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(71) Applicants:
- **Presign Holding B.V.**
  1976 CE Ijmuiden (NL)
- **P&R Systems**
  1976 CE Ijmuiden (NL)

(72) Inventor: **Prins, Reinout Klaar Norfolc Jaap**
1566 WG, ASSENDELFT (NL)

(74) Representative: **Nijs, Erik Anton Marie**
Exter Polak & Charlouis B.V. (EP&C)
P.O. Box 3241
2280 GE Rijswijk (NL)

(54) Method for stabilizing a floating vessel against a stationary object

(57) A floating vessel is stabilized against a stationary object, for example a mast of an offshore wind turbine. The vessel comprises a hull, a motor for the propulsion of the vessel, a buffer body, which protrudes with respect to the hull, as well as at least one engagement arm. The engagement arm is at one end provided with an engagement member for engaging on the stationary object. First, the buffer body of the vessel is pushed against the stationary object by means of the motor. The buffer body is hereby substantially stabilized against the stationary object. Next, the engagement body engages on the stationary object while the buffer body and the stationary object remain mutually stabilized by the pushing. After this, the engagement arm is subjected to tensile load while the stationary object is engaged by the engagement member.

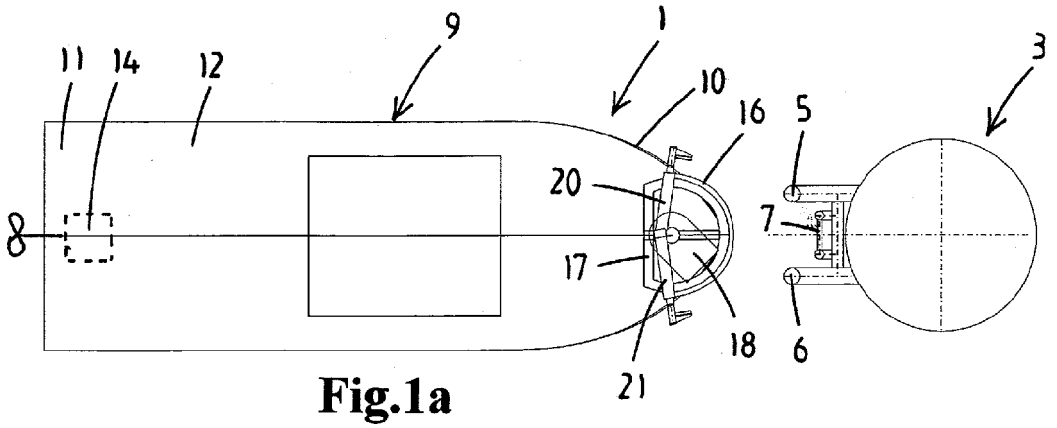

Fig.1a

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Description

[0001] The invention relates to a method for stabilizing a floating vessel against a stationary object, such as a mast of an offshore wind turbine. The stationary object is sited in open water, for example, the vessel being stabilized against it for the transfer of persons or goods. During the installation of a windmill park at sea, persons and goods are repeatedly transferred to offshore wind turbines under construction. In addition, installed wind turbines are regularly visited for maintenance activities. Other stationary objects at sea are also frequently visited with vessels for transfer of crew or equipment.

[0002] EP 1695902 discloses a method for stabilizing a floating vessel against an offshore construction. The vessel has a motor for the propulsion of the vessel. With the motor, a fender on the bow of the vessel is pushed firmly against the offshore construction. The force applied by the motor and the friction between the fender and the offshore construction prevent the fender from sliding down along the offshore construction. As long as the fender is stabilized against the offshore construction, crew or equipment can be transferred between the vessel and the offshore construction.

[0003] There are safety regulations which limit the use of this method to a maximum of 1.5 metres significant wave height. The significant wave height Hs is a term which is commonly known within shipping. The significant wave height is the average height of the highest 1/3 of the waves. The significant wave height can be determined visually or by measurements. If the significant wave height is less than 1.5 metres, waves will therefore still come past which are higher. It is impossible to predict when precisely this will happen and what the height of the wave will then be. In principle, each successive wave can create a hazardous situation in connection with the transfer of persons or goods. If, as a result of the wave motion, the propeller of the motor emerges above the water surface, even if only briefly, then the friction between the fender and the offshore construction is lost immediately. In that case, the bow of the vessel breaks free from the offshore construction and can move up or down depending on the wave situation. The random wind and current conditions, which are unpredictable or scarcely predictable, also play a part in this. The unforeseen wave patterns and other conditions offshore adversely affect safety in the transfer of persons or goods. In addition, there is a risk that the motor will misfire or cut, for example as a result of contaminated fuel, mechanical or electrical defects, whereby a dangerous situation directly arises. It must here be borne in mind that the transfer of persons or goods to an offshore wind turbine can last, for example, 20 minutes or more.

[0004] An object of the invention is to provide an improved method for stabilizing a floating vessel against a stationary object.

[0005] This object is achieved according to the invention by a method for stabilizing a floating vessel against a stationary object, wherein the vessel is provided with:

- a hull,
- a motor for the propulsion of the vessel,
- a buffer body, which protrudes with respect to the hull, as well as
- at least a first engagement arm, which at one end is provided with an engagement member for engaging on the stationary object,

and wherein the method comprises:

- the pushing of the buffer body of the vessel against the stationary object by means of the motor, whereby the buffer body is substantially stabilized against the stationary object,
- the engagement of the engagement member on the stationary object while the buffer body and the stationary object are mutually stabilized by the pushing,
- the subjection of the engagement arm to tensile load while the engagement member engages on the stationary object.

[0006] According to the invention, the buffer body of the floating vessel is first pushed against the stationary object, for example a mast of an offshore wind turbine, by means of the motor. The buffer body is then substantially stabilized against the stationary object by continued pushing by the motor of the buffer body against the stationary object. The stabilization of the buffer body against the stationary object takes place by virtue of friction between the buffer body and the stationary object. The buffer body is in this case unable or scarcely able to slide downwards or upwards along the stationary object. The buffer body therefore forms a friction body - in this patent application, the term buffer body can be replaced by the term friction body. While the buffer body remains stabilized against the stationary object by the pushing, the engagement member of the engagement arm next engages on the stationary object. The vessel and the stationary object are then connected to each other by the engagement arm. After this, the engagement arm pulls the vessel more firmly against the stationary object, or the vessel is pushed away from the stationary object. As a result of this, the engagement arm is subjected to tensile load in the longitudinal direction thereof. The buffer body is hereupon clamped firmly against the stationary object. The buffer body and the tensile-loaded engagement arm provide a stable connection between the vessel and the stationary object. Once this stable connection is established, the vessel no longer needs to be stabilized by the pushing with the motor. If the motor force, as a result of an unforeseen high wave, suddenly decreases or even totally falls away, the stable connection between the vessel and the stationary object remains guaranteed. According to the invention, crew and equipment can hence be transferred in a safe and guaranteed manner even if an unforeseen high wave comes past.

[0007] From WO 02/20343, a vessel having a gangway is known. One part thereof is pivotally connected about

a horizontal axis to a platform at the upper end of a column which is mounted on the deck of the vessel rotatably about a vertical axis. A second part of the gangway may be retracted or extended with respect to the first part of the gangway. The second part has a crossover platform and a coupling device in order to establish a connection to a vertical bar of a pile in open water. A buffer body which is pushed against the pile by means of the propulsion motor of the vessel is not known, however. Nor is the buffer body substantially stabilized against the vertical bar of the pile. And nor, therefore, can the engagement of the coupling jaws on the vertical bar take place while the buffer body and the vertical bar are mutually stabilized by the pushing.

[0008] In addition, it is noted that, from WO 2005/097591, the coupling of a vessel to a stationary object by means of a gangway fastened to the vessel is known. The gangway comprises a first gangway part and a second gangway part which telescopes into said first gangway part. A bumper strip on the side edge of the gangway is placed against a support of the stationary object. The bumper strip is not, however, substantially stabilized against the support, nor is the engagement of clamps on a coupling pipe of the stationary object conducted while the bumper strip and the coupling pipe are mutually stabilized by the pushing of the vessel by means of the propulsion motor.

[0009] According to the invention, it is possible to form a first connection between the vessel and the stationary object by the substantial stabilization of the buffer body against the stationary object by the pushing of the buffer body of the vessel against the stationary object by the propulsion of the vessel by means of the motor. The stabilization of the buffer body against the stationary object is realized by means of friction between the buffer body and the stationary object, so that the buffer body is unable or scarcely able to slide downwards or upwards along the stationary object. While the first connection remains in place by virtue of the fact that the buffer body and the stationary object are mutually stabilized by the pushing, a second connection between the vessel and the stationary object is formed by the engagement of the engagement member on the stationary object. The second connection guarantees that the vessel and the stationary object are mutually coupled.

[0010] According to the invention, it is possible that the stationary object is provided with at least two substantially vertical bumper bars, wherein the engagement member of the first engagement arm engages on a first bumper bar, and wherein the vessel is provided with at least a second engagement arm, which at one end is provided with an engagement member for engaging on a second bumper bar, and wherein both engagement members engage on the bumper bars while the buffer body and the stationary object are mutually stabilized by the pushing, and wherein both engagement arms are subjected to tensile load while the engagement members thereof engage on the bumper bars. The bumper bars of the stationary object are placed parallel to each other and at a distance apart. If the vessel is connected to both bumper bars by the engagement arms, the vessel can be prevented from pivoting in a horizontal plane about the stationary object. This increases safety in the transfer of persons or goods.

[0011] It is possible that the or each engagement arm is displaceable between an engagement position, in which the engagement member thereof engages on the stationary object, and a release position, in which the engagement member thereof releases the stationary object, and wherein the or each engagement arm is in the release position prior to the pushing, and wherein the or each engagement arm is displaced from the release position to the engagement position after the buffer body has been stabilized against the stationary object by the pushing.

[0012] For example, the or each engagement arm is rotatably connected to the vessel about a substantially vertical rotational axis. In this case, the or each engagement arm is first pivoted against the stationary object, for example against the bumper bars, so that the engagement member can engage on the stationary object. Then tensile load is applied to the or each engagement arm. This is favourable, for example, if the engagement arms are fitted to a pointed bow of the vessel.

[0013] It is also possible that the or each engagement arm is fitted to a trolley which is displaceable in the transverse direction of the vessel. The trolley with engagement arm can in this case slide from the outside inwards against the stationary object, for example against the bumper bars, after which the engagement member engages on the stationary object. Then the or each engagement arm is subjected to tensile load. This can be used, for example, where there are one or more engagement arms fitted to a flat bow or stern of the vessel.

[0014] It is possible that the or each engagement arm comprises an elongated supporting portion and an elongated engagement portion, wherein the supporting portion is connected to the vessel, and wherein the engagement portion is displaceable in the longitudinal direction with respect to the supporting portion, and wherein the engagement portion, at the end facing away from the supporting portion, is provided with the engagement member. The engagement portion forms a boom which is fitted to the supporting portion such that it can be moved to and fro. During normal passage, the engagement portion is in a retracted position with respect to the supporting portion. For the stabilization of the vessel against the stationary object, the engagement member of the engagement portion is movable from the hull of the vessel into an extended position, in which the engagement member can engage on the stationary object while the buffer body rests against the stationary object. The supporting portion is tubular, for example, the engagement portion being accommodated telescopically in the tubular supporting portion.

[0015] It is possible that the or each engagement arm

is provided with a drive member for driving the engagement portion with respect to the supporting portion, and wherein the or each engagement arm is subjected to tensile load by the drive member of the said engagement arm. The drive member comprises, for example, a hydraulic cylinder, which is fitted to the engagement portion. The hydraulic cylinder can move the engagement portion to and fro with respect to the supporting portion.

[0016] It is possible that the drive member of the or each engagement arm enables a displacement of the engagement portion in the longitudinal direction with respect to the supporting portion as the engagement arm is subjected to tensile load. The buffer body and the tensile-loaded engagement arm or engagement arms provide a stable connection between the vessel and the stationary object. Suppose that the buffer body is fixedly fastened to the hull of the vessel. If the stable connection has been established, the vessel can still rotate about a transverse axis determined by the buffer body. The or each engagement arm is located at a distance above the said transverse axis. If the vessel, for example as the result of a wave, rotates downwards about the said transverse axis, the engagement portion moves outwards with respect to the supporting portion. The length of the engagement arm increases. The fact that the engagement arm is here kept at a substantially constant pressure and remains under tensile load means that the stable connection can be guaranteed.

[0017] The length of the displacement of the engagement portion with respect to the supporting portion is less than the length of the engagement arm, for instance no greater than about 25% of the length of the engagement arm. The length of the said displacement is, for example, less than 70 cm, in particular less than about 50 cm.

[0018] Tensile load can be applied to the engagement arm by the application of tensile load from the vessel to the engagement arm. It is also possible that the engagement arm is subjected to tensile load by a thrust from the vessel onto the stationary object. The thrust is applied to the stationary object, for example, by the buffer body.

[0019] It is possible that the buffer body is displaceable with respect to the hull of the vessel, wherein the buffer body is provided with a drive member for driving the buffer body with respect to the hull of the vessel, and wherein the or each engagement arm is subjected to tensile load by the drive member of the buffer body. The drive member of the buffer body comprises, for example, a hydraulic cylinder. The hydraulic cylinder is connected to the vessel. The hydraulic cylinder can move the buffer body to and fro with respect to the hull of the vessel and can abut the buffer body under pressure against the stationary object.

[0020] It is possible that the drive member of the buffer body enables a displacement of the buffer body with respect to the hull as the or each engagement arm is subjected to tensile load. The buffer body and the tensile-loaded engagement arm or engagement arms provide a stable connection between the vessel and the stationary object. Suppose that the engagement arm or engagement arms possess a fixed length. If the stable connection has been established, the vessel can still rotate about a transverse axis which is determined by the engagement member of the engagement arm connected to the stationary object. The buffer body is placed at a height below the engagement arm or engagement arms, i.e. below the said transverse axis. If the vessel, for example as the result of a wave, rotates upwards about the said transverse axis, the buffer portion moves outwards with respect to the hull of the vessel. By virtue of the fact that the buffer body is here kept at a substantially constant pressure, tensile load continues to be applied to the or each engagement arm. The stable connection is hereby guaranteed.

[0021] The length of the displacement of the buffer body with respect to the hull of the vessel is less than the length of the engagement arm, for instance no greater than about 25% of the length of the engagement arm. The length of the said displacement is, for example, less than 70 cm, in particular less than about 50 cm.

[0022] A displacement of the engagement portion with respect to the supporting portion or of the buffer body with respect to the hull of the vessel, while at the same time tensile load continues to be applied to the engagement arm, can be achieved in a variety of ways. For example, the drive member of the or each engagement arm and/or the drive member of the buffer body each comprises a hydraulic cylinder and a collecting container, wherein the collecting container is provided with a movable partition wall, wherein the partition wall divides the collecting container into two chambers, wherein the first chamber is closed off and comprises a compressible fluid, and wherein the second chamber comprises hydraulic fluid and is connected to the hydraulic cylinder. The movable partition wall, such as a bellows-shaped partition wall, divides the interior of the collecting container into two chambers. In the first chamber there is a gas, while the second chamber is filled with hydraulic fluid and is connected to the hydraulic cylinder. The or each engagement arm is hence kept at a substantially constant pressure as tensile load is applied to the said engagement arm, while a displacement of the engagement portion with respect to the supporting portion remains possible by the displacement of the movable partition wall in the collecting container.

[0023] After tensile load has been applied to the or each engagement arm while the engagement member thereof engages on the stationary object, the pushing of the buffer body of the vessel against the stationary object by means of the motor can substantially be halted. The buffer body remains stabilized against the stationary object by the buffer body and the tensile-loaded engagement arm. The motor can even be switched off, which saves on fuel.

[0024] The invention additionally relates to a vessel, comprising:

- a hull,
- a motor for the propulsion of the vessel,
- a buffer body protruding with respect to the hull, which buffer body is designed to be pushed against a stationary object,
- at least a first engagement arm, which at one end is provided with an engagement member for engaging on the stationary object when the buffer body and the stationary object are mutually stabilized by the pushing of the buffer body against the stationary object by means of the motor, as well as
- an actuating device for subjecting the engagement arm to tensile load when this engages on the stationary object.

[0025] With the vessel according to the invention, persons and goods can be transferred in a safe and guaranteed manner to an offshore construction, such as an offshore wind turbine.

[0026] In one embodiment, the engagement member of the first engagement arm is designed to engage on a first, substantially vertical bumper bar of the stationary object, wherein the vessel is provided with at least a second engagement arm, which at one end is provided with an engagement member for engaging on a second, substantially vertical bumper bar of the stationary object, and wherein both engagement members are designed to engage on the bumper bars while the buffer body and the stationary object are mutually stabilized by the pushing, and wherein the actuating device is designed to apply tensile load to both engagement arms when they engage on the bumper bars. As a result, instability of the vessel by rotation about a vertical axis can be counteracted.

[0027] It is possible that the or each engagement arm is displaceable between an engagement position, in which the stationary object is engageable by the engagement member, and a release position, in which the stationary object has been released by the engagement member. As a result of the fact that the engagement arm or engagement arms are adjustable they can adapt to the position of the vessel with respect to the stationary object.

[0028] In one embodiment, the or each engagement arm comprises an elongated supporting portion and an elongated engagement portion, wherein the supporting portion is connected to the vessel, and wherein the engagement portion is displaceable in the longitudinal direction with respect to the supporting portion, and wherein the engagement portion, at the end facing away from the supporting portion, is provided with the engagement member. The length of the or each engagement arm is hereby variable.

[0029] In one embodiment, the actuating device comprises one or more drive members, wherein the or each engagement arm is provided with the drive member or a respective drive member, wherein the or each drive member is designed to drive the engagement portion with respect to the supporting portion of the engagement arm, and wherein the drive member of the or each engagement arm is designed to apply tensile load to the said engagement arm when this engages on the stationary object.

[0030] It is possible that the drive member of the or each engagement arm is designed to enable a displacement of the engagement portion in the longitudinal direction with respect to the supporting portion as the engagement arm is subjected to tensile load. If a buffer body is fixedly fastened to the hull, the vessel can rotate about that buffer body, whereupon the engagement arm becomes to some extent longer or shorter, while the said engagement arm is kept at pressure.

[0031] The actuating device can be designed to apply tensile load to the engagement arm by the application of a tensile load from the vessel to the engagement arm. It is also possible that the actuating device is designed to apply tensile load to the engagement arm by the application of a thrust from the vessel to the stationary object. For example, the actuating device is designed to apply tensile load to the engagement arm by the application of a thrust to the stationary object by the buffer body.

[0032] In one embodiment, the buffer body is displaceable with respect to the hull of the vessel, wherein the actuating device is provided with a drive member for driving the buffer body with respect to the hull of the vessel, and wherein the drive member of the buffer body is designed to apply a tensile load to the or each engagement arm.

[0033] It is here possible that the drive member for driving the buffer body is designed to enable a displacement of the buffer body with respect to the hull as the or each engagement arm is subjected to tensile load.

[0034] In one embodiment, the drive member of the or each engagement arm and/or the drive member of the buffer body each comprises at least one hydraulic cylinder and a collecting container, wherein the collecting container is provided with a movable partition wall, wherein the partition wall divides the collecting container into two chambers, wherein the first chamber is closed off and comprises a compressible fluid, and wherein the second chamber comprises hydraulic fluid and is connected to the hydraulic cylinder.

[0035] The invention likewise relates to a system comprising a vessel as described above and a stationary object, for example the mast of an offshore wind turbine or another offshore construction. The stationary object can be provided with two substantially vertical bumper bars, which are placed substantially parallel to each other and at a distance apart. The engagement members of the engagement arms can engage on the bumper bars.

[0036] The invention will now be explained in greater detail by way of example with reference to the appended drawings.

Figure 1 a shows a top view of a first embodiment of a vessel approaching a stationary object, wherein the engagement arms are in the release position.

Figure 1b shows a top view of the vessel shown in Figure 1a, which is being pushed against a stationary object by the motor, wherein the engagement arms are in the release position.

Figure 1c shows a top view of the vessel shown in Figure 1a wherein the engagement arms are in the engagement position.

Figure 1d shows a side view of the vessel shown in Figure 1 b.

Figure 2 shows a perspective view of the supporting frame with the engagement arms of the vessel shown in Figures 1a-1d.

Figure 3 shows a side view of a vessel which has been rotated downwards about the buffer body.

Figure 4 shows a perspective view of an alternative embodiment of the supporting frame with the engagement arms for use in connection with the vessel shown in Figures 1a-1d.

Figure 5 shows a side view of a vessel which has been rotated upwards about the engagement members of the engagement arms.

Figure 6a shows a top view of a third embodiment of a vessel approaching a stationary object, wherein the engagement arms are in the release position.

Figure 6b shows a top view of the vessel shown in Figure 6a, which is pushed against a stationary object by the motor, wherein the engagement arms are in the release position.

Figure 6c shows a top view of the vessel shown in Figure 6a, wherein the engagement arms are in the engagement position.

Figure 6d shows a side view of the vessel shown in Figure 6b.

[0037] A stationary object 3 is installed in a sea 2. In this illustrative embodiment, the stationary object 3 is an offshore wind turbine, which is provided with a mast. To the mast of the wind turbine 3 are fitted two substantially vertical bumper bars 5, 6. Between the bumper bars 5, 6 there is a ladder 7, by which installation or maintenance crew can climb up and down the wind turbine 3. The crew is brought to the offshore wind turbine 3 with a floating vessel 1 (a so-called "crew transport vessel"). The floating vessel 1 comprises a motor 14 for the propulsion of the vessel 1. In this illustrative embodiment, the motor 14 drives a propeller. The motor 14 can however drive some other propulsion member, such as a water jet, etc. (not shown). The motor 14 has, for example, a power to deliver 4-8 tonnes of thrust. The vessel 1 has a hull 9, which is provided with a bow 10, a middle body and a stern 11. On the deck 12 of the vessel 1, a supporting frame 17 is fixed (see Figures 1a-1d, 2). In this illustrative embodiment, the supporting frame 17 is located by the bow 10. Fastened to the supporting frame 17 is a buffer body 16, which protrudes from the hull 9. The buffer body 16 can otherwise also be fitted to the outer side of the hull 9 (not shown). The supporting frame 17 comprises a landing 18, on which a person can stand.

[0038] In this illustrative embodiment, two engagement arms 20, 21 are rotatably connected to the supporting frame 17 about a common vertical rotational axis 26. The engagement arms 20, 21 are also pivotably connected to the supporting frame 17 about two respective horizontal axes. Each engagement arm 20, 21 comprises a tubular supporting portion 22 and an engagement portion 23, which fits telescopically into the supporting portion 22. The supporting portion 22 and the engagement portion 23 are each elongated. At the free end of the engagement portion 23 there is placed an engagement member 24.

[0039] The engagement members 24 of the engagement arms 20, 21 are designed to engage on the bumper bars 5, 6 of the offshore wind turbine 3. In this illustrative embodiment, the engagement members 24 are each hook-shaped. Each engagement member 24 has a hook portion, which protrudes transversely from the engagement portion 23. The hook portion can grip at least partially behind one of the bumper bars 5, 6. The inner surface of the hook portion is provided with a resilient lining (not shown).

[0040] Each engagement arm 20, 21 is provided with a drive member for driving the engagement portion 23 with respect to the supporting portion 22. In this illustrative embodiment, the drive member of each engagement arm 20, 21 comprises a hydraulic cylinder (not shown). The hydraulic cylinder is placed inside the tubular supporting portion 22. The engagement portion 23 is connected to the supporting portion 22 by means of the hydraulic cylinder. The hydraulic cylinder can move the engagement portion 23 to and fro with respect to the supporting portion 22. If the engagement arms 20, 21 with the engagement members 24 are connected to the bumper bars 5, 6 of the offshore wind turbine 3, tensile load can be applied to the engagement arms 20, 21 by the application of a tensile force into the hydraulic cylinders of the engagement arms 20, 21.

[0041] The vessel 1 is stabilized against the bumper bars 5, 6 of the offshore wind turbine 3 as follows. First, by means of the motor 14, the buffer body 16 of the vessel 1 is pushed against the bumper bars 5, 6. The thrust of the motor 14 continues to push the buffer body 16, whereby the buffer body 16 is stabilized against the bumper bars 5, 6. The bumper body 16 is in this case unable or scarcely able to slide upwards or downwards along the bumper bars 5, 6. The engagement arms 20, 21 are here in a release position (see Figures 1a and 1b).

[0042] While the buffer body 16 remains stabilized against the bumper bars 5, 6 by the pushing with the motor 14, the engagement arms 20, 21 are displaced to an engagement position shown in Figure 1 c. The engagement arms 20, 21 rotate towards each other about the common rotational axis 26 until the engagement arms 20, 21 make contact with the bumper bars 5, 6. Next the hydraulic cylinders in the engagement arms 20, 21 are operated to move the engagement portion 23 inwards into the supporting portion 22. The hook portions of the

engagement members 24 hereupon come to bear against the rear side of the bumper bars 5, 6.

[0043] By subsequent further actuation of the hydraulic cylinders, the engagement arms 20, 21 are subjected to tensile load. The engagement arms 20, 21 hereby draw the bumper body 14 of the vessel 1 more firmly against the bumper bars 5, 6. The buffer body 14 and the bumper bars 5, 6 are hereby clamped stably together. The buffer body 14 and the tensile-loaded engagement arms 20, 21 then provide a stable connection between the vessel 1 and the offshore wind turbine 3. The thrust of the motor 14 is no longer necessary to hold the vessel 1 stably against the offshore wind turbine 3. Crew can hence safely cross from the landing 18 to the ladder 7 and back.

[0044] The drive members in the engagement arms 20, 21 are designed to enable a telescopic displacement of the engagement portion 23 with respect to the supporting portion 22, while at the same time tensile load continues to be applied to the engagement arms 20, 21. In this illustrative embodiment, the drive member of each engagement arm 20, 21 comprises an accumulator (not shown). The accumulator is provided with a collecting container, in which a movable partition wall is accommodated. The partition wall divides the interior of the collecting container into two chambers, the volume of which can vary through the displacement of the partition wall.

[0045] The first chamber is closed off by the movable partition wall, while the second chamber is connected to the hydraulic cylinder of the associated engagement arm 20, 21. In the first chamber is housed a compressible fluid under pressure, for example air or another gas. The second chamber is filled with hydraulic fluid, which can flow to and from the hydraulic cylinder. Hence the engagement arms 20, 21 are each kept at a substantially constant pressure when the engagement arms 20, 21 are subjected to tensile load, while a displacement of the engagement portion 23 with respect to the supporting portion 22 remains possible through the displacement of the movable partition wall in the collecting container.

[0046] In Figure 3, the buffer body 16 is fixedly fastened to the bow 10 of the vessel 1. When the stable connection has been established by the tensile loading of the engagement arms 20, 21, the vessel 1 can still rotate about a transverse axis 27 which is determined by the buffer body 16. The engagement arms 20, 21 are situated above the transverse axis 27. If the vessel 1 rotates downwards about the transverse axis 27, for example as the result of a wave, the engagement portion 23 shifts outwards with respect to the supporting portion 22 of the engagement arms 20, 21. The length of the displacement of the engagement portion with respect to the supporting portion is, for example, no greater than about 30 cm.

[0047] When the hydraulic cylinders in the engagement arms 20, 21 are extended, hydraulic fluid flows from each collecting container to the hydraulic cylinders. The movable partition wall in each collecting container moves jointly outwards, i.e. the volume of the second chamber decreases, while the volume of the first chamber increases proportionally. The engagement arms 20, 21 are hence kept at a constant pressure. As the length of the engagement arms 20, 21 is varied as a result of wave motions, tensile load therefore continues to be applied to the engagement arms 20, 21. A stable connection remains guaranteed.

[0048] It is also possible that the engagement arms 20, 21 are subjected to tensile load by the application of a thrust from the vessel 1 to the bumper bars 5, 6 of the offshore wind turbine 3. The supporting frame with engagement arms which is shown in Figure 2 can be replaced, for example, by the embodiment of the supporting frame with engagement arms which is shown in Figure 4. The same or similar components are here denoted with the same reference numerals.

[0049] In Figure 4, the supporting frame 17 is guided displaceably on a base frame 32 placed on the deck of the vessel. Since the buffer body 16 is fastened to the supporting frame 17, the buffer body 16 is displaceable with respect to the hull 9 of the vessel 1. The buffer body 16 and the engagement member 24 are mutually displaceable. One or more hydraulic cylinders 30, which can move the buffer body 16 to and fro with respect to the hull 9, are connected between the supporting frame 17 and the base frame 32. By means of the hydraulic cylinders 30, a thrust can be applied by the buffer body 16. The buffer body 16 can then rest under pressure against the bumper bars 5, 6.

[0050] In the illustrative embodiment according to Figure 4, the engagement arms 20, 21 are of rigid construction, i.e. the engagement arms 20, 21 possess a fixed length. When the stable connection has been established by actuation of the buffer body 16 outwards against the bumper bars 5, 6 so as to apply tensile load to the engagement arms 20, 21, the vessel 1 can still rotate about a transverse axis 28 which is determined by the rigid engagement arms 20, 21 (see Figure 5). The buffer body 16 is situated below the transverse axis 28. If the vessel 1 rotates upwards about the transverse axis 27, for example as the result of a wave, the buffer body 16 shifts outwards with respect to the hull 9. The length of the displacement of the buffer body 16 with respect to the hull 9 is, for example, no greater than about 30 cm. In the same way as described above for varying the length of the engagement arms 20, 21, tensile load continues to be applied to the engagement arms 20, 21 as the buffer body 14 is moved inwards and outwards by the use of an accumulator pertaining to each hydraulic cylinder 30.

[0051] In Figures 6a-6d, a further embodiment of the vessel to be stabilized against a stationary object is represented. The same or similar components are here denoted with the same reference numerals. The vessel 1 according to Figures 6a-6d has a flat bow 10. In this illustrative embodiment, the engagement arms 20, 21 are each fastened to a trolley, which is fitted on the supporting frame 17 such that it is displaceable in the transverse direction of the vessel 1. Figures 6a, b show the release position, in which the engagement arms 20, 21 have

moved apart. In Figure 6c, the engagement position is represented, in which the engagement members 20, 21 have moved closer together and clamp the bumper bars 5, 6. The construction and working of the vessel is further substantially the same as described above.

[0052] The invention is not limited to the illustrative embodiments represented in the figures. The person skilled in the art can make various adaptations which lie within the scope of the invention. For example, the buffer body and the engagement arms can be fitted to the stern of the vessel. In that case, the vessel is stabilized against the stationary object stemwards. Instead of engaging on bumper bars, the engagement arms can engage on the stationary object in another way.

[0053] The invention can also be described by the following clauses:

1. Method for stabilizing a floating vessel (1) against a stationary object (3), wherein the vessel (1) is provided with:

- a hull (9),
- a motor (14) for the propulsion of the vessel (1),
- a buffer body (16), which protrudes with respect to the hull (9), as well as
- at least a first engagement arm (20, 21), which at one end is provided with an engagement member (24) for engaging on the stationary object (3), and wherein the method comprises:
- the pushing of the buffer body (16) of the vessel (1) against the stationary object (3) by means of the motor (14), whereby the buffer body (16) is substantially stabilized against the stationary object (3),
- the engagement of the engagement member (24) on the stationary object (3) while the buffer body (16) and the stationary object (3) are mutually stabilized by the pushing,
- the application of a tensile load to the engagement arm (20, 21) while the engagement member (24) engages on the stationary object (3).

2. Method according to clause 1, wherein the buffer body (16) is fitted to a part of the vessel (1) which is not the first engagement arm or one of the engagement arms (20, 21), for example to a supporting frame (17) on the deck (12) of the vessel (1) or to the hull (9) of the vessel (1).

3. Method according to clause 1 or 2, wherein that end of the or each engagement arm (20, 21) which is provided with the engagement member (24) forms a free end of the said engagement arm (20, 21), and wherein the or each engagement arm (20, 21), at the opposite end, is fitted to the vessel (1).

4. Method according to one of the preceding clauses, wherein the buffer body (16) is substantially stabilized against the stationary object (3) by friction between the buffer body (16) and the stationary object (3).

5. Method according to one of the preceding clauses, wherein a first connection between the vessel (1) and the stationary object (3) is formed by the substantial stabilization of the buffer body (16) against the stationary object (3) by means of the pushing of the buffer body (16) of the vessel (1) against the stationary object (3) by means of the propulsion of the vessel (1) by means of the motor (14), and wherein a second connection between the vessel (1) and the stationary object (3) is formed by the engagement of the engagement member (24) on the stationary object (3) while the first connection remains in place by virtue of the fact that the buffer body (16) and the stationary object (3) are mutually stabilized by the pushing.

6. Method according to clause 5, wherein the first connection between the vessel (1) and the stationary object (3) is broken once the second connection between the vessel (1) and the stationary object (3) has been formed.

7. Method according to one of the preceding clauses, wherein tensile load is continuously applied to the or each engagement arm (20, 21) while the engagement member (24) engages on the stationary object (3).

8. Method according to one of the preceding clauses, wherein the or each engagement arm (20, 21) is subjected to tensile load by the application of a tensile force from the vessel (1) to the or each engagement arm (20, 21) and/or by the application of a thrust from the vessel (1) to the stationary object (3).

9. Method according to one of the preceding clauses, wherein the stationary object (3) is provided with at least two substantially vertical bumper bars (5, 6), and wherein the engagement member (24) of the first engagement arm (20) engages on a first bumper bar (5), and wherein the vessel (1) is provided with at least a second engagement arm (21), which at one end is provided with an engagement member (24) for engaging on a second bumper bar (6), and wherein both engagement members (24) engage on the bumper bars (5, 6) while the buffer body (16) and the stationary object (3) are mutually stabilized by the pushing, and wherein tensile load is applied to both engagement arms (20, 21) while the engagement members (24) thereof engage on the bumper bars (5, 6).

10. Method according to one of the preceding clauses, wherein the or each engagement arm (20, 21) is

displaceable between an engagement position, in which the engagement member (24) thereof engages on the stationary object (3), and a release position, in which the engagement member (24) thereof releases the stationary object (3), and wherein the or each engagement arm (20, 21) is in the release position prior to the pushing, and wherein the or each engagement arm (20, 21) is displaced from the release position to the engagement position after the buffer body (16) has been stabilized against the stationary object (3) by the pushing.

11. Method according to one of the preceding clauses, wherein the or each engagement arm (20, 21) comprises an elongated supporting portion (22) and an elongated engagement portion (23), wherein the supporting portion (22) is connected to the vessel (1), and wherein the engagement portion (23) is displaceable in the longitudinal direction with respect to the supporting portion (22), and wherein the engagement portion (23), at the end facing away from the supporting portion (22), is provided with the engagement member (24).

12. Method according to clause 11, wherein the or each engagement arm (20, 21) is provided with a drive member for driving the engagement portion (23) with respect to the supporting portion (22), and wherein the or each engagement arm (20, 21) is subjected to tensile load by the drive member of the said engagement arm (20, 21).

13. Method according to clause 12, wherein the drive member of the or each engagement arm (20, 21) enables a displacement of the engagement portion (23) in the longitudinal direction with respect to the supporting portion (22) as the engagement arm (20, 21) is subjected to tensile load.

14. Method according to one of the preceding clauses, wherein the buffer body (16) is displaceable with respect to the hull (9) of the vessel (1), and wherein the buffer body (16) is provided with a drive member for driving the buffer body (16) with respect to the hull (9) of the vessel (1), and wherein the or each engagement arm (20, 21) is subjected to tensile load by the drive member of the buffer body (16).

15. Method according to clause 14, wherein the drive member of the buffer body (16) enables a displacement of the buffer body (16) with respect to the hull (9) as the or each engagement arm (20, 21) is subjected to tensile load.

16. Method according to clause 13 or 15, wherein the drive member of the or each engagement arm (20, 21) and/or the drive member of the buffer body (16) each comprises a hydraulic cylinder and a collecting container, wherein the collecting container is provided with a movable partition wall, wherein the partition wall divides the collecting container into two chambers, wherein the first chamber is closed off and comprises a compressible fluid, and wherein the second chamber comprises hydraulic fluid and is connected to the hydraulic cylinder.

17. Method according to one of the preceding clauses, wherein after tensile load has been applied to the or each engagement arm (20, 21) while the engagement member (24) thereof engages on the stationary object (3), the pushing of the buffer body (16) of the vessel (1) against the stationary object (3) by means of the motor (14) is substantially halted.

18. Vessel, comprising:

- a hull (9),
- a motor (14) for the propulsion of the vessel,
- a buffer body (16) protruding with respect to the hull (9), which buffer body (16) is designed to be pushed against a stationary object (3),
- at least a first engagement arm (20, 21), which at one end is provided with an engagement member (24) for engaging on the stationary object (3) when the buffer body (16) and the stationary object (3) are mutually stabilized by the pushing of the buffer body (16) against the stationary object (3) by means of the motor (14), as well as
- an actuating device for subjecting the engagement arm (20, 21) to tensile load when this engages on the stationary object (3).

19. Vessel according to clause 18, wherein the buffer body (16) is fitted to a part of the vessel (1) which is not the first engagement arm or one of the engagement arms (20, 21), for example to a supporting frame (17) on the deck (12) of the vessel (1) or to the hull (9) of the vessel (1).

20. Vessel according to clauses 18 or 19, wherein that end of the or each engagement arm (20, 21) which is provided with the engagement member (24) forms a free end of the said engagement arm (20, 21), and wherein the or each engagement arm (20, 21), at the opposite end, is fitted to the vessel (1).

21. Vessel according to clauses 18-20, wherein the buffer body (16) can be substantially stabilized against the stationary object (3) by friction between the buffer body (16) and the stationary object (3).

22. Vessel according to one of clauses 18-21, wherein a first connection between the vessel (1) and the stationary object (3) can be formed by the substantial stabilization of the buffer body (16) against the sta-

tionary object (3) by means of the pushing of the buffer body (16) of the vessel (1) against the stationary object (3) by means of the propulsion of the vessel (1) by means of the motor (14), and wherein a second connection between the vessel (1) and the stationary object (3) can be formed by the engagement of the engagement member (24) on the stationary object (3) while the first connection remains in place by virtue of the fact that the buffer body (16) and the stationary object (3) are mutually stabilized by the pushing.

23. Vessel according to clause 22, wherein the first connection between the vessel (1) and the stationary object (3) can be broken once the second connection between the vessel (1) and the stationary object (3) has been formed.

24. Vessel according to one of clauses 18-23, wherein tensile load is continuously applied to the or each engagement arm (20, 21) while the engagement member (24) engages on the stationary object (3).

25. Vessel according to one of clauses 18-24, wherein the or each engagement arm (20, 21) is subjected to tensile load by the application of a tensile force from the vessel (1) to the or each engagement arm (20, 21) and/or by the application of a thrust from the vessel (1) to the stationary object (3).

26. Vessel according to one of clauses 18-25, wherein the stationary object (3) is provided with at least two substantially vertical bumper bars (5, 6), and wherein the engagement member (24) of the first engagement arm (20) engages on a first bumper bar (5), and wherein the vessel (1) is provided with at least a second engagement arm (21), which at one end is provided with an engagement member (24) for engaging on a second bumper bar (6), and wherein both engagement members (24) engage on the bumper bars (5, 6) while the buffer body (16) and the stationary object (3) are mutually stabilized by the pushing, and wherein both engagement arms (20, 21) are subjected to tensile load while the engagement members (24) thereof engage on the bumper bars (5, 6).

27. Vessel according to one of clauses 18-26, wherein the engagement member (24) of the first engagement arm (20) is designed to engage on a first, substantially vertical bumper bar (5) of the stationary object (3), and wherein the vessel (1) is provided with at least a second engagement arm (21), which at one end is provided with an engagement member (24) for engaging on a second, substantially vertical bumper bar (6) of the stationary object (3), and wherein both engagement members (24) are designed to engage on the bumper bars (5, 6) while the buffer body (16) and the stationary object (3) are mutually stabilized by the pushing, and wherein the actuating device is designed to apply tensile load to both engagement arms (20, 21) when they engage on the bumper bars (5, 6).

28. Vessel according to one of clauses 18-27, wherein the or each engagement arm (20, 21) is displaceable between an engagement position, in which the stationary object (3) can be engaged by the engagement member (24), and a release position, in which the stationary object (3) has been released by the engagement member (24).

29. Vessel according to one of clauses 18-28, wherein the or each engagement arm (20, 21) comprises an elongated supporting portion (22) and an elongated engagement portion (23), wherein the supporting portion (22) is connected to the vessel (1), and wherein the engagement portion (23) is displaceable in the longitudinal direction with respect to the supporting portion (22), and wherein the engagement portion (23), at the end facing away from the supporting portion (22), is provided with the engagement member (24).

30. Vessel according to clause 29, wherein the actuating device comprises one or more drive members, wherein the or each engagement arm (20, 21) is provided with the drive member or a respective drive member, wherein the or each drive member is designed to drive the engagement portion (23) with respect to the supporting portion (22) of the engagement arm (20, 21), and wherein the drive member of the or each engagement arm (20, 21) is designed to apply tensile load to the said engagement arm (20, 21) when this engages on the stationary object (3).

31. Vessel according to clause 30, wherein the drive member of the or each engagement arm (20, 21) is designed to enable a displacement of the engagement portion (23) in the longitudinal direction with respect to the supporting portion (22) as the engagement arm (20, 21) is subjected to tensile load.

32. Vessel according to one of clauses 18-31, wherein the buffer body (16) is displaceable with respect to the hull (9) of the vessel (1), and wherein the actuating device is provided with a drive member for driving the buffer body (16) with respect to the hull (9) of the vessel (1), and wherein the drive member of the buffer body (16) is designed to apply a tensile load to the or each engagement arm (20, 21).

33. Vessel according to clause 32, wherein the drive member for driving the buffer body (16) is designed to enable a displacement of the buffer body (16) with

respect to the hull (9) as the or each engagement arm (20, 21) is subjected to tensile load.

34. Vessel according to clause 31 or 33, wherein the drive member of the or each engagement arm (20, 21) and/or the drive member of the buffer body (16) each comprises a hydraulic cylinder and a collecting container, wherein the collecting container is provided with a movable partition wall, wherein the partition wall divides the collecting container into two chambers, wherein the first chamber is closed off and comprises a compressible fluid, and wherein the second chamber comprises hydraulic fluid and is connected to the hydraulic cylinder.

35. System comprising a vessel (1) according to one of clauses 18-34 and a stationary object (3), for example the mast of an offshore wind turbine.

Claims

1. Method for stabilizing a floating vessel (1) against a stationary object (3), wherein the vessel (1) is provided with:

- a hull (9),
- a motor (14) for the propulsion of the vessel (1),
- a buffer body (16), which protrudes with respect to the hull (9), as well as
- at least a first engagement arm (20, 21), which at one end is provided with an engagement member (24) for engaging on the stationary object (3), and wherein the method comprises:
- the pushing of the buffer body (16) of the vessel (1) against the stationary object (3) by means of the motor (14), whereby the buffer body (16) is substantially stabilized against the stationary object (3),
- the engagement of the engagement member (24) on the stationary object (3) while the buffer body (16) and the stationary object (3) are mutually stabilized by the pushing,
- the subjection of the engagement arm (20, 21) to tensile load while the engagement member (24) engages on the stationary object (3).

2. Method according to claim 1, wherein the buffer body (16) is fitted to a part of the vessel (1) which is not the first engagement arm or one of the engagement arms (20, 21), for example to a supporting frame (17) on the deck (12) of the vessel (1) or to the hull (9) of the vessel (1).

3. Method according to claim 1 or 2, wherein that end of the or each engagement arm (20, 21) which is provided with the engagement member (24) forms a free end of the said engagement arm (20, 21), and wherein the or each engagement arm (20, 21), at the opposite end, is fitted to the vessel (1).

4. Method according to one of the preceding claims, wherein the buffer body (16) is substantially stabilized against the stationary object (3) by friction between the buffer body (16) and the stationary object (3).

5. Method according to one of the preceding claims, wherein a first connection between the vessel (1) and the stationary object (3) is formed by the substantial stabilization of the buffer body (16) against the stationary object (3) by means of the pushing of the buffer body (16) of the vessel (1) against the stationary object (3) by means of the propulsion of the vessel (1) by means of the motor (14), and wherein a second connection between the vessel (1) and the stationary object (3) is formed by the engagement of the engagement member (24) on the stationary object (3) while the first connection remains in place by virtue of the fact that the buffer body (16) and the stationary object (3) are mutually stabilized by the pushing.

6. Method according to claim 5, wherein the first connection between the vessel (1) and the stationary object (3) is broken once the second connection between the vessel (1) and the stationary object (3) has been formed.

7. Method according to one of the preceding claims, wherein tensile load is continuously applied to the or each engagement arm (20, 21) while the engagement member (24) engages on the stationary object (3).

8. Method according to one of the preceding claims, wherein the or each engagement arm (20, 21) is subjected to tensile load by the application of a tensile force from the vessel (1) to the or each engagement arm (20, 21) and/or by the application of a thrust from the vessel (1) to the stationary object (3).

9. Method according to one of the preceding claims, wherein the stationary object (3) is provided with at least two substantially vertical bumper bars (5, 6), and wherein the engagement member (24) of the first engagement arm (20) engages on a first bumper bar (5), and wherein the vessel (1) is provided with at least a second engagement arm (21), which at one end is provided with an engagement member (24) for engaging on a second bumper bar (6), and wherein both engagement members (24) engage on the bumper bars (5, 6) while the buffer body (16) and the stationary object (3) are mutually stabilized by the pushing, and wherein both engagement arms (20, 21) are subjected to tensile load while the en-

gagement members (24) thereof engage on the bumper bars (5, 6).

10. Method according to one of the preceding claims, wherein the or each engagement arm (20, 21) comprises an elongated supporting portion (22) and an elongated engagement portion (23), wherein the supporting portion (22) is connected to the vessel (1), and wherein the engagement portion (23) is displaceable in the longitudinal direction with respect to the supporting portion (22), and wherein the engagement portion (23), at the end facing away from the supporting portion (22), is provided with the engagement member (24), wherein the or each engagement arm (20, 21) is provided with a drive member for driving the engagement portion (23) with respect to the supporting portion (22), and wherein the or each engagement arm (20, 21) is subjected to tensile load by the drive member of the said engagement arm (20, 21), wherein the drive member of the or each engagement arm (20, 21) enables a displacement of the engagement portion (23) in the longitudinal direction with respect to the supporting portion (22) as the engagement arm (20, 21) is subjected to tensile load.

11. Method according to one of the preceding claims, wherein the buffer body (16) is displaceable with respect to the hull (9) of the vessel (1), and wherein the buffer body (16) is provided with a drive member for driving the buffer body (16) with respect to the hull (9) of the vessel (1), and wherein the or each engagement arm (20, 21) is subjected to tensile load by the drive member of the buffer body (16), wherein the drive member of the buffer body (16) enables a displacement of the buffer body (16) with respect to the hull (9) as the or each engagement arm (20, 21) is subjected to tensile load.

12. Method according to claim 10 or 11, wherein the drive member of the or each engagement arm (20, 21) and/or the drive member of the buffer body (16) each comprises a hydraulic cylinder and a collecting container, wherein the collecting container is provided with a movable partition wall, wherein the partition wall divides the collecting container into two chambers, wherein the first chamber is closed off and comprises a compressible fluid, and wherein the second chamber comprises hydraulic fluid and is connected to the hydraulic cylinder.

13. Vessel, comprising:

- a hull (9),
- a motor (14) for the propulsion of the vessel,
- a buffer body (16) protruding with respect to the hull (9), which buffer body (16) is designed to be pushed against a stationary object (3),
- at least a first engagement arm (20, 21), which at one end is provided with an engagement member (24) for engaging on the stationary object (3) when the buffer body (16) and the stationary object (3) are mutually stabilized by the pushing of the buffer body (16) against the stationary object (3) by means of the motor (14), as well as
- an actuating device for subjecting the engagement arm (20, 21) to tensile load when this engages on the stationary object (3).

14. Vessel according to claim 13, wherein the or each engagement arm (20, 21) comprises an elongated supporting portion (22) and an elongated engagement portion (23), wherein the supporting portion (22) is connected to the vessel (1), and wherein the engagement portion (23) is displaceable in the longitudinal direction with respect to the supporting portion (22), and wherein the engagement portion (23), at the end facing away from the supporting portion (22), is provided with the engagement member (24), wherein the actuating device comprises one or more drive members, wherein the or each engagement arm (20, 21) is provided with the drive member or a respective drive member, wherein the or each drive member is designed to drive the engagement portion (23) with respect to the supporting portion (22) of the engagement arm (20, 21), and wherein the drive member of the or each engagement arm (20, 21) is designed to apply tensile load to the said engagement arm (20, 21) when this engages on the stationary object (3), wherein the drive member of the or each engagement arm (20, 21) is designed to enable a displacement of the engagement portion (23) in the longitudinal direction with respect to the supporting portion (22) as the engagement arm (20, 21) is subjected to tensile load.

15. Vessel according to claim 13 or 14, wherein the buffer body (16) is displaceable with respect to the hull (9) of the vessel (1), and wherein the actuating device is provided with a drive member for driving the buffer body (16) with respect to the hull (9) of the vessel (1), and wherein the drive member of the buffer body (16) is designed to apply a tensile load to the or each engagement arm (20, 21), wherein the drive member for driving the buffer body (16) is designed to enable a displacement of the buffer body (16) with respect to the hull (9) as the or each engagement arm (20, 21) is subjected to tensile load.

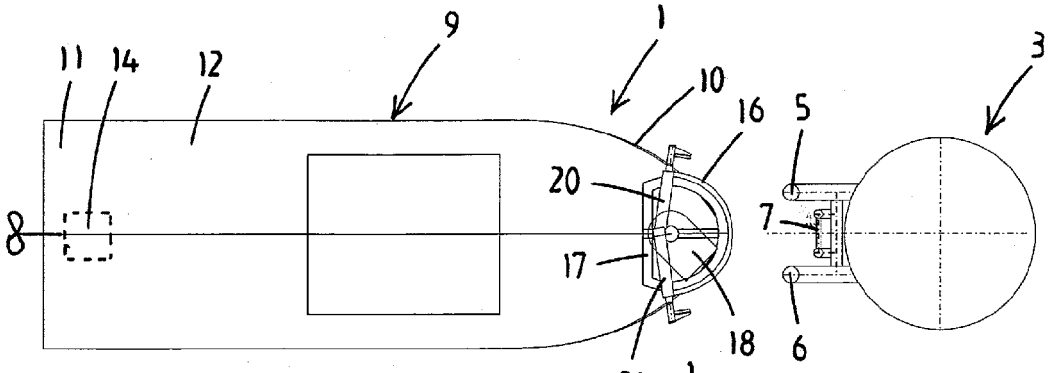

Fig.1a

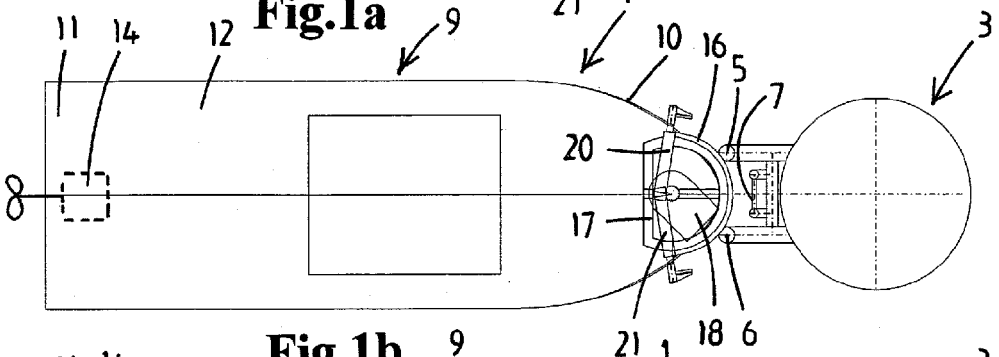

Fig.1b

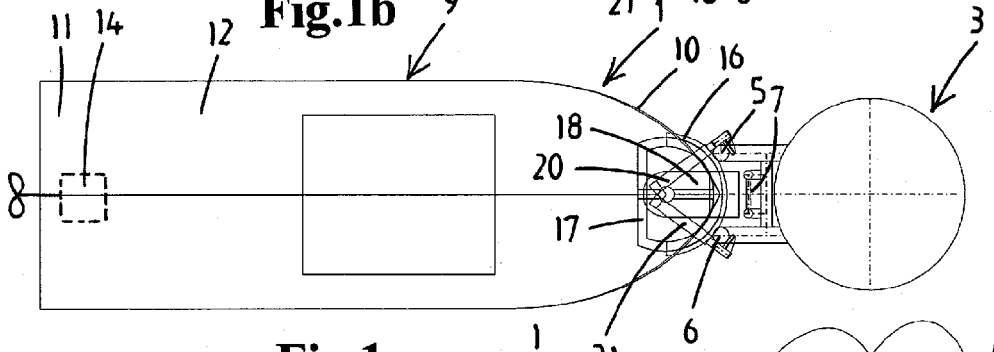

Fig.1c

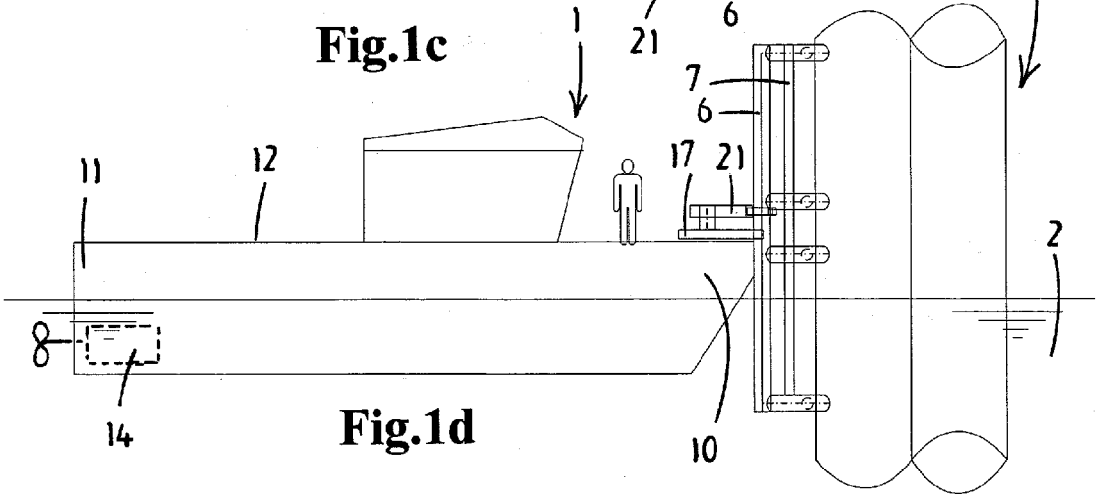

Fig.1d

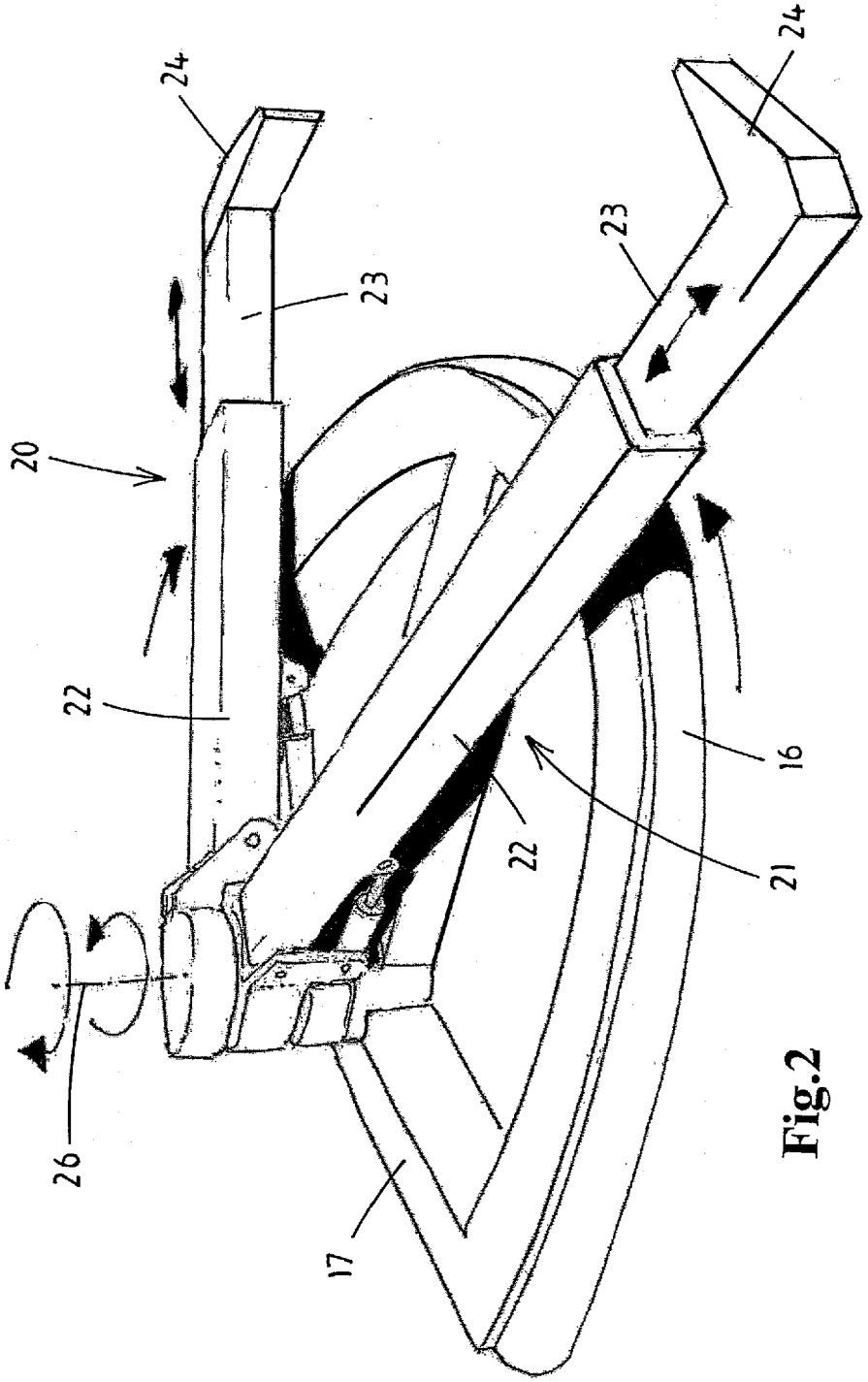

Fig.2

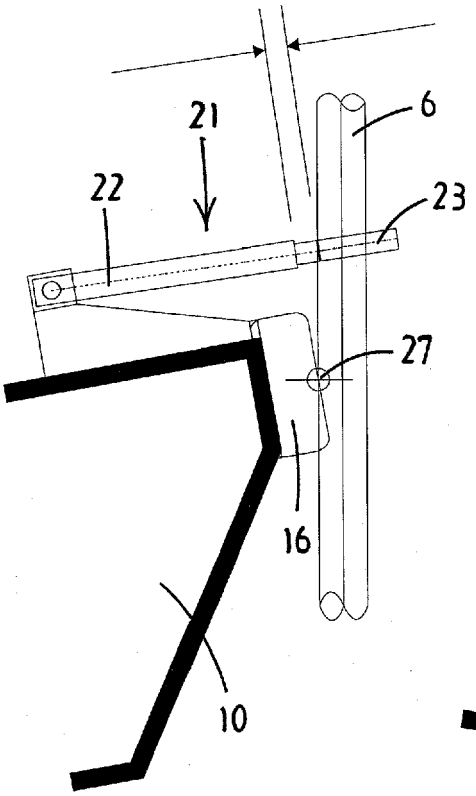

Fig.3

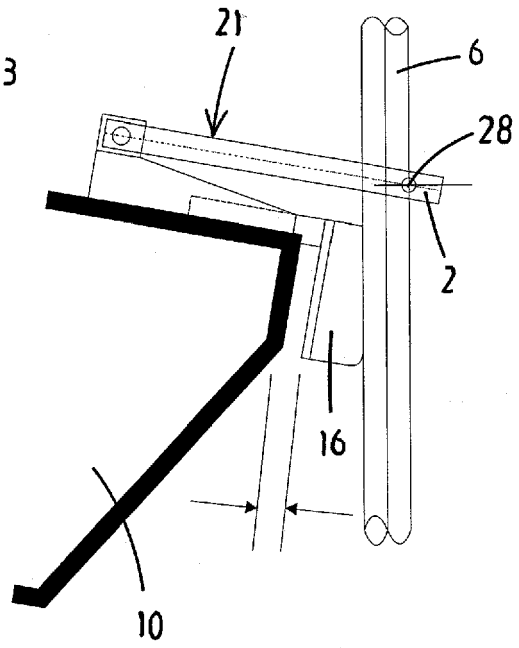

Fig.5

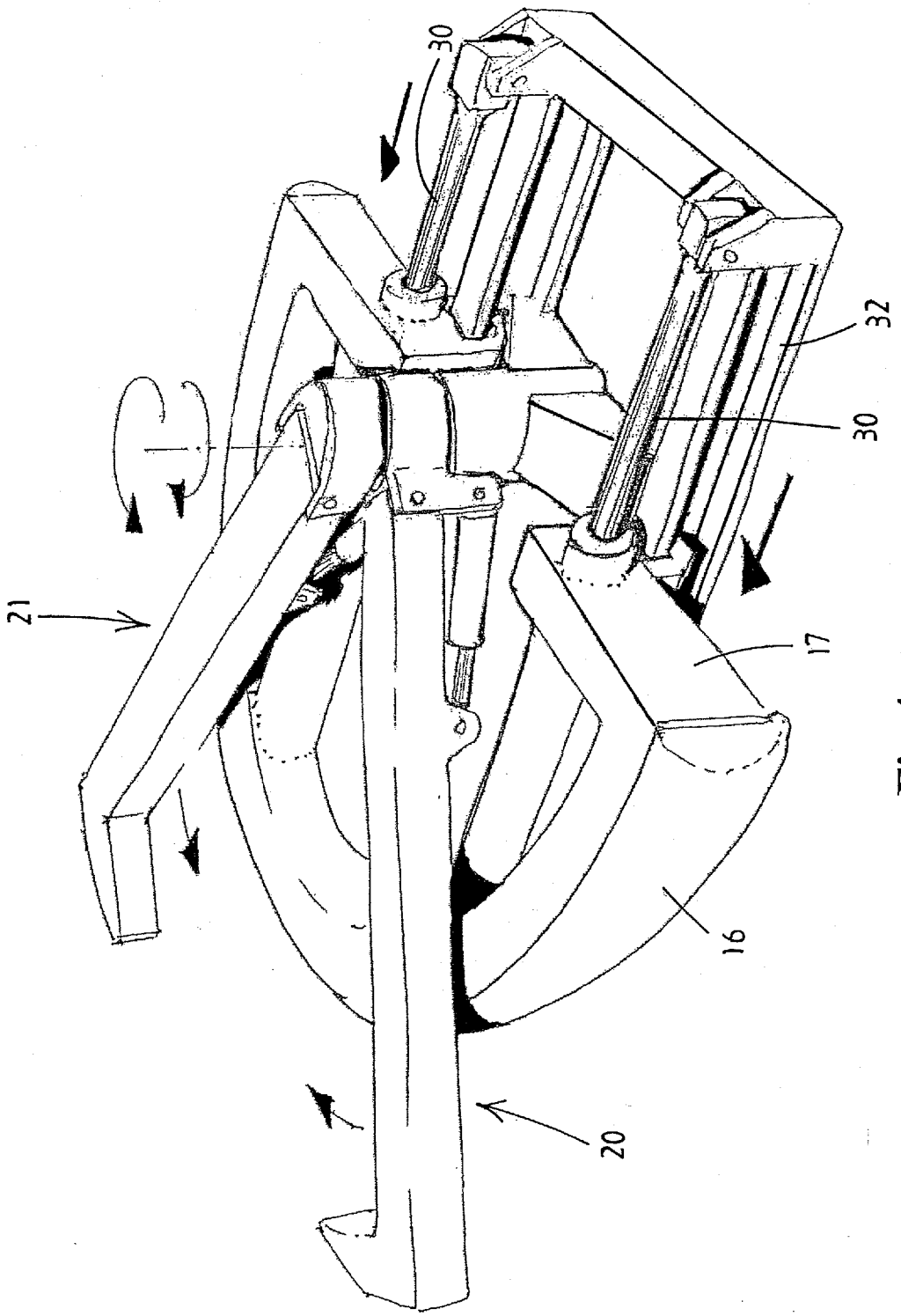

Fig.4

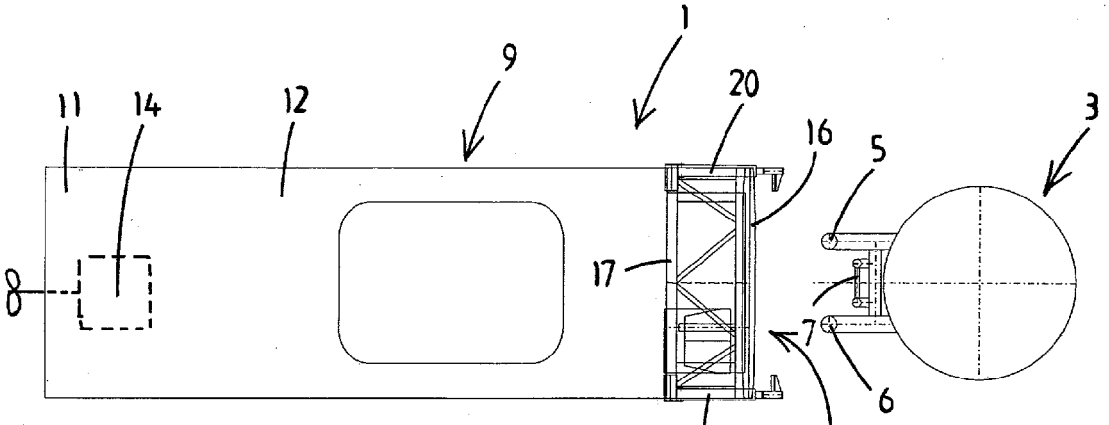

Fig.6a

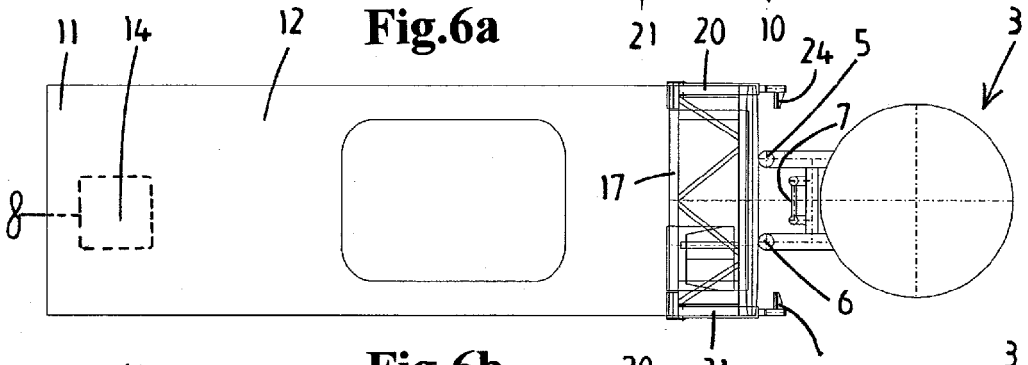

Fig.6b

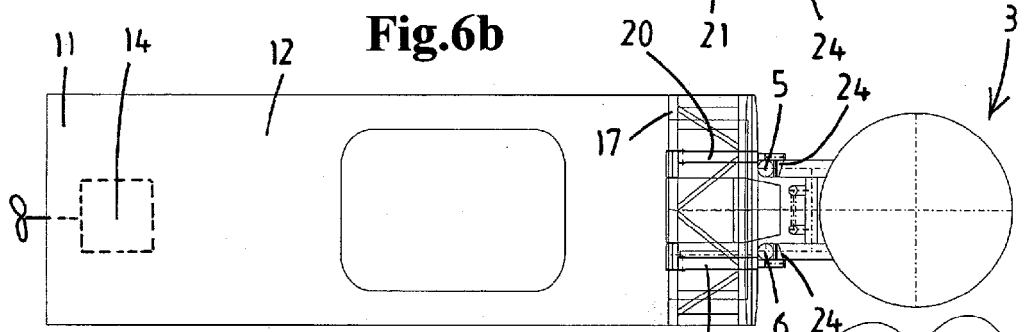

Fig.6c

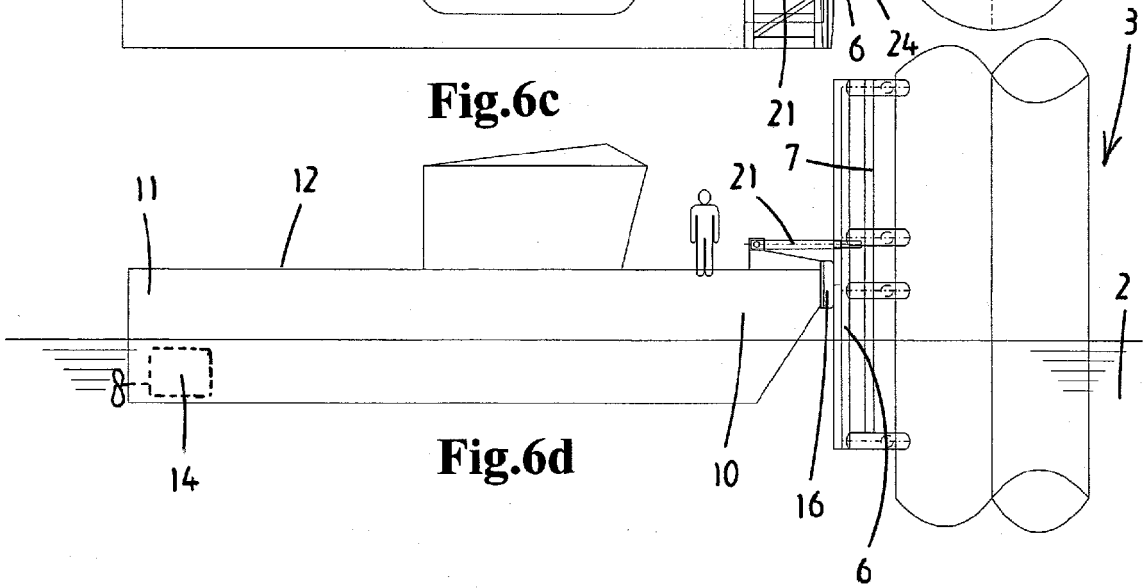

Fig.6d

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EUROPEAN SEARCH REPORT

Application Number
EP 10 18 9291

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 02/20343 A1 (P & R SYSTEMS [NL]; PRINS REINOUT KLAAR NORFOLC JA [NL]) 14 March 2002 (2002-03-14) * figures 1-2 *	1,3,8, 10,13,14	INV. B63B27/14
X	WO 2005/097591 A1 (FABRICOM OIL & GAS B V; STAPEL HENDRIK PIETER [NL]) 20 October 2005 (2005-10-20) * figures 3,4,5,6,8 *	1,3,8, 10,13,14	
X	WO 00/15489 A1 (AEGIR KONSULT AB [SE]; ENGSTROEM STAFFAN [SE]) 23 March 2000 (2000-03-23) * figures 2,3,4 *	1-6,8, 11,13,15	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 February 2011	van Rooij, Michael

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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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

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 10 18 9291

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
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