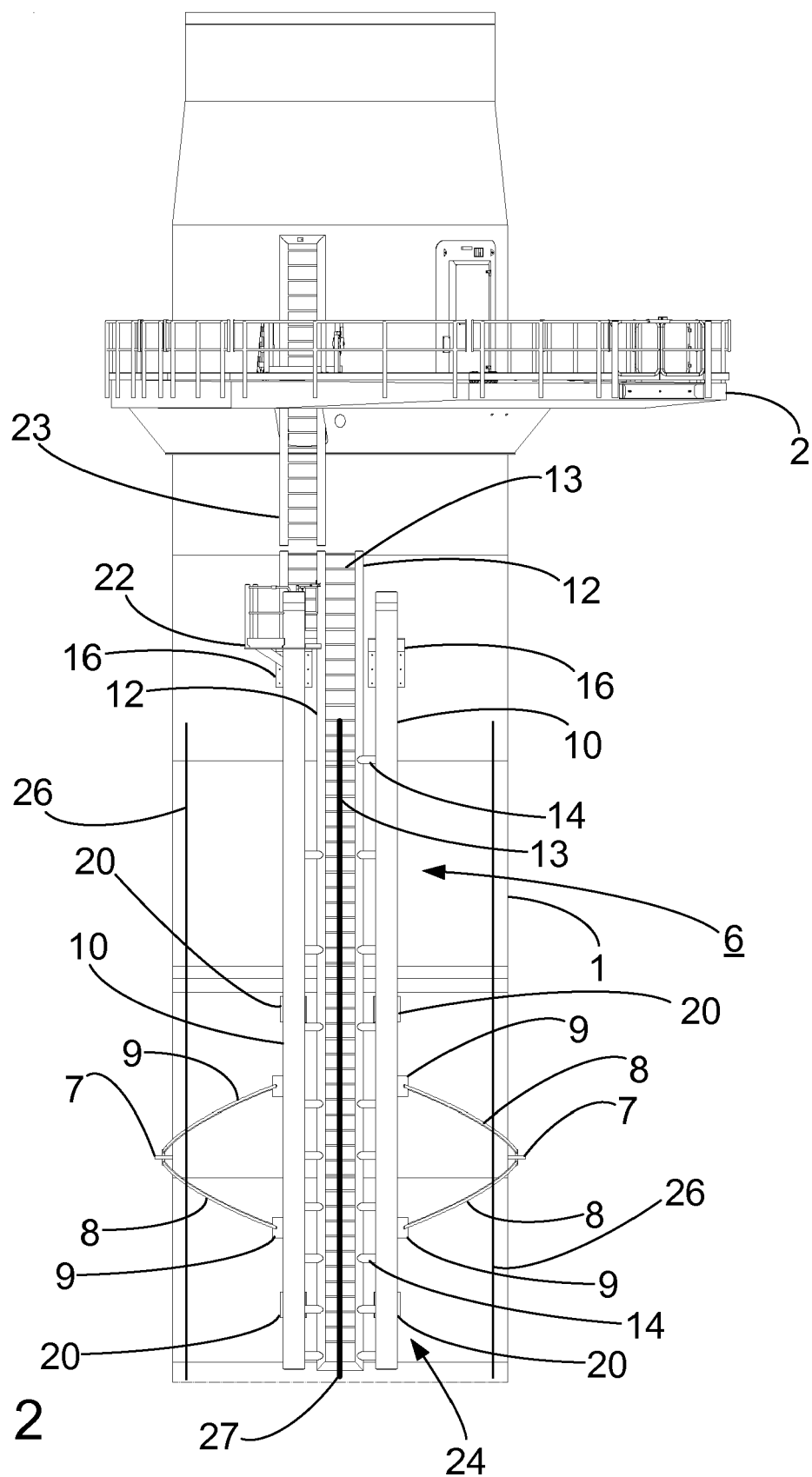
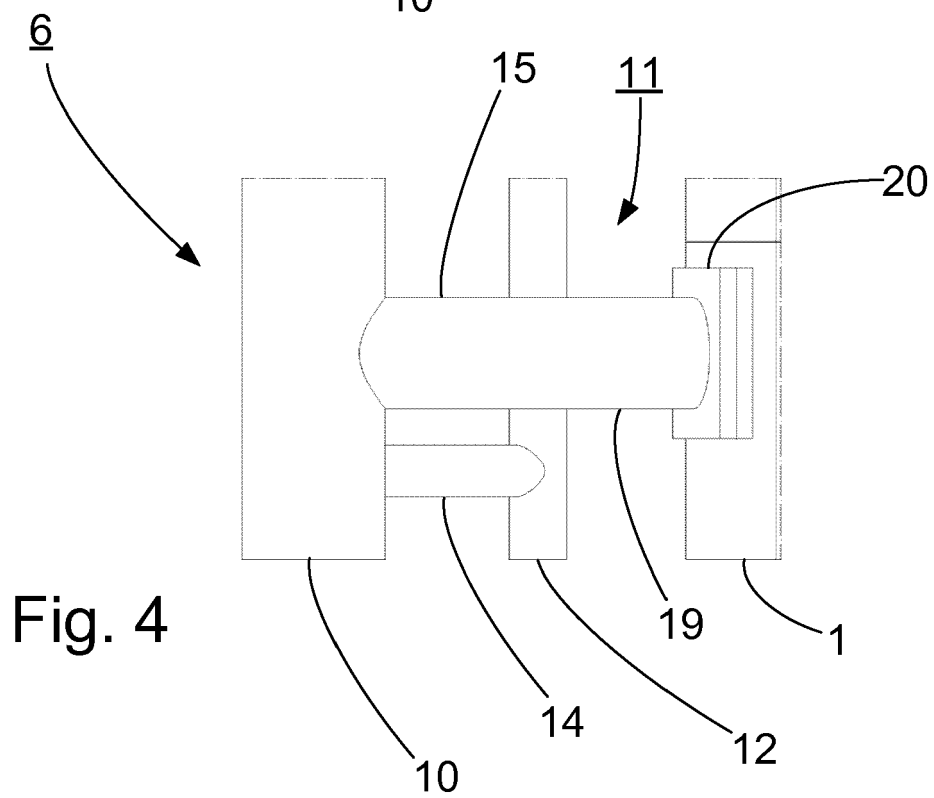
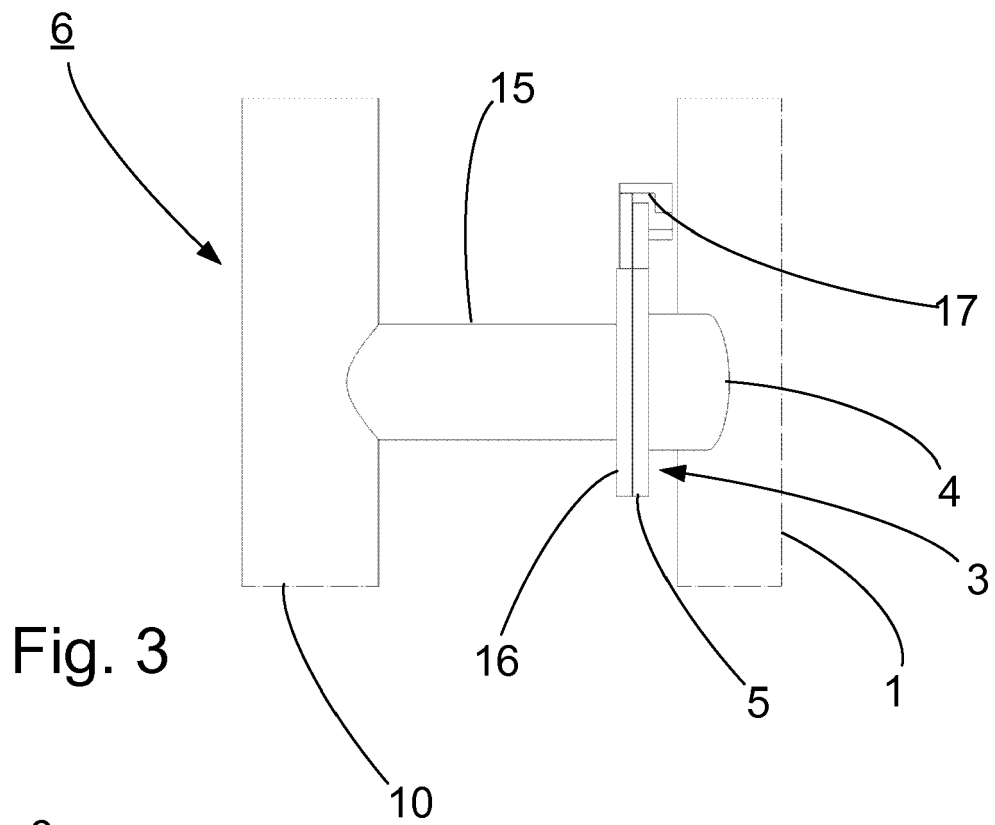
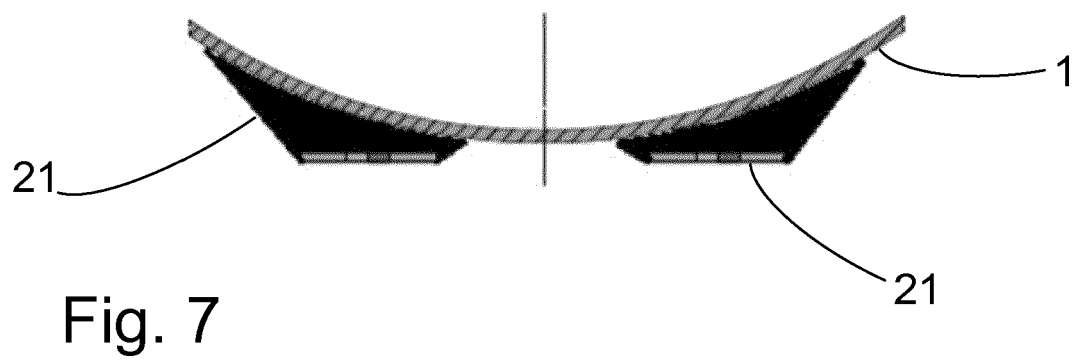
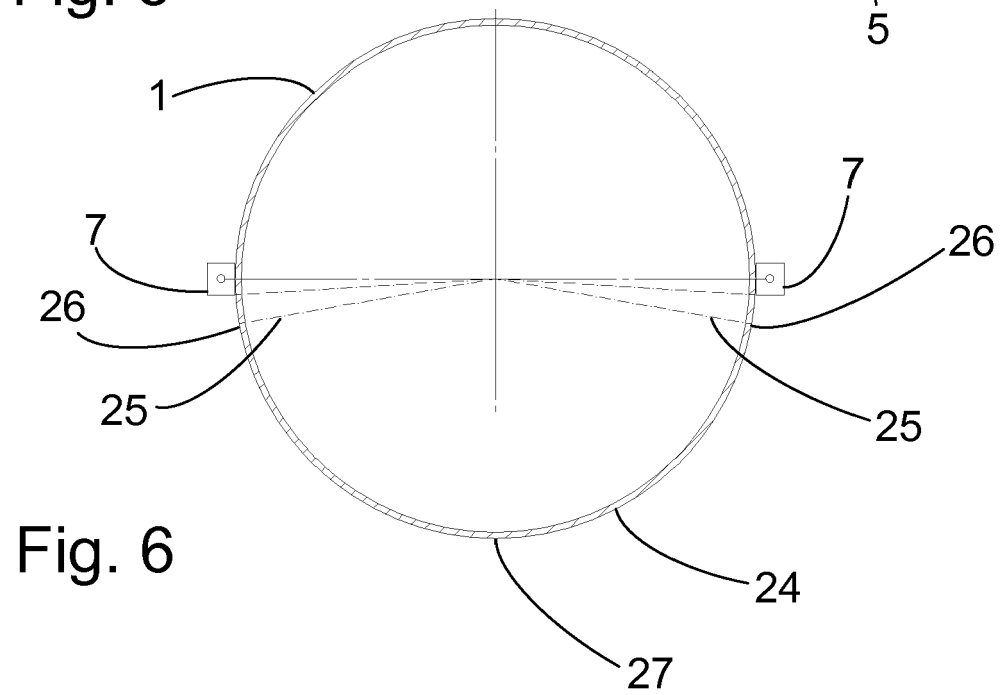
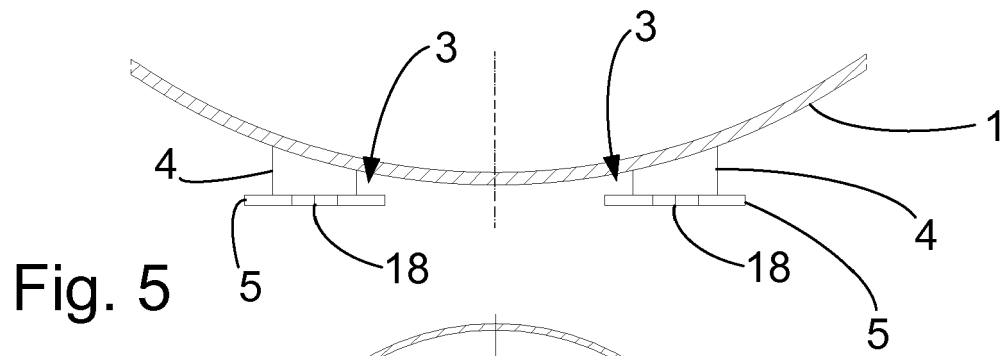


Fig. 2









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Application Number  
EP 18 21 1061

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                             |                                                        |                                                                        |
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| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                             |                                                        |                                                                        |
| Place of search<br><b>The Hague</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                             | Date of completion of the search<br><b>17 May 2019</b> | Examiner<br><b>Barré, Vincent</b>                                      |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                                                                                                                             |                                                        |                                                                        |

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