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(54) SHIP FOR DRILLING AND PRODUCTION IN ICY WATERS

(57) Ship adapted for drilling and/or production from an oil and/or gas well, which ship is adapted to have connection to at least one production riser that is connected to a turret connected to the ship or a drill riser string that extends through a turret connected to the ship. The ship between its bow and stern exhibits two longitudinal sides which along at least 50 % of their length are provided with an ice belt that exhibits an angle α between the hull of the ship and the horizontal, which angle α is between 45 and 80 degrees. The turret has a centre axis which is arranged in a position on the ship corresponding to 0,15 - 0,45 Lpp in front of the ship's half Lpp (length between perpendiculars).

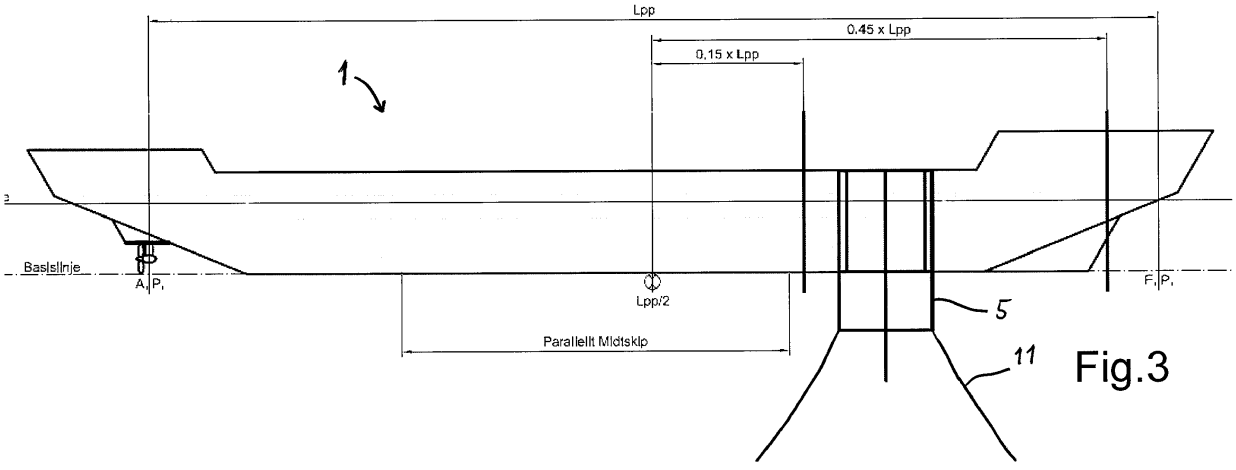

Fig.3

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Description

[0001] The present invention relates to a ship which is adapted for drilling of oil and/or gas wells, as well as for production. In particular, the invention relates to such a ship adapted for use in arctic waters.

[0002] Ships with turrets for drilling of wells on the seabed are known, for instance from patent publication US 5,359,957. The turret makes an arbitrary orientation of the ship with respect to the well possible, as the ship can turn about the centre axis of the turret. Such a turning of the ship is often desirable in order to reduce the load on moorings or thrusters. For this purpose the ship is oriented in such a way that it is exposed to as small forces as possible coming from currents.

[0003] In arctic regions one will have an additional challenge due to ice in the sea. This may be ice structures (icebergs) which forces the ship to leave the well. It may also be packed floating ice. The floating ice will exert large forces on a big ship and must be dealt with in a good way in order to avoid excessive forces on moorings or thrusters.

[0004] The article "Arctic drilling systems" (H. O. Jahns, Exxon Production Reasearch Company, P.O. Box 2189, Houston, Texas 77001, USA) discusses challenges with mooring in icy waters. Here, a solution proposed for meeting the forces exerted onto moored hulls by floating ice is to increase the dimensions of the mooring systems.

The invention

[0005] There is provided a ship adapted for drilling of and/or production from an oil and/or gas well, which ship is adapted to have connection to at least one production riser connected to a turret connected to the ship, or to a drill riser string that extends through a turret connected to the ship. This ship is advantageously characterized in that

- the ship, between its bow and stern exhibits two long sides which along at least 50 % of their length are provided with an ice belt that exhibits an angle a between the ship's hull and the horizontal, which angle α is between 45 and 80 degrees; and that
- the turret has a centre axis which is arranged in a position on the ship corresponding to 0,15 - 0,45 Lpp in front of the ship's half Lpp (length between perpendiculars).

[0006] This design of the ship makes a turning process of the ship possible when it is packed in with floating ice in the water surface, when the drifting direction of the ice has an angle in relation to the longitudinal axis of the ship. This is described closer in the example description. This ship is further preferably characterized in that if the ship has a parallel middle aisle, the centre axis of said turret is arranged in front of this.

[0007] The ship according to one of the above-mentioned aspects of the present invention preferably exhibits a length between the perpendiculars (Lpp) of more than 200 m, a width between 40 and 55 m, and has a draught of at least 10 m.

[0008] As will appear from the example descriptions below, the invention is particularly well suited for offshore operations in arctic waters where large amounts of ice may be present at the sea surface, including drifting ice.

Description of examples of embodiments

[0009] In the following a plurality of examples of embodiments are described with reference to the figures, in which

Fig. 1 a and 1 b show a ship according to the invention and an enlarged section view of a part of the ship's ice belt;
Fig. 2a to 2h show a method for dealing with drifting ice;
Fig. 3 shows the placing of a turret in a ship according to the invention;

[0010] In the following, a particularly advantageous design of the hull of a ship 1 according to the invention will be described. As will be described later, the hull of the ship 1 is designed particularly advantageous for execution of a process for turning the ship 1 when it is influenced by densely packed drifting ice with a drifting direction with an angle in relation to the longitudinal axis of the ship.

[0011] The Figs. 1 a and 1 b show a ship 1 for drilling of an oil and/or gas well according to the invention. Far ahead on the ship 1 there is arranged a turret 5. The ship 1 is moored here. Fig. 1b shows a section view of a cross section of the ship's side, crosswise to the longitudinal direction of the ship 1. The ship hull exhibits a lower part 1 a, a middle part or ice belt 1 b and an upper part 1 c. The ice belt 1 b is an area of the hull which extends around the ship along the water line, in the area where ice floating in the sea will impinge against the ship 1. Thus, the ice belt has a certain vertical extension, as floating ice may have different dimensions and shape, and the ship 1 may have different draught. As appears from Fig. 1b, the ice belt 1 b exhibits an angle α with respect to the water line. The angle α is preferably between 45 and 80 degrees.

[0012] The ship 1 has a bow and a stern. Between the bow and the stern the ship 1 has two longitudinal sides. The ship exhibits an ice belt with such an angle α along at least 50 % of the length of the longitudinal sides. However, preferably the ship 1 exhibits an ice belt with such an α along the whole of both longitudinal sides.

[0013] A longitudinal side with such a designed ice belt will result in that ice which abuts against the ship 1 with an angle to the longitudinal axis of the ship 1 will be pushed down by the ice belt 1 b so that the ice brakes. As will appear from the description below, such a ship 1 will exhibit considerable advantages when used in arctic

regions, where large amounts of ice can accumulate about the ship.

[0014] In the following, it is referred to the Figs. 2a to 2h. These figures illustrate a ship 1 according to the present invention, which has been packed in by ice on the sea surface. As described above, the ship is moored in the turret 5. In order to explain the functional principle which is made possible by the advantageous design of the ship's ice belt 1 b, it is assumed that ice is drifting in the direction shown with the arrow U, perpendicular onto one of the longitudinal sides of the ship, as shown in Fig. 2a. The ice will operate on the ship 1 with large forces, which are countered by the forces F of the mooring. Gradually the ice that meets the longitudinal side of the ship will be broken due to the inclined angle α, as described above. The ice will still drift towards the ship 1, and thus a slit of open water is created on the opposite side of the ship 1. This is shown in Fig. 2b.

[0015] Since the turret 5 with which the ship is moored, is arranged at the bow of the ship 1, a turning of the ship 1 will arise as the accumulated forces from the ice (U) and the mooring (F) create a rotational force on the ship 1. As appears from Fig. 2c the ship 1 will turn its stern as far as is possible into the slit of open water, in the direction of the drifting ice (U). In Fig. 2d this process has continued an additional distance, and here one can see how the ice breaking bow of the ship is being forced against the drifting direction (U) of the ice, and breaks the ice. The entire ship 1 functions as a lever bar, turning about the turret 5. The Figs. 2e - 2h show the rest of the process, where the ship 1 in the end has aligned itself with its longitudinal axis parallel to the drifting direction of the ice. When the ice drifts further the icebreaking bow of the ship will break the ice continuously and there will be considerably less forces operating on the moorings.

[0016] This process shows how the ship 1 according to the invention, comprising longitudinal sides with the ice belt described above, is suited for operations in waters with the possibility of ice formation or accumulation of ice around the ship 1. Ships for operations as described herein typically have large length-to-with relationships. This results in large forces in the mooring lines. A normal drilling vessel with vertical longitudinal sides would lead to significantly larger forces on the mooring, since the ice would not be broken when meeting the longitudinal sides. The ice would instead have to be crushed by compression forces, which requires significantly larger forces.

[0017] It shall be noticed that the ship 1 according to the invention not is meant to alter its draught or vertical position significantly by contact with the ice. This is different from known ships, such as the polar ship *Fram,* which with its inclined longitudinal sides was adapted to be forced up by the ice, by sufficiently large forces onto the ship broadsides.

[0018] It is of course not compulsory that the entire longitudinal sides of the ship 1 exhibit an ice belt 1 b with the described angle α. For example, a ship 1 with only 50 % of the longitudinal sides provided with such an angle will also work. However, this will result in unnecessary and undesired large forces on ship and mooring.

[0019] For the process described under reference to the Figs. 2a - 2h to operate appropriately, the turret 5 must be arranged on a suitable location in the ship 1. For indication of such a desired location it is referred to Fig. 3. The ship 1 is characterized by its *length between perpendiculars,* or LPP (or LBP). According to the invention the location of the turret 5 in the ship 1 is preferably characterized in that its centre axis is arranged 0,15 - 0,45 Lpp in front of the half Lpp. Furthermore, if the ship has a parallel middle isle, the centre axis of the turret 5 shall preferably be arranged in front of this.

[0020] The design of the hull of the ship 1 and the location of the turret 50 is hence such that the resultants of the ice forces at any time will turn the ship 1 optimally, so that the ship's longitudinal axis is parallel to the drifting direction of the ice. The ship 1 will thus be suitable for use in waters with possibility of packaging with one or multi-year ice.

[0021] As described, the ship 1 has preferably an ice-breaking design of the bow. The ship 1 has also preferably an ice-breaking stern. This will be useful if the drift of the ice should change direction, for instance to the opposite direction.

[0022] Furthermore, the ship 1 preferably has thrusters that can be turned in order to assist the orientation of the ship 1, as well as to reduce the tension in the mooring lines 11.

Claims

1. Ship adapted for drilling and/or production from an oil and/or gas well, which ship is adapted to have connection to at least one production riser that is connected to a turret connected to the ship or a drill riser string that extends through a turret connected to the ship, **characterized in that**

   - the ship between its bow and stern exhibits two longitudinal sides which along at least 50 % of their length are provided with an ice belt that exhibits an angle α between the hull of the ship and the horizontal, which angle α is between 45 and 80 degrees; and that
   - the turret has a centre axis which is arranged in a position on the ship corresponding to 0,15 - 0,45 Lpp in front of the ship's half Lpp (length between perpendiculars).

2. Ship according to claim 1, **characterized in that** if the ship has a parallel middle aisle, the centre axis to said turret is arranged in front of it.

3. Ship according to one of the preceding claims, **characterized in that** it exhibits a length between perpendiculars (Lpp) of more than 200 m, a with be-

tween 40 and 55 m, and has a draught of at least 10 m.

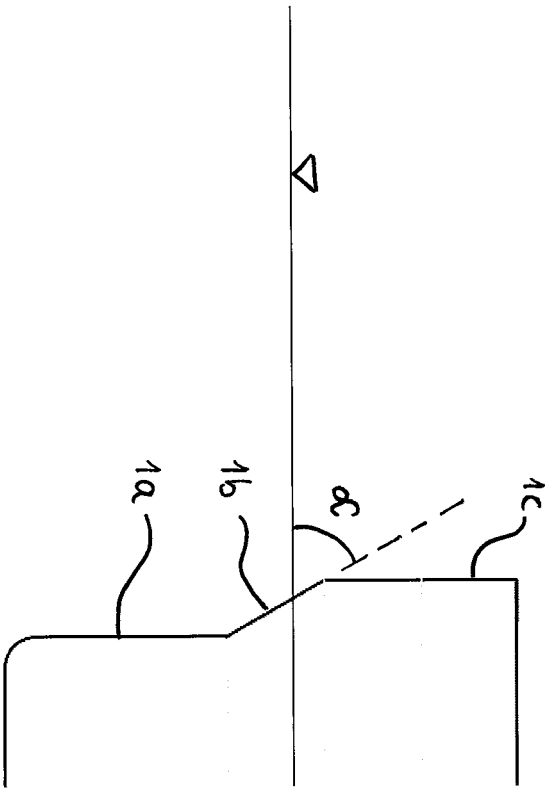

Fig.1b

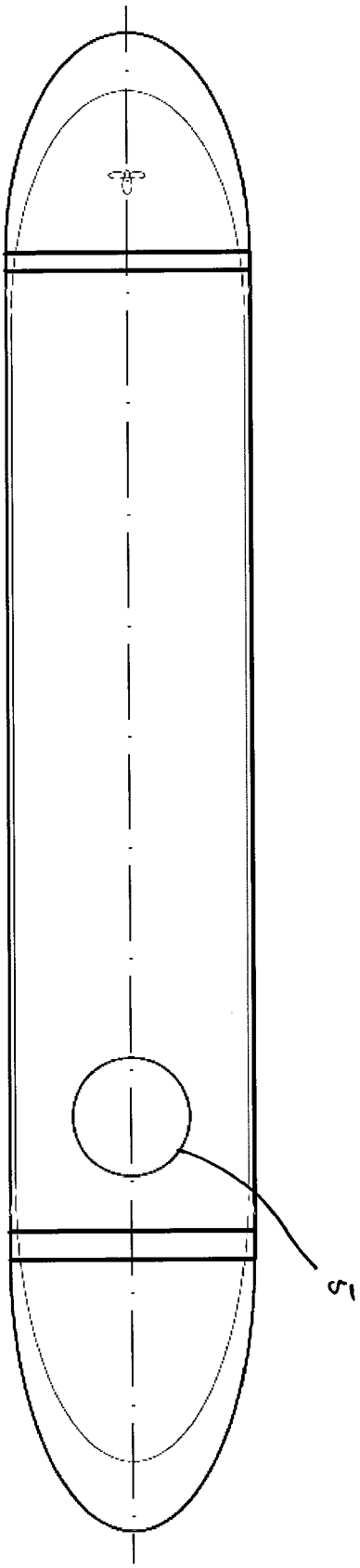

Fig.1a

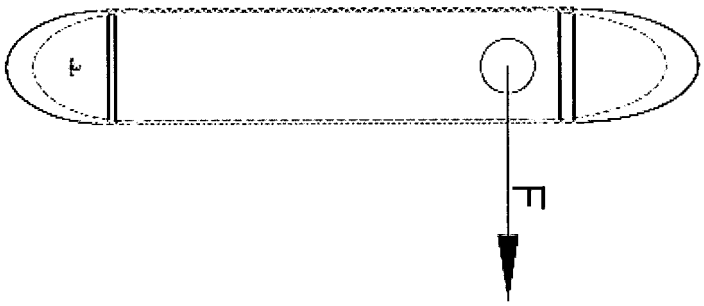

Fig.2a

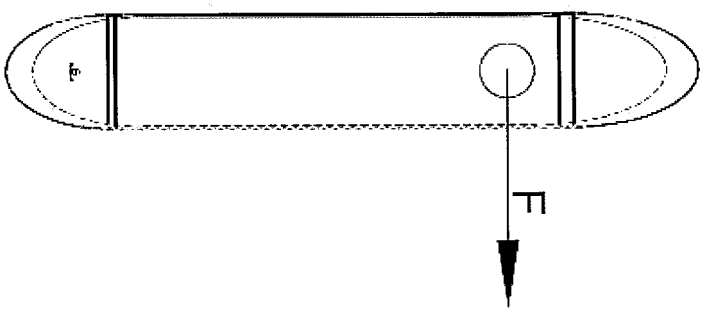

Fig.2b

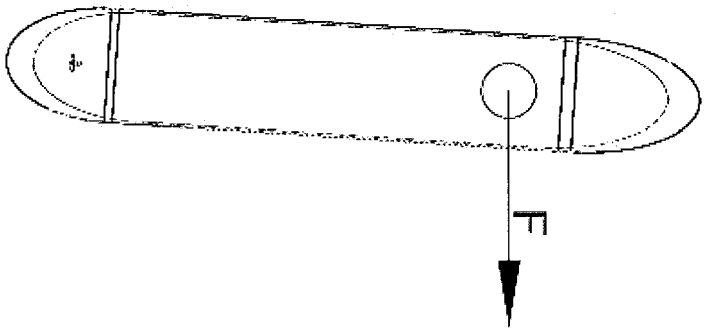

Fig.2c

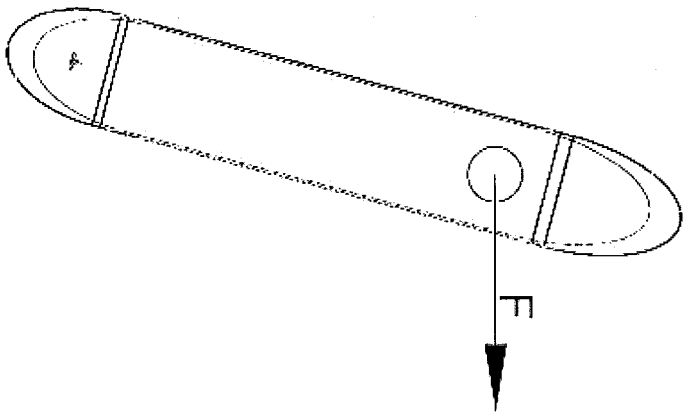

Fig.2d

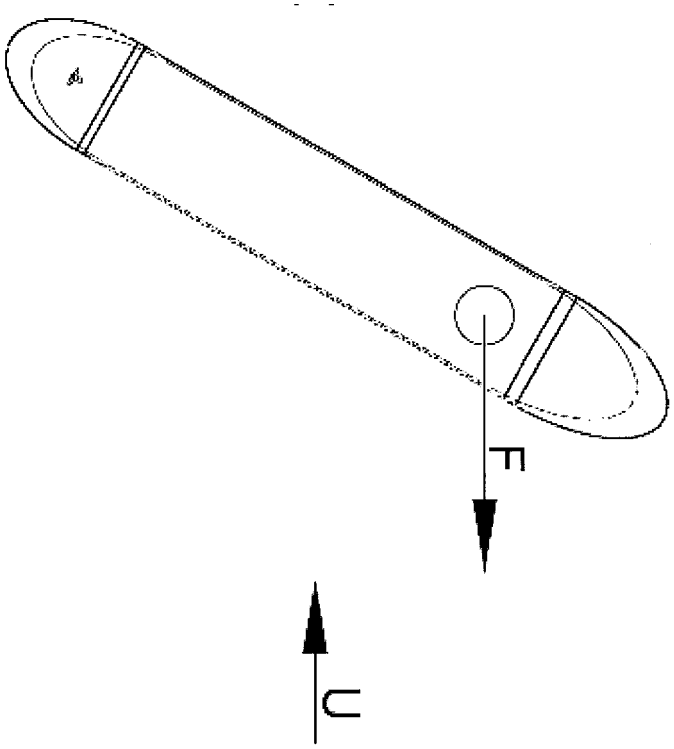

Fig.2e

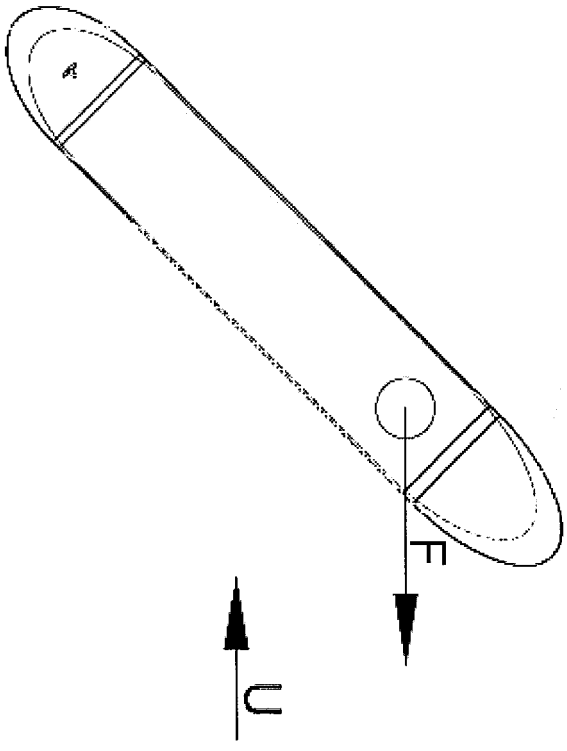

Fig.2f

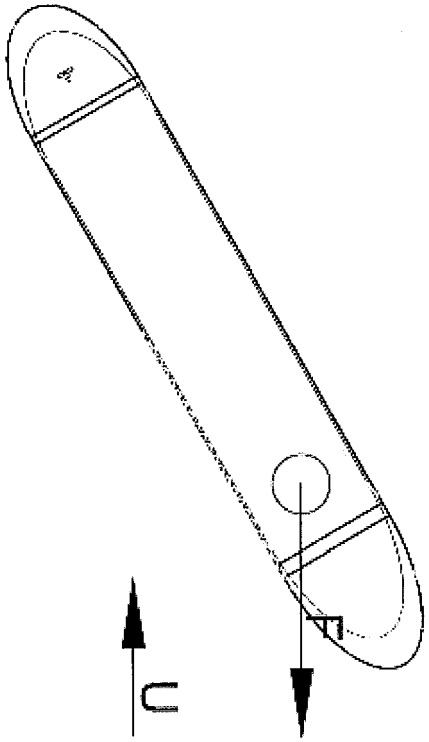

Fig.2g

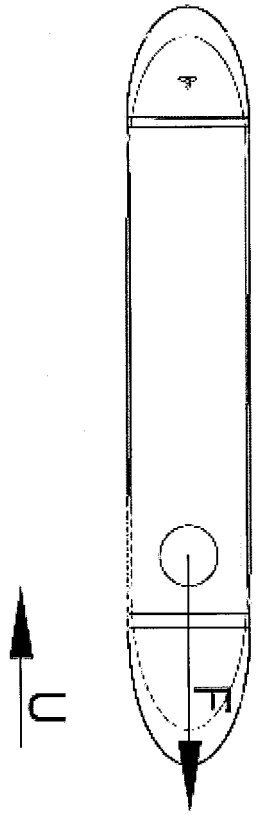

Fig.2h

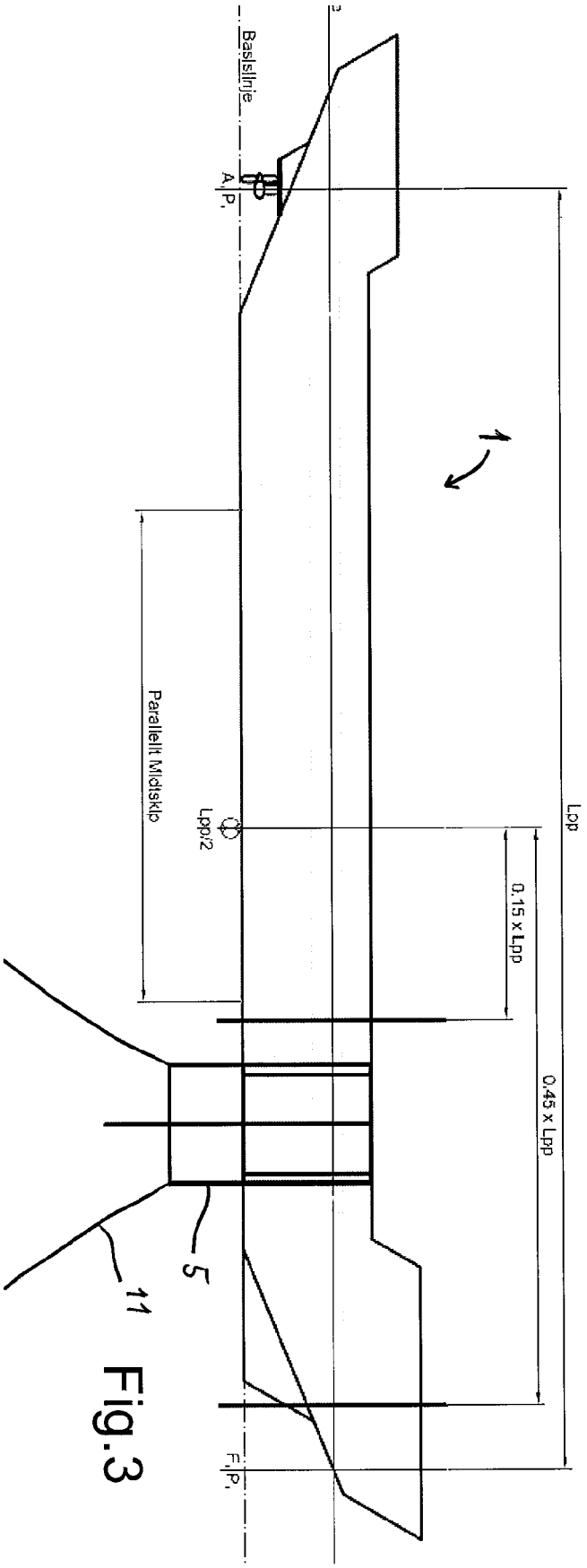
Baslinje
A.P.
F.P.
Parallellt Midtskip
Lpp/2
Lpp
0.15 x Lpp
0.45 x Lpp
1
5
11

Fig.3

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EUROPEAN SEARCH REPORT

Application Number
EP 16 17 0143

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	GB 2 160 166 A (EXXON PRODUCTION RESEARCH CO) 18 December 1985 (1985-12-18) * abstract; figures * -----	1	INV. B63B21/50 B63B35/12 B63B22/02
A	WO 2007/089152 A1 (STATOIL ASA [NO]; BREIVIK KAARE [NO]; KJERSEM GEIR [NO]) 9 August 2007 (2007-08-09) * abstract; figures * -----	1	B63B35/08
A	EP 0 328 720 A1 (THYSSEN NORDSEEWERKE GMBH [DE]) 23 August 1989 (1989-08-23) * abstract; figures * -----	1	
A	US 4 436 046 A (BRALEY WILLIAM W [US]) 13 March 1984 (1984-03-13) * abstract; figures * -----	1	

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
Munich	7 September 2016	Nicol, Yann

CATEGORY OF CITED DOCUMENTS

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07-09-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2160166 A	18-12-1985	CA 1220385 A	14-04-1987
		GB 2160166 A	18-12-1985
		JP S619387 A	16-01-1986
		NO 852289 A	09-12-1985
		US 4604961 A	12-08-1986
WO 2007089152 A1	09-08-2007	NONE	
EP 0328720 A1	23-08-1989	CA 1301559 C	26-05-1992
		CN 1035468 A	13-09-1989
		DE 8802053 U1	15-06-1989
		EP 0328720 A1	23-08-1989
		FI 884246 A	19-08-1989
		JP 2656340 B2	24-09-1997
		JP 2847035 B2	13-01-1999
		JP 2847036 B2	13-01-1999
		JP H01249587 A	04-10-1989
		JP H07237584 A	12-09-1995
		JP H07237585 A	12-09-1995
		NO 883731 A	21-08-1989
		PL 164206 B1	30-06-1994
		PL 164327 B1	29-07-1994
		PL 277466 A1	04-09-1989
		RU 2053922 C1	10-02-1996
		SU 1762746 A3	15-09-1992
		US 4942837 A	24-07-1990
US 4436046 A	13-03-1984	NONE	

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5359957 A **[0002]**

Non-patent literature cited in the description

- **H. O. JAHNS.** Arctic drilling systems. Exxon Production Reasearch Company **[0004]**