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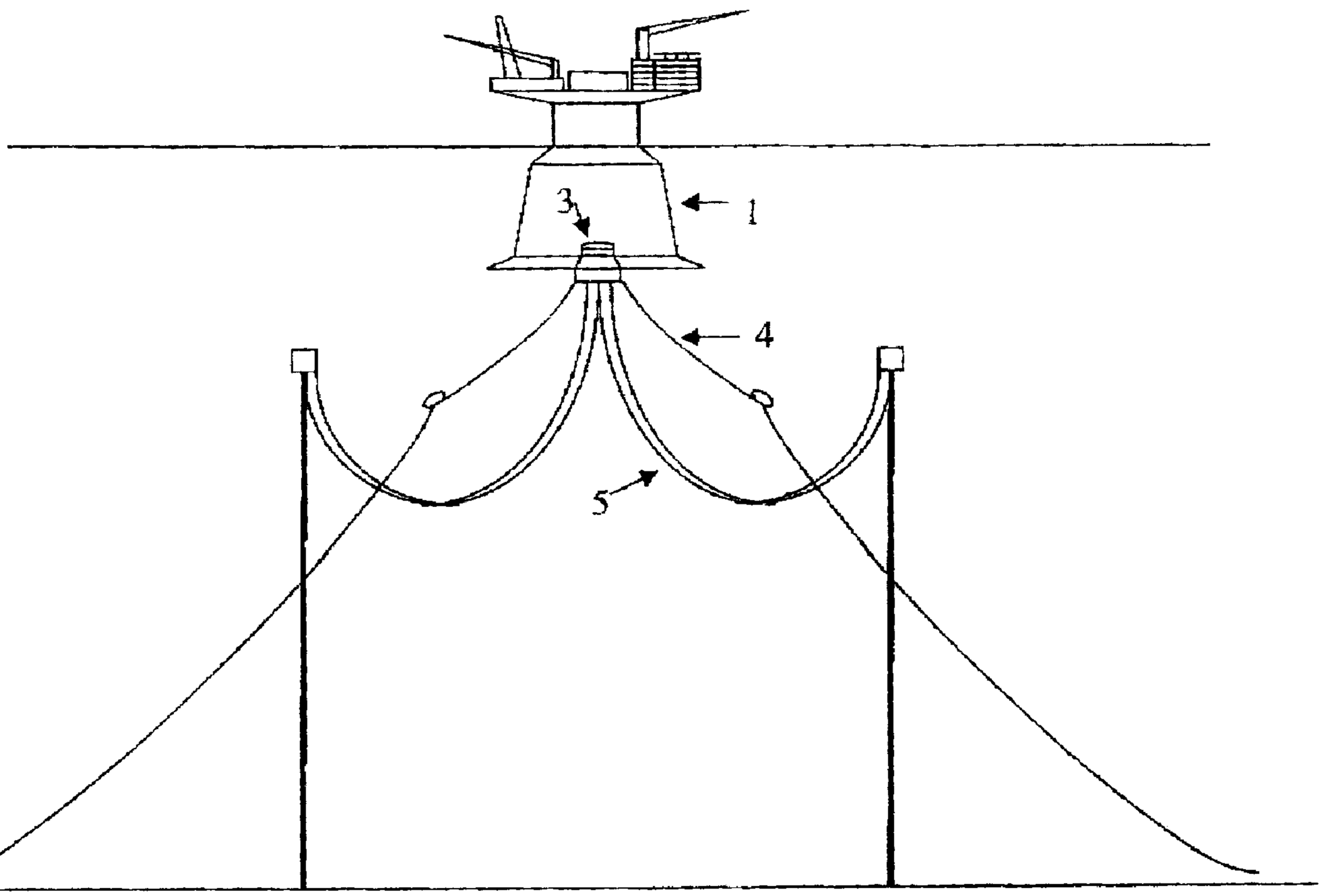
(54) Titre : BOUEE D'AMARRAGE
(54) Title: A MOORING BUOY



(57) **Abrégé/Abstract**:
In a method for releasing a mooring buoy (3) from a floating structure (1) the buoy is lowered by means of a chain (3) to a fist equilibrium position where the net buoyancy of the buoy is balanced by the weight of mooring lines (4) and risers (5). The chain (3) is lowered further by a second winch line (6) while the chain moves through a guide in the buoy until an upper stopper on the chain

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(57) **Abrégé(suite)/Abstract(continued)**:
abuts the buoy. By further paying out of the second winch line (6), the weight of the chain is gradually transferred to the buoy and pulls it down to a second equilibrium position at a substantial depth safe from e.g. drifting icebergs. The second winch line (6) is disconnected from the chain and retrieved to the floating structure (1).

Abstract

In a method for releasing a mooring buoy (3) from a floating structure (1) the buoy is lowered by means of a chain (3) to a fist equilibrium position where the net buoyancy of the buoy is balanced by the weight of mooring lines (4) and risers (5). The chain (3) is lowered further by a second winch line (6) while the chain moves through a guide in the buoy until an upper stopper on the chain abuts the buoy. By further paying out of the second winch line (6), the weight of the chain is gradually transferred to the buoy and pulls it down to a second equilibrium position at a substantial depth safe from e.g. drifting icebergs. The second winch line (6) is disconnected from the chain and retrieved to the floating structure (1).

(Fig. 3)

A mooring buoy

The present invention relates to a method for lowering a mooring buoy from a floating structure by means of a chain which is paid out from the floating structure via a chain-winch until the buoy is near a first equilibrium position due to the weight of mooring lines and any risers connected to the buoy, whereupon the chain is lowered further by means of a second winch line until the chain is supported by the buoy.

Such a method is known from US 5860840. In this prior art method the basic purpose is to minimize the size and strength of the buoy. This is obtained by avoiding any direct connection of the majority of mooring lines to the buoy. Instead, these mooring lines are connected directly to the turret of the vessel during the normal moored condition. When the buoy has to be disconnected, e.g. in an emergency situation, each of said mooring lines are disconnected from the turret and lowered by means of lighter auxiliary lines through guide tubes in the buoy and to the sea floor in order to reduce the load on the buoy also in its disconnected condition. However, this individual disconnection and lowering of some of the mooring lines will cause a considerable delay in what may be an emergency situation where time is of essence.

Due to the reduced size of the buoy the size and weight of the chain used to lower the buoy may be sufficiently small for it to be stored in a central space in the buoy. However, once the buoy is disconnected from the vessel, there are no longer any mooring lines to keep the vessel in place. Consequently, the vessel may tend to drift off under the influence of environmental forces and cause a lateral pull in the chain. The chain will no longer be vertical and when it is lowered further by means of the second winch line, all of it may not end up in its intended central space in the buoy, but may instead be left hanging over the

side of the buoy where it can get tangled in the risers and mooring lines.

The purpose of the present invention is to provide a method of the type mentioned by way of introduction which may be used in deep water and hostile environments, where the buoy will have to reach a substantial depth in the disconnected condition in order to avoid threats from e.g. passing icebergs, yet without being too heavy to lift back up to re-docking position in the surface vessel. In addition, the method should permit quick and easy disconnection of the buoy from the vessel without the need for separate disconnection of mooring lines.

This is obtained in the method according to the invention by letting the chain, during said further lowering, move down through a guide in the buoy until an upper enlargement on the chain stops against the buoy, whereby the chain is permitted to depend below the buoy and constitute a substantial ballasting element which brings the buoy to a second, substantially deeper equilibrium position.

By using the chain as a ballasting element the first equilibrium position may be considerably higher than the required final equilibrium position, which means that the buoy will have to be lifted a shorter distance and with a lower force exerted by the chain winch. This is because the buoy can be made with a higher net buoyancy than what would be required if it were to obtain equilibrium at the lower depth without any removable substantial ballast like the chain. The higher net buoyancy permits the buoy to carry a heavier load from the moorings or risers, thus avoiding any separate disconnection thereof.

Further advantageous features of the invention are recited in the dependent claims.

The invention also relates to a buoy for use in the aforesaid method, wherein the buoy is provided with a ballasting element in the form of a chain, said chain also being suitable for lifting and lowering the buoy in the submerged position, said chain being free to move through a guide in the buoy except for end stoppers on the chain preventing it from becoming loose from the buoy.

The invention will be explained in more detail with reference to the exemplifying embodiment illustrated in the appended drawings, where:

Fig. 1 shows a schematic view of an offshore hydrocarbon production facility incorporating a buoy according to the present invention,

Fig. 2 is a view similar to fig. 1, but shows the buoy disconnected and in a first equilibrium position, and

Fig. 3 shows a view similar to fig. 2, but with the buoy in a second equilibrium position.

The production facility shown in fig. 1 comprises a floating vessel 1 having a generally axi-symmetric underwater body supporting a deck structure carrying facilities well known in the art. The vessel is moored by means of a buoy 3 attached thereto, the buoy 3 being connected to mooring lines 4 and flexible risers 5 of two hybrid riser systems.

If the vessel 1 temporarily has to move from its location, e.g. if it is in the path of a drifting iceberg, the buoy 3 is disconnected from the vessel and lowered by means of a chain winch (not shown) on the vessel until it reaches a first equilibrium position where its net buoyancy is balanced by the weight of the mooring lines 4 and flexible risers 5. This first equilibrium position is illustrated in fig. 2 and may be at a depth of about 130 m. This figure further shows that the chain 2 has been lowered further so

that part of it depends below the buoy 3. This lowering of the chain continues by means of a second winch line 6 until a stopper at the upper end of the chain abuts the buoy and pulls the buoy down to a second equilibrium position wherein the entire weight of the chain 2 is carried by the buoy 3. The buoy may now be at a depth of e.g. 250 m.

The lower end of the second winch wire 6 may be connected to the chain 2 by means of a coupling that automatically will disconnect from the chain when the second winch wire goes slack. The vessel is now free to move off the location.

When the vessel is to be reconnected to the buoy 3 at a later stage, the second winch wire 6 has to be lowered to the buoy and reconnected to the chain 2, e.g. by the aid of a remotely operated vehicle or other means well known in the art. As the winch line 6 gradually takes over the weight of the chain 2, the buoy 3 rises until it reaches the first equilibrium position illustrated in fig. 2. Further operation of the second winch pulls the chain up through the buoy until the chain can be connected to its chain winch and raise the buoy to its docking position in the vessel as shown in fig. 1.

The present invention has been described in connection with its preferred embodiment. However, persons skilled in the art will recognize that modifications, alterations and variations of the invention are possible without departing from the scope of the invention. Accordingly, such modifications, alterations and variations shall be deemed to be included in this invention as defined by the appended claims.

C l a i m s

1. A method for lowering a mooring buoy from a floating structure by means of a chain which is paid out from the floating structure via a chain winch until the buoy is near a first equilibrium position due to the weight of mooring lines and any risers connected to the buoy, whereupon the chain is lowered further by means of a second winch line until the chain is supported by the buoy, wherein, during said further lowering, the chain is permitted to move down through a guide in the buoy until an upper enlargement on the chain stops against the buoy, whereby the chain will depend below the buoy and constitute a substantial ballasting element which brings the buoy to a second, substantially deeper equilibrium position.

2. A method according to claim 1, wherein said second winch line, when the buoy is at its second equilibrium position, is released from the chain and raised to the floating structure.

3. A method according to claim 2, wherein the second winch line is released automatically from the chain when the second winch line goes slack.

4. A method according to any one of claims 1 to 3, wherein, when the buoy at a later stage is to be connected to the floating structure, the second winch line is reconnected to the upper end of the chain and made to raise the chain to the floating structure, whereupon the buoy is raised to said structure by means of the chain and said chain winch.

5. A method according to claim 4, wherein, when said upper end of the chain is raised to said structure, the chain is permitted to move through a guide in the buoy until a stopper at the lower end of the chain abuts the buoy.

6. A method according to any one of claims 1 to 5, wherein the buoy is used to support risers in addition to the mooring lines.

7. A method according to any one of claims 1 to 6, wherein said second equilibrium position is at a depth of about 250 m.

8. A method according to any one of claims 1 to 7, wherein said first equilibrium position is at a depth of about 130 m.

9. A method according to any one of claims 1 to 8, wherein the floating structure used has a generally axi-symmetric underwater body, thereby obviating a rotatable turret or swivel connection between the buoy and said structure.

10. A buoy for use in the method according to any one of claims 1 to 9, wherein the buoy is provided with a ballasting element in the form of a chain, said chain being suitable for lifting and lowering of the buoy, said chain being freely moveable through a guide in the buoy, the ends of the chain being provided with stoppers preventing the chain from coming loose from the buoy.

FIG. 1

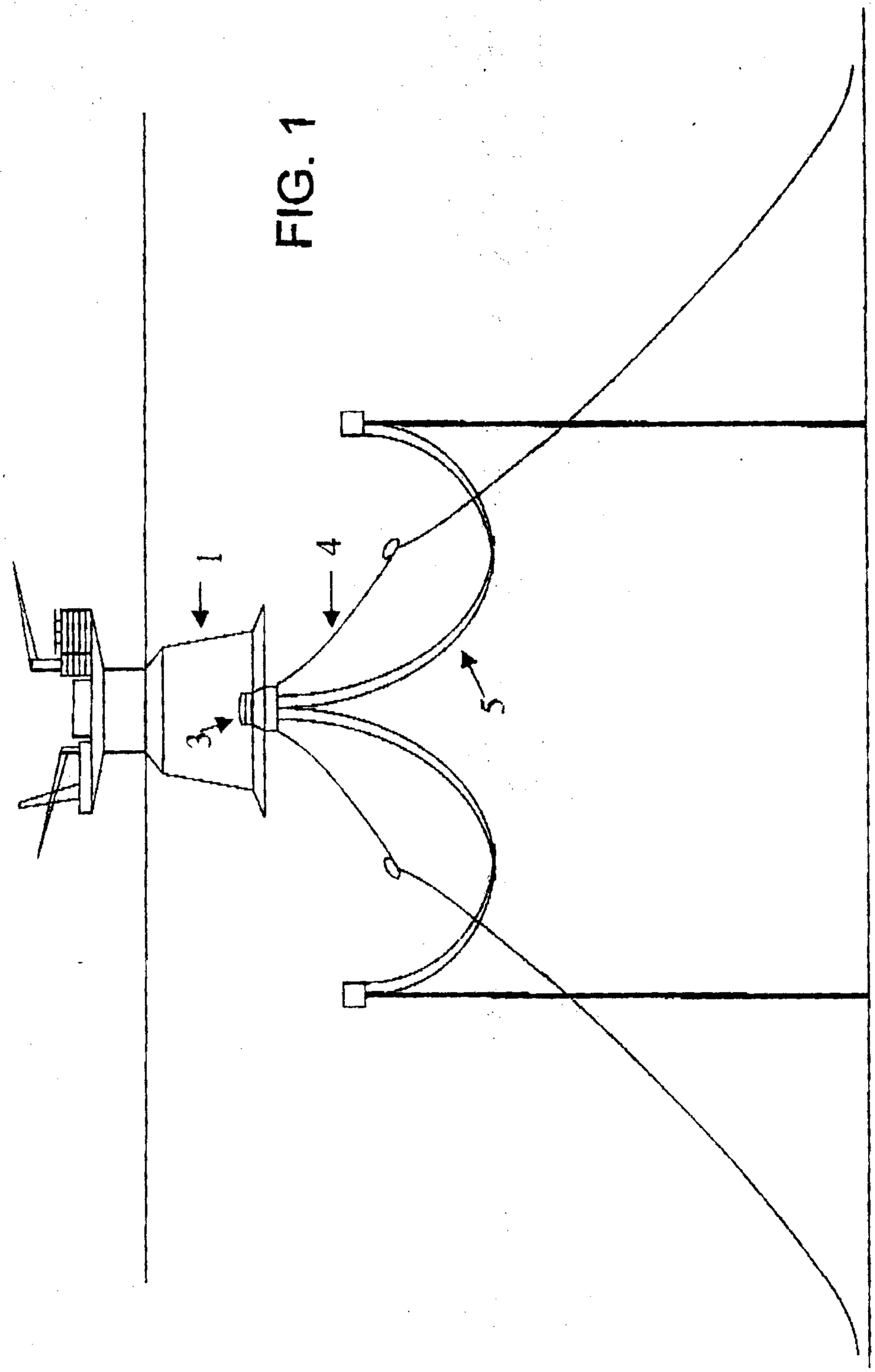


FIG. 2

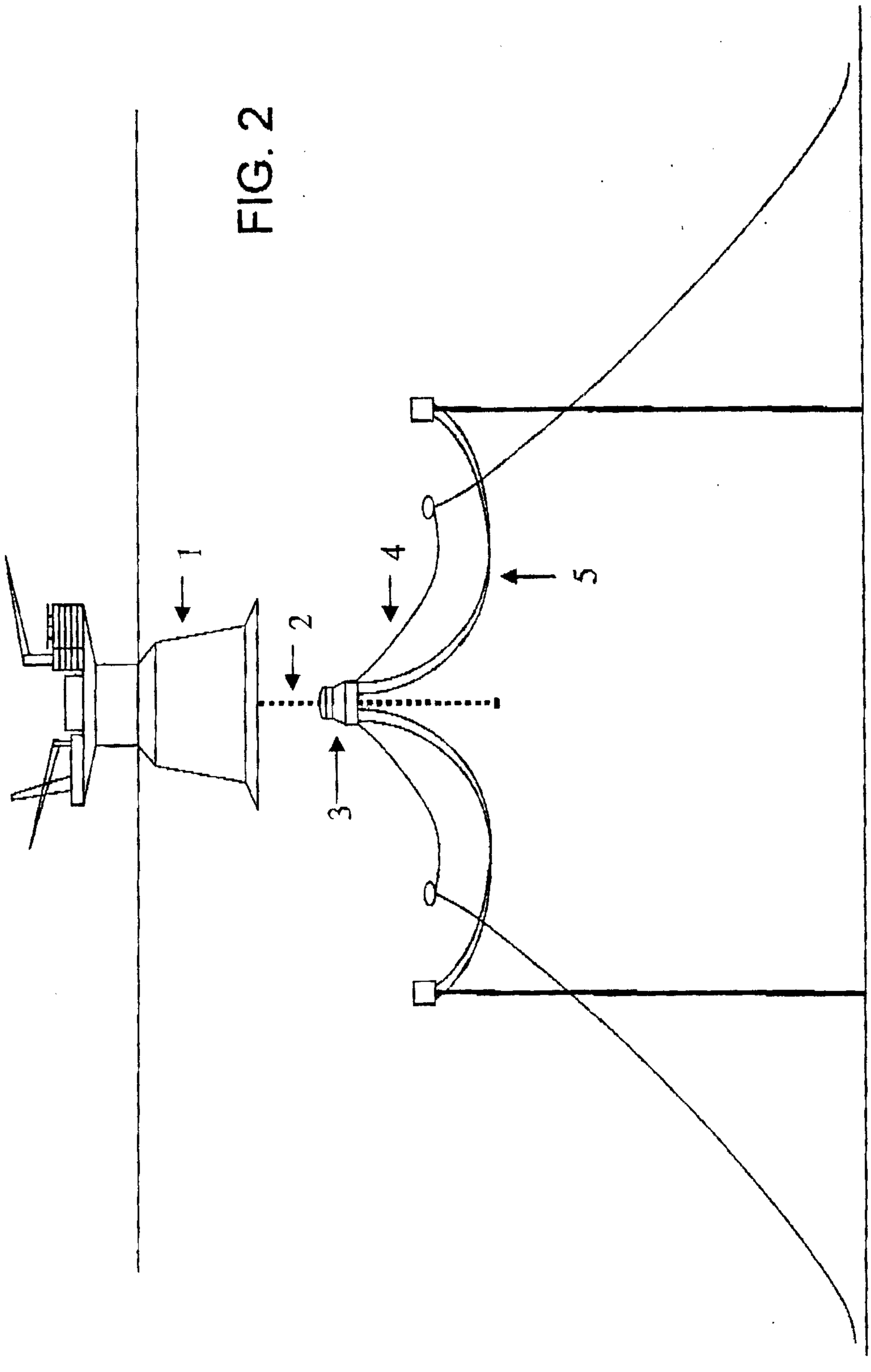
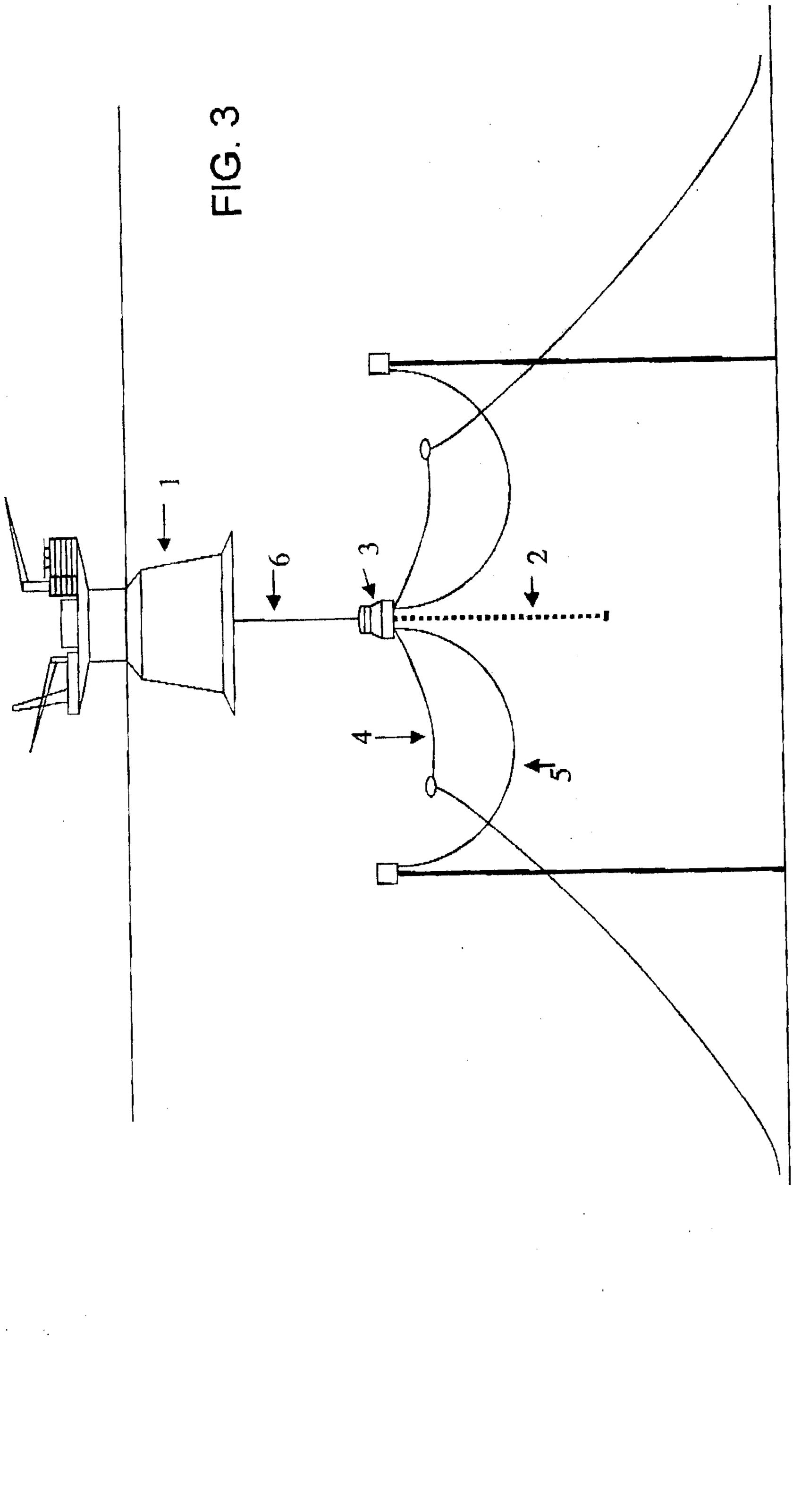
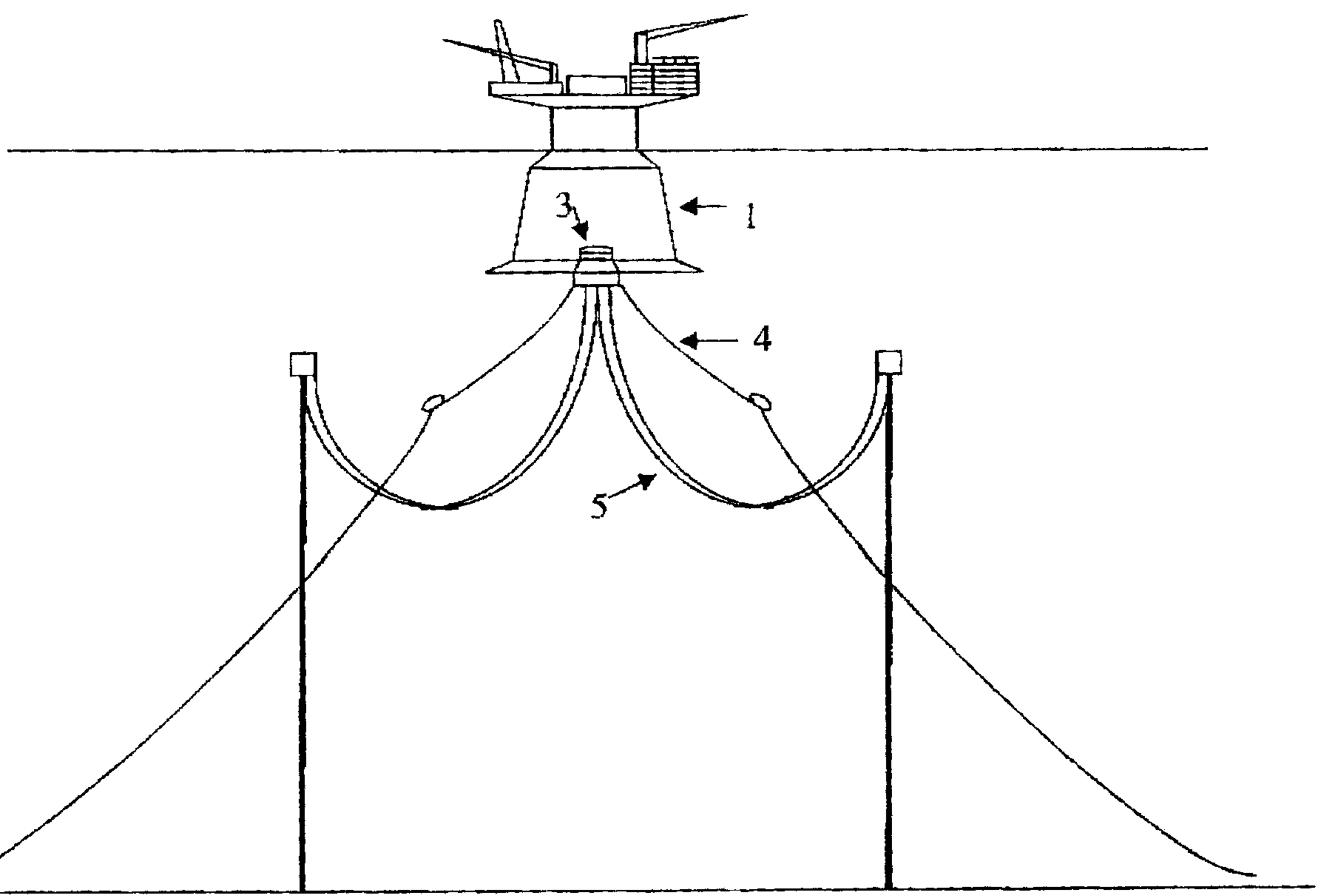


FIG. 3

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