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(54) Benævnelse: **Method of mooring of ship and arrangement to accomplish the method**

(56) Fremdragne publikationer:
US 5447114 A
WO 2009023222 A2
WO WO2012032163 A1
US 5240446 A
GB 2016059 A
WO 2011047736 A1
US 4547163 A

(57) Sammendrag:
The invention relates both to a method and to an arrangement of accomplishing mooring of ship in a definite position at a distance from land and with possibility to make the ship leave the moorage, and also to be able to return exactly to the same place later.
The mooring is accomplished by means of a substantially ring-shaped mooring unit (6), which can be raised (4) and lowered (5) and which has a gap (7) along its periphery, which can be connected to (I) and disconnected from (II) the ship (1), respectively, by means of a connectable part (9) located below the surface of the water (8). Said mooring unit (6) makes it possible for the ship (1), with downwards protruding load (10) supported by the ship (1), to pass by after disconnection and lowering of said mooring unit (6), and to be rotated round an essentially vertical imaginary axis (11).

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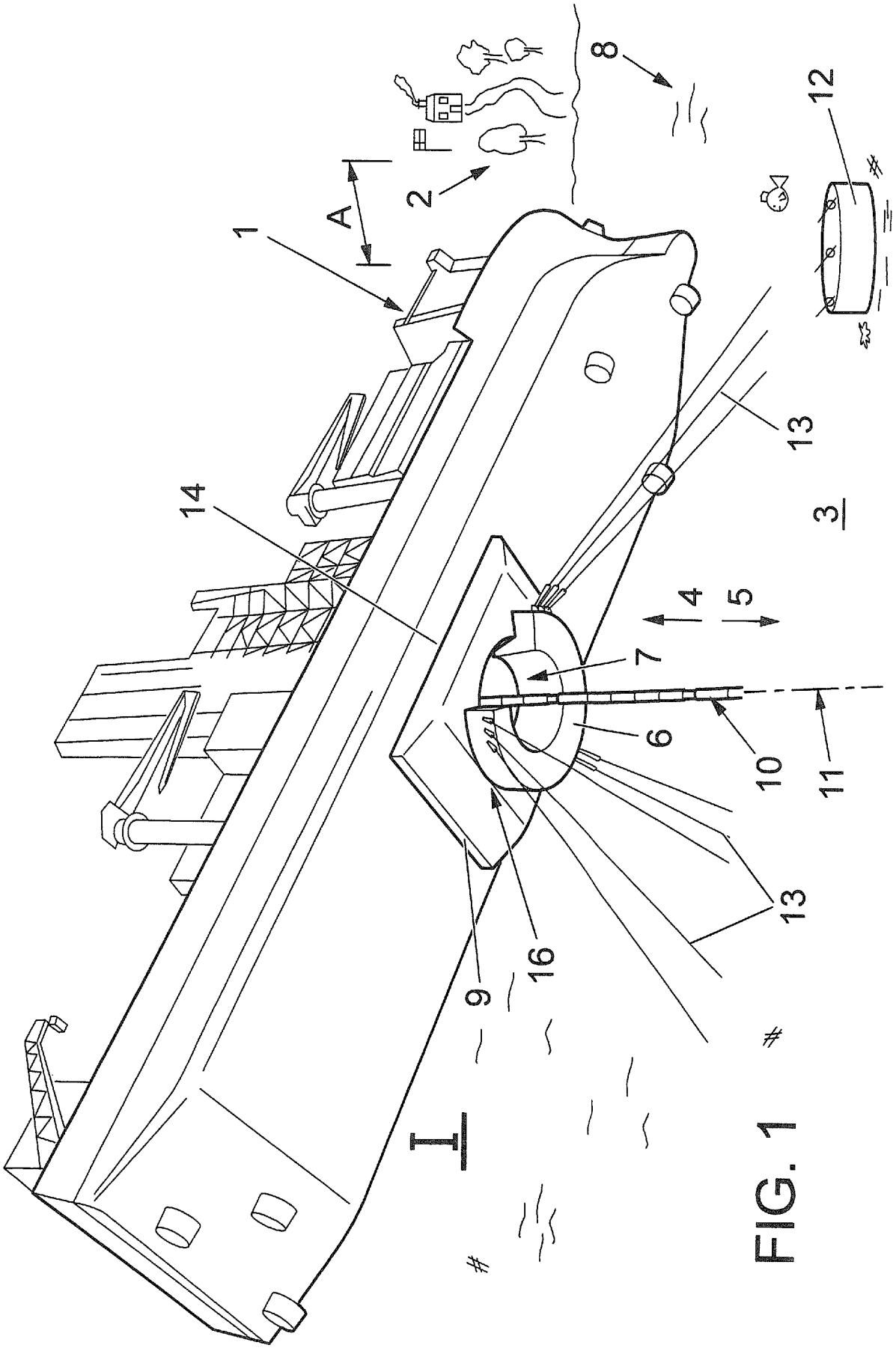


FIG. 1

Method of mooring of ship and arrangement to accomplish the method

The present invention relates to a method of accomplishing mooring of a ship in a definite position at a distance from land and with possibility to make the ship leave its moorage in question.

The invention also concerns an arrangement for carrying out the method according to the invention.

For floating vessels Dynamic Positioning (DP) and/or mooring systems are used in order to prevent the vessel from moving, i.e. to keep it in a definite position. Depending on the assignment of the ship and the water depth in question, various demands are made as to the immobility of the ship or, inversely, demands on the maximum allowed deviation from the definite position.

The capability of the ship of keeping the definite position depends on the reaction time of the DP-system to counteract the environmental forces arising from wind, waves and currents. In certain waters the ship might also be affected by forces caused by drift ice. The DP-system consists of thrusters, i.e. propulsors which can be rotated 360 degrees in the horizontal plane, and one or several reference systems for definition of the definite position. The thrusters generate a resulting force, which counteracts the environmental forces, so that the definite position of the ship is maintained.

US 5447114 A discloses a mooring system for a vessel. A cylindric part 47 shaped like a cylinder having rings is connected to a bouy 10 which can be attached to the bottom surface of a vessel 30.

In certain operation areas there might be restrictions concerning emissions. Reduction of the power

necessary to keep the ship in the definite position increases the availability by reduced emissions.

A complication when mooring of for example ships adapted to drill into the sea bed is that certain situations might require that the ship in question can be disconnected in a controlled way at relatively short notice and leave the definite position, and after some time can be connected to the mooring system again.

A further complication is that during certain operations a steel pipe, a so called "riser", is used between a valve at the sea bed and the ship. To take up the "riser" before it is disconnected is too time-consuming, why it is necessary to design the arrangement so that disconnection can be effected without it being necessary to take up the "riser" to the ship.

W0 2009/023222 A2 discloses a device for moving a riser system 3200 from a wellhead 3277 to a garage bouy 3230. Nothing is told about how the ship leaves the said position without taking up the riser to the ship, only to move away.

The main object of the present invention is, therefore, in the first place to solve among other things said problems in an effective way by means of simple and well working means.

Said object is reached by means of a method wherein the mooring is accomplished by means of a mooring unit, which can be raised and lowered and which can be connected to and disconnected from the ship, respectively, below the surface of the water. The method according to the invention is peculiar in that the mooring unit is arranged to be connected to a bearing unit, which is supported by the ship below the surface of the water and which comprises a rotatory bearing for the connectable

mooring unit, that said mooring unit is substantially ring-shaped and which has a gap along the periphery, that said mooring unit is remote-controlled, that locking means, which can be remote-controlled, are arranged to lock the mooring unit to the supported bearing unit, and which mooring unit makes it possible for the ship, with downwards protruding load supported by the ship, to pass by after disconnection and lowering of said mooring unit and to be rotated round an essentially vertical imaginary axis.

A further problem with the invention is to find means, which can be applied effectively and safely when carrying out a method according to the invention.

According to the invention, such means are provided by an arrangement which is peculiar in that a substantially ring-shaped mooring unit, which can be raised and lowered and which has a gap along the periphery in the form of a permanently open opening, for example a horseshoe-shaped body, that locking means, which can be remote-controlled, are arranged to lock the mooring unit to a bearing unit, which is supported by the ship in question so that said mooring unit can be releasably connected to and disconnected from the ship in question, respectively, below the surface of the water, and that the mooring unit is arranged to be connected to the bearing unit, which is supported by the ship below the surface of the water and which comprises a rotatory bearing for the connectable mooring unit, so said mooring unit can be rotated in relation to the ship round an essentially vertical imaginary axis.

The invention is described in the following with reference to the accompanying drawings, in which

Fig. 1 is a perspective view of the invention in active state connected to the underside of the hull of a ship,

Figs. 2-3 illustrate the invention in connected and disconnected state, respectively, seen obliquely from below,

Fig. 4 is a perspective view obliquely from above of a disconnected mooring unit,

Fig. 5 is a perspective view obliquely from above of a connectable part, which is disconnected from a ship, and with a mooring unit connected to said part,

Figs. 6-8 illustrate various stages from a connected state to a state, in which said mooring unit and the part, which can be connected to a ship, are separated from each other, and

Fig. 9 illustrates a state, in which the connectable mooring unit and the connectable part, which can be connected to a ship, can be reconnected to a ship.

A method of accomplishing safe mooring of a ship 1 in a definite position at a distance from land 2 and with possibility to make the ship 1 in question leave the moorage 3 in question, and where the mooring is accomplished by means of a mooring unit 6, which can be raised 4 and lowered 5 and which has a gap 7 seen along its periphery. Further, said mooring unit 6 is so constituted, that it can be connected to I and disconnected from II the ship 1, respectively, by means of a bearing unit 9 located below the surface of the water 8. Said mooring unit 6 makes it possible for the ship 1, with downwards protruding load 10 supported by the ship, to pass by said mooring unit 6 after disconnection and lowering of said mooring unit 6, and said unit can rotate

in relation to the ship 1 round an essentially vertical imaginary axis 11.

According to the invention said mooring unit 6 is remote-controlled in order to accomplish the desired raising and lowering 4, 5 thereof, and the mooring is accomplished by means of chains 13 or other pulling elements, which are connected to a part 12 anchored in the bottom of the sea. Further, said mooring unit 6, which can be raised and lowered by buoyancy, is releasably connected from below the ship 1 to the moon pool 14 of the ship 1 in question, i.e. an opening of the ship located below the surface of the water, or to another part of the ship 1. Preferably, fastening means 19 for bearing unit are used, which operate with vacuum and excess of displacement. A rotatory bearing 15 adapted to connected mooring unit 6 is received by the connectable bearing unit 9.

An arrangement 16 for carrying out a method of accomplishing mooring of a ship 1 in a definite position at a distance A from land 2, and with possibility to make the ship 1 leave the moorage in question of the ship 1, comprises an essentially ring-shaped mooring unit 6, which can be raised and lowered 4, 5 and which has a gap 7 along the periphery, and which exhibits locking means 20 so that the mooring unit 6 can be releasably connected to and disconnected from the ship 1 in question, respectively, below the surface of the water 8, and so it can be rotated in relation to the ship 1 round an essentially vertically directed imaginary axis 11. Said mooring unit 6 is constituted by a horseshoe-shaped body, which has a gap in the form of a permanently open opening 7, and which is arranged to have the function of a mooring buoy, which can be raised to the desired level 21 in the water. Further, the mooring unit 6 is arranged to be

connected to a bearing unit 9, which is supported by the ship 1 below the surface of the water 8 and which comprises a rotatory bearing 15 for the connectable mooring unit 6, and whereby locking means 20, which can be remote-controlled, are arranged to lock the mooring unit 6 to the bearing unit 9, which can be connected to the ship 1 in question and which can be adjusted itself depending on arising environmental forces. The mooring unit 6 exhibits chains 13 or other pulling elements, which are connected to a part 12 anchored in the bottom of the sea, and a mechanism 18 for said chains 13, etc., the length of which is adjustable, and said unit is arranged to be anchored with its opening 7 in a definite direction and at the desired level 21 in the water, by means of for instance said chains 13, etc. The mooring unit 6 has adjustable buoyancy and submerging capacity, respectively, owing to air tank and container therein, which can be filled with liquid, whereby also this function is of use when the level is adjusted, especially when the height of the mooring unit 6 is adjusted.

To sum up, it can be mentioned that the invention makes it possible to moor the ship 1 to the bottom of the sea by means of a separate arrangement 16. The arrangement is so designed, that the ship can adjust itself to the least possible environmental force, so called "weathervaning". The arrangement has a rotary part in order to make "weathervaning" possible. To this rotary part a buoy 6 supporting the mooring system is connected. When all these parts are connected the ship is moored. In certain situations the arrangement is a complement to the DP-system, in other situations the DP-system is a complement to the mooring system. In order to make disconnection possible when for example the riser 10 is mounted, the

buoy 6 is provided with an opening 7 to make it possible to move the ship 1 from the definite position without taking up the riser 10 to the ship 1.

The nature and the function of the invention should have been clear from the above description and also from the drawings, which illustrate the nature and the function.

Of course, the invention is not limited to the embodiments described above and illustrated in the accompanying drawings. Modifications are possible, especially as far as the nature of the different parts is concerned, or by using equivalent technique, without departing from the scope of the invention as it is defined in the patent claims.

Patentkrav

1. Fremgangsmåde til fortøjning af et skib (1) i en bestemt position i en afstand fra land (2) og med mulighed for at lade skibet (1) forlade sin fortøjning (3), og at fortøjningen sker ved hjælp af en fortøjningsenhed (6), der kan hæves (4) og sænkes (5), og som henholdsvis kan tilkobles (I) og frakobles (II) skibet under vandets overflade (8), **kendetegnet ved** at fortøjningsenheden (6) er indrettet til forbindelse med en lejeenhed (9), som bæres af skibet (1) under vandets overflade (8), og som omfatter et roterbart leje (15) til fortøjningsenheden (6), der kan tilkobles, at fortøjningsenheden (6) er i det væsentlige ringformet og har et mellemrum (7) langs periferien, at fortøjningsenheden (6) er fjernstyret, at låseorganer (20), som kan fjernstyres, er arrangeret, så de kan låse fortøjningsenheden (6) til den bårne lejeenhed (9), og hvilken fortøjningsenhed (6) gør det muligt for skibet (1), som bærer nedad ragende last (10), at passere forbi efter frakobling og sænkning af fortøjningsenheden (6) og dreje omkring en i det væsentlige lodret, imaginær akse (11).

2. Fremgangsmåde ifølge krav 1, **kendetegnet ved** at fortøjningen kan ske ved hjælp af kæder (13) eller andre trækelementer, som er forbundet med en del (12) forankret i havbunden.

3. Fremgangsmåde ifølge krav 2, **kendetegnet ved**, at fortøjningsenheden (6), som kan hæves og sænkes ved opdrift, er løsbart koblet til lejeenheden (9), som kan fastgøres under et skibs moonpool (14)eller en anden del

af skibet (1), og som er forsynet med det roterbare leje (15) indrettet til forbindelse med fortøjningsenheden (6).

4. Arrangement (16) til udførelse af en fremgangsmåde ifølge ethvert foregående krav til fortøjning af et skib (1) i en bestemt position i en afstand (A) fra land (2)og med mulighed for at skibet (1) kan forlade den pågældende fortøjning af skibet (1), **kendetegnet ved** at en i det væsentlige ringformet fortøjningsenhed (6), som kan hæves og sænkes (4, 5), og som har et mellemrum (7) langs periferien i form af en permanent åben åbning, for eksempel et hesteskoformet legeme, at låseorganer (20), som kan fjernstyres, er indrettet til at låse fortøjningsenheden (6) til en lejeenhed (9), som bæres af skibet (1), sådan at fortøjningsenheden (6) kan løsbart tilkobles og frakobles skibet (1) under vandets overflade (8), og at fortøjningsenheden (6) er arrangeret til at forbindes med lejeenheden (9), som bæres af skibet (1) under vandets overflade (8), og som omfatter et roterbart leje (15) for fortøjningsenheden (6), som kan tilkobles, sådan at fortøjningsenheden (6) kan dreje i forhold til skibet (1) omkring en i det væsentlige lodret, imaginær akse (11).

5. Arrangement ifølge krav 4, **kendetegnet ved** fortøjningsenheden (6) har kæder (13) eller andre trækelementer, som er forbundet med en del (12) forankret i havbunden, og en mekanisme (18) til kæderne (13) etc., sådan at kædernes længde kan justeres, og at fortøjningsenheden (6) er indrettet til at forankres med sin åbning (7) i en bestemt retning.

6. Arrangement ifølge ethvert af krav 4-5, **kendetegnet ved** at fortøjningsenheden (6) har justerbar opdrifts- og neddykningskapacitet tilvejebragt med en lufttank og en beholder deri, som kan fyldes med væske.

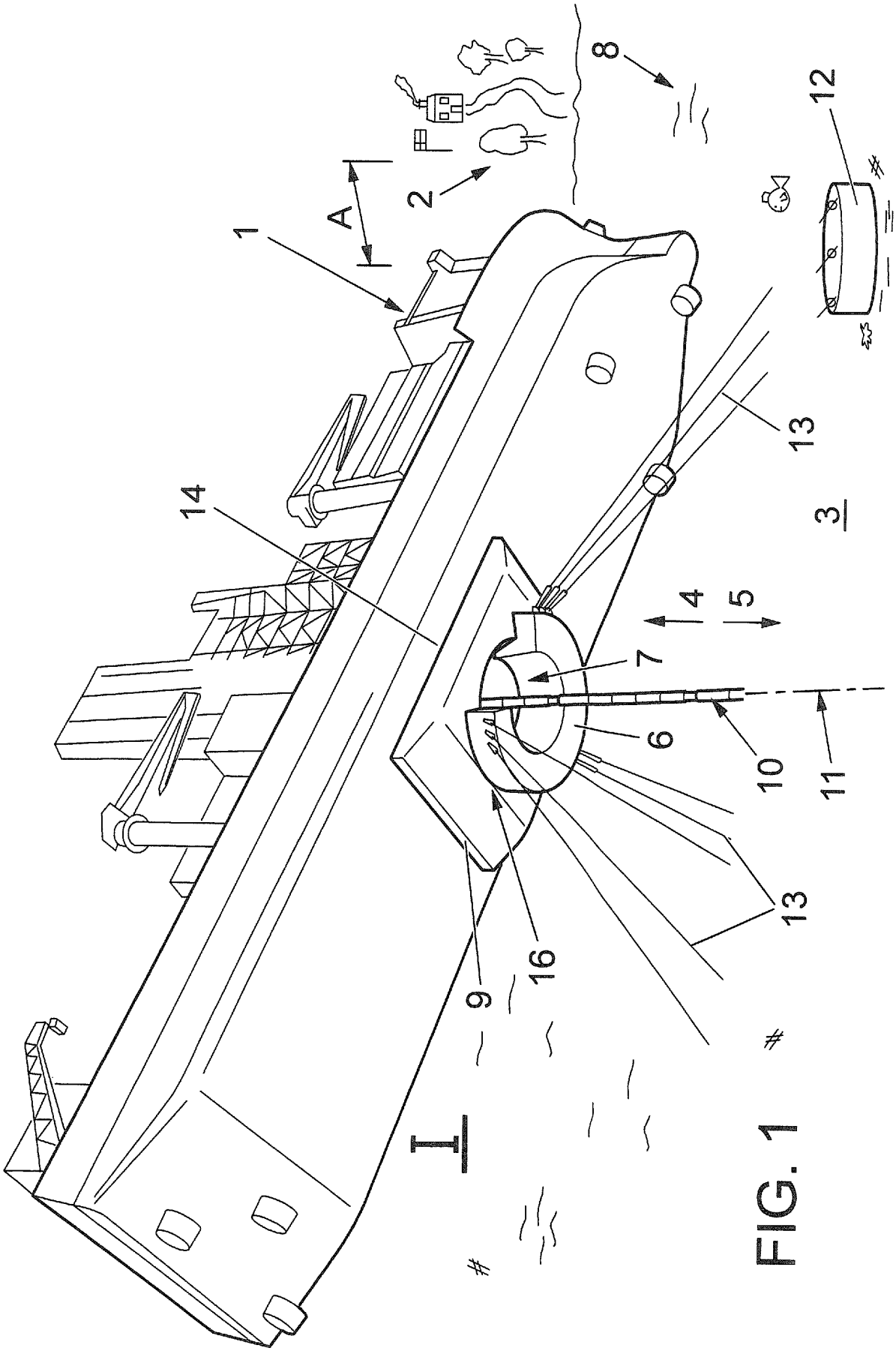


FIG. 1

FIG. 2

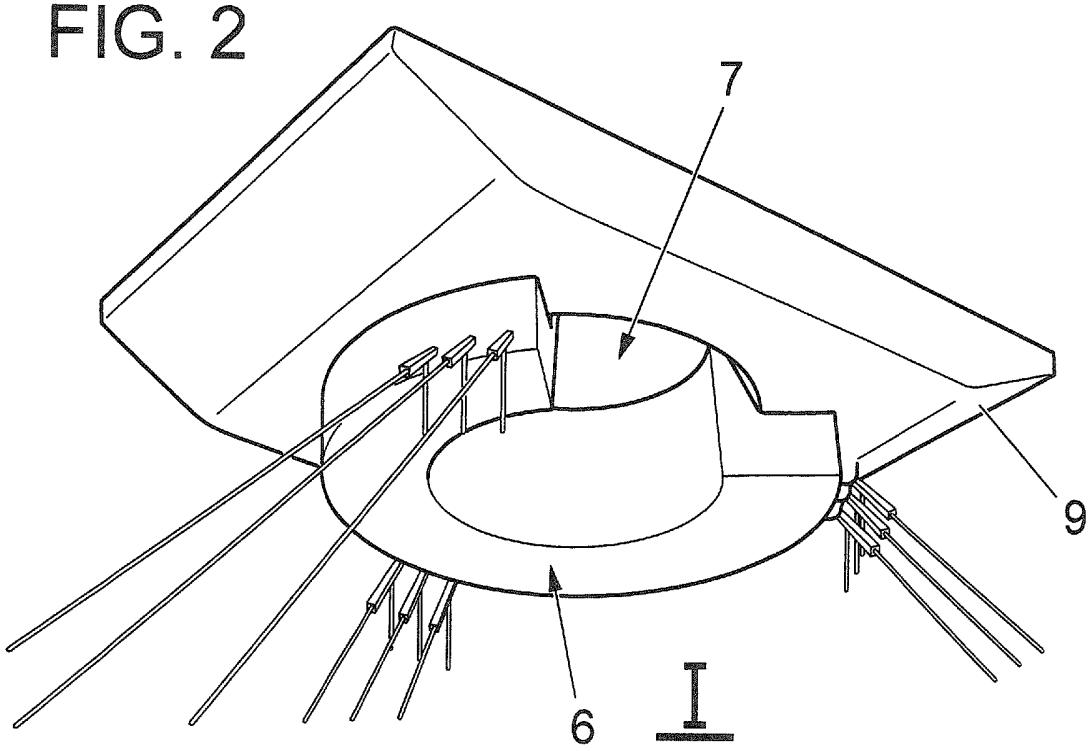
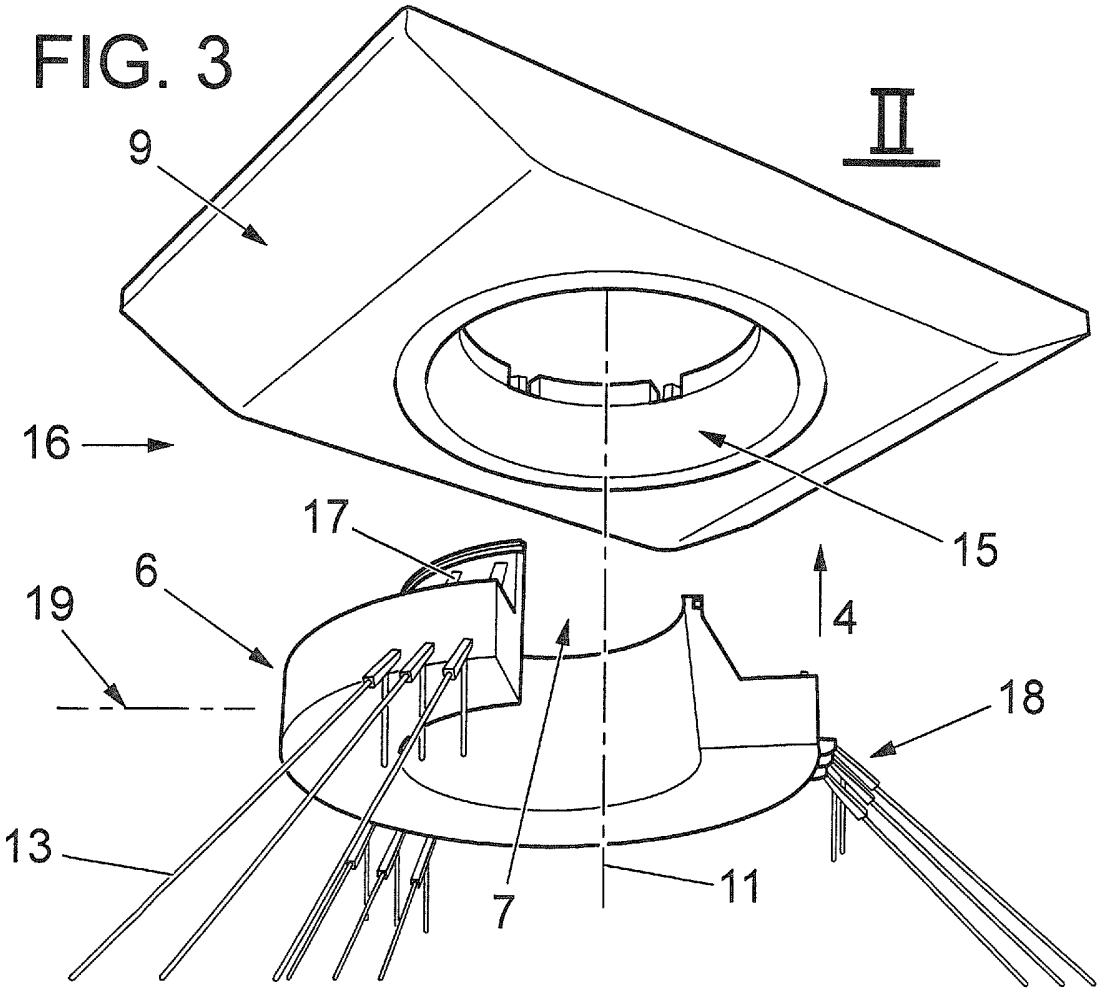


FIG. 3



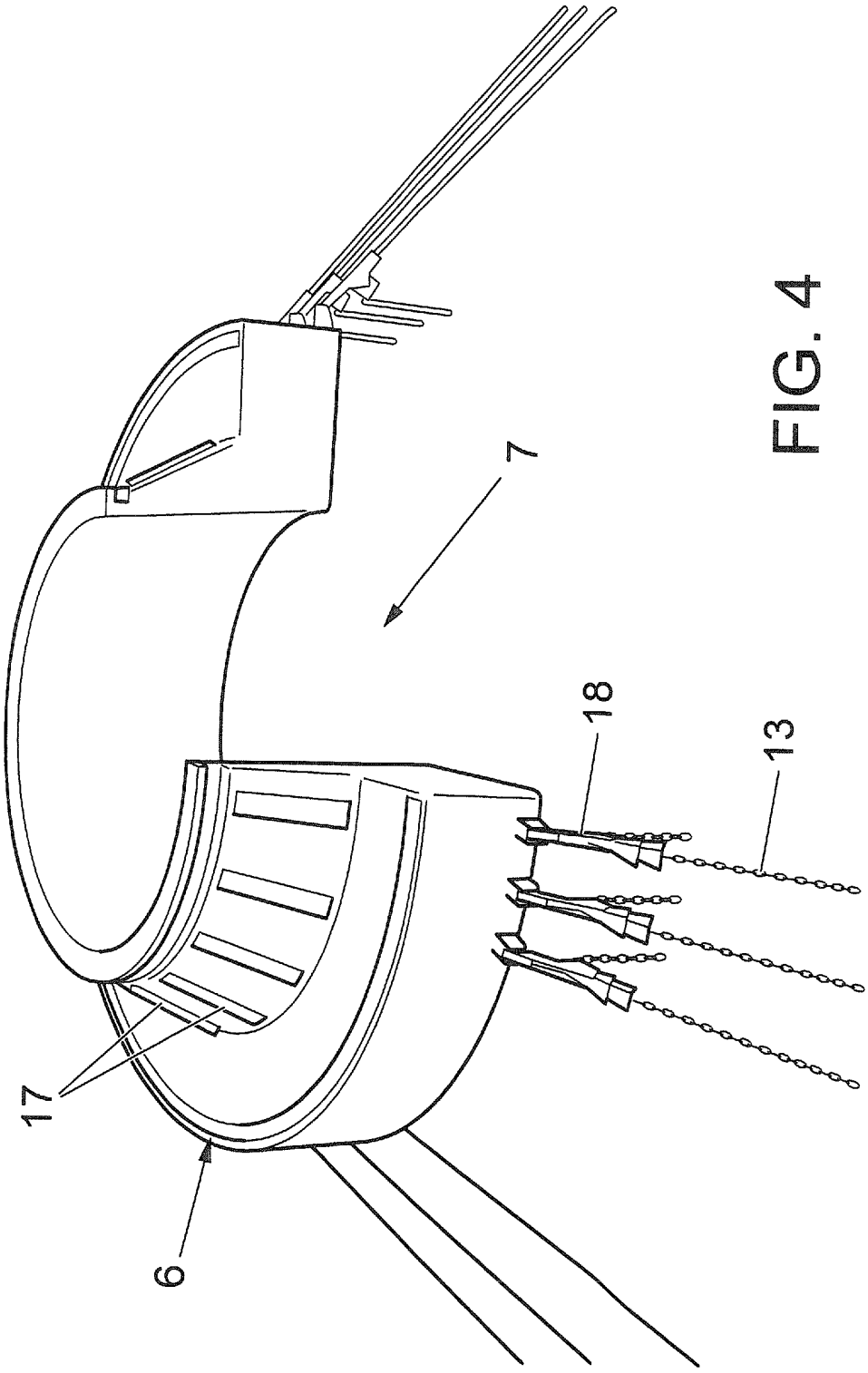


FIG. 4

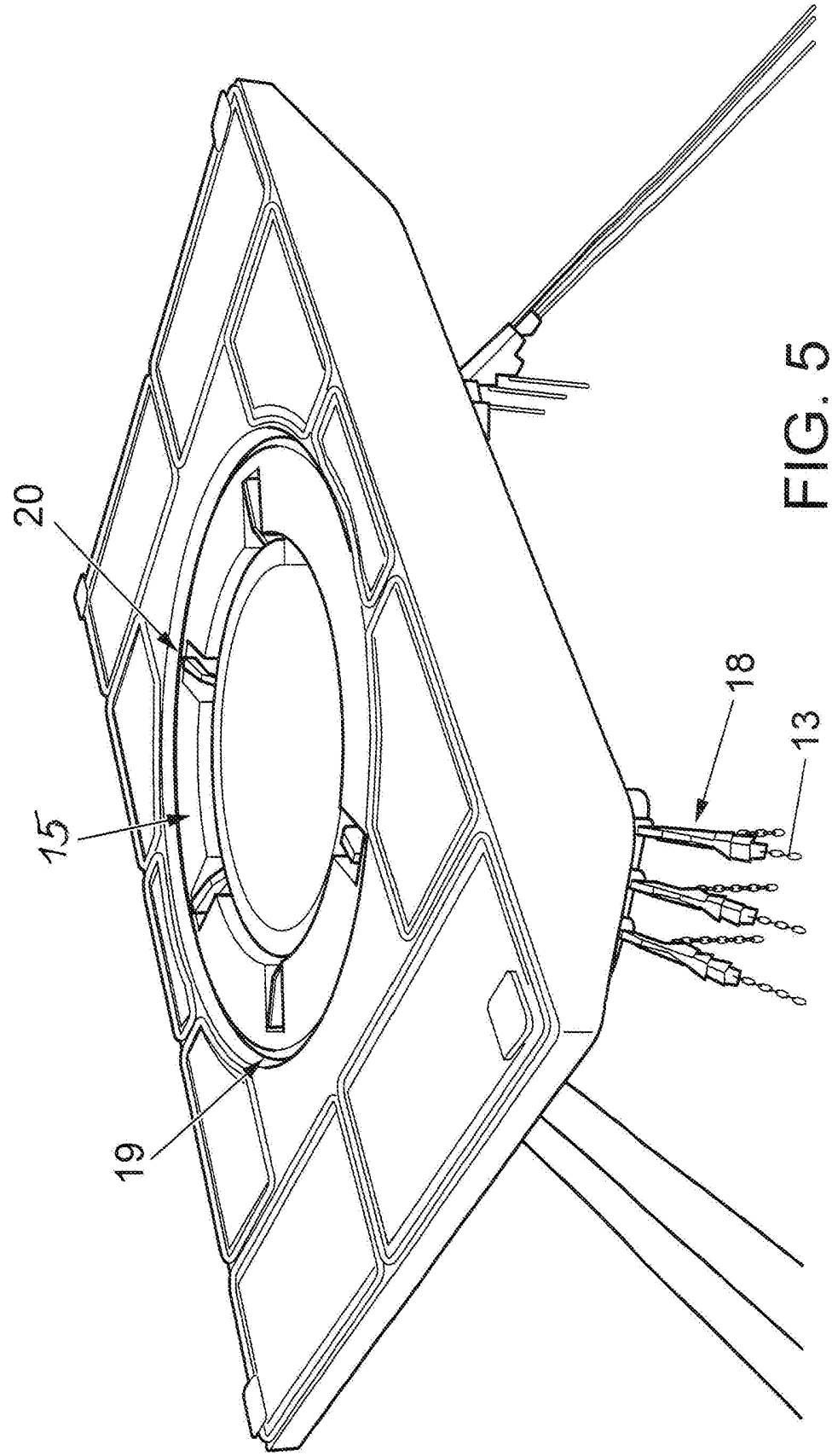


FIG. 5

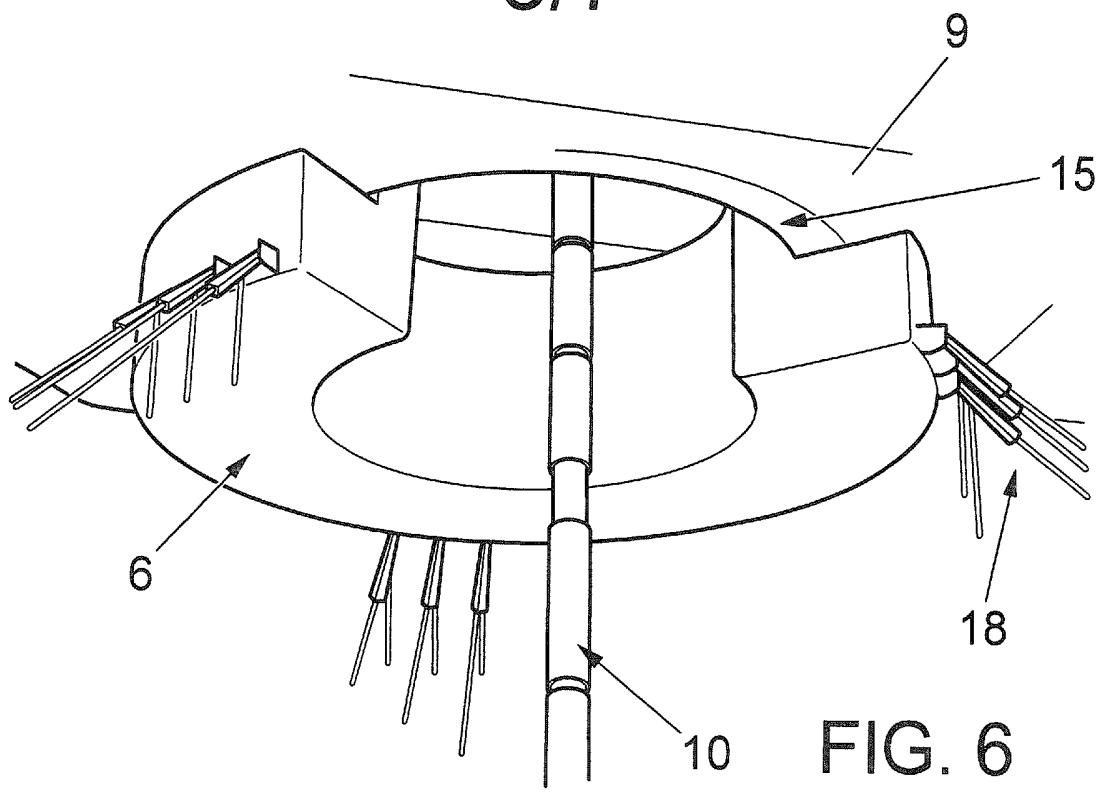


FIG. 6

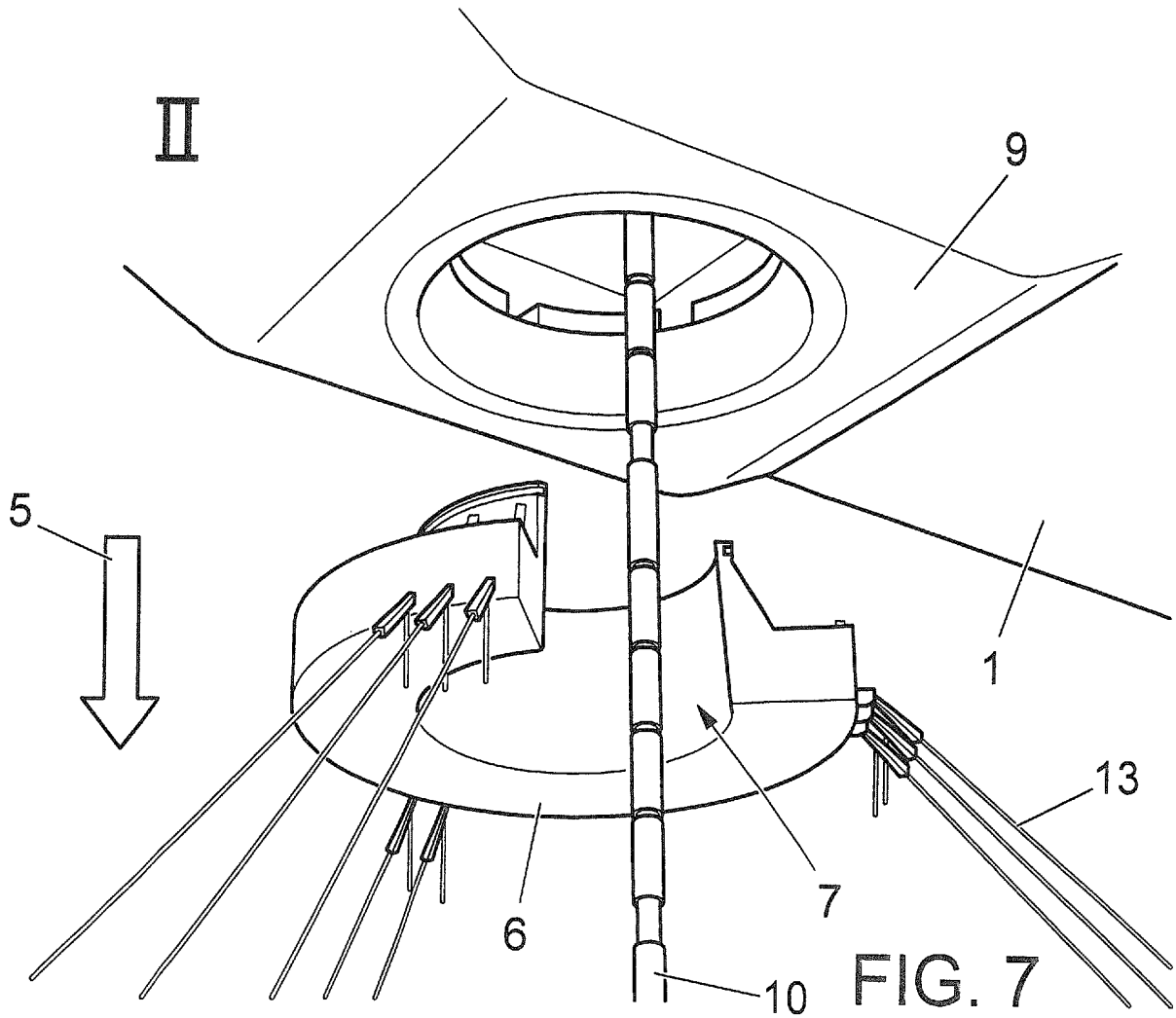


FIG. 7

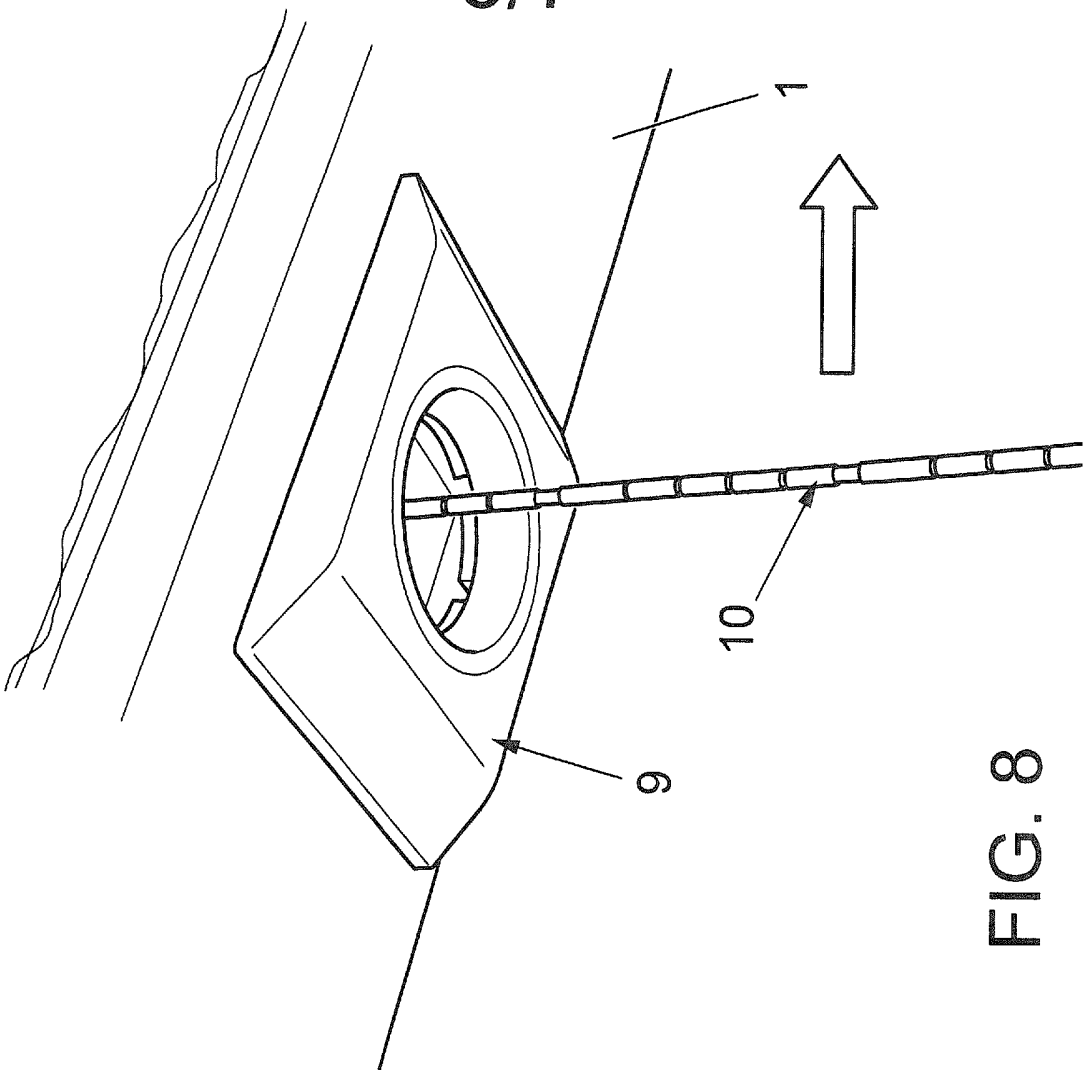
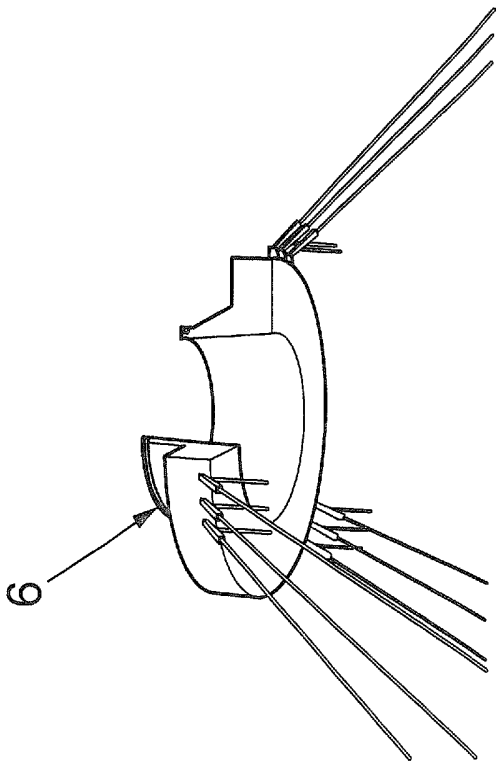


FIG. 8



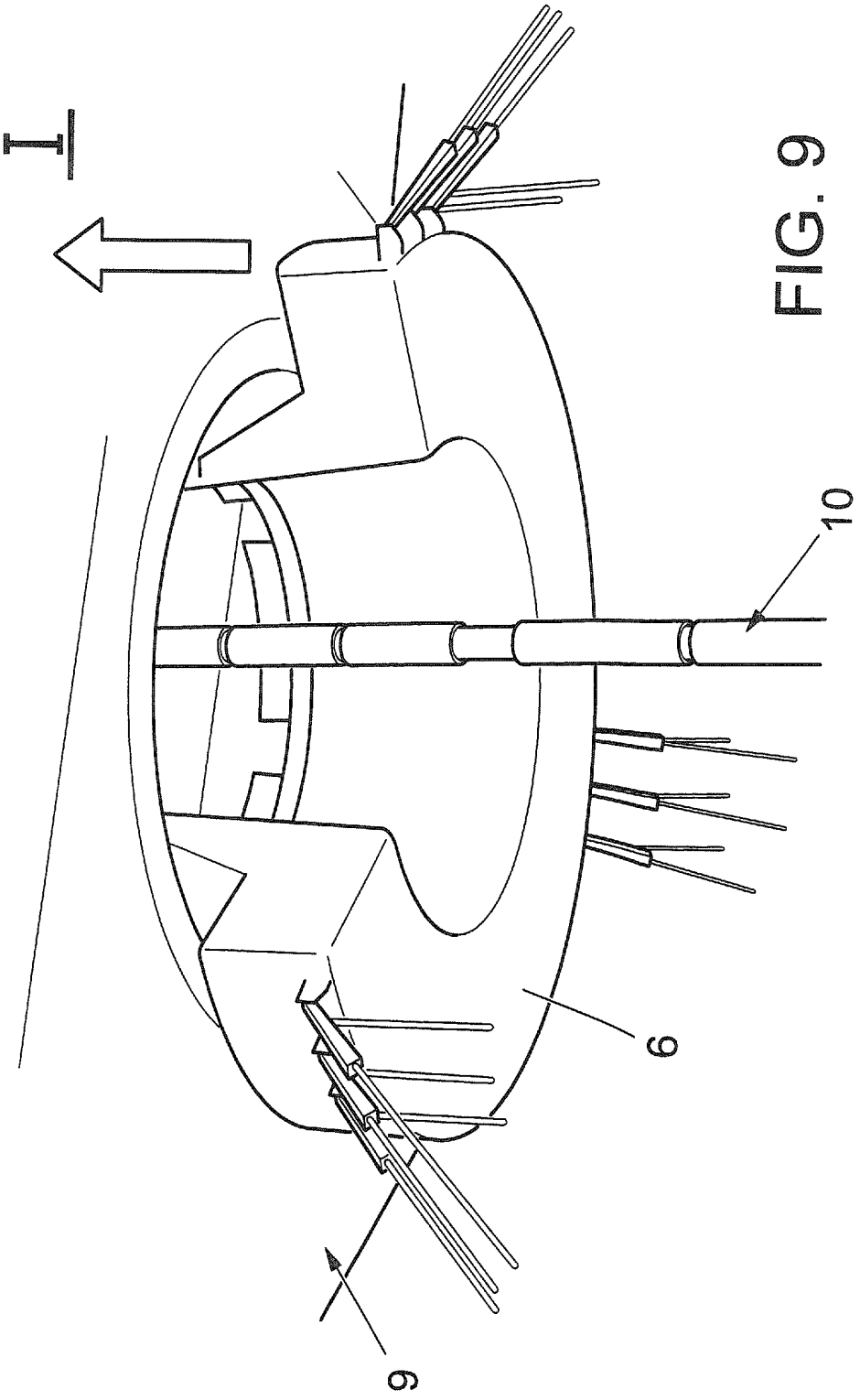


FIG. 9

DANISH PATENT AND TRADEMARK OFFICE

SEARCH REPORT - PATENT	Application No. PA 2015 70088

1. ☐ Certain claims were found unsearchable (See Box No. I).

2. ☐ Unity of invention is lacking prior to search (See Box No. II).

A. CLASSIFICATION OF SUBJECT MATTER

B63B 21/50 (2006.01); ***B63B 22/02*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC&CPC: B63B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

DK, NO, SE, FI: IPC-classes as above.

Electronic database consulted during the search (name of database and, where practicable, search terms used)

EPODOC, WPIAP, FULLTEXT: ENGLISH

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant for claim No.
Y	US5447114 A (KORSGAARD J) 1995-09-05. See whole document.	1-10
Y	WO2009023222 A2 (BOUDREAU P) 2009-02-19. See whole document.	1-10
Y ; A	WO2012032163 A1 (SINGLE BUOY MOORINGS INC.) 2012-03-15. See whole document.	1, 4-6, 8 ; 2-3, 7, 9-10

☒ Further documents are listed in the continuation of Box C.

*	Special categories of cited documents:	"P"	Document published prior to the filing date but later than the priority date claimed.
"A"	Document defining the general state of the art which is not considered to be of particular relevance.	"T"	Document not in conflict with the application but cited to understand the principle or theory underlying the invention.
"D"	Document cited in the application.	"X"	Document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone.
"E"	Earlier application or patent but published on or after the filing date.	"Y"	Document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"L"	Document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified).	"&"	Document member of the same patent family.
"O"	Document referring to an oral disclosure, use, exhibition or other means.		

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Date of completion of the search report
25 August 2015

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SEARCH REPORT - PATENT		Application No. PA 2015 70088
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant for claim No.
Y ; A	US5240446 A (BOATMAN L et al.) 1993-08-31. See whole document.	1, 4-6, 8 ; 2-3, 7, 9-10
A	GB2016059 A (SOCIETE EUROPEENNE DE PROPULSION) 1979-09-19. See in particular p2, 77-79 and p4, 39-45.	2, 7-8
A	WO2011047736 A1 (BLUE WATER ENERGY SERVICES BV) 2011-04-28. See in particular p5, 22-35.	2, 7
A	US4547163 A (LANGPAAP R et al.) 1985-10-15. See in particular col. 4, 59 col. 5, 14.	2, 8

SEARCH REPORT - PATENT	Application No. PA 2015 70088

Box No. I Observations where certain claims were found unsearchable

This search report has not been established in respect of certain claims for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched, namely:

2. ☐ Claims Nos.:
because they relate to parts of the patent application that do not comply with the prescribed requirements to such an extent that no meaningful search can be carried out, specifically:

3. ☐ Claims Nos.:
because of other matters.

Box No. II Observations where unity of invention is lacking prior to the search

The Danish Patent and Trademark Office found multiple inventions in this patent application, as follows:

SEARCH REPORT - PATENT	Application No. PA 2015 70088

SUPPLEMENTAL BOX

Continuation of Box [.]