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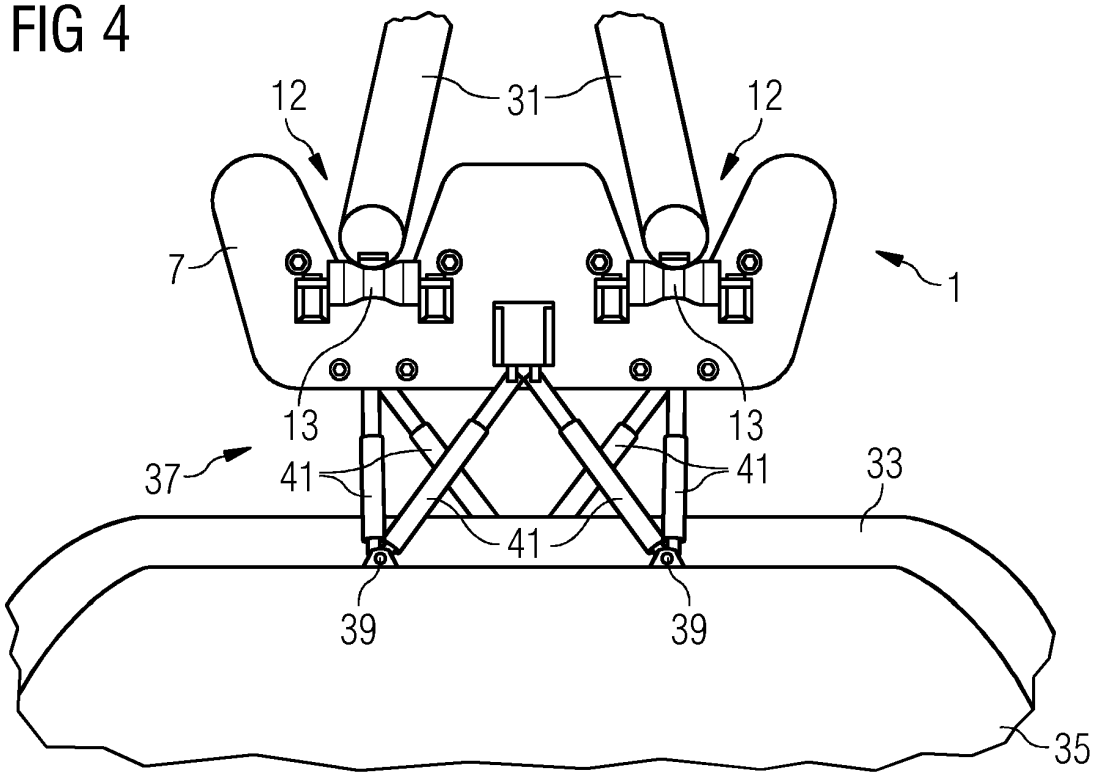
(54) **Vessel, docking system and docking structure**

(57) A docking structure for docking a vessel (35) to at least one bumper bar (31) of a marine structure (43) comprises:
- a buffer (1) with at least one gripping system (15) suitable for gripping a bumper bar (31) of a marine structure (43);
- a mounting section (39) for mounting the docking system to a vessel; and
- a kinematic structure (37) which connects the mounting section (39) to the buffer (1) and offers six degrees of freedom for a relative movement between the mounting section (39) and the buffer (1).

FIG 4



EP 2 818 396 A1

Description

[0001] The present invention relates to a docking structure for docking a vessel to at least one bumper bar of a marine structure such as, for example, an offshore wind turbine. The invention further relates to a docking system comprising such a docking structure and to a vessel with such a docking structure.

[0002] After installing a marine structure the structure has to be maintained on a regular basis. For maintaining the structure personal needs to access the structure from time to time. To bring personal to the structure to be maintained a transfer vessel is used which docks to the marine structure. However, the transfer of personal and material to the marine structure might be difficult or even dangerous if the marine structure is more or less fixed relative to the waves while the boat is floating. Therefore, docking systems are used which fix the vessel relative to the marine structure so as to reduce movements of the vessel relative to the marine structure. Such a docking system is, for example, disclosed in EP 2 316 721 A1. The docking system disclosed therein is fixed to the bow of a vessel and includes a buffer and hydraulic engagement arms with hook portions. The engagement arms can be moved towards each other so as to grip bumper bars located at the marine structure. Moreover, the engagement arms comprise hydraulic cylinders by means of which they can draw the vessel firmly against the bumper bars. After the vessel is secured to the marine structure by means of the buffer and the engagement arms the personal and material can be transferred from the vessel to the structure.

[0003] Docking systems as described above are suitable for use in waves up to a given wave height. If this wave height is exceeded, no personal or material can be transferred to the marine structure. In some situations this may lead to a shutdown of the marine structure until personal and material can reach the marine structure. In particular in case of offshore wind turbines shutting down means losing money since the wind turbine cannot produce energy. It is therefore desirable to have docking systems which allow transfer of personal and material to a marine structure even in case of relative large wave height.

[0004] It is, therefore, an objective of the present invention to provide an advantageous docking structure and an advantageous docking system which allow for docking a vessel to a marine structure and for the transfer of personal or material from the vessel to the marine structure even with relatively large wave height. It is a second objective of the present invention to provide an advantageous vessel which can be used for transferring personal or material to a marine structure even in case of relatively large wave height.

[0005] The first objective is achieved by a docking structure as claimed in claim 1 and by a docking system as claimed in claim 12. The second objective is achieved by a vessel as claimed in claim 11. The depending claims contain further developments of the invention.

[0006] An inventive docking structure that can be used for docking a vessel to at least one bumper bar of a marine structure such as, for example, of an offshore wind turbine comprises a buffer with at least one gripping system suitable for gripping a bumper bar of a marine structure, a mounting section for mounting the docking system to a vessel, and a kinematic structure. The kinematic structure connects the mounting section to the buffer and offers six degrees of freedom for a relative movement between the mounting section and the buffer.

[0007] In the inventive docking structure the buffer with the gripping system allows for securely fixing the buffer to a bumper bar of a marine structure. At the same time, the kinematic structure with the six degrees of freedom allows the mounting section of the docking structure, and thereby a vessel connected to the docking structure by means of the mounting section, to move and rotate within a given range relative to the buffer, and thereby relative to the bumper bar of the marine structure to which the buffer is fixed. By this measure loads acting on the docking structure due to relative movement between a vessel and the marine structure can be reduced, which in the end allows using the docking structure at relative large wave height.

[0008] The kinematic structure may comprise a damping structure for damping relative movement between the mounting section and the buffer. By this measure the vessel, which can move in six degrees of freedom due to the kinematic structure, is prevented from crashing into the bumper bar. The damping structure may, in particular, be the hydraulic or pneumatic damping structure.

[0009] Moreover, in the inventive docking structure, the kinematic structure may comprise a hydraulic or pneumatic actuator that is able to set a relative orientation of the buffer relative to the mounting section. By this measure it is possible to suitably orientate the buffer when the vessel calls at the bumper bar of the marine structure. Due to the freedom in orientation of the buffer calling at the bumper bar under various angles becomes possible. Moreover, if controlling of the actuator is fast movements of the vessel during calling at the bumper bar can be compensated by adapting the orientation of the buffer relative to the mounting section.

[0010] A suitable kinematic structure which can be used in the inventive docking structure is Stewart platform. Such a Stewart platform has a good relation between loads that can be handled by the kinematic structure to the weight of the structure.

[0011] In a further development of the inventive docking structure the buffer comprises at least one buffer abutment face, where for each bumper bar a buffer abutment face is present. Moreover, the gripping system comprises at least one pair of engagement arms, where for each bumper bar to be gripped a pair of engagement arms is present and where each engagement arm includes an arm abutment face for contacting the bumper bar. By providing a buffer abutment face and a pair of engage-

ment arms for each bumper bar the bumper bar can be contacted at three points which allows for securely fixing the buffer to the bumper bar. The buffer abutment face and/or the arm abutment faces may be formed by roller surfaces. By this measure moving the buffer up and down the bumper bar can be simplified.

[0012] In a still further development of the inventive docking structure the buffer is equipped with at least one moveable gear wheel, where for each bumper bar a gear wheel is present and where each gear wheel is moveable within the buffer from a storage position to a working position in which it contacts the bumper bar when the buffer abutment face and the arm abutment faces are in contact with the bumper bar. Such a gear wheel allows for actively moving the bow of a vessel to which the docking system is fixed up and down along the bumper bar if the bumper bar is equipped with a respective gear rod. The gear wheel may be located above or below a roller containing the roller surface forming the buffer abutment face. Moreover, two rollers may be present for each bumper bar, where each of the two rollers includes a roller surface forming a buffer abutment face and where the gear wheel is located between the two rollers. This arrangement may help to reduce loads on the gear wheel. If a locking mechanism is associated to the gear wheels so that the gear wheels can be locked by use of the locking mechanism. By locking the gear wheels an up or down movement of the along the bumper bar can be suppressed.

[0013] An inventive docking system comprises an inventive docking structure and at least one bumper bar. The bumper bar is connected or connectable to a marine structure such as, for example, to an offshore wind turbine. The properties and advantages of such a docking system correspond to those that have already been discussed with respect to the inventive docking structure.

[0014] In a special development of the inventive docking system each bumper bar is equipped with a gear rod and the docking structure is a docking structure that is equipped with at least one gear wheel for each bumper bar. The properties and advantages of such an arrangement have already been discussed with respect to the inventive docking structure.

[0015] An inventive vessel has an inventive docking structure fixed to its bow. The properties and advantages that can be achieved with a vessel having an inventive docking structure fixed to its bow have already been described with respect to the inventive docking structure.

[0016] Further features, properties and advantages of the present invention will become clear from the following description of embodiments in conjunction with the accompanying drawings.

Figure 1 shows a buffer of the inventive docking structure in a perspective front view.

Figure 2 shows the buffer of figure 1 in perspective rear view.

Figure 3 shows an engagement arm used in a gripping system of the buffer shown in figures 1 and 2.

Figure 4 shows the kinematic structure by which the buffer shown in figures 1 and 2 is fixed to the bow of a vessel.

Figure 5 shows bumper bars of the inventive docking system.

Figures 6 to 22 show how a vessel is secured to a marine structure by means of the inventive docking system.

[0017] Figure 1 shows a buffer which is part of the inventive docking structure in a perspective front view while figure 2 shows the buffer in a perspective rear view. The buffer 1 comprises a carrier structure 3 which includes a frame 5 to which an upper carrier plate 7 and a lower carrier plate 9 are fixed. Each of the upper carrier plate 7 and the lower carrier plate 9 is equipped with two recesses 11 which form receiving sections, where each recess 11 is in the form of a trapezoid with the open side of the recess being formed by the longer base of the trapezoid and the rear side of the recess being formed by the shorter base of the trapezoid. The recesses of the upper carrier plate 7 are located above the recesses 11 of the lower carrier plate 9 so that they together form receptacles 12 for receiving bumper bars 31 (the bumper bars are shown in figure 5) of a docking system. Rollers 13 are located on the upper and lower carrier plates 7, 9 close to the rear sides of the recesses 11 in such a way that the roller surfaces project over the rear sides towards the open sides of the recesses 11. Thus, the roller surfaces form abutment surfaces which can butt at bumper bars 31.

[0018] In addition, the buffer 1 comprises a gripping system, which is formed by engagement arms 15. One engagement arm is shown separately in figure 3. The gripping system of the present embodiment includes two pairs of engagement arms 15, one pair for each receptacle 12 of the buffer, i.e. one pair for each bumper bar 31 to be gripped. The engagement arms 15 are located between the upper carrier plate 7 and the lower carrier plate 9 at the leg sides of the trapezoid recesses 11. They can be rotated about a rotation axis 17 by means of hydraulic cylinders 19 or any other suitable drive means, such as, e. g., electric motors. Engagement rollers 21 are positioned at the free ends of the engagement arms 15 and can project into the respective receptacle 12 formed by the recesses 11 to butt at a bumper bar 31 received in the receptacle when the engagement arms are activated.

[0019] When the engagement arms 15 are not activated the free ends with the engagement rollers 21 are located between the upper carrier plate 7 and the lower carrier plate 9 so that they do not project into the receptacles 12. After being activated the engagement arms 15

are rotated about their respective rotation axis 17 by means of the hydraulic cylinders 19 or any other suitable drive means so that the engagement rollers 21 will project into the receptacles 12 to butt at a bumper bar 31 located within the receptacles 12. When the engagement rollers 21 and the rollers 13 butt at a bumper bar 31 the bumper bar is engaged at three points which are distributed about the circumference of the bumper bar 31 so that the bumper bar 31 is securely gripped and cannot slip out of the receptacle 12. In particular, the three points of contact with the bumper bar 31 may substantially form an equilateral triangle.

[0020] Gear wheels are present at the rear side of the receptacles 12. They are located between the upper carrier plate 7 and the lower carrier plate 9 and each gear wheel is moveable from a location outside of the respective receptacle 12 to a location in which it at least partly projects into the receptacle 12. For moving the gear wheel 23 into the receptacle 12 and out of the receptacle 12 a swivel axis 27 is present about which the gear wheel 23 can be swivelled, driven by a hydraulic cylinder 25 or any other suitable drive means such as, e. g., an electric motor. When the gear wheel 23 is swivelled into the receptacle 12 it can engage a gear rod 29 that is located at a bumper bar 31 of an inventive docking system. Bumper bars 31 of a marine structure 32 which are equipped with gear rods 29 are shown in figure 5.

[0021] Figure 4 shows a top view of the inventive docking system that illustrates an inventive docking structure fixed to the bow 33 of a vessel 35. Moreover, the figure shows two bumper bars 31. In addition to the buffer 1 which has been described with respect to figures 1 to 3 the docking structure includes a Stewart platform 37 one side of which is connected to the rear end of the buffer 1 and the other side of which comprises one or more mounting sections for mounting it to the bow 33 of a vessel 35. In the present embodiment, the mounting sections are formed by three fixing points 39 by which the Stewart platform can be fixed to the bow 33 of a vessel 35. However, the mounting section may also be realised as a fixing platform of the Stuart platform that can be fixed to the bow of a vessel.

[0022] The Stewart platform 37 includes 6 diagonal Hydraulic jacks that are mounted in pairs at the fixing points 39 or at the fixing platform and cross over to three mounting points at the buffer 1 where they are also mounted in pairs but in another configuration than at the fixing pints 39 or at the fixing platform. The Stewart platform 37 is a kinematic construction which allows to move the buffer relative to the fixing points 39, and thereby relative to the vessel 35, in six degrees of freedom, i.e. the Stewart platform allows the buffer 1 to be shifted relative to the vessel in three independent directions and to be rotated relative to the vessel 35 about three independent rotational axes. Hence, the Stewart platform 37 allows the buffer 1 to be freely rotated and shifted relative to the vessel 35 in a given translational range and the given angular range. Please note that it is not mandatory to use a Stewart platform 37 for connecting the buffer 1 to the bow 33 of a vessel 35. Any other suitable kinematic structure offering six degrees of freedom would be useable as well. However, since the Stewart platform is a parallel kinematics it can achieve a high rigidity with a relatively low weight construction. Moreover, the Stewart platform 37 can also be used as a suitable shock-absorbing means.

[0023] The use of the inventive docking structure will now be described with reference to figures 6 to 22. While figures 6 to 13 show the approach of the vessel 35 to the bumper bars figures 14 to 22 show how the vessel is moored to the marine structure by use of the inventive docking system.

[0024] Figure 6 shows a vessel 35 to the bow 33 of which a docking structure with a buffer 1 as has been described with respect to figures 1 to 3 and with a Stewart platform 37 is fixed by means of the fixing points 39. The figure also shows a tower 43 of an offshore wind turbine which forms the marine structure of the present embodiment. The tower 43 is equipped with two bumper bars 31 as they are shown in figure 5. Figures 7 to 13 show the vessel 35 and the tower 43 in a schematic top view, where Figures 6 to 9 show the vessel as it approaches the wind turbine tower 43. As can be seen from figures 6 to 9, the vessel 35 approaches the bumper bars 31 not frontally but at an angle so that the buffer 1 will contact one of the bumper bars 31 (the lower bumper bar in figures 6 to 9) first. In the stage of approaching the bumper bars 31 the Stewart platform is fully extended, i.e. its hydraulic jacks 41 are fully extended. Moreover, the buffer 1 is oriented in line with the vessel 35.

[0025] The final stage of approaching the bumper bars 31 is shown in figures 10 to 13. In the final approach, the skipper heads for one of the bumper bars 31 so that the respective bumper bar 31 is received within one of the receptacles 12 of the buffer 1. The receptacle 12 that is to receive the bumper bar 31 is chosen such that the other receptacle 12 is able to receive the second bumper bar 31. Once the first bumper bar 31 contacts the rollers 13 on the upper and lower carrier plates 7, 9 the skipper ensures relevant vessel heading and forward trust while the Stewart platform 37 rotates to engage the second bumper bar 31 with the other receptacle 12 (see figure 11). When the rollers 13 of the other receptacle 12 contact the second bumper bar (see figure 12) the vessel turns into position so that the bumper bars 31 are straight ahead of the bow 33 of the vessel 35. This last stage of approaching the bumper bars 31 is shown in figure 13. In the final approach of the vessel 35 to the tower 43, contact between the rollers located at the upper and lower carrier surfaces 7, 9 with the bumper bars 31 can be detected by means of suitable detectors which are known to a person skilled in the art and will, therefore, not be described in further detail here. Moreover, the Stewart platform 37 is absorbing the shocks when the rollers butt at the bumper bars 31. The operation of the docking system may be done manually or by means of on board

computer aid, which in the latter case will manage the simultaneous operation of the various parts of the docking system and forward and sideward engine generated pull during docking on and docking off operation. Auto pilot will control the ships movements with information from the platform (piston position and hydraulic pressure). This gives a safe ship control.

[0026] Figures 14 to 18 show the gripping of the bumper bars 31 by means of the gripping structure that is part of the buffer 1. The figures show, in a top view, the bumper bars 31, the buffer 1 and the Stewart platform 37. Figure 14 is more or less and enlarged detailed view of figure 13. The rollers 13 of the buffer 1 contact the bumper bars 31 and the vessel 35, the buffer 1 and the wind turbine tower 43 have been aligned relative to each other. Once contact of the rollers 13 of the buffer 1 with the bumper bars 31 is affirmed, i. e. once contact between the bumper bars 31 and the rollers 13 of the buffer 1 has been detected, the engagement arms 15 will be activated, as it is shown in figure 15. Upon activation of the engagement arms 15 the hydraulic cylinders 19 expand to rotate the engagement arms 15 about their respective rotation axis 17 until the engagement rollers 21 butt at the bumper bars 31 (compare figures 16 and 17). Butting of the engagement rollers 21 at the bumper bars can be detected by suitable detectors which are known to a person skilled in the art. When the engagement rollers 21 and the rollers 13 butt at the bumper bars 31 the buffer 1, and thereby the vessel 35, is secured against slipping off from the bumper bars 31. Due to the fact that the abutment faces butting at the bumper bars 31 are roller faces the buffer 1 can move up and down the bumper bars 31 without great resistance. This stage of the docking process is shown in figures 18 and 19.

[0027] Figures 20 to 22 show the final steps of mooring the vessel 35 to the wind turbine tower 43. In particular, figures 20 and 21 show the buffer 1 in a side view without the side walls so that the interior of the buffer 1 is visible. After the buffer 1 has been secured to the bumper bars 31 against slipping off the gear wheels 23 will be swivelled about the swivel axis 27 from a first position in which they are located fully between the upper carrier plate 7 and the lower carrier plate 9 into a second position in which they at least partly project into the receptacles 12 so that they engage the gear rods of the bumper bars 31. Swivelling the gear wheels 23 is done by means of hydraulic cylinders 25. After swivelling the gear wheels 27 into the second position, the teeth of the gear wheels 23 are in working contact with the teeth of the gear rods 29 shown in figure 5. The stage with the teeth of the gear wheels 23 contacting the teeth of the gear rods 29 is shown in figure 21. In this stage the gear wheels 23 are freewheeling so that the vessel 35 can still move up and down together with the waves.

[0028] A locking mechanism is associated with the gear wheels 23 which allow locking the gear wheels 23 so that freewheeling can be stopped. Locking the gear wheels 23 is done when the vessel 35 is on top of a wave, where the locking is realised, for example, by means of a hydraulic mechanism. Once the gear wheels 23 are locked the bow 33 of the vessel 35 stays at a certain height so that the bow 33 is out of the waves and personal or material can be transferred from the vessel to the wind turbine tower 43. Since the bow 33 of the vessel 35 is always above the waves the risk for personal transferring from the vessel to the wind turbine tower 43 can be reduced, even in case of a relatively large wave height. While the bow 33 of the vessel is located above the waves the stern 45 of the vessel 35 can freely follow the waves since the Stewart platform 37 allows for a relative motion between the vessel 35 and the buffer 1 in six degrees of freedom. Movement of the bow 33 is thereby greatly reduced since the movement of the vessel is more or less a relative movement of its stern 45 about the buffer.

[0029] For casting off, the gear wheels 23 are used to slowly lower the bow 33 into the waves again. Then, the gear wheels 23 are disengaged from the gear rods 29 and the engagement arms 15 are moved out of the recesses 11 so that the vessel 35 is free to move away from the wind turbine tower 43.

Claims

1. A docking structure for docking a vessel (35) to at least one bumper bar (31) of a marine structure (43), comprising:

   - a buffer (1) with at least one gripping system (15) suitable for gripping a bumper bar (31) of a marine structure (43);
   - a mounting section (39) for mounting the docking system to a vessel; and
   - a kinematic structure (37) which connects the mounting section (39) to the buffer (1) and offers six degrees of freedom for a relative movement between the mounting section (39) and the buffer (1).

2. The docking structure as claimed in claim 1, in which the kinematic structure (37) comprises a damping structure for damping the relative movement between the mounting section (39) and the buffer (1).

3. The docking structure as claimed in claim 2, in which the kinematic structure (37) comprises a hydraulic or pneumatic damping structure.

4. The docking structure as claimed in any of the claims 1 to 3, in which the kinematic structure (37) comprises a hydraulic or pneumatic actuator (41) that is able to manipulate the relative orientation of the buffer (1) relative to the mounting section (39).

5. The docking structure as claimed in any of the claims 1 to 4, in which the kinematic structure (37) is a Stew-

art platform.

6. The docking structure as claimed in any of the claims 1 to 5, in which the buffer (1) comprises at least one buffer abutment face (13), where for each bumper bar (31) a buffer abutment face (13) is present, and the gripping system comprises at least one pair of engagement arms (15), where for each bumper bar (31) to be gripped a pair of engagement arms (15) is present and where each engagement arm (15) includes an arm abutment face (21) for contacting the bumper bar (31).

7. The docking structure as claimed in claim 6, in which the buffer abutment face and/or arm abutment faces are formed by roller surfaces (13, 21).

8. The docking structure as claimed in claim 7, in which the buffer (1) is equipped with at least one gear wheel (23), where for each bumper bar (31) a gear wheel (23) is present and where each gear wheel (23) is arranged such at the buffer (1) that it can be moved into contact with the bumper bar (31) when the buffer (1) abutment face (13) and the arm abutment faces (21) are in contact with the bumper bar (31).

9. The docking structure as claimed in claim 8, in which the gear wheel (23) is located above or below a roller (13) containing the roller surface forming the buffer abutment face.

10. The docking structure as claimed in claim 9, in which

- two rollers (13) are present for each bumper bar (31),
- each of the two rollers (13) includes a roller surface forming a buffer abutment face and
- the gear wheel (23) is located between the two rollers.

11. The docking structure as claimed in any of the claims 8 to 10, in which a locking mechanism is associated to the gear wheels (23) so that the gear wheels (23) can be locked by use of the locking mechanism.

12. A vessel (35) with a docking structure according to any of the claims 1 to 11 fixed to its bow (33).

13. A docking system comprising a docking structure as claimed in any of the claims 1 to 11 and at least one bumper bar (31) connected or being connectable to a marine structure (43).

14. The docking system as claimed in claim 13, in which each bumper bar (31) is equipped with a gear rod (29) and the docking structure is a docking structure according to any of the claims 8 to 11.

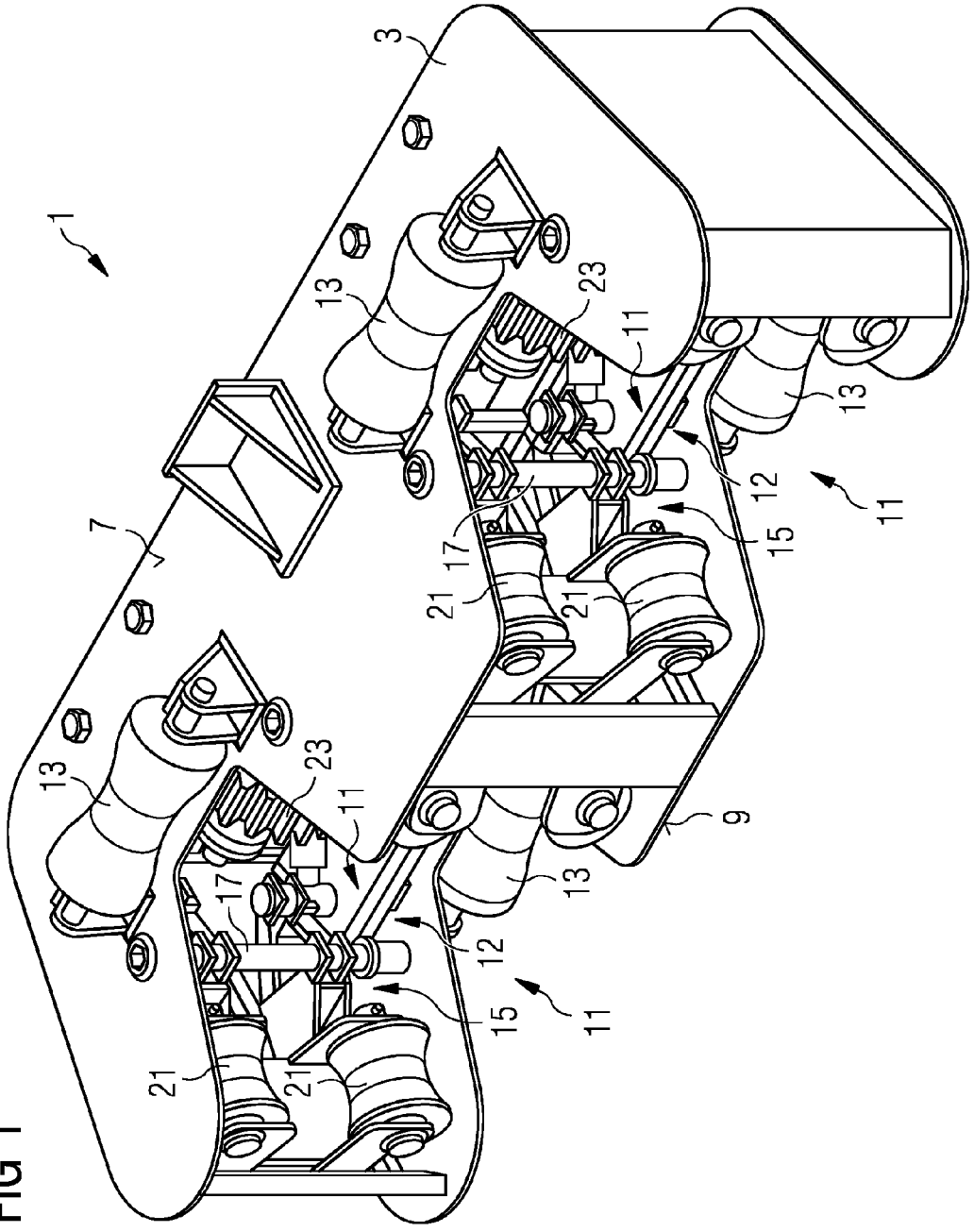


FIG 1

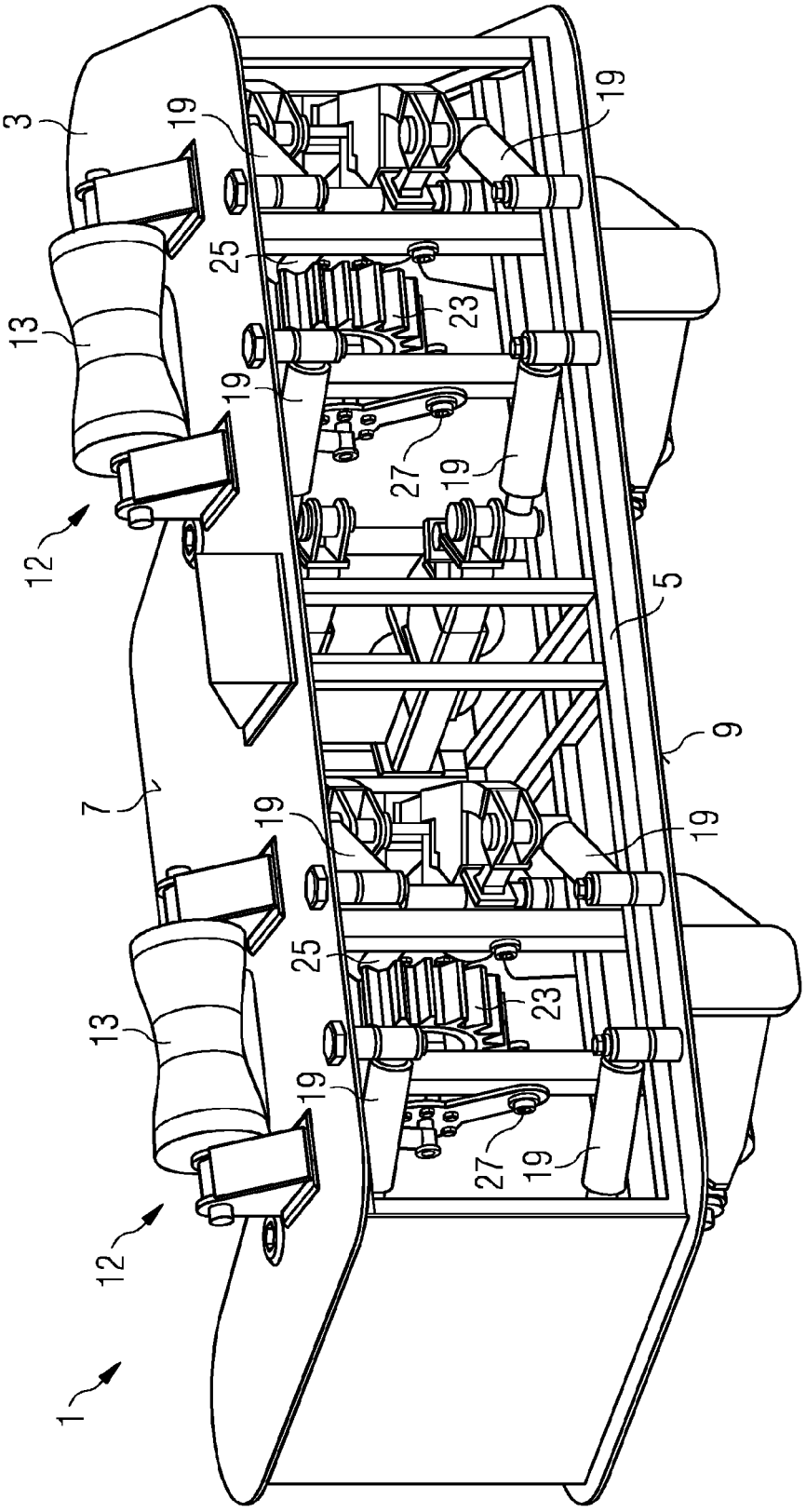


FIG 2

FIG 3

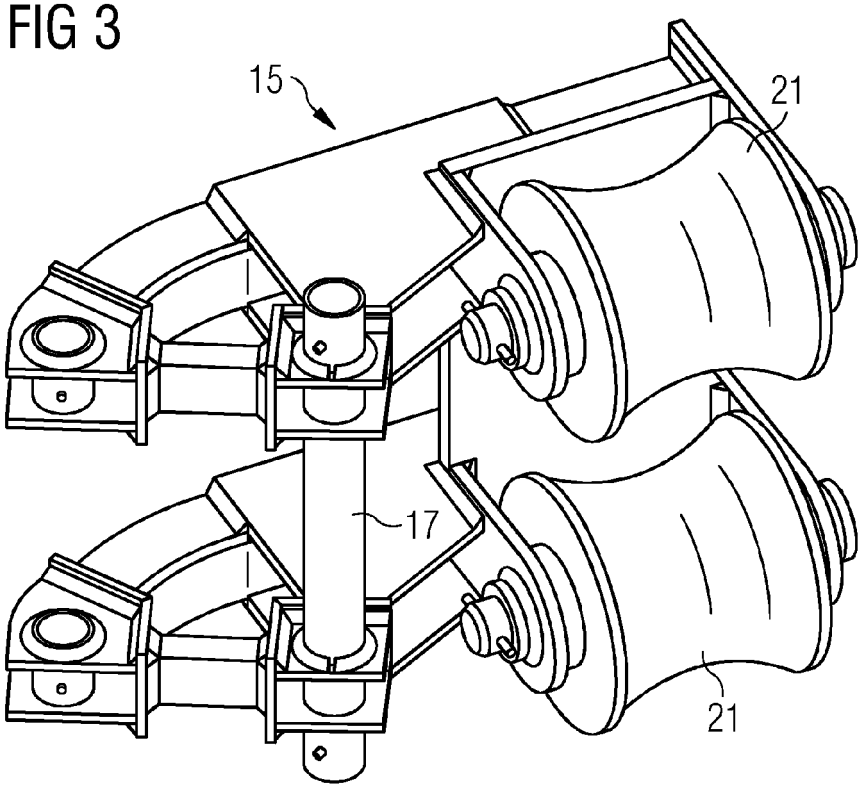


FIG 4

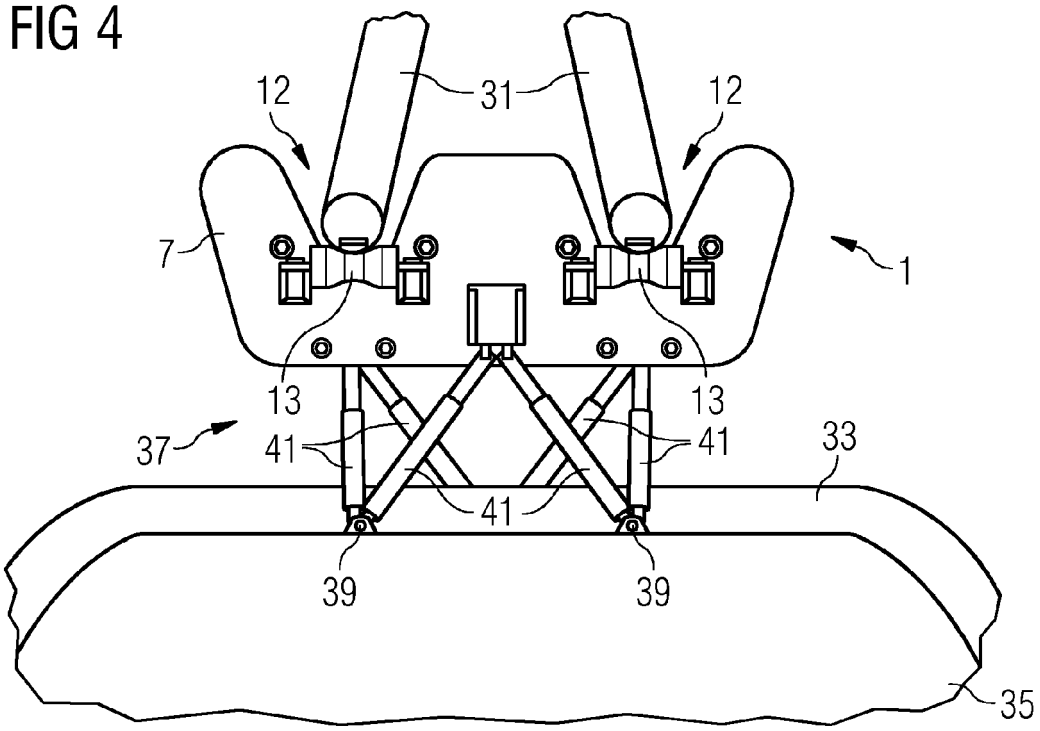


FIG 5

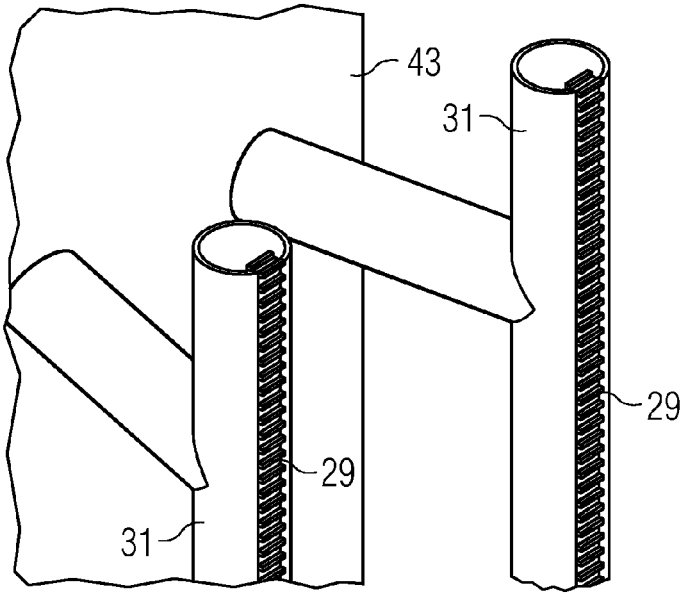


FIG 6

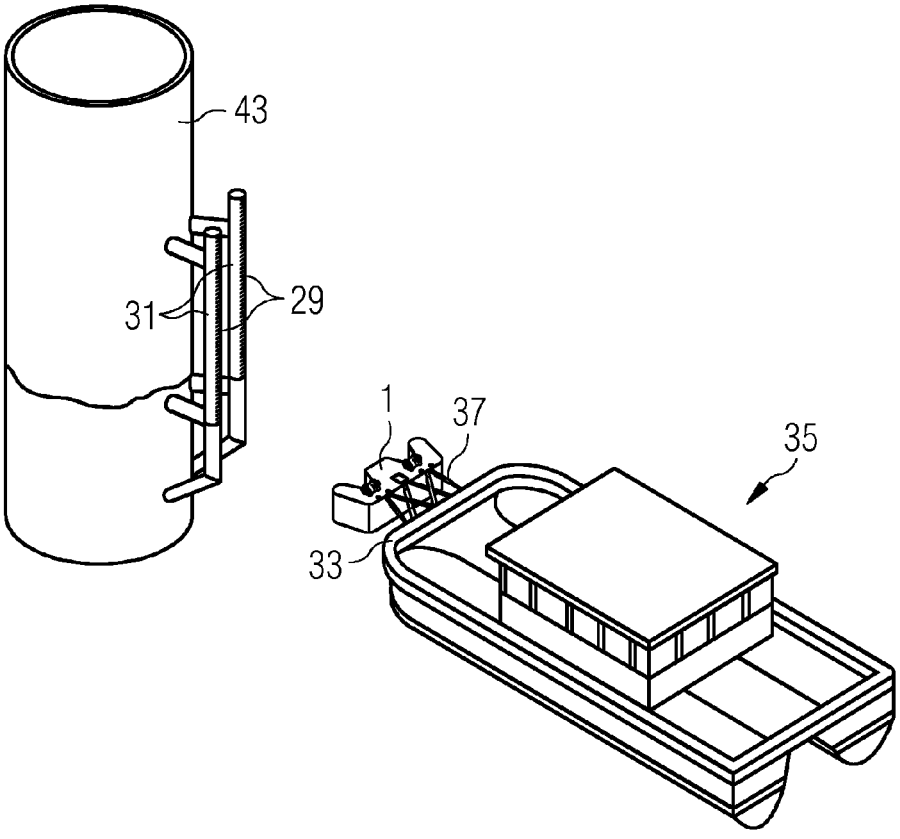


FIG 7

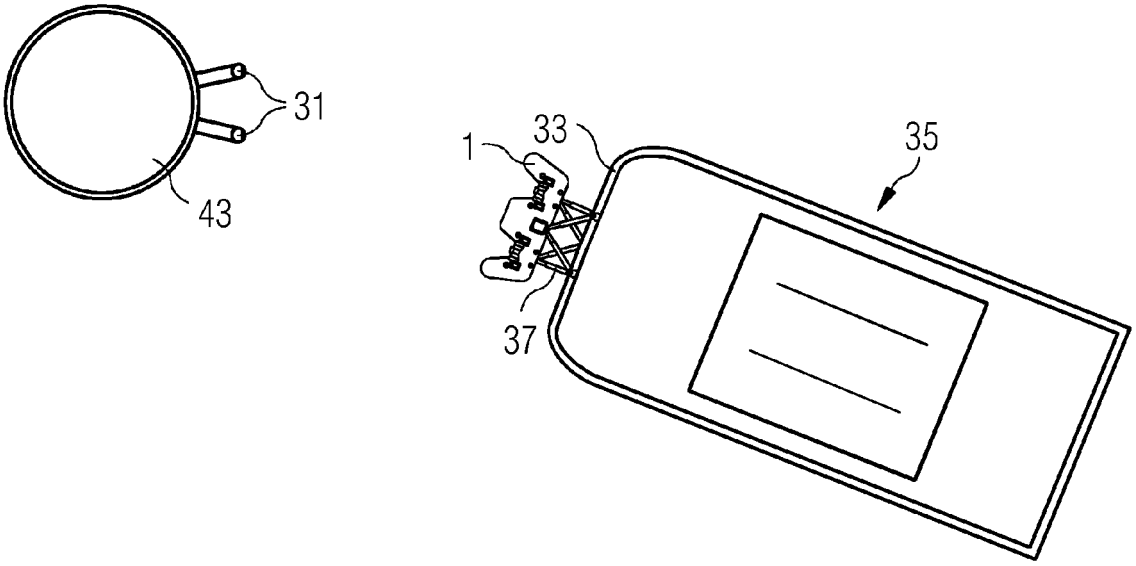


FIG 8

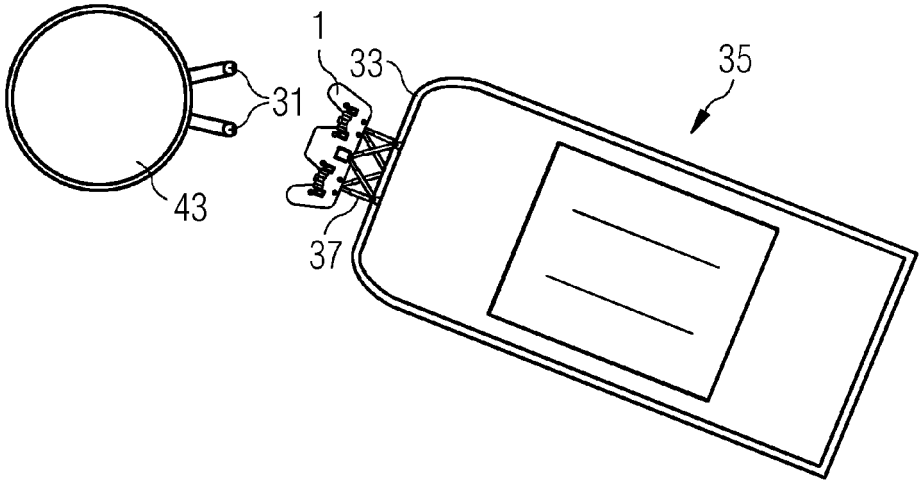


FIG 9

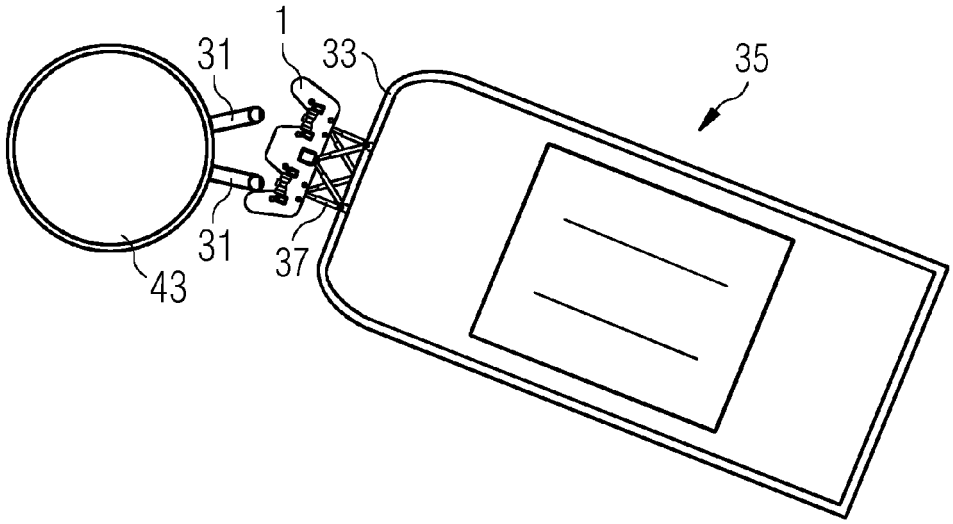


FIG 10

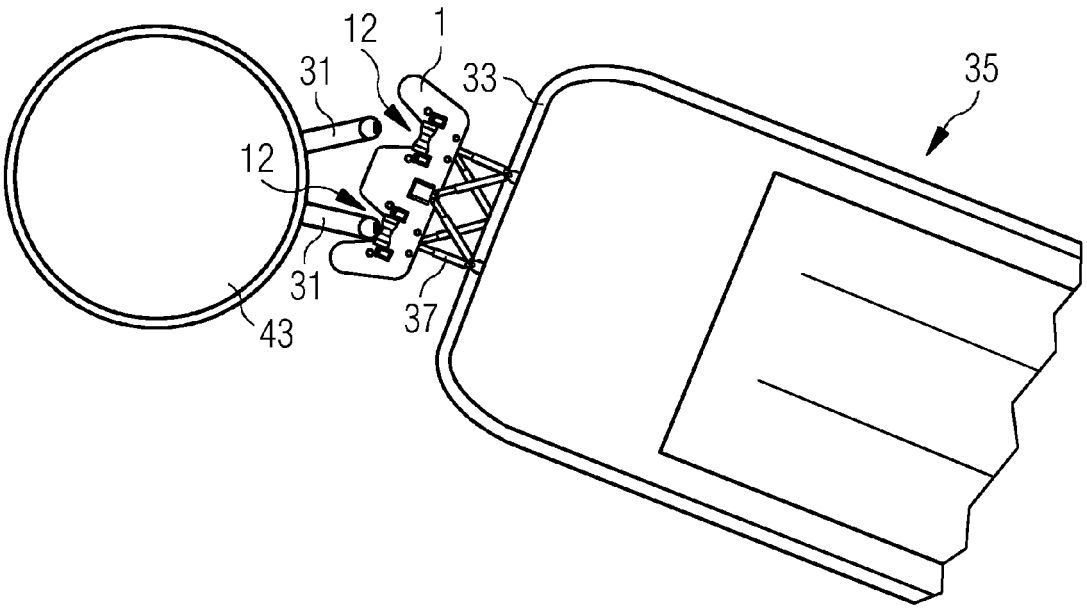


FIG 11

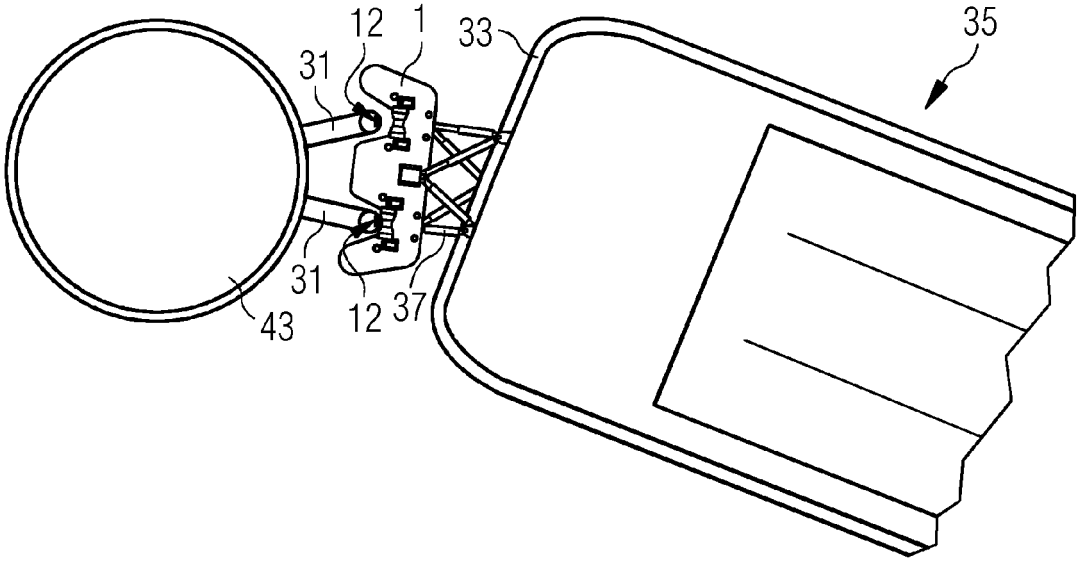


FIG 12

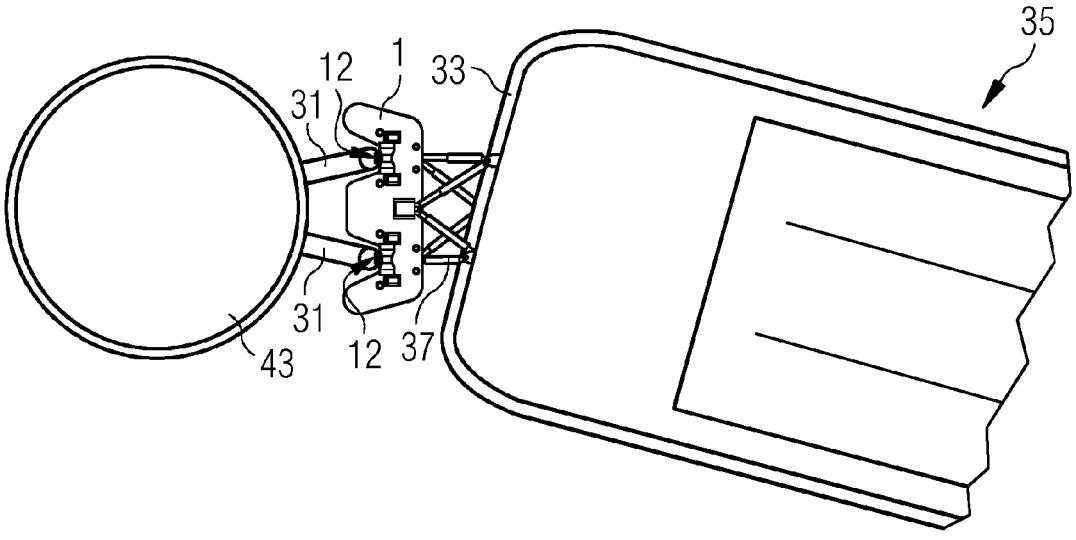


FIG 13

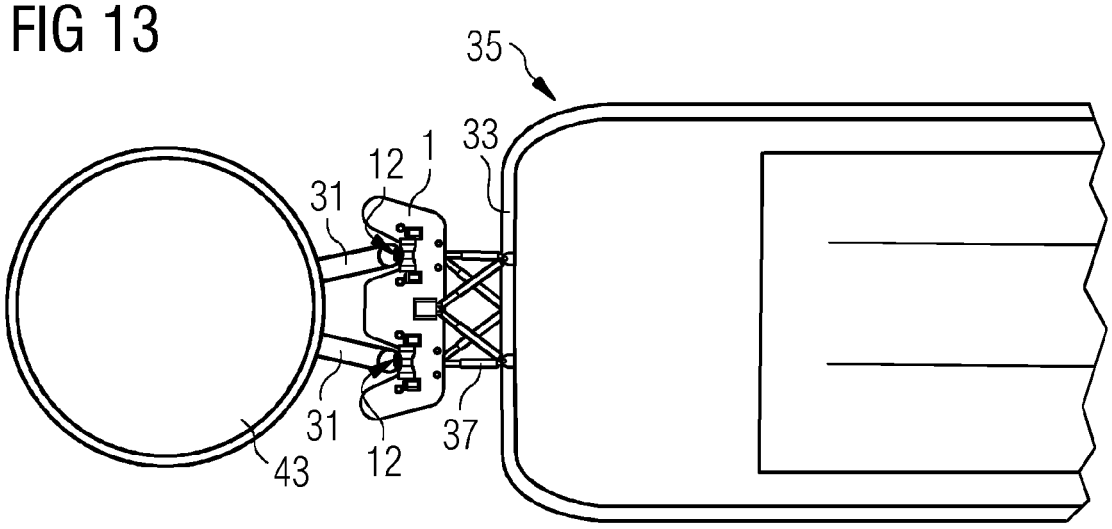


FIG 14

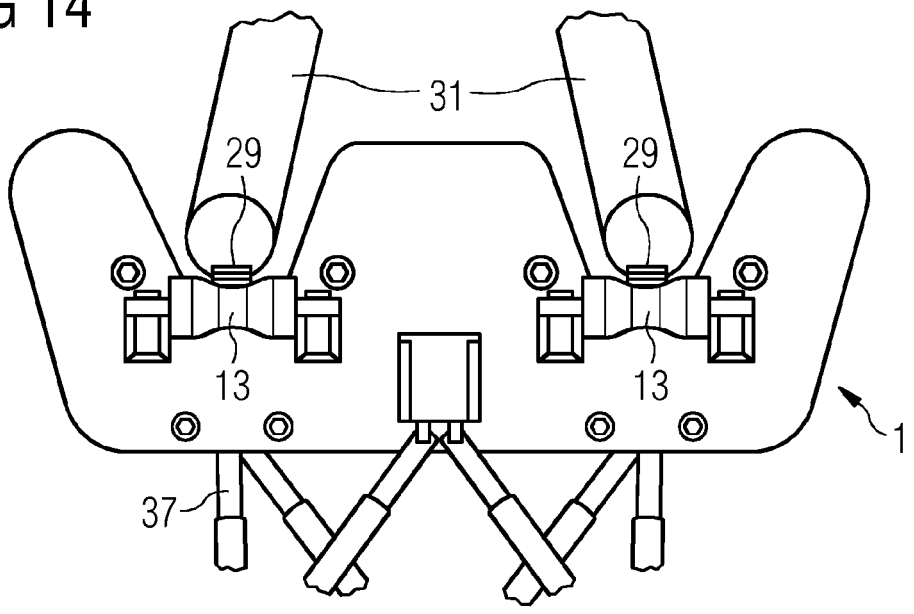
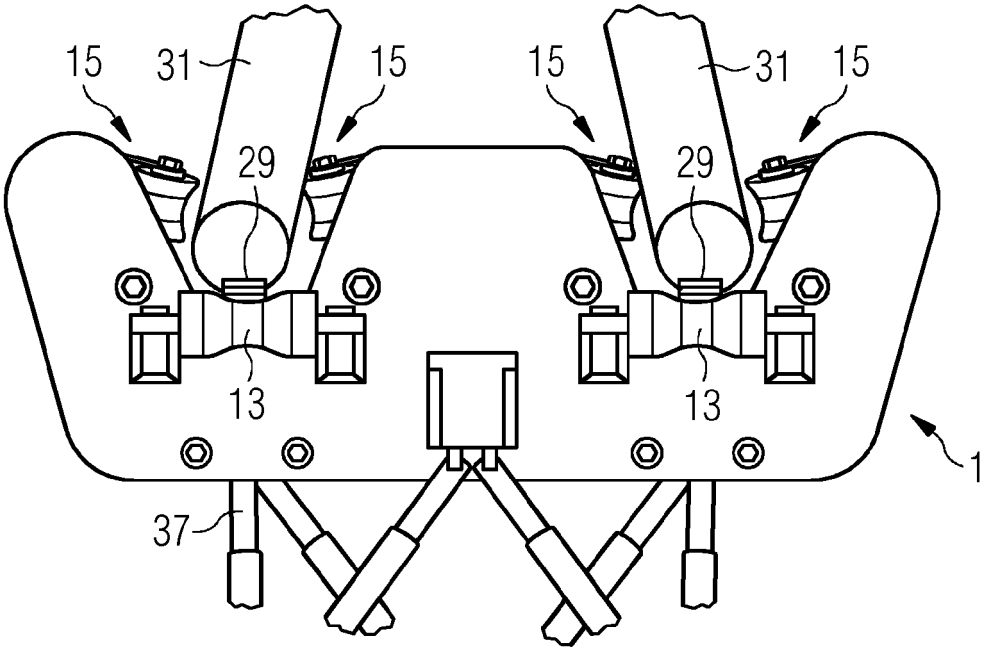


FIG 15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31
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29
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FIG 16

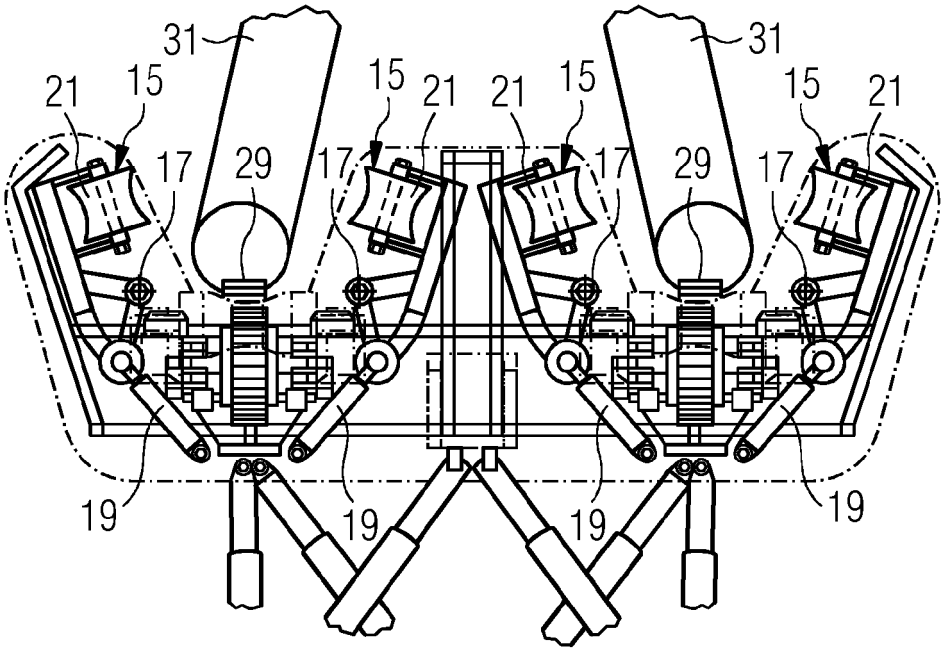
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FIG 17

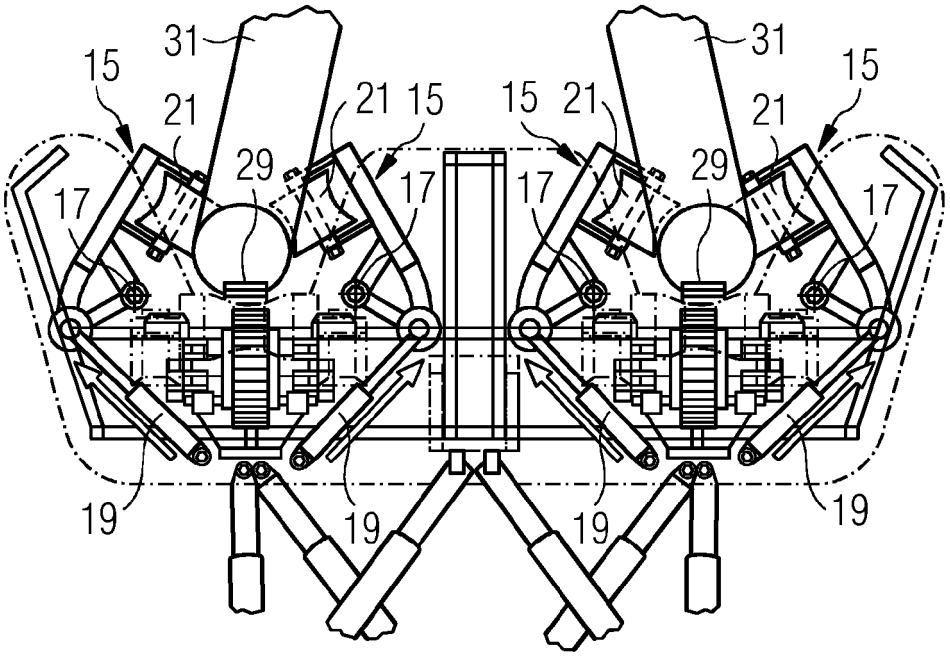
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FIG 18

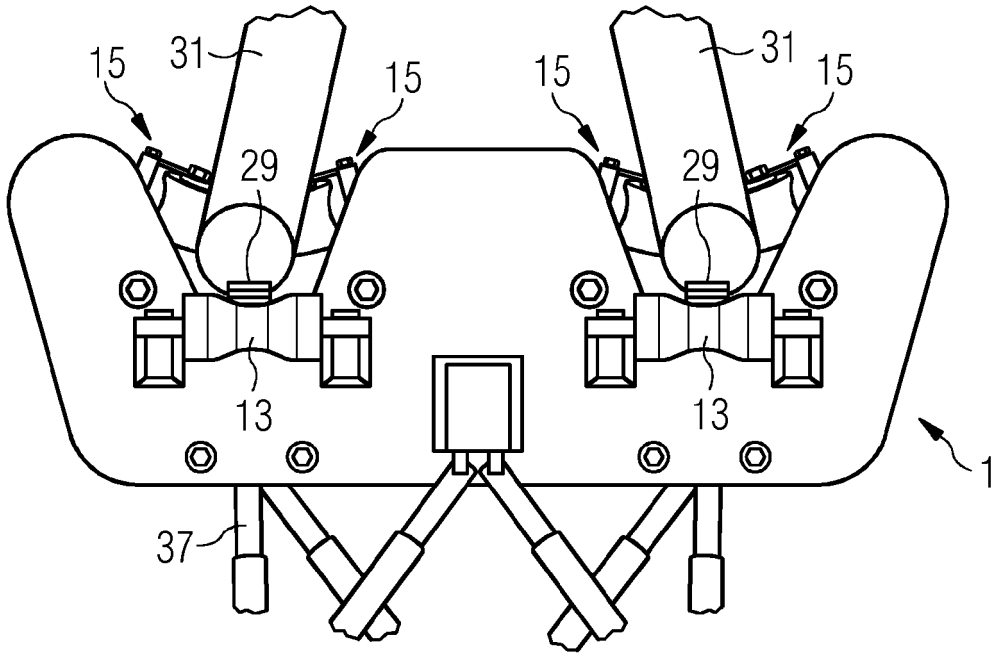
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FIG 19

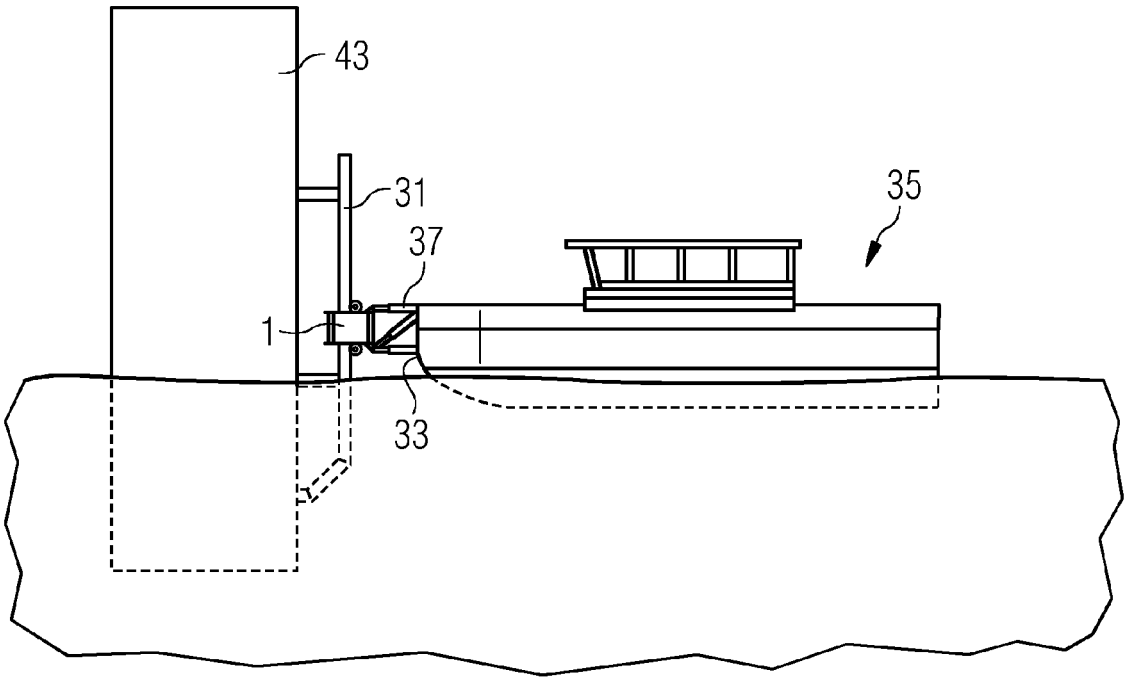


FIG 20

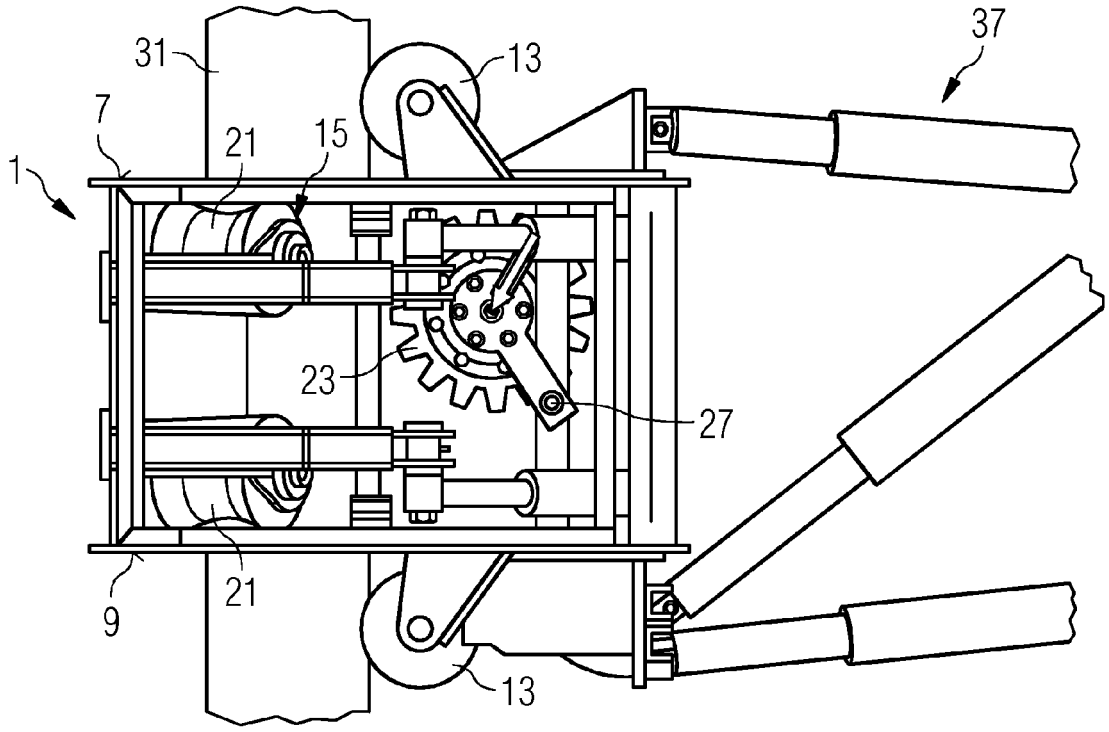


FIG 21

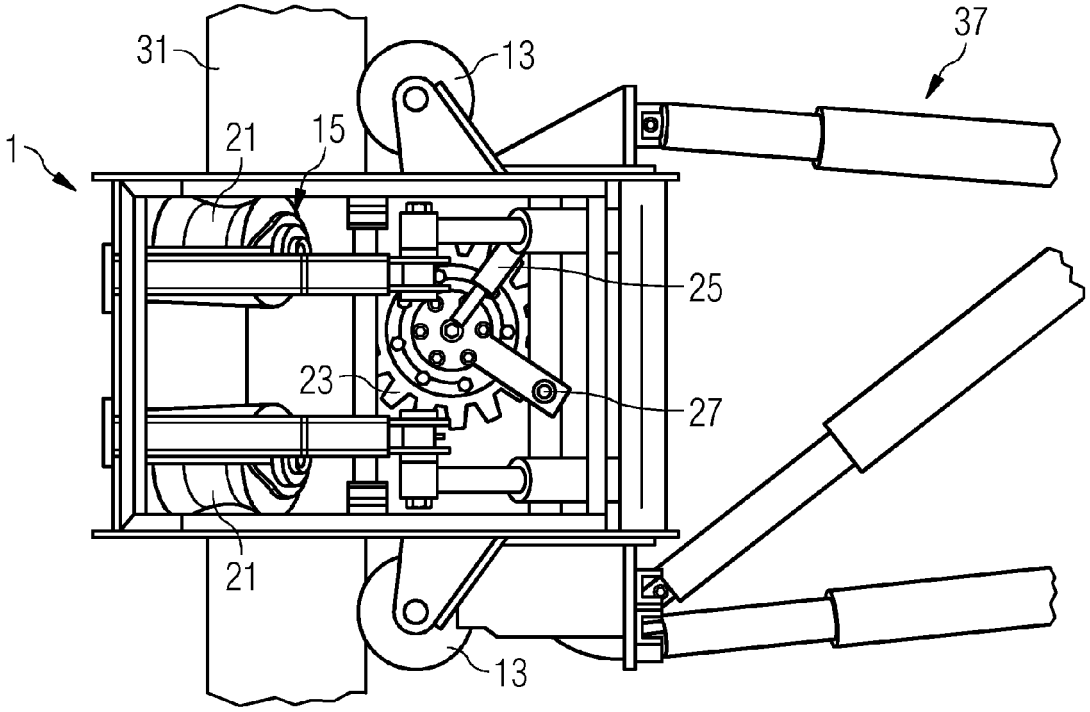
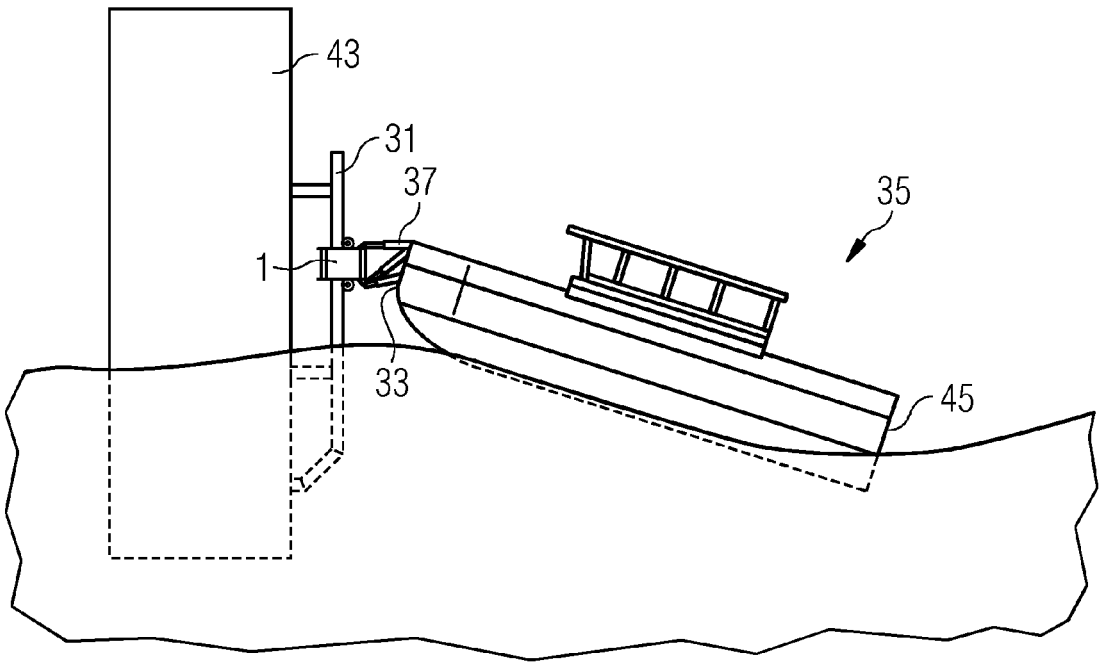


FIG 22



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EUROPEAN SEARCH REPORT

Application Number
EP 13 17 3593

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	GB 2 474 374 A (PHILLIPS BRYNMOR WINSTON [GB]) 13 April 2011 (2011-04-13) * page 8, line 29 - page 9, line 10; figures 6,7 *	1-14	INV. B63B21/00 B63B27/30
A	EP 2 298 641 A2 (MOBIMAR OY [FI]) 23 March 2011 (2011-03-23) * paragraph [0044] - paragraph [0048]; figures 1,2 *	1-14	
A	US 2003/182741 A1 (PRINS REINOUT KLAAR NORFOLC JAAP [NL]) 2 October 2003 (2003-10-02) * the whole document *	1-14	
A	US 4 083 072 A (RYAN WILLIAM J) 11 April 1978 (1978-04-11) * the whole document *	1-14	
			TECHNICAL FIELDS SEARCHED (IPC) B63B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	8 November 2013	De Sena Hernandorena

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08-11-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2474374 A	13-04-2011	NONE	
EP 2298641 A2	23-03-2011	NONE	
US 2003182741 A1	02-10-2003	AT 335652 T	15-09-2006
		AU 9438801 A	22-03-2002
		BR 0113414 A	29-07-2003
		CA 2421428 A1	14-03-2002
		DE 60122172 T2	05-07-2007
		DK 1315651 T3	04-12-2006
		EP 1315651 A1	04-06-2003
		ES 2269464 T3	01-04-2007
		NL 1016111 C2	07-03-2002
		PT 1315651 E	30-11-2006
		US 2003182741 A1	02-10-2003
		WO 0220343 A1	14-03-2002
US 4083072 A	11-04-1978	GB 1525501 A	20-09-1978
		NL 7510233 A	02-03-1976
		NO 752977 A	02-03-1976
		US 4003473 A	18-01-1977
		US 4083072 A	11-04-1978
		US 4133283 A	09-01-1979

EPO FORM P0459

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Patent documents cited in the description

- EP 2316721 A1 **[0002]**