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The present invention relates to a ship and a method for transporting and setting up offshore structures. The ship and the method are notably destined for transporting and setting up offshore wind turbines.

- 5 Due to high mean wind velocities, the operation of wind turbines on the sea promises a high current efficiency. For this reason, offshore wind turbines are to be constructed increasingly. Several big areas in the North Sea have been designated for the construction of wind turbines. These are mostly located outside of the twelve mile zone. The water depths amount to ten up to some ten meters. In
10 many cases, they are in the range of 40m to 50m.

In the construction of the offshore wind farm Alpha-Ventus, the wind turbines were set using the platform Thialf of the Dutch company Heerema. This is a matter of very big working equipment, which is typically used for the construction of oil platforms. In doing this, the working equipment remains on the set-up
15 location for longer periods of time. However, the construction of an offshore wind turbine takes only one to two days, and thereafter, the platform has to be hauled to another set-up location. The utilization of this working equipment for the construction of wind turbines is too sumptuous and expensive.

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The document WO 2004/087494 A2 describes a ship for transporting several complete wind turbines in vertical alignment. The ship has means for transporting the wind turbines from a hold to a discharging position. Further, the ship has winches with at least three lines with fastening means for fastening on at
25 least three attachment points on the foundation of the wind turbine. The lines are arranged on the discharging position such that their portions running to the attachment points are spaced apart in the horizontal direction. On the stern, the ship has projecting arms on which the winches are placed. The wind turbines can be let down on their foundations by way of the lines that are guided over the
30 winches. The wind turbines are transported from their position in the hold to the discharging position on rails. In this special ship, it is disadvantageous that the wind turbines are transported in a completely ready-installed condition together with their foundations, so that the charge projects far upward over the ship. With

increasing height or number of the wind turbines positioned on the ship, the stability of the ship is increasingly compromised. The transportation capacity and the applicability of the ship are limited through this.

- 5 The document WO 2007/091042 A1 describes a method and a system for transporting offshore structures and wind turbines. These have a carrier frame, into which the wind turbine is inserted on land in upright position. The carrier frame is utilized for lifting the wind turbine onto a transport ship on which it is held in upright arrangement. The transport ship has pivotal crane arms, on
- 10 which the transport frame is hanged up. The wind turbine is received on the transport ship from a quay by swinging the crane arms. At the set-up location, the wind turbine is set onto a prepared foundation by swinging the crane arms in the opposite direction. The foundation has a frame, which co-operates with the carrier frame. The carrier frame is provided with a plurality of legs with hy-
- 15 draulically steered feet. The frame on the foundation has a corresponding number of carrier structures, on which the feet rest at the end of the action. The feet are movable along a vertical axis depending on a hydraulic steering system, and they form a dampening arrangement for mounting the wind turbine on the foundation. The ship is suited for transporting only one mast of a single wind
- 20 turbine. The foundations must be set separately. After the mounting, the transport ship has to be navigated to the harbour in order to receive a further wind turbine. This is disadvantageous in case that several wind turbines have to be set up, like in wind farms.
- 25 In the known transport ships, setting up offshore structures is strongly hindered by the influence of the state of the sea, dangerous currents and wind.

The document FR 2 849 877 A1 describes a swimming platform with jack-up legs. A crane for transporting masts of wind turbines exists on the platform. The

30 platform has a telescopically foldable bridge for setting down a mast, by means of the crane, onto a foundation of a wind turbine which is anchored in the sea-bed.

Starting from this, the present invention is based on the objective to provide a ship and a method for transporting and setting up offshore structures, which can be used more independently of the state of sea and weather, and by which a greater number of offshore structures can be transported and set up in a certain
5 period of time.

The objective is resolved by a ship with the features of claim 1. Advantageous embodiments of the ship are indicated in subclaims.

10 The ship of the present invention for transporting and setting up offshore structures has:

- a hull with an U-shaped cross section, which has an open stern and comprises overhangs of the sidewalls extending beyond the rear edge of the
15 ship's bottom at the rear end, characterised by
- jack-up leg systems, integrated into the hull and having jack-up legs, which can be moved in a vertical direction into positions below the ship's bottom with their lower ends, and
- a crane, movable on the upper edge of at least one the sidewall.

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The U-shaped cross section of the hull is particularly advantageous for the ship's stability. Thus, the ship is particularly suited for transporting offshore structures having great weight. In addition, it is advantageous for the ship's hydrodynamic properties and the connection of both structures that the jack-up leg
25 systems can be integrated into the sidewalls. When setting up the offshore structures, the ship can be fixed by lowering the jack-up legs onto the seabed. Through this, the ship is held in a stable reference position, which is independent of the conditions of the sea, the current and the wind. This is advantageous for setting up wind turbines, because the masts must be aligned quite
30 accurately vertically. Further, the U-shaped cross section has the advantage that the upper edges of the sidewalls can be used as a basis for the movable crane. As a consequence, the crane can be moved above the offshore structures by which the ship is loaded. The ship has preferably a cargo deck on the

upper side of the ship's bottom, in order to provide a high hold above which the crane can travel. Offshore structures stored on the cargo deck can be picked up by the movable crane and can be transported to the overhangs. The offshore structures can be veered down between the overhangs and set down on the seabed, because the hull does not have a cargo deck or ship bottom there. Several offshore structures situated consecutively in the long side direction of the hull can be brought to the set-up location in one navigation, and can be set up one after the other. Thus, the utilisation of the ship is particularly effective. The crane can transport offshore structures in the vertical alignment, because the cargo pick-up of the crane can grasp the offshore structures on a high pick-up point. In particular, the ship can transport masts and foundations of wind turbines in vertical alignment and join them together. The wind turbine does not have to be transported and set down as one piece, with mast mounted on the foundation. Therefore, the charge projects less upward from the hull than in WO 2004/087494 A2, so that the ship has more opportunities of utilization.

The crane is preferably movable along a rail system which is arranged on the upper edge of at least one sidewall.

According to one embodiment, the crane comprises a crane bridge, which is supported on both sidewalls. Through this, the burdens are optimally transferred into the hull. The present invention incorporates embodiments wherein a crane is movably arranged on the upper edge of only one sidewall. Further, it incorporates embodiments wherein separate cranes can be moved on the upper edges of both sidewalls.

According to a further embodiment, the crane is a gantry crane which bears the crane bridge on supports that are movable on the upper edges of the sidewalls. In the gantry crane, the crane bridge is arranged particularly high, so that the ship can be used for transporting and setting up particularly high offshore structures. According to another embodiment, the crane is an overhead crane. The crane bridge of the overhead crane can be supported and movable directly on the upper edges of the sidewalls. According to another embodiment, the crane

bridge of the overhead crane is movable on rails which are supported on the upper edges of the sidewalls via supports. In this ship, the crane bridge is arranged particularly high, so that it can transport and set up particularly high offshore structures.

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According to one embodiment, the sidewalls are cut out on the bottom side in the area of the overhangs, so that the lower edge of the overhangs is arranged above the water line of the hull during the way. Thus, the stern of the ship is formed like a console, so that the ship can be navigated over a pier with its stern, so that a transfer location for offshore structures is situated between the overhangs. Offshore structures placed on the transfer location can be picked up with the aid of the crane which is arranged on the ship, and can be set down on the ship. Thus, the ship can take up offshore structures in a harbour without having to use harbour cranes. In principle, picking up load in the harbour can be done without using the jack-up legs. But preferably, the ship is fixed on the harbour bottom by lowering the jack-up legs when it is being loaded.

According to one embodiment, the ship is a semi-submersible with ballast tanks integrated into the hull and with pumps to fill the ballast tanks with ballast water and/or to drain the ballast water out of the ballast tanks. The ship can be navigated to the set-up location with emptied ballast tanks. The ballast tanks can be flooded on the set-up location, so that the ship sinks deeper and is more stable in the water. In this embodiment, the position of the ship is additionally stabilized by the ballast. In the embodiment as a semi-submersible, the ship can be used for other transportation tasks also, wherein load is to be taken up and/or delivered through the stern. For instance, the ship can be used for transporting pontoons or other floatable loads, which are floated in or out through the open stern.

In order to fix it in a stable position, the ship has preferably at least three jack-up leg systems. According to one embodiment, the ship comprises three jack-up leg systems, wherein one jack-up leg system is integrated into the hull on the

mid-axis ahead, and two additional jack-up leg systems are integrated rear in the hull into the two sidewalls.

According to a further embodiment, the ship comprises four jack-up leg systems, two opposite jack-up leg systems being integrated ahead in the hull into the sidewalls, and two additional opposing jack-up leg systems being integrated rear in the hull into the sidewalls. In this embodiment, the jack-up leg systems can be dimensioned so as to be less strong than in the embodiment with three jack-up leg systems, wherein the front-side jack-up leg system is exposed to higher burdens than the two rear jack-up leg systems.

The bow of the ship can be formed in a conventional manner, with or without bow nose. According to a further embodiment, the ship has a deckhouse arranged ahead on the hull. The deckhouse arranged ahead on the hull does not limit the hold.

Of course, the ship comprises a drive. The same can be realised in different manners. According to one embodiment, the ship has a marine propeller drive and front and rear manoeuvring aids. The marine propeller drive, combined with the bow thrusters, permits accurate positioning of the ship next to the set-up location and in the harbour before it is fixed by the jack-up legs. Alternatively, the marine drive can comprise thruster propellers by which the ship can be manoeuvred accurately.

According to a further embodiment, the ship has a dynamic positioning system. By the dynamic positioning system, the ship can be positioned at the set-up location automatically, before it is fixed on the seabed by way of the jack-up legs.

According to a further embodiment, the ship comprises devices for fixing foundations and/or masts of wind turbines on the hull in a vertical alignment. According to a further embodiment, the devices for fixing comprise seats in the upper side of the hull, into which foundations and/or masts can be set in. For fixing masts, the seats can have a perforated collar onto which the mast can be put

with a screwing ring which comprises a complementary perforated collar. The mast can be screwed to the hull by inserting screws into the perforated collars. According to one embodiment, the seats can be perpetrated through a path in the hull, so that the screws can be installed and detached in case the screwing
5 ring is arranged in the mast's inside.

According to a further embodiment, the hull has fastening devices for lashing systems. These can be tensioning ropes and/or bars with fastening means and in case tensioning means at the ends.
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The ship can be equipped with offshore structures in different ways. According to one embodiment, it is either homogeneously equipped with several foundations or masts of wind turbines, arranged consecutively in the direction of the ship's longitudinal axis, or heterogeneously with alternating masts and foundations of wind turbines. In the heterogeneous equipment, a foundation is preferably next to the stern of the ship, because this must be set down at first in order to set a mast onto the foundation thereafter. The position of the ship has not to be changed in doing so. But in principle it is also possible to equip the ship heterogeneously with a group of masts and subsequently with a group of foundations. After setting down the foundations, the masts can be attached on the set-down foundations. At least one position change is necessary for this.
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The present invention is further achieved by a method with the features of claims 15.
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Advantageous embodiments of the method are indicated in subclaims.

In the method of the present invention for transporting and setting up offshore structures using a ship according to any one of the claims explained above,
30

- the ship is loaded with the offshore structures,
- the loaded ship is navigated to the setup location for the offshore structures,

- the ship is fixed to the seabed at the setup location using jack-up legs,
- the offshore structures are set down at the setup location by the crane between the rear overhangs of the sidewalls, and
- the jack-up legs are released from the seabed.

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According to one embodiment, before loading, the ship is fixed to the floor of the harbour by means of jack-up legs, and the jack-up legs are released from the floor of the harbour after loading.

- 10 According to one embodiment, the ship is immersed more deeply by flooding the ballast tanks when it is being fixed to the seabed. By doing so, the seabed is made denser below the jack-up legs, thus it provides a rigid substructure.

- 15 According to another embodiment, the ship is lifted at least partially out of the water with its hull by means of the jack-up legs. Through this, the burden on the jack-up legs is increased and the ship is fixed on the ground more safely. When the hull is lifted out of the water by the jack-up legs only partially, the buoyancy acts on the hull. The jack-up leg systems are unburdened through this, so that they can be dimensioned less strongly than in a ship whose hull can be lifted
- 20 out of the water completely by way of the jack-up leg systems.

- According to one embodiment, the ship is positioned at the setup location for the offshore structures and/or the loading location in the harbour by means of a dynamic positioning system until the jack-up legs are fixed.

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- According to a further embodiment, the ship is loaded with offshore structures by moving the ship with the rear overhangs of the sidewalls over a pier, so that the overhangs encompass a transfer location for offshore structures between themselves, and offshore structures placed on the transfer location are picked
- 30 up with the aid of the crane and placed on the hull.

According to a further embodiment, the ship is loaded with wind turbines, and the wind turbines are set up at the setup location.

According to a further embodiment, the ship is loaded with foundations and/or masts of wind turbines in vertical alignment, and the foundations and/or masts of wind turbines are set up at the setup location.

- 5 According to a further embodiment, the ship is loaded with several foundations of wind turbines or several masts of wind turbines consecutively in a longitudinal direction, or alternately with masts and foundations of wind turbines, and the foundations are set up at the setup location, or the masts of wind turbines are placed on foundations of wind turbines, or foundations are set up and the masts
10 of wind turbines are placed thereon alternately.

The present invention will be explained in more detail by the attached drawings of an example of its realisation. In the drawings show:

- 15 Fig. 1 a-c a ship with three jack-up leg systems, equipped with foundations and masts of wind turbines, in a side view (Fig. 1a), a vertical longitudinal section (Fig. 1b) and in the top view (Fig. 1c);

- Fig. 2a-c a ship having four jack-up leg systems, equipped with foundation and
20 masts of wind turbines, in a side view (Fig. 2a), a vertical longitudinal section (Fig. 2b) and in the top view (Fig. 2c);

- Fig. 3a-i the ship of Fig. 2 during the way (Fig. 3a), with lowered jack-up legs at the set-up location (Fig. 3b), when picking up a foundation (Fig. 3c), when set-
25 ting down the foundation (Fig. 3d and e), when picking up a mast (Fig. 3f), when transporting the mast (Fig. 3g), when positioning the mast above the foundation (Fig. 3h), when setting the mast onto the foundation (Fig. 3i), always in a vertical longitudinal section;

- 30 Fig. 4 the ship of Fig. 2 with lowered jack-up legs and hull lifted out of the water at the set-up location, in a vertical longitudinal section;

Fig. 5a-j the ship of Fig. 2 when being manoeuvred to a transfer location for wind turbines on a pier (Fig. 5a), when encompassing the transfer location between the overhangs (Fig. 5b), when lowering the jack-up legs into the harbour bottom (Fig. 5c), when picking up the mast of a wind turbine (Fig. 5d), when setting down the mast on the ship (Fig. 5e), when moving the gantry crane to the stand-by position (Fig. 5f), when picking up a foundation Fig. 5g), when setting down the foundation on the hull (Fig. 5h), when positioning the gantry crane in the navigating position (Fig. 5i), when leaving from the pier with jack-up legs moved upward (Fig. 5j), always in a vertical longitudinal section;

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Fig. 6a-c the ship of Fig. 2, homogeneously equipped with foundations in a side view (Fig. 6a), in a vertical longitudinal section (Fig. 6b) and in the top view (Fig. 6c);

15 Fig. 7a-c the ship of Fig. 2, homogeneously equipped with masts of wind turbines in a side view (Fig. 7a), in a vertical longitudinal section (Fig. 7b) and in the top view (Fig. 7c).

In the following explanations of different realisation examples, corresponding parts are provided with the same reference numerals.

25 According to Fig. 1, a ship 1.1 for transporting and setting up offshore structures has a hull 2, which has a U-shaped cross section with a ship bottom 3 and sidewalls 4.1, 4.2. At the front, the ship has a conventional bow 5. Further, a deck house 6 is arranged on the ship in the front region. A helicopter landing deck 7 exists at option.

The ship bottom 3 and the sidewalls 4.1, 4.2 as well as the rear wall of the deck house 6 limit a hold in the hull 2.

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The sidewalls 4.1, 4.2 of the hull have overhangs 9.1, 9.2 which stand over beyond the rear edge 8 of the ship bottom 3. Each of the overhangs 9.1, 9.2 has a recess 10.1, 10.2 on the downside, whose upper edge is arranged above the

water line 11 when the ship is on the way. Thus, the stern 12 of the ship is formed like a console when seen from the side. The hull 2 has a big opening 13 between the overhangs 9.1, 9.2. Furthermore, it is opened towards the rear side on the stern 12.

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A not shown marine drive is arranged in the hull 2, which has a marine propeller drive and front and rear manoeuvring aids (e.g., bow thrusters) and the associated drive motors.

10 A cargo deck 14 is on the upper side of the ship bottom 3.

Further, jack-up leg systems 15.1, 15.2, 15.3 with jack-up legs 16.1, 16.2 and 16.3 are integrated into the hull 2. In the front portion of the hull 2, a jack-up leg system 15.1 is arranged centrally on the middle axis 17 immediately behind the
15 deck house 6. In the rear portion of the hull 2, two opposing further jack-up leg systems 15.2, 15.3 are integrated into the sidewalls 4.1, 4.2.

Each jack-up leg system 15.1, 15.2, 15.3 comprises a torsion box in which the jack-up legs 16.1, 16.2, 16.3 are guided. On the lower end, the jack-up legs
20 16.1, 16.2, 16.3 have a stamp-like foot 18. The jack-up legs 16.1, 16.2, 16.3 can be displaced in the torsion boxes in the vertical direction. In order to do this, drives are integrated into the jack-up leg systems 15.1, 15.2, 15.3, which comprise for instance hydraulic cylinders or toothed wheels which engage into toothed racks. The drives of the jack-up leg systems 15.1, 15.2, 15.3 have for instance
25 electric motors.

A gantry crane 20 is arranged on the upper edges 19.1, 19.2 of the sidewalls 4.1, 4.2 so as to be movable on rails. The gantry crane 20 has two lateral supports 21.1, 21.2, which are guided on the rails via rollers at their bottom sides.
30 At the topside, the supports 21.1, 21.2 are bridged by a crane bridge 22. A not shown hoisting device with a load bearing equipment is arranged on the crane bridge 22.

Further, the gantry crane 20 comprises not shown drive means for moving the gantry crane 20 along the upper edges 19.1, 19.2 of the sidewalls 4.1, 4.2. The gantry crane 20 can be moved from a position shortly behind the deck house 6 up to the overhangs 9.1, 9.2, so that loads can be veered down through the opening 13 between the overhangs 9.1, 9.2 by way of the hoisting device.

In the example, the ship 1.1 is equipped with two complete wind turbines 23. The wind turbines 23 are disaggregated into a foundation 23.1 and a mast 23.2, which carries the generator with the windmill 23.3. The foundation 23.1 and the mast 23.2 can be vertically assembled in a conically formed connection region. The foundations 23.1 are formed as tripods. Each foot of the tripod is equipped with a nail 23.4, which sits in a vertical guiding sleeve and can be driven into the seabed. Rams are carried on board of the ship 1.1 for this purpose. These can be mounted onto the upper ends of the nails 23.4 and can be operated by a supply device of the ship 1.1 by way of flexible supply lines. This supply can take place electrically, hydraulically or pneumatically.

The masts 23.2 and foundations 23.1 are arranged in the longitudinal direction of the ship 1.1 one after the other in alternating sequence, a foundation 23.1 being positioned at the rear side.

The foundations and the masts 23.2 of the windmills 23 are each arranged in vertical alignment on the cargo deck 14. They are held and secured in this position by not shown fixing devices.

The ship 1.2 of Fig. 2 differs from that one described before in that it has four jack-up leg systems 15.1, 15.2, 15.3 and 15.4. In this ship 1.2, two opposing jack-up leg systems 15.1, 15.2 are also integrated into the sidewalls 4.1, 4.2 ahead. However, no jack-up leg system is arranged on the middle axis 17 of the ship 1.1. The ship 1.2 has a bigger hold than the ship 1.1.

According to fig. 2, the gantry crane 20 is located in a position on the overhangs 9.1, 9.2 for picking up and delivering load. The ship 1.2 is loaded with wind turbines 23 like ship 1.1.

- 5 At option, ship 1.1 or 1.2 has a not shown tailgate on the stern 12, which can be closed in order to prevent the intrusion of waves. The tailgate is preferably arranged on the rear end of the hold or on the rear edge 8 of the ship bottom 3, and extends preferably up to the upper edges of the sidewalls 4.1, 4.2.
- 10 In Fig. 3a, the ship is shown when it arrives at the set-up location, where it is held in position by a dynamic positioning system.

- 15 According to Fig. 3b, the jack-up legs 16.1, 16.2, 16.3, 16.4 are lowered at the set-up location, so that the feet 18 penetrate the sludge line 24.1 and sit on solid ground 24.2. The ship 1.2 is only slightly lifted by the jack-up legs 16.1, 16.2, 16.3, 16.4, so that the buoyancy acting on the hull unburdens the jack-up leg systems 15.1, 15.2, 15.3 15.4.

- 20 According to Fig. 3c, the gantry crane 20 is moved over the rear foundation 23.1, in order to pick it up by the not shown load-bearing equipments. According to Fig. 3d, the gantry crane 20 veers the foundation 23.1 down through the opening 13 between the overhangs 9.1, 9.2. According to Fig. 3c, the foundation 23.1 rests on the seabed 24, so that the nails 22.4 can be driven in. In this position, the foundation 23.1 projects over the water line 11 with the connection
25 area.

Thereafter, the gantry crane 20 travels to the rear mast 23.2 according to Fig. 3e, and picks it up with the load-bearing equipments.

- 30 Fig. 3g and h show the ship 1.2 when it transports the mast 23.2 to the foundation 23.1.

According to Fig. 3i, mast 23.2 is joined to the foundation 23.1 on the conical connection areas. Due to the support of the ship 1.2 via the jack-up legs 16.1, 16.2, 16.3, 16.4, the foundation 23.1 can be aligned vertically very accurately, and easily be joined to the mast 23.2.

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Thereafter, the jack-up legs 16.1, 16.2, 16.3, 16.4 are moved upward and the ship 1.2 is manoeuvred to a further set-up location, where the parts 23.1, 23.2 of the further windmill 23 are set up.

10 According to a further embodiment, clarified in Fig. 4, the ship 1.2 can be lifted by means of the jack-up legs 16.1, 16.2, 16.3, 16.4, so that the hull 2 is arranged above the water line 11. This has the advantage that the burdens to the hull and the jack-up leg system by the seaway are significantly reduced.

15 Fig. 5 shows the ship 1.2 when it is being loaded with wind turbines 23. For this purpose, the ship 1.2 is moved to a pier 25 with its stern 12 in a harbour. This is shown in Fig 5a. According to Fig. 5b, the ship 1.2 is manoeuvred such that it encompasses a loading position 26 for wind turbines 23 between the overhangs 9.1, 9.2, on which loading position 26 a mast 23.1 is already standing by. The
20 ship 1.2 is held in this position by the dynamic positioning system. In this, the jack-up legs 16.1, 16.2 16.3, 16.4 are lowered, so that the feet 18 penetrate into the ground 27 of the harbour and fix the ship 1.2 in the loading position, like shown in Fig. 5c.

25 Thereafter, the gantry crane 20 is moved over the overhangs 9.1, 9.2 according to Fig 5d, until it overlaps the mast 23.2. The load bearing means are fixed on the mast 23.2, and the mast 23.2 is transported into the position of Fig. 5e by means of the gantry crane 20. It is fixed and secured in this position on the hull 2 by means of suitable fixing devices.

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Thereafter, the gantry crane 20 is moved rearwards, like shown in Fig 5f. A foundation 23.1 is already provided between the overhangs. The gantry crane travels on the overhangs into the position shown in Fig. 5g. The load bearing

means pick up the foundation 23.1, and the gantry crane 20 lifts it into the position in the hold shown in Fig. 5h. In this drawing, another mast 23.2 is already shown, which is placed on the transfer location 26. In the already described way, the gantry crane 20 picks up the further mast 23.2 and a further foundation 23. 1, until the ship 1.2 is completely equipped with two wind turbines 23, like shown in Fig. 5i. Thereafter, the jack-up legs 16.1, 16.2, 16.3, 16.4 are moved upward according to Fig. 5j, and the ship 1.2 is navigated to the set-up location.

Fig. 6 shows an alternative equipment of the ship 1.2 with only five foundations 23. This equipment can be preferred over the equipment with complete wind turbines 23, consisting of foundations 23.1 and masts 23.2, for instance when it seems advisable to transport less load in case of unfavourable sea- and weather conditions. With a ship 1.2 equipped in this way, only foundations 23.2 are placed on different set-up locations at first.

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Fig. 7 shows an alternative equipment of the ship 1.2 with masts 23.2 only. This equipment can be preferred at good weather and favourably conditions of the sea, in order to equip foundations 23.1, which are already placed on the set-up location, with masts 23.2.

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Patentkrav

1. Skib til transport og opstilling af offshore-konstruktioner med
 - 5 - et skibsskrog (2) med et U-formet tværsnit, som har en åben agterende (12) og bagtil har på sidevæggene (4.1, 4.2) værende fremspring (9.1, 9.2), som ved agterenden peger ud over skibsbundens (3) bagkant (8), **kendetegnet ved**
 - i skibsskroget (2) integreret løftestøttesystem (15.1, 15.2, 15.3, 15.4) med
 - 10 løftestøtter (16.1, 16.2, 16.3, 16.4), som er indrettet til at kunne bevæges i lodret retning med deres nedre ender (18) i positioner under skibsbunden (2), og
 - en kran (20), som er indrettet til at kunne køre på sidevæggene (4.1, 4.2) øvre kanter (19.1, 19.2).
 - 15 2. Skib ifølge krav 1, ved hvilket kranen (20) omfatter en kranbro (22).
 3. Skib ifølge krav 2, ved hvilket kranen er en portalkran (20), som bærer kranbroen (22) på støtter (21.1, 21.2), som er indrettet til at kunne køre på side-
 - 20 væggene (4.1, 4.2) øvre kanter (19.1, 19.2).
 4. Skib ifølge et af kravene 1 til 3, ved hvilket sidevæggene (4.1, 4.2) er udsparet på undersiden inden for området af fremspringene (9.1, 9.2), således at fremspringenes nedre kant under sejlads befinder sig over skibsskrogets (2)
 - 25 vandlinje (11).
 5. Skib ifølge et af kravene 1 til 4, som som delvis nedsænkkelig platform er forsynet med i skibsskroget (2) integreret ballasttanke og pumper til fyldning af ballasttankene med ballastvand og/eller lænsning af ballastvand fra ballasttan-
 - 30 kene.
 6. Skib ifølge et af kravene 1 til 5, som omfatter tre løftestøttesystemer (15.1, 15.2, 15.3), hvorved et løftestøttesystem (15.1) er integreret på midteraksen

(17) fortil i skibsskrogets (2) indre, og to yderligere løftestøttesystemer (15.2, 15.3) er integreret i skibsskroget (2) bagtil i de to sidevægge (4.1, 4.2).

7. Skib ifølge et af kravene 1 til 5, som omfatter fire løftestøttesystemer (15.1, 15.2, 15.3, 15.4), hvorved to løftestøttesystemer (15.1, 15.2) er integreret i skibsskroget (2) fortil og over for hinanden beliggende i sidevæggene (4.1, 4.2), og to yderligere løftestøttesystemer (15.3, 15.4) er integreret i skibsskroget (2) efter hinanden bagtil over for hinanden i sidevæggene (4.1, 4.2).

8. Skib ifølge et af kravene 1 til 7 med et dækshus (6), som er anbragt fortil på skibsskroget (2).

9. Skib ifølge et af kravene 1 til 8 med et skibsskruedrev og forreste og bageste manøvreringshjælpemidler.

15

10. Skib ifølge et af kravene 1 til 9 med et dynamisk positioneringssystem.

11. Skib ifølge et af kravene 1 til 10, som har indretninger til fiksering af fundamenter (23.1) og/eller master (23.2) fra vindenergianlæg (23) i lodret opretning på skibsskroget (2).

20

12. Skib ifølge et af kravene 1 til 11, som har optagelsesindretninger til fundamenter (23.1) og/eller master (23.2) fra vindenergianlæg (23) og/eller fastgørelsesindretninger til laskesystemer.

25

13. Skib ifølge et af kravene 1 til 12 udstyret med flere fundamenter (23.1) eller master (23.2) fra vindenergianlæg (23), og som er anbragt efter hinanden i retning af skibets længdeakse, eller skiftevis master (23.2) og fundamenter (23.1) fra vindenergianlæg (23).

30

14. Skib ifølge et af kravene 1 til 13, som er forsynet med en agterendeklap til aflukning af den åbne agterende (12).

15. Fremgangsmåde til transport og opstilling af offshore-konstruktioner med et skib ifølge et af kravene 1 til 13, ved hvilken
- skibet (1) lastes med offshore-konstruktioner (23),
 - 5 - det lastede skib (1) bevæges til opstillingsstedet for offshore-konstruktionerne (23),
 - skibet (1) på opstillingsstedet fikseres ved hjælp af løftestøtter (16) på havbunden,
 - offshore-konstruktionerne (23) afsættes på opstillingsstedet ved hjælp af
 - 10 kranen (20) imellem de ved agterenden værende fremspring (9.1, 9.2) på sidevæggene (4.1, 4.2), og
 - løftestøtterne (16) løsgøres fra havbunden (24).
16. Fremgangsmåde ifølge krav 15, ved hvilken skibet (1) før lastningen fikseres ved hjælp af løftestøtter (16) på bunden (27) af havnen, og løftestøtterne (16) efter læsningen løsgøres fra havnens bund (27).
17. Fremgangsmåde ifølge krav 15 eller 16, ved hvilken skibet (1) ved forankring på havets bund (24) sænkes længere ned ved at slippe vand ind i ballast-
- 20 tankene.
18. Fremgangsmåde ifølge krav 15 eller 16, ved hvilken skibet (1) løftes i det mindste delvis op af vandet med skibsskroget (2) ved hjælp af løftestøtterne (16).
- 25
19. Fremgangsmåde ifølge et af kravene 15 til 18, ved hvilken skibet (1) ind til fikseringen af løftestøtterne (16) i havbunden (24) positioneres ved hjælp af et dynamisk positioneringssystem på opstillingsstedet for offshore-konstruktionerne (23).
- 30
20. Fremgangsmåde ifølge et af kravene 15 til 19, ved hvilken skibet (1) lastet med offshore-konstruktionerne (23), idet skibet (1) med de ved agterenden værende fremspring (9.1, 9.2) på sidevæggene (4.1, 4.2) bevæges hen over en

pier (25), således at fremspringene (9.1, 9.2) imellem sig optager et klargøringssted (26) for offshore-konstruktionerne (23) og på klargøringsstedet (26) placerede offshore-konstruktioner (23) optages ved hjælp af kranerne (20) og placeres på skibsskroget (2).

5

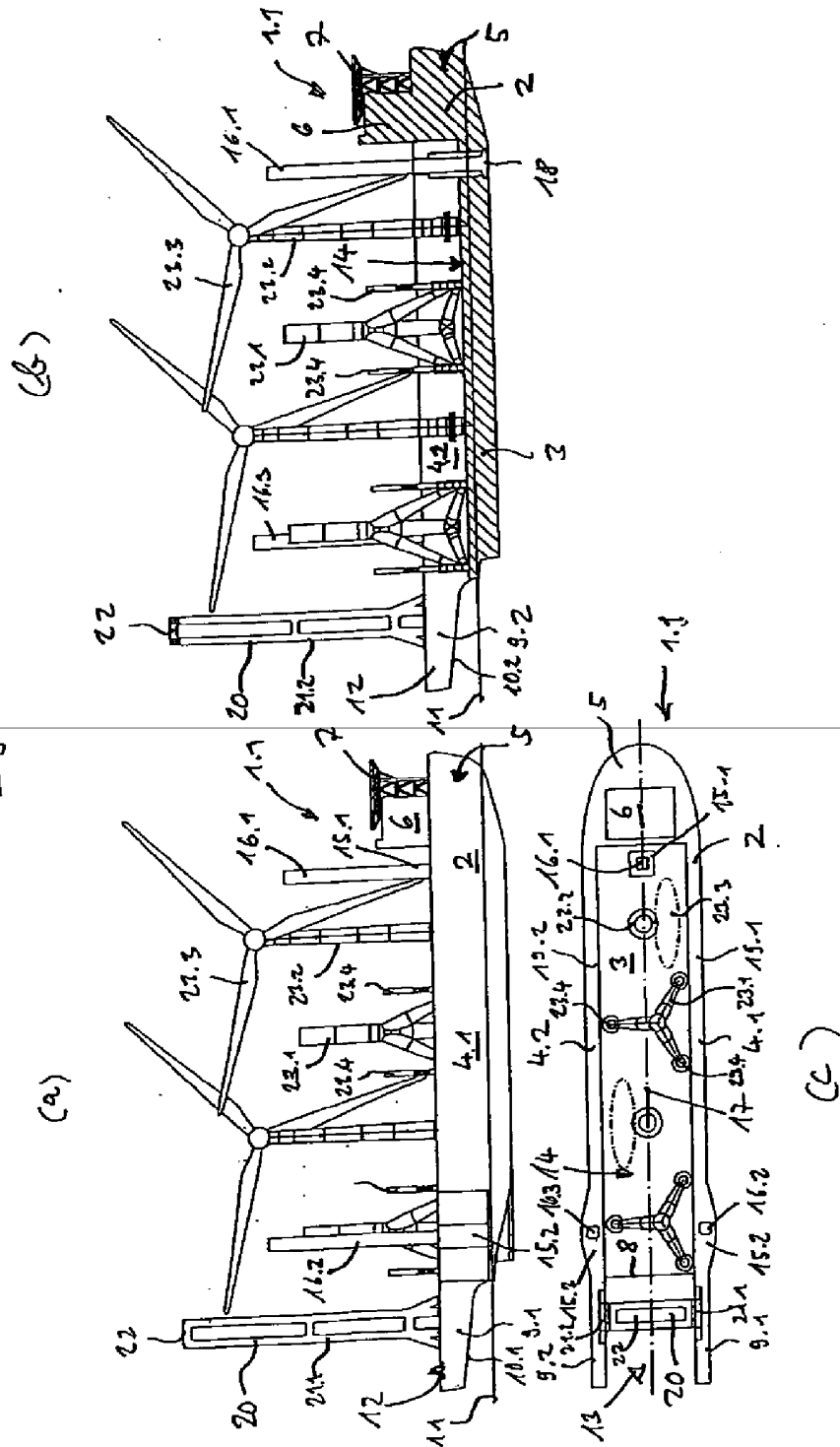
21. Fremgangsmåde ifølge et af kravene 15 til 20, ved hvilken skibet (1) læsses med vindenergianlæg (23), og vindenergianlæggene (23) opstilles på opstillingsstedet.

10 22. Fremgangsmåde ifølge et af kravene 15 til 21, ved hvilken skibet (1) med fundamenter (23.1) og/eller master (23.2) læsses med vindenergianlæg (23) i lodret opretning, og fundamenterne (23.1) og/eller masterne (23.2) fra vindenergianlægget (23) opstilles på opstillingsstedet.

15 23. Fremgangsmåde ifølge krav 22, ved hvilken skibet (1) læsses med i længderetningen efter hinanden placerede flere fundamenter (23.1) fra vindenergianlægget (23) eller flere master (23.2) fra vindenergianlægget (23) eller skiftevis master (23.2) og fundamenter (23.1) fra vindenergianlæg (23), og fundamenterne (23.1) opstilles på opstillingsstedet eller masterne (23.2) fra vindenergianlægget (23) anbringes på fundamenter (23.1) fra vindenergianlægget (23) eller
20 at fundamenterne (23.1) opstilles skiftevis, og masterne (23.2) anbringes skiftevis.

24. Fremgangsmåde ifølge et af kravene 15 til 23, ved hvilken skibets lastrum
25 aflukkes ved hjælp af en hækklap under sejlads.

Fig. 1



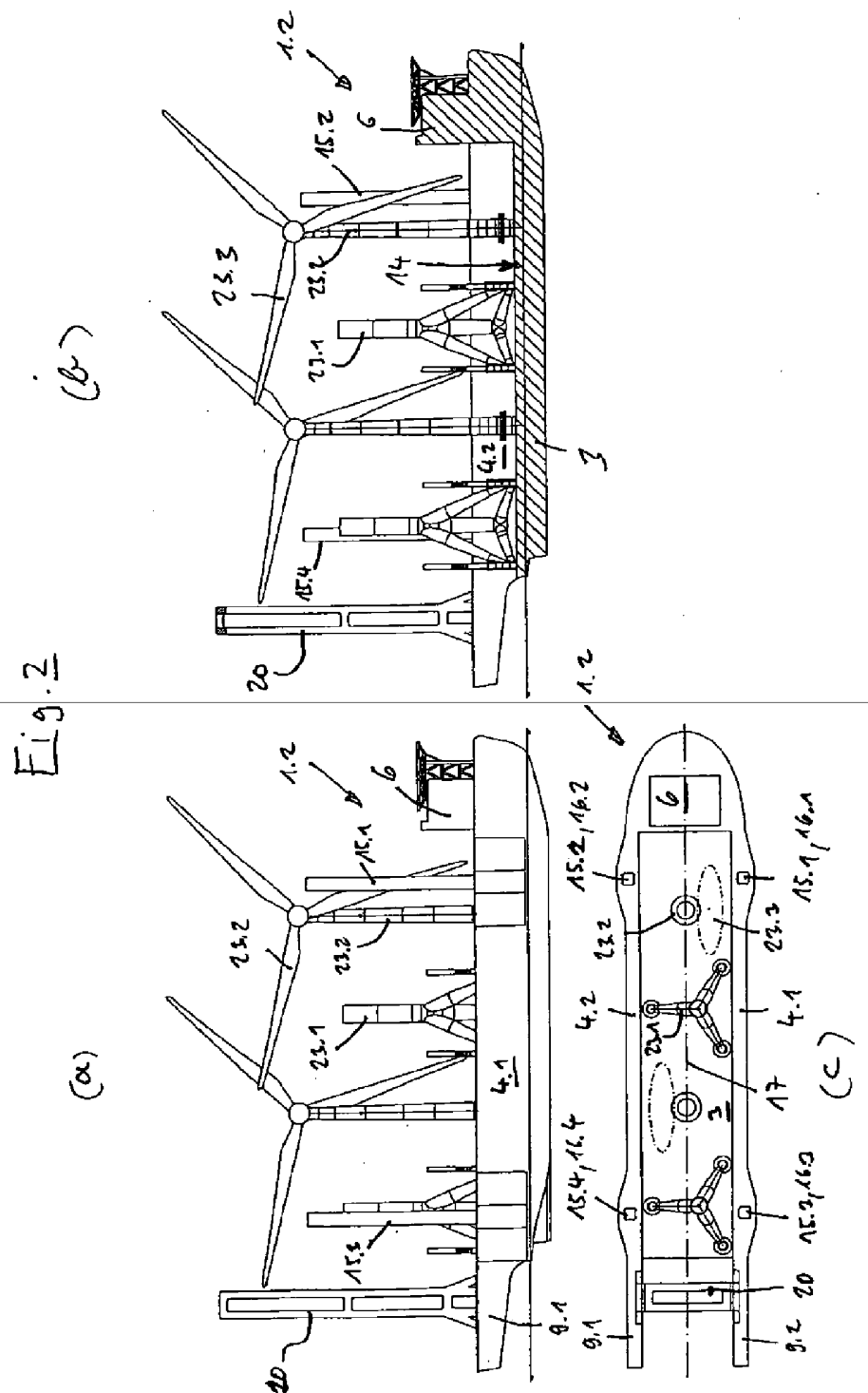


Fig. 3a

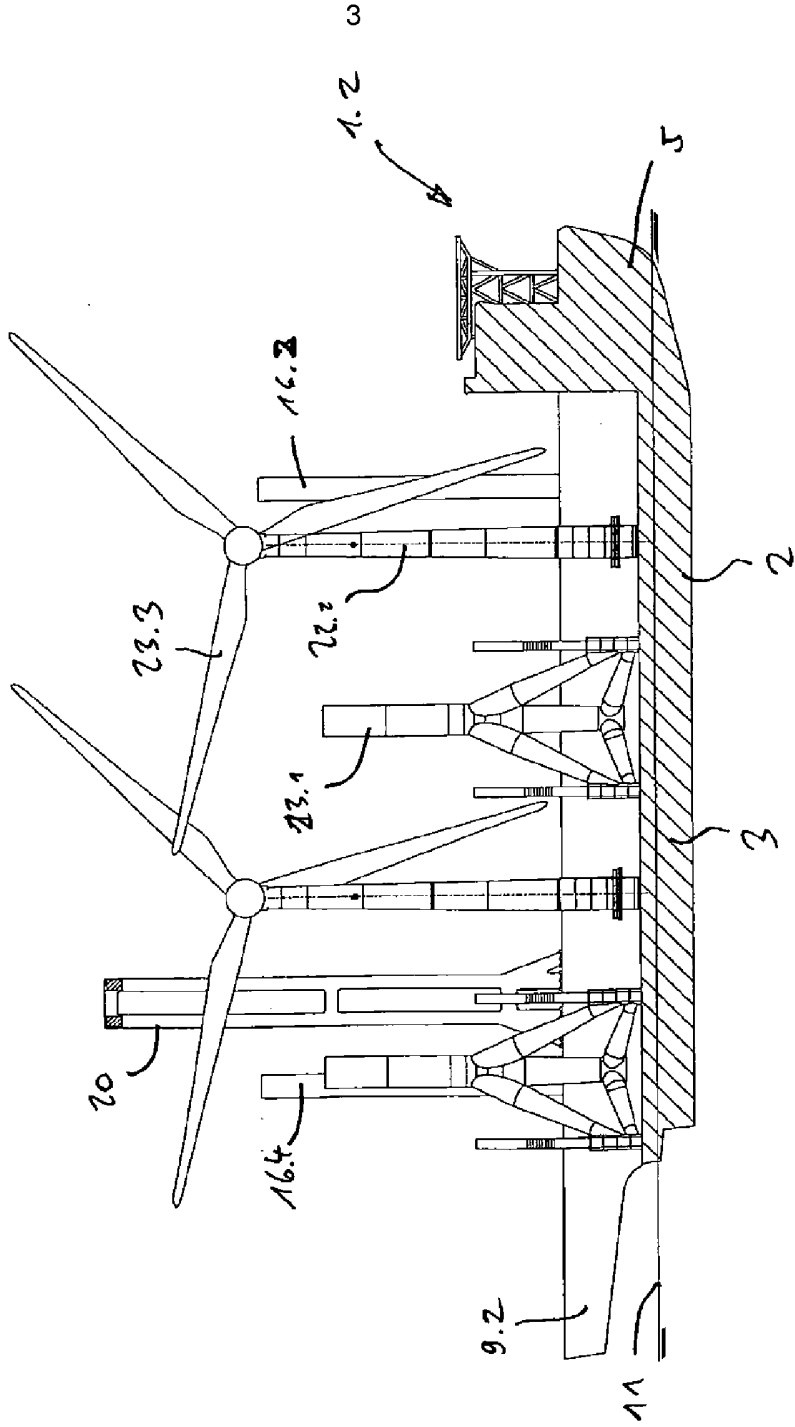
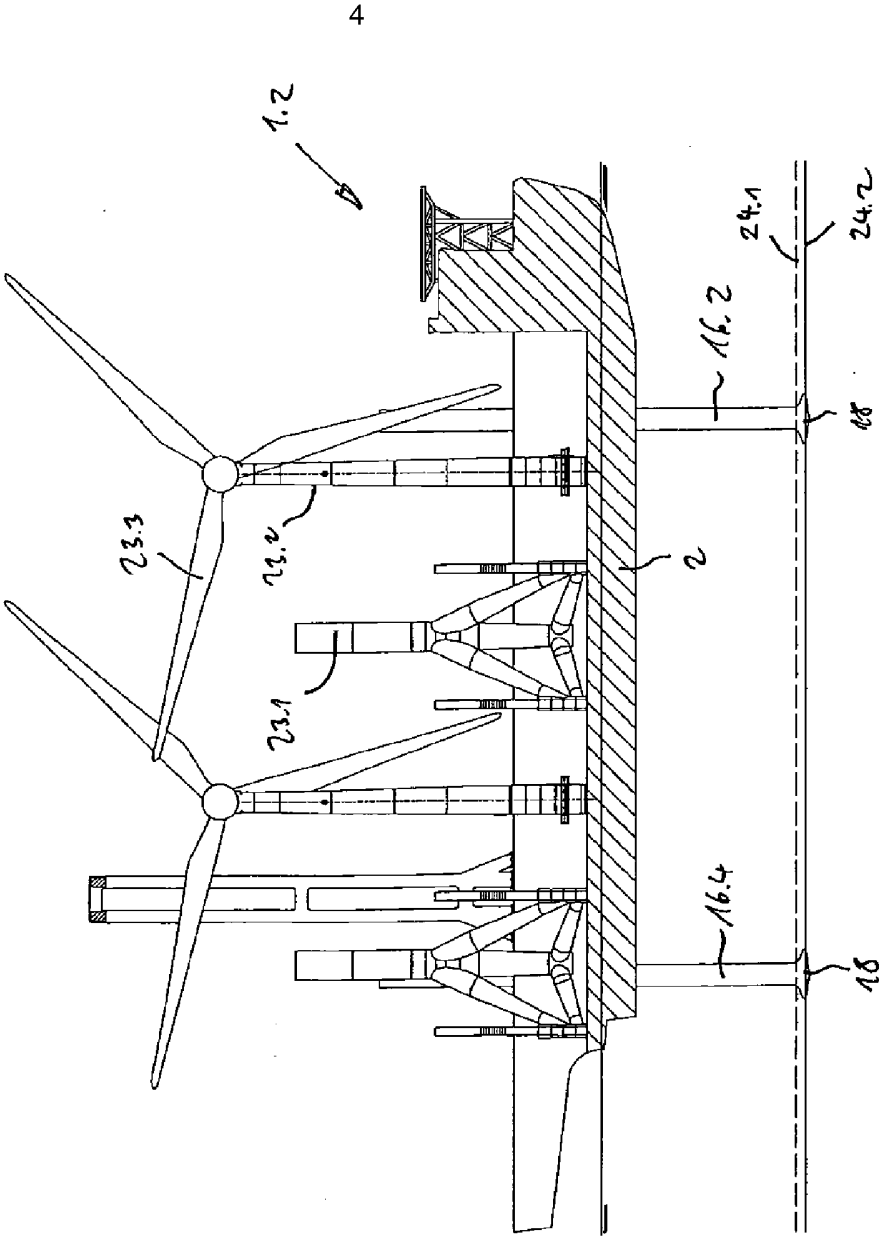


Fig. 3b



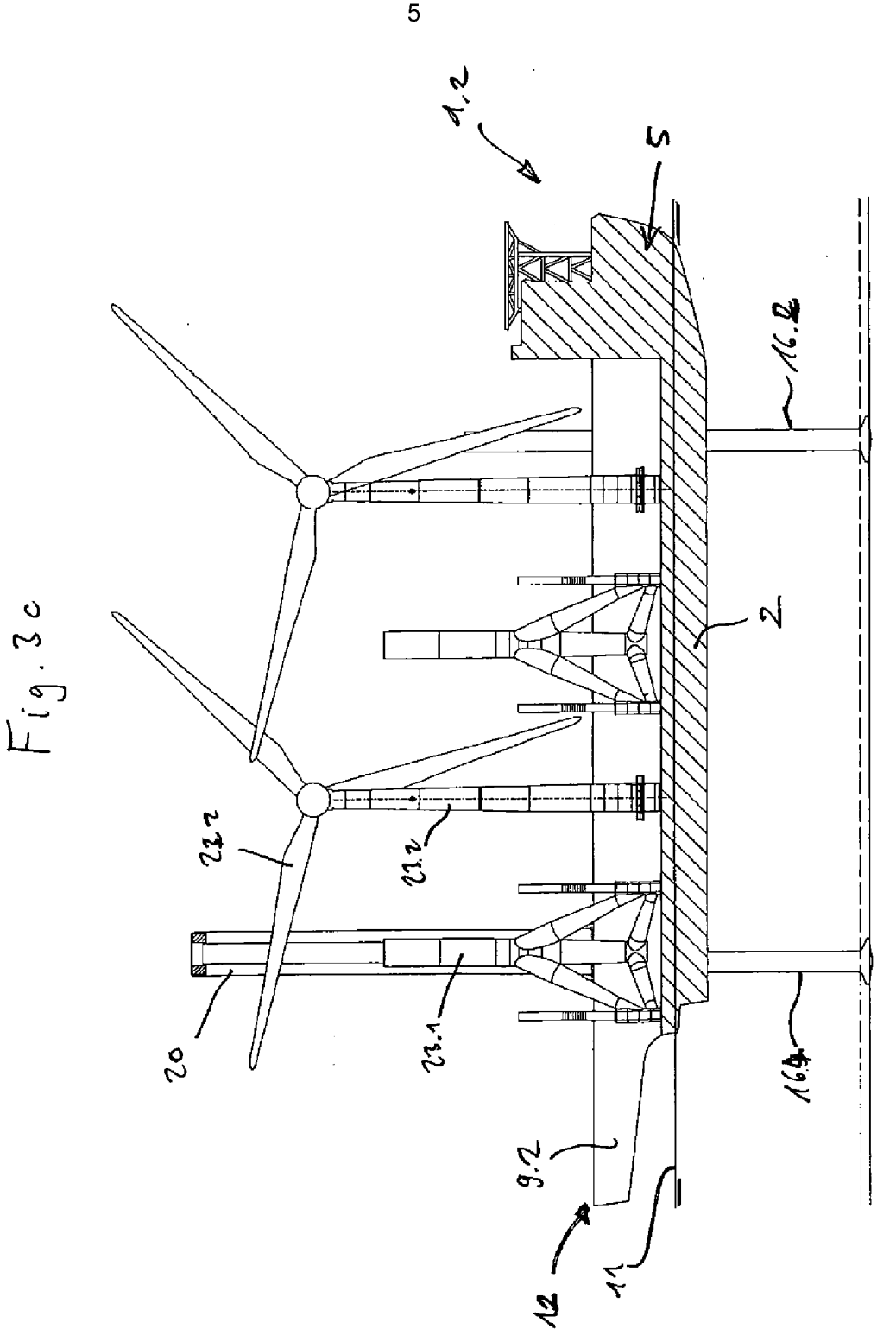
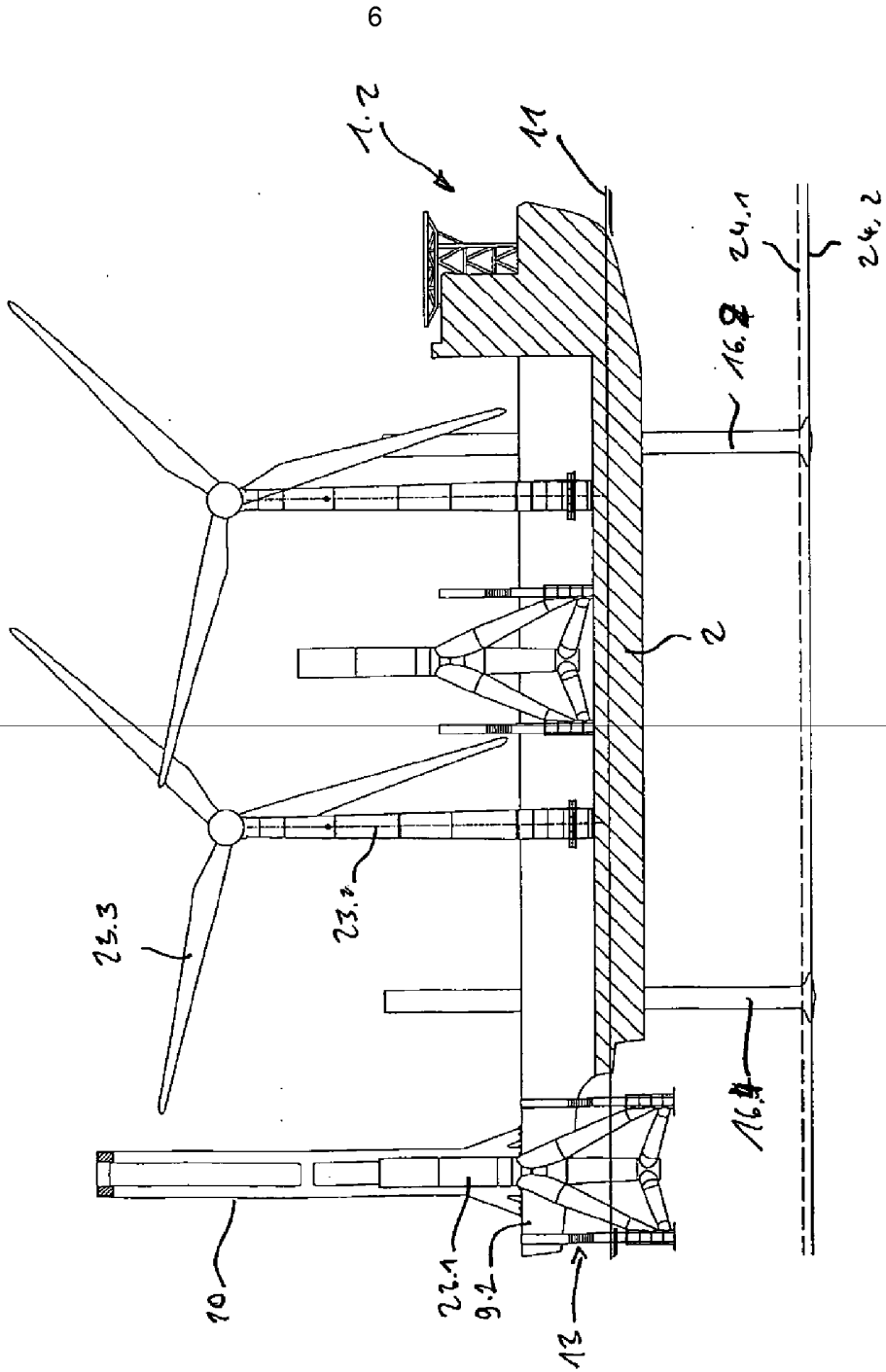


Fig. 3d



7

Fig. 3e

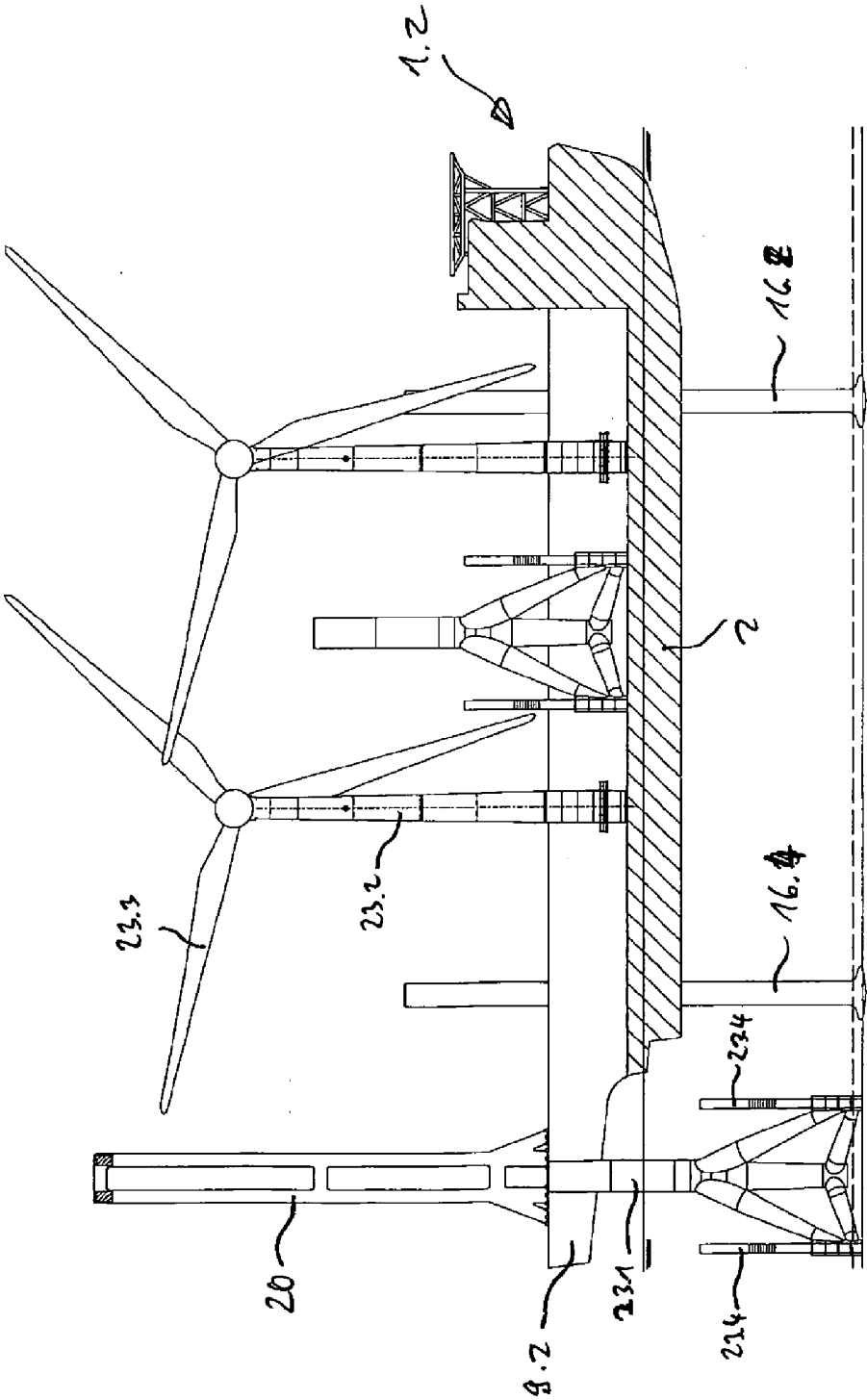
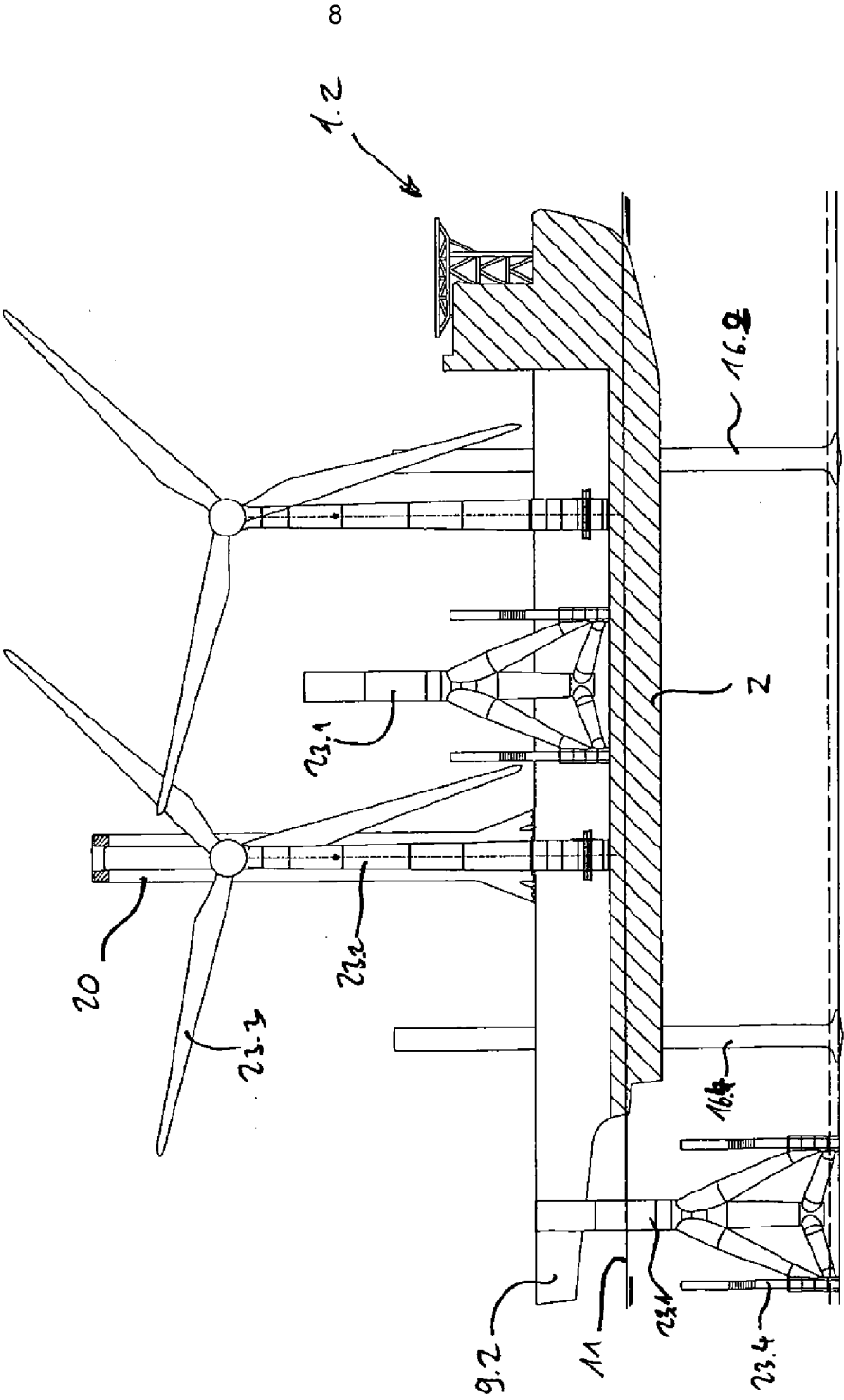


Fig. 3f



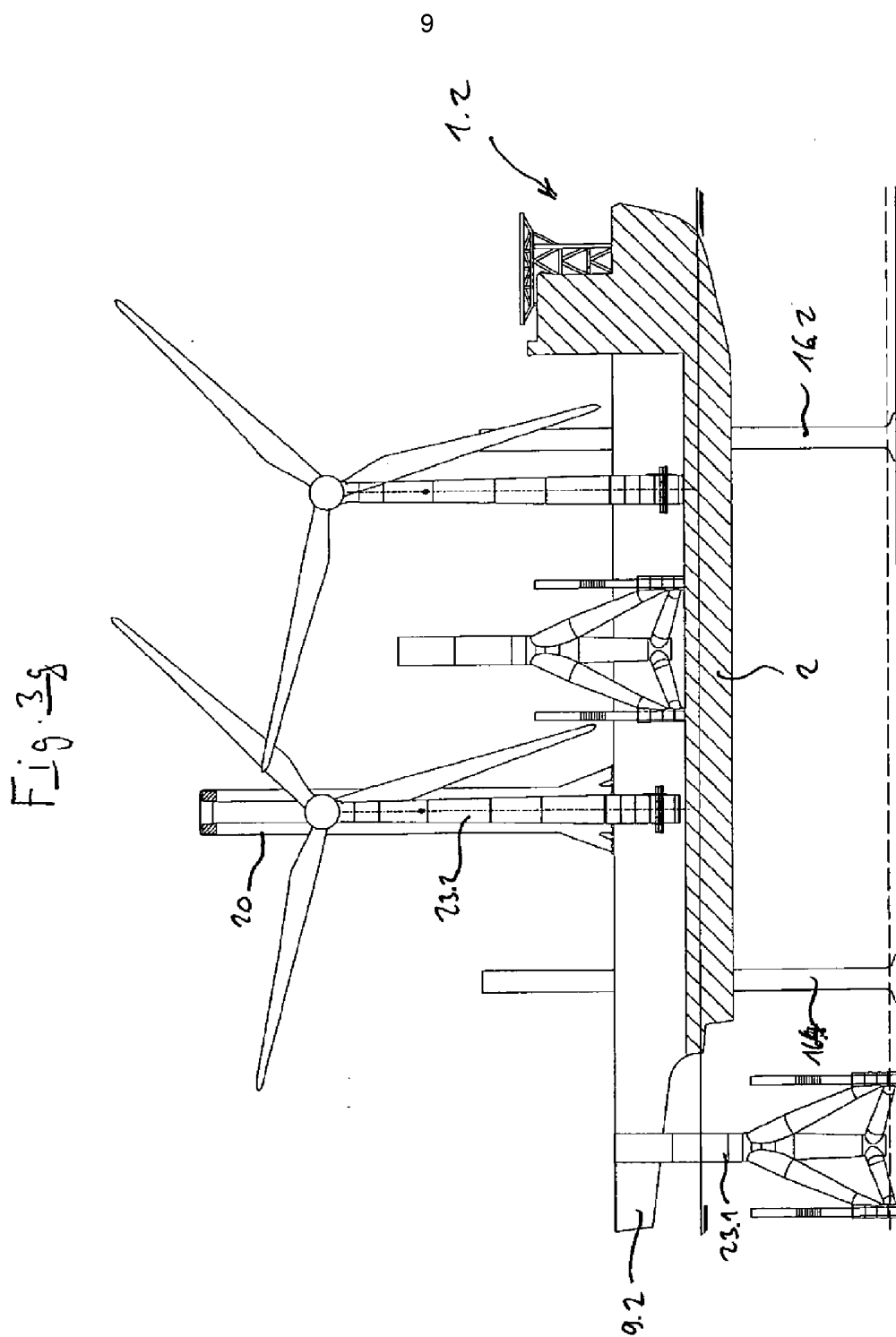


Fig. 3b

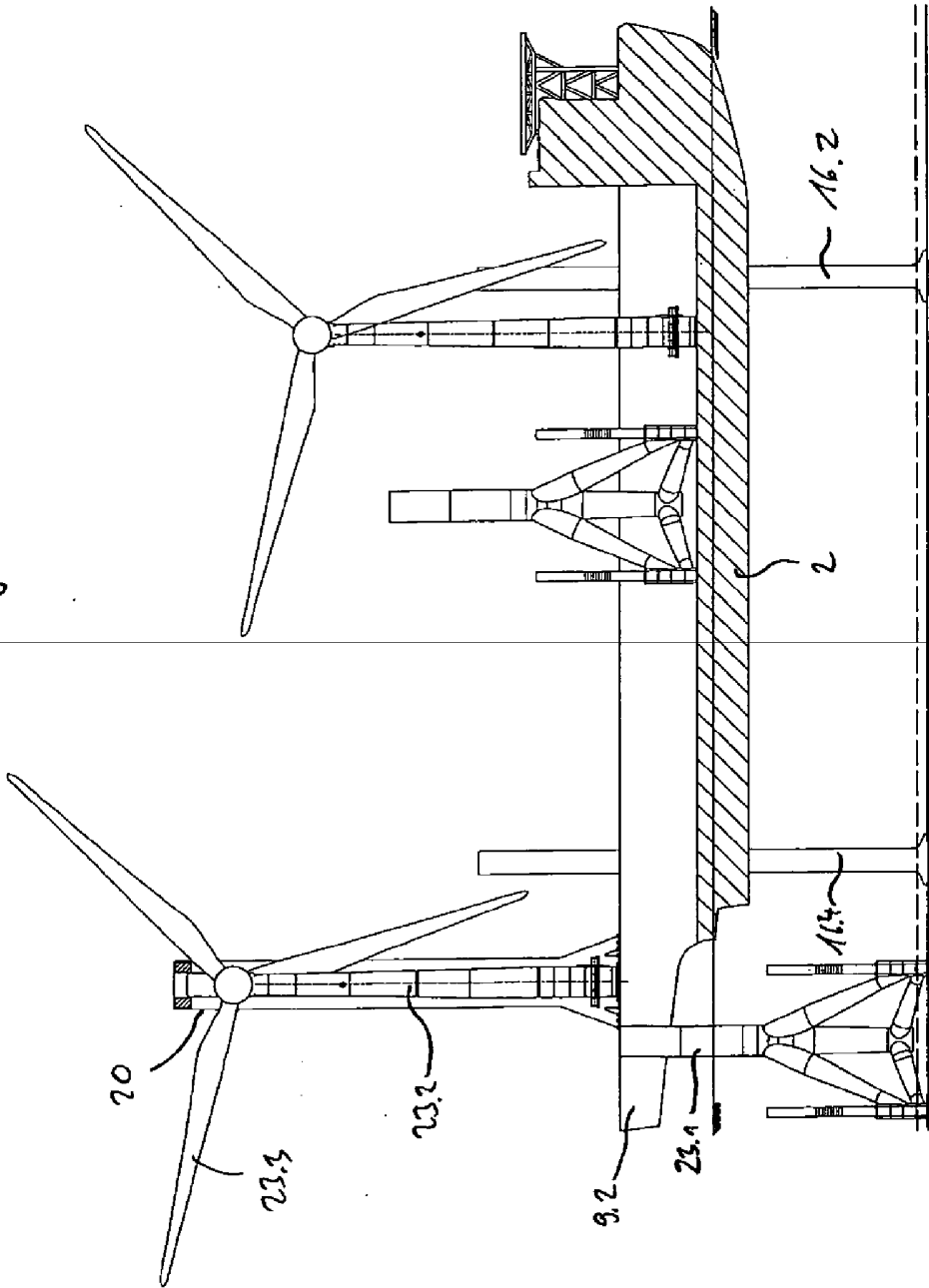
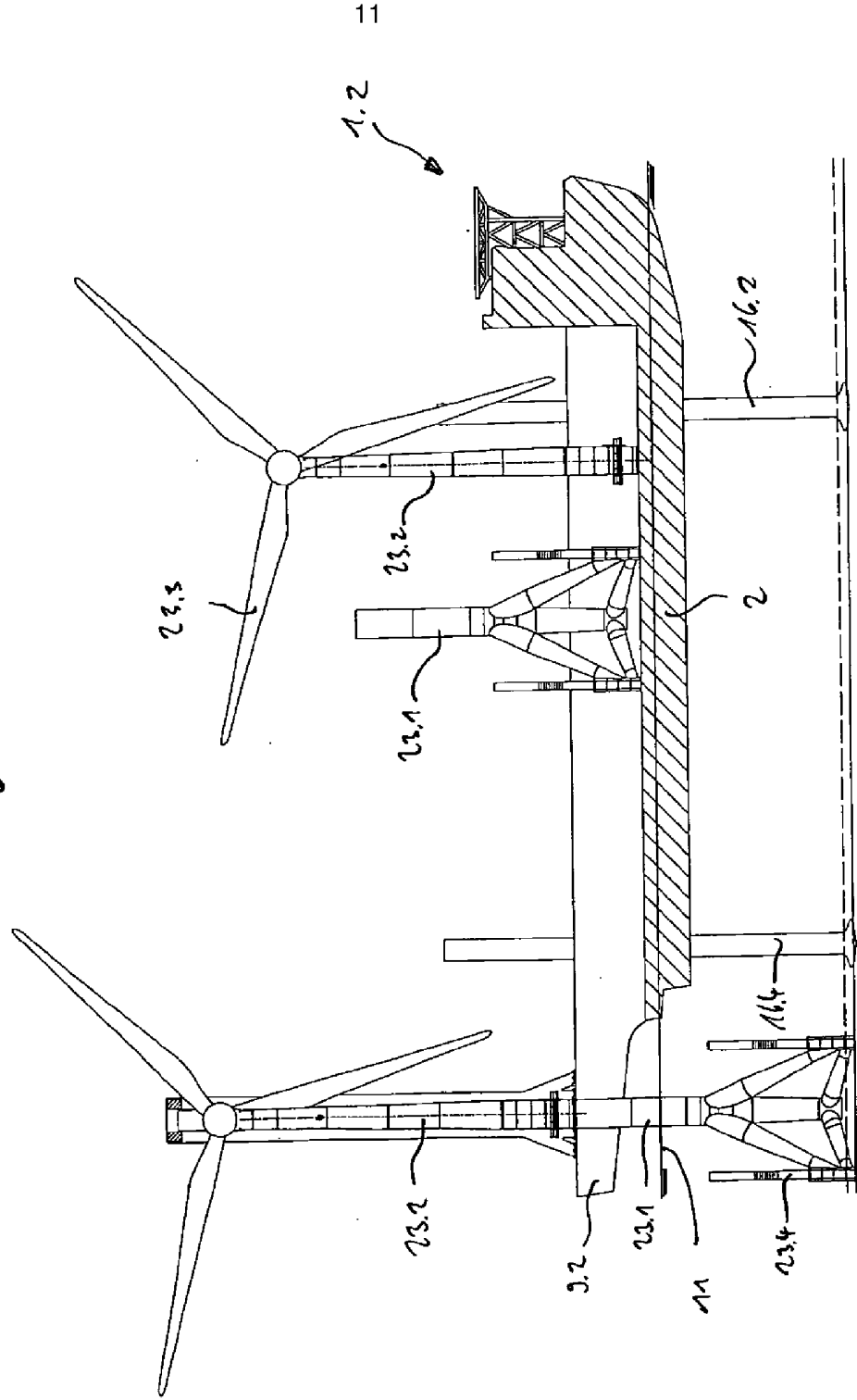


Fig. 3i



12

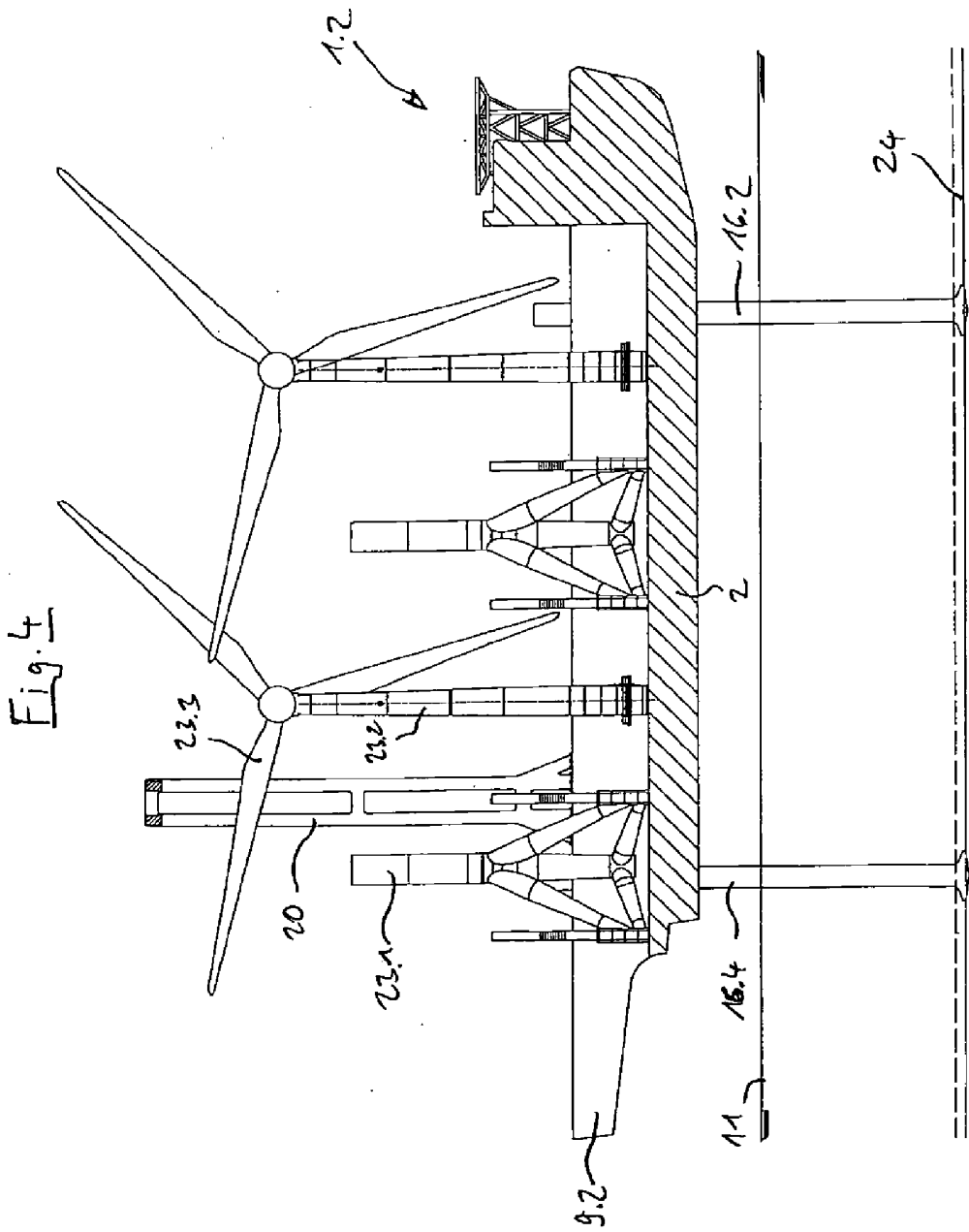


Fig. 5a

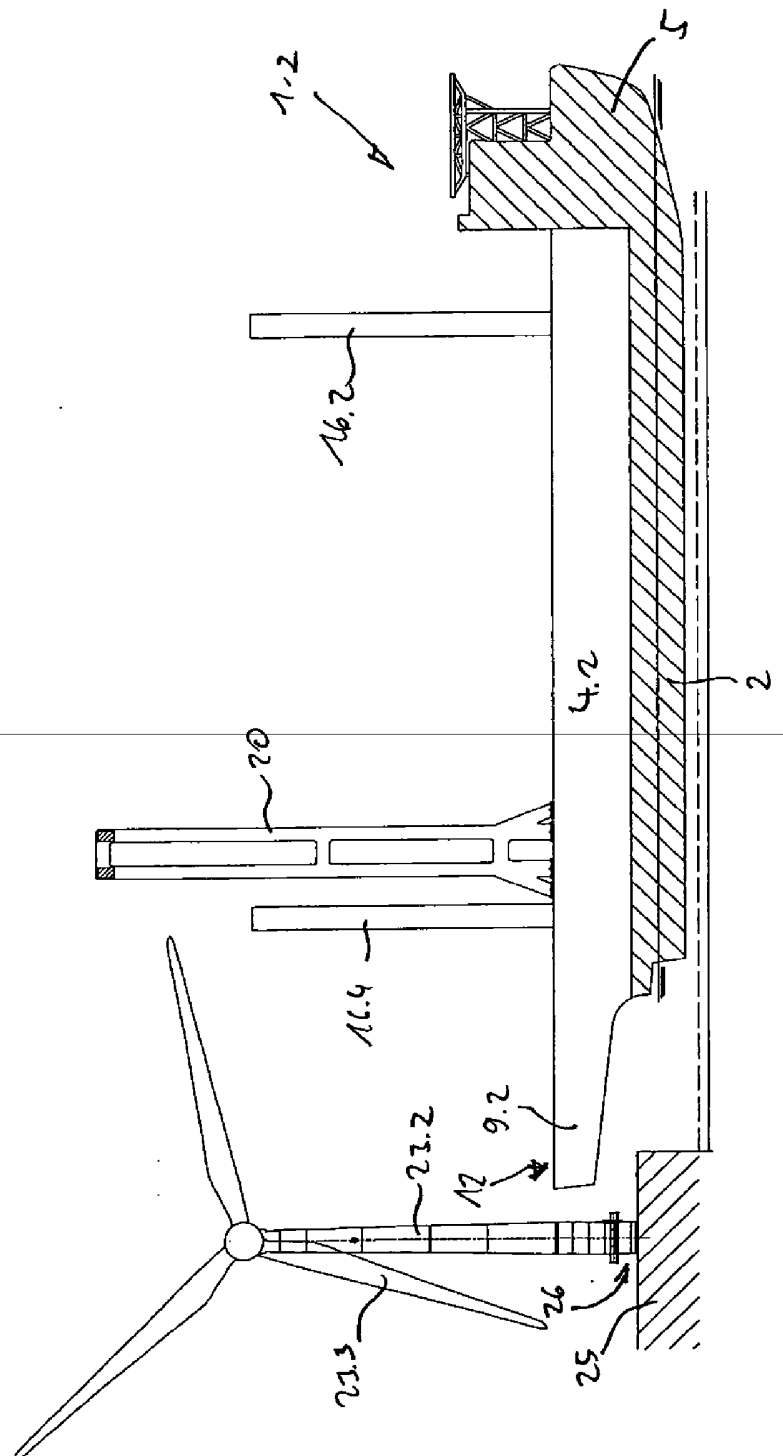
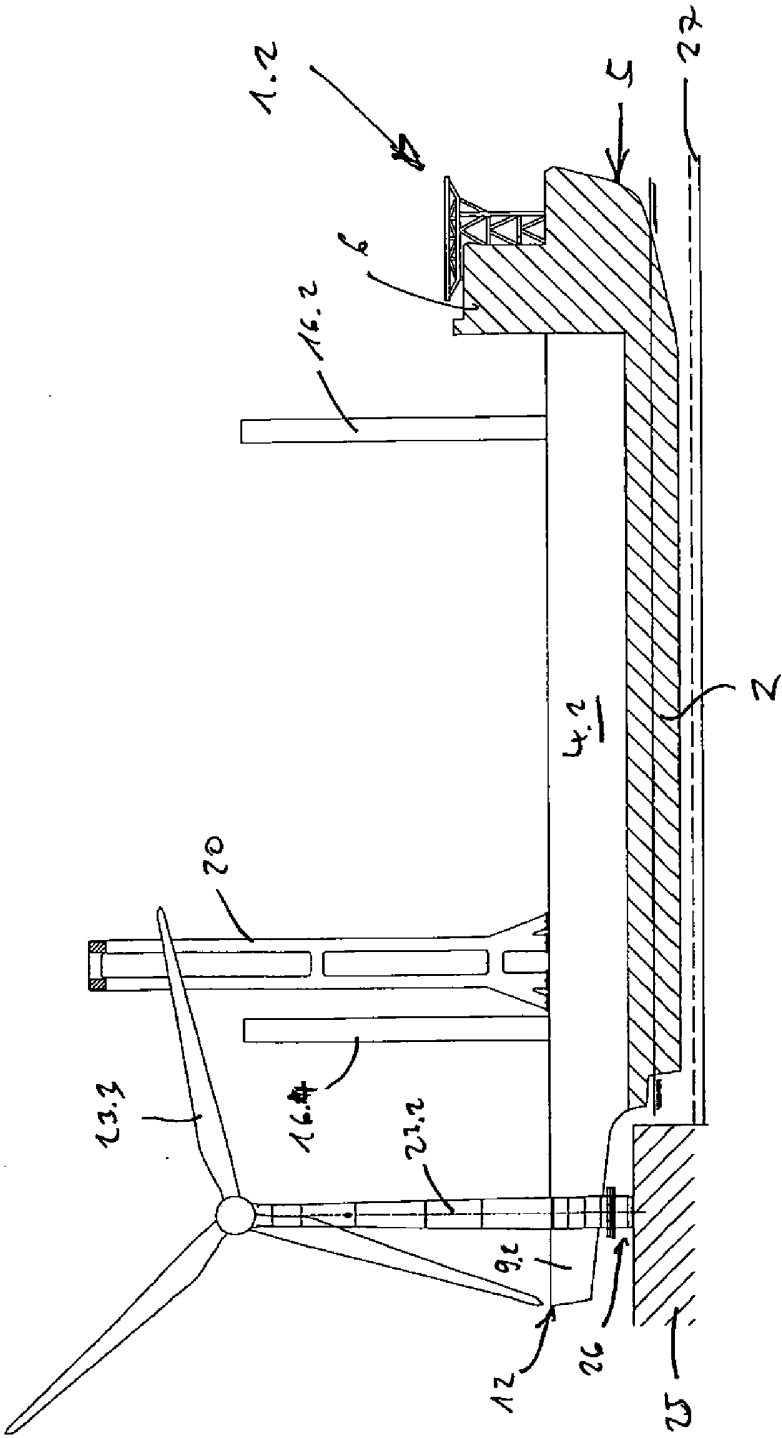
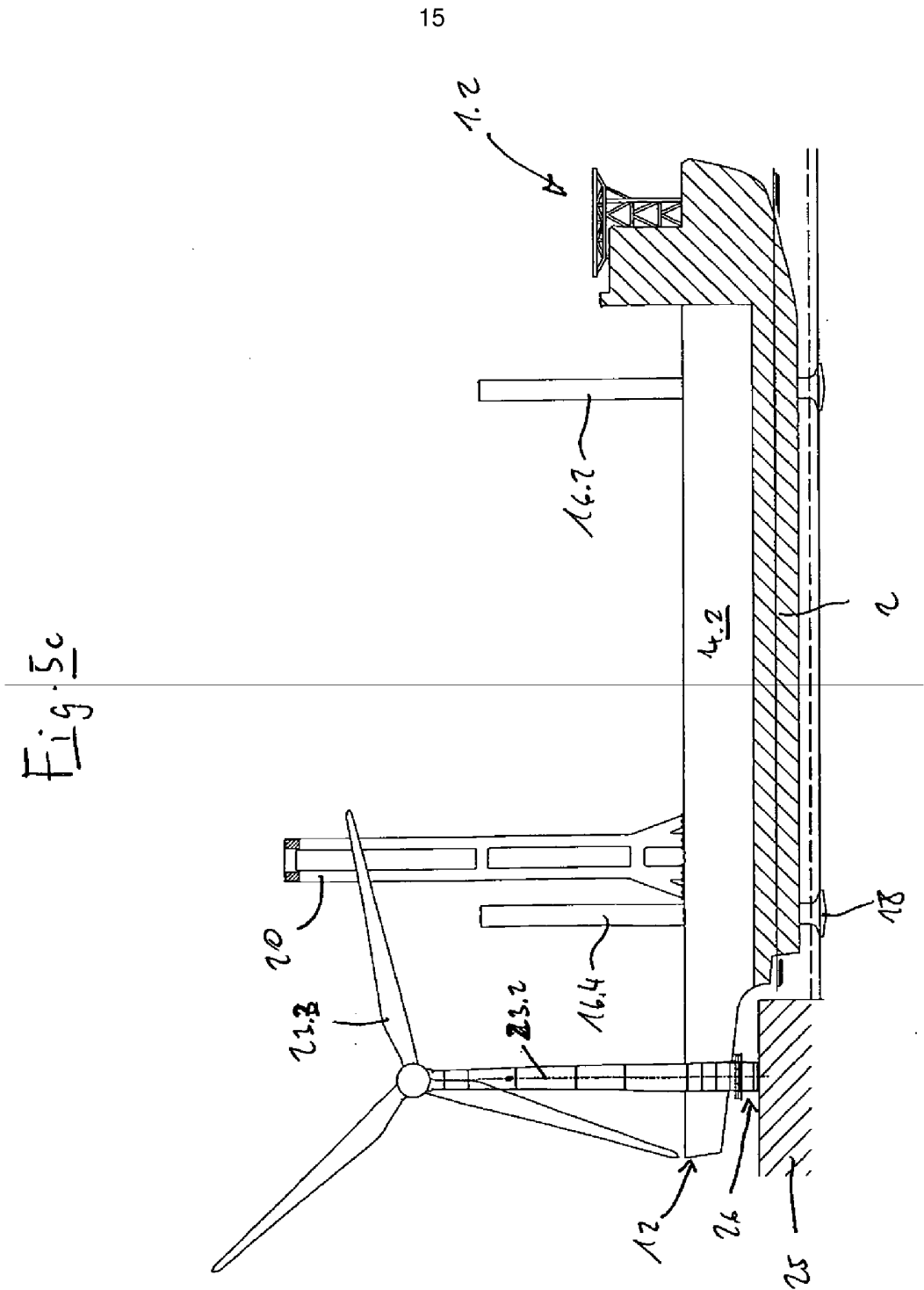


Fig. 5b





16

Fig. 5d

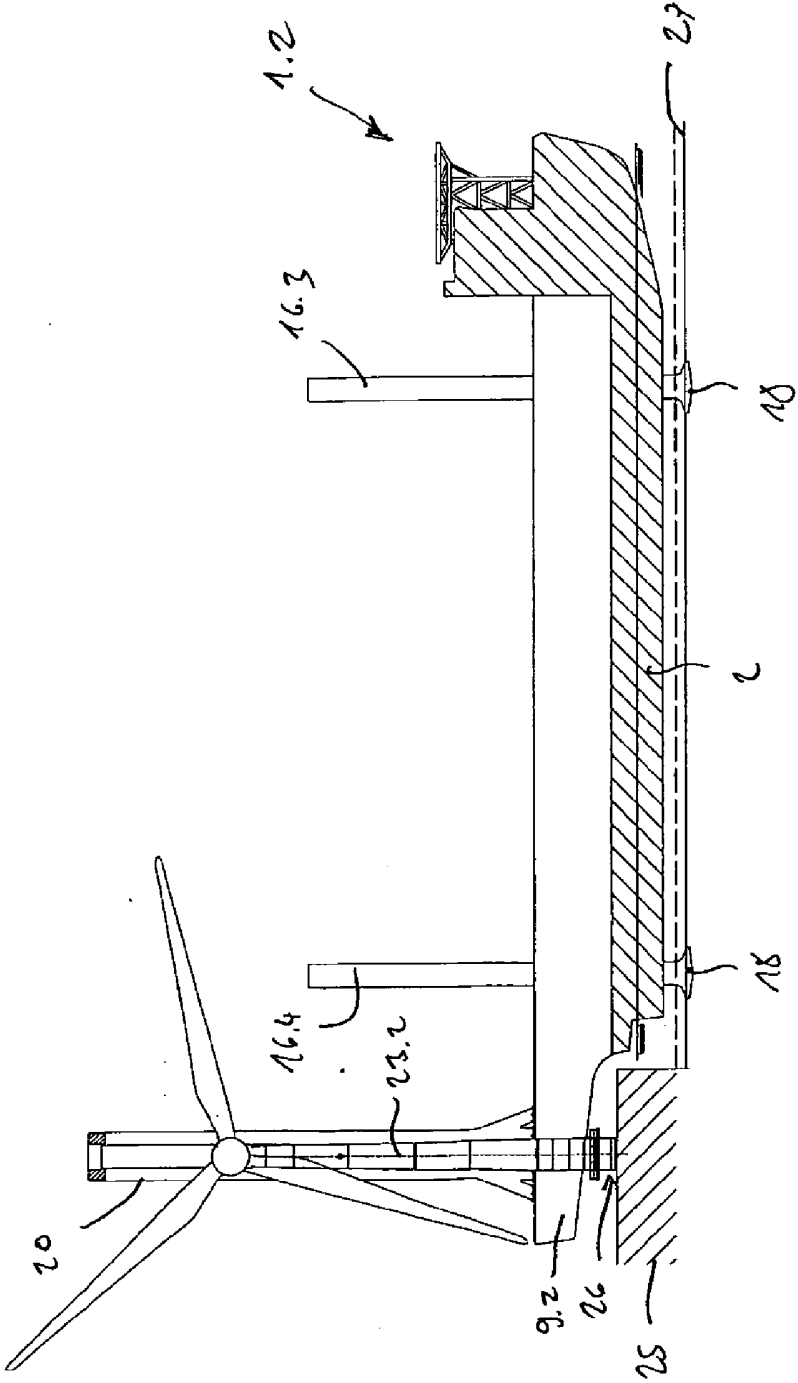


Fig. 5e

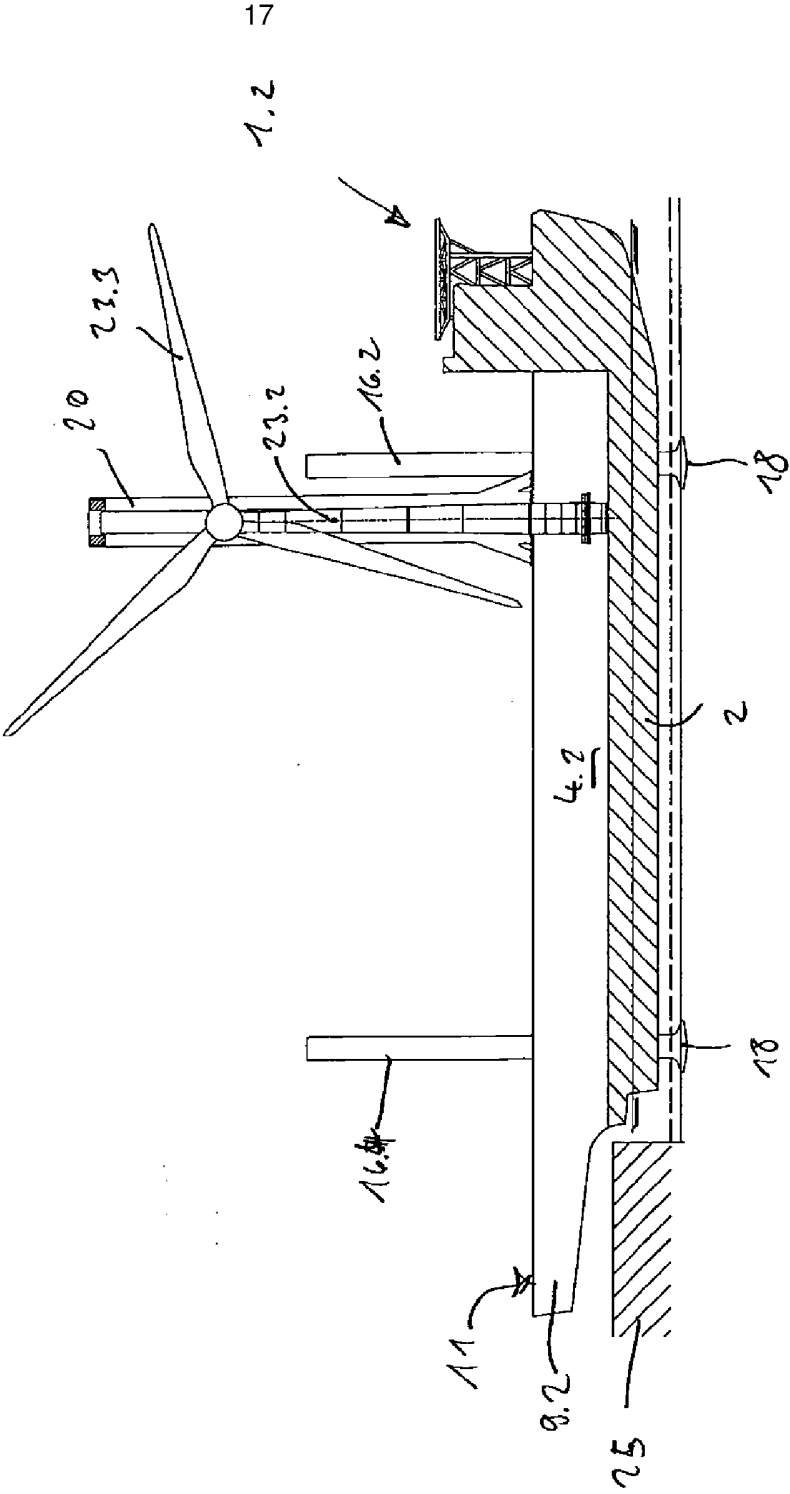
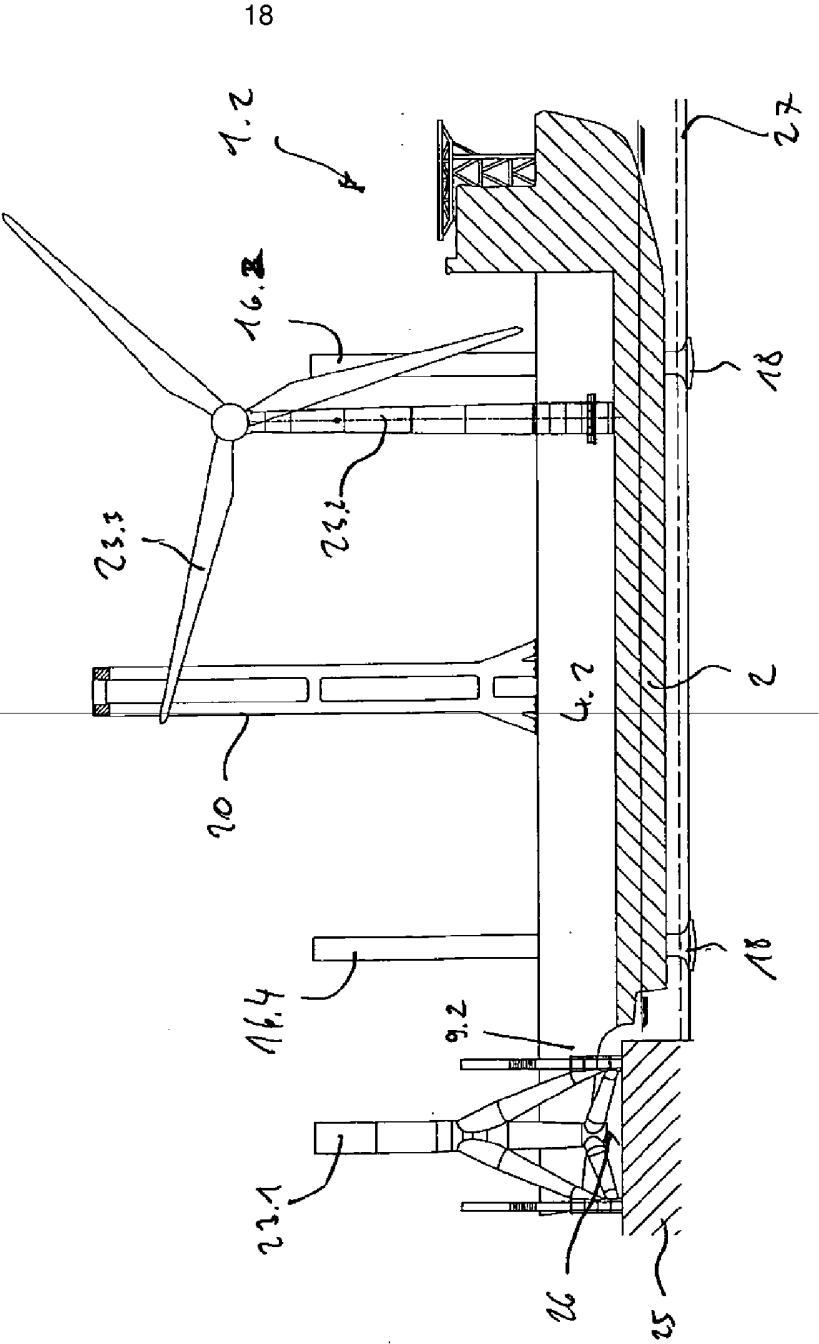


Fig. 5f



19

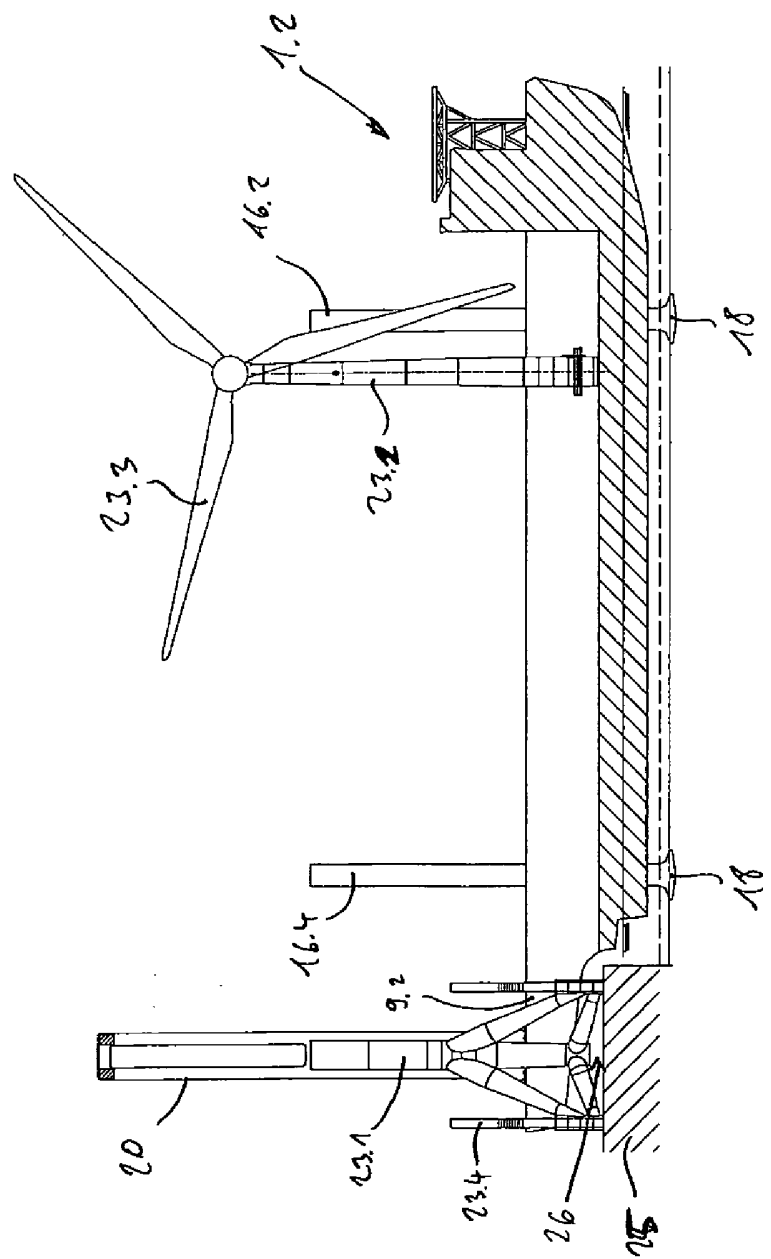
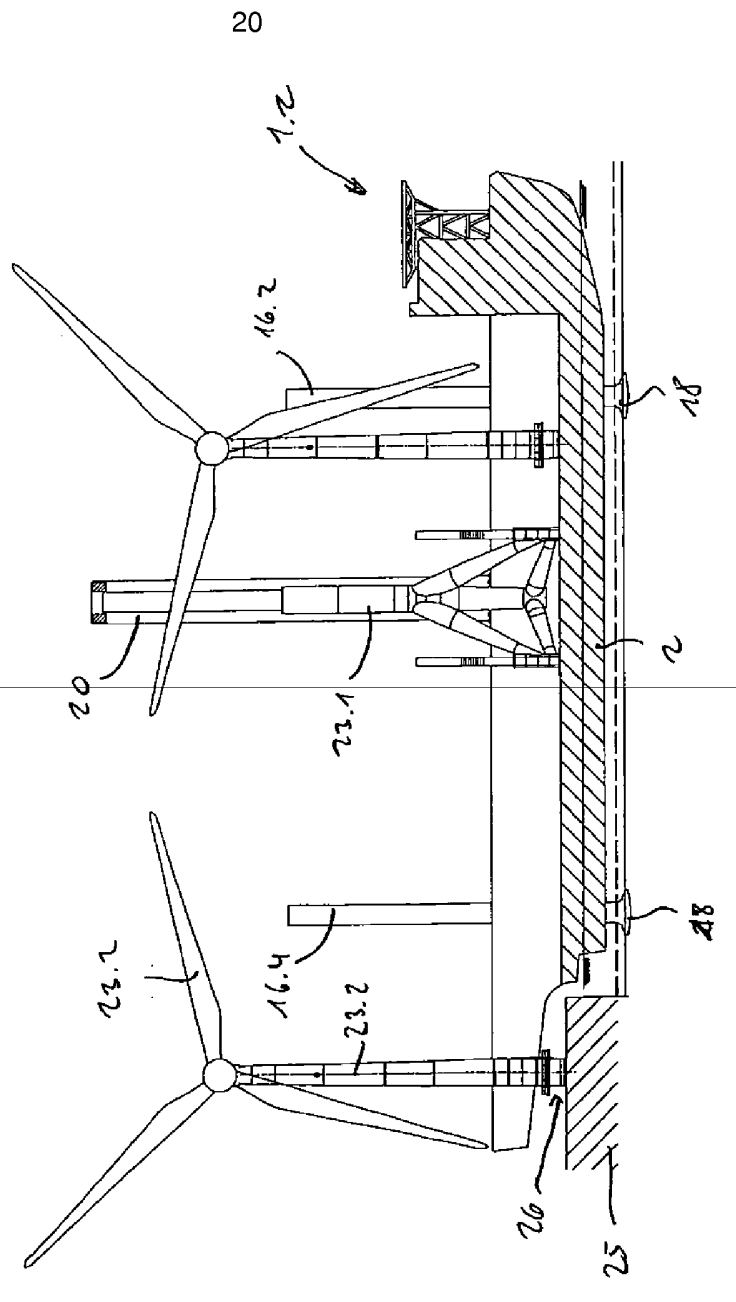


Fig. 5

Fig. 5h



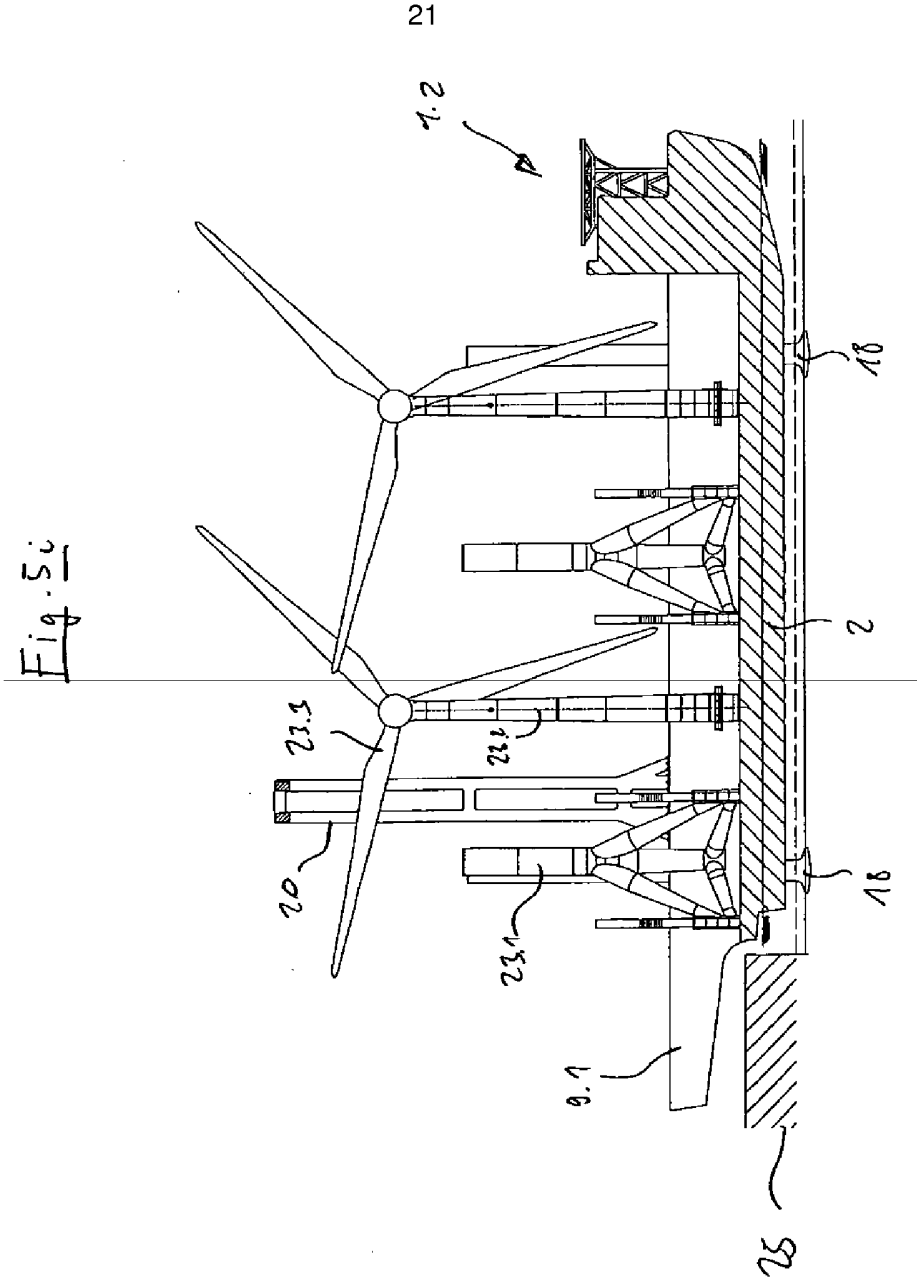


Fig. 5j

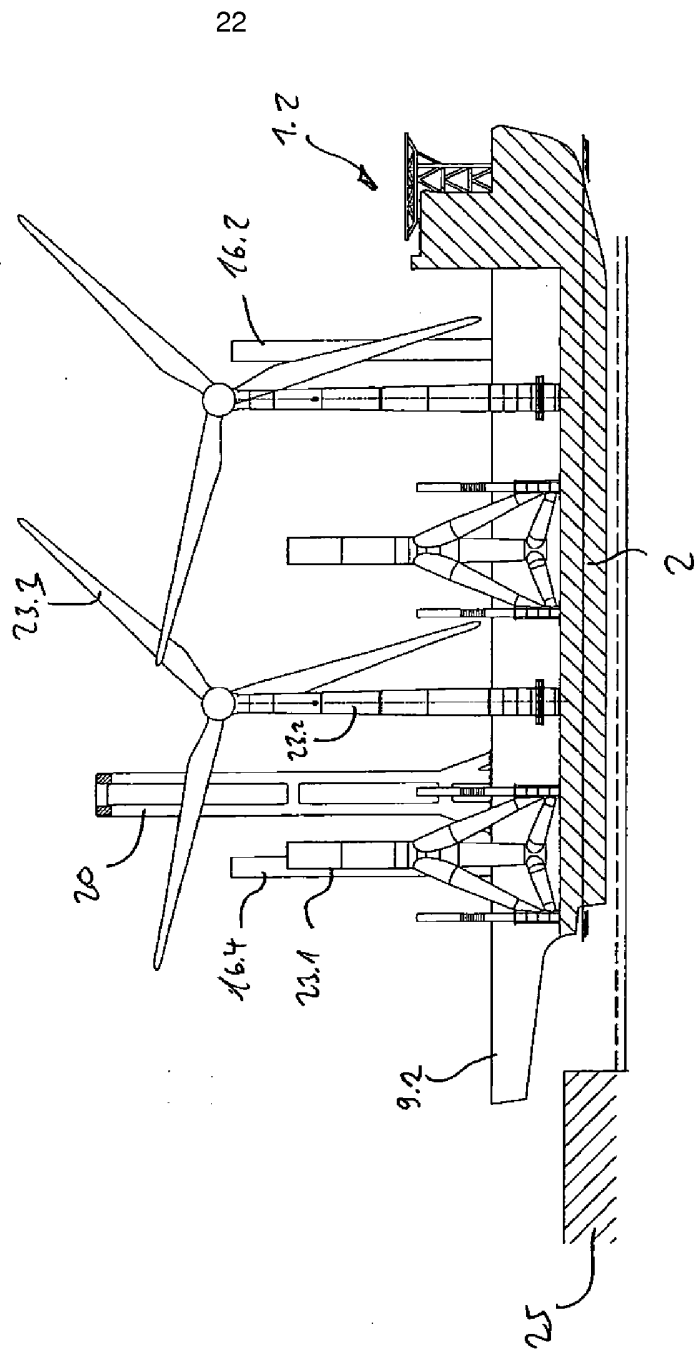
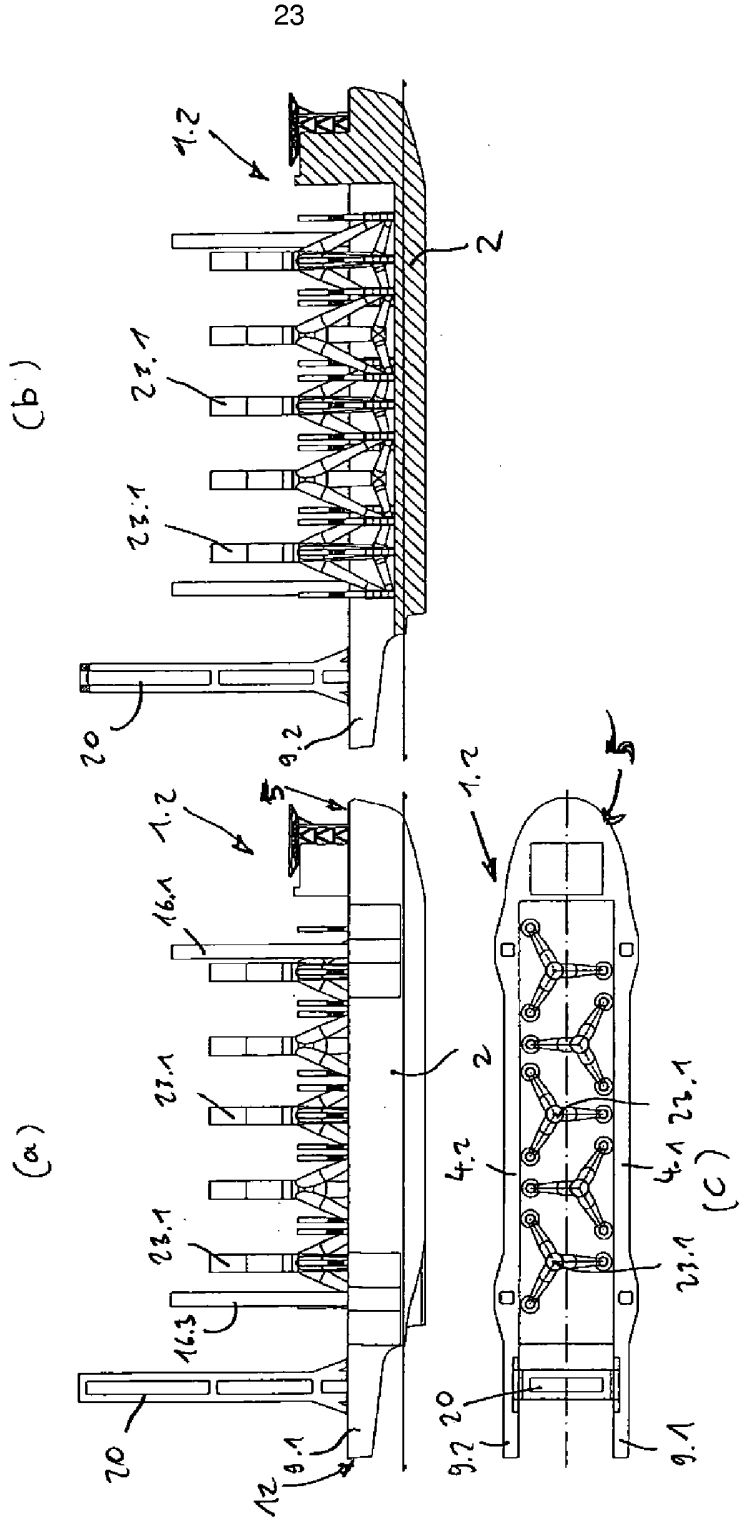


Fig. 6



23

Fig. 7

(a)

(b)

