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(12) # EUROPEAN PATENT APPLICATION

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(54) **A mooring system.**

(57) Mooring system comprising a turret with a stationary part 5 anchored to the seabed 12 and carrying an outrigger 8 to which is connected the end of a flowline 7 which is subsequently connected to an underwater buoyant body 10.

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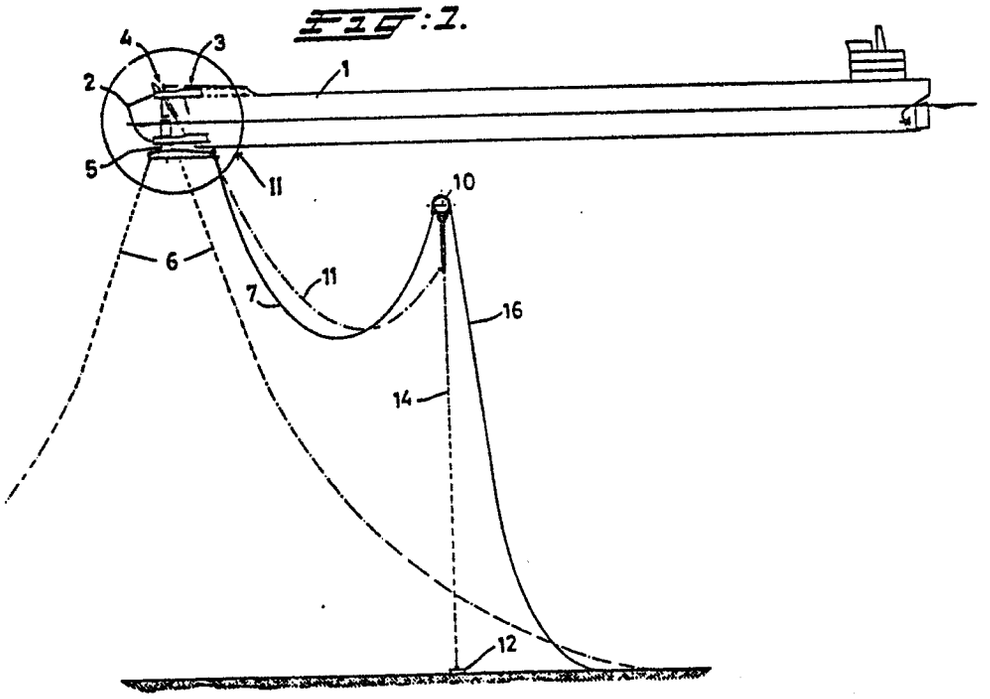
FIG: 1.



A mooring system.

The invention relates to a mooring system comprising a turret of which the stationary part is anchored to the seabed, and to which is to be connected the end of a flexible flowline which is subsequently connected to an underwater buoyant body anchored to the seabed.

Such a mooring system is known in itself from for instance, U.S. Patent Specification 3,335,690; U.K. Patent 1,115,155; and from the advertisement of Imodco Inc. in, for example, "Ocean Industry", June 1982, Page 73. The use of a buoyant body and the requirements thereof are described in the 1982 Offshore Technology Conference Paper No. OTC.4321.

To allow for movements of the vessel, which can be a tanker used for the storage of crude oil and even provided with production facilities on its deck, or a large barge, depending on the occurrence of waves, currents and winds, the vessel can rotate through an angle of 360° with regard to the stationary second part of the mooring system. A swivel coup-

ling at the upper part of this stationary part allows for the transfer of fluids from the flexible flowline upto the vessel deck.

The flexible flowline, however, must be kept within the periphery of the anchor chains or anchor cables with which the second part of the mooring is anchored to the seabed. In deep water these anchor chains or cables hang relatively steeply from the stationary part, for instance under an angle of 25° with the vertical. To prevent chafing and subsequent damage of the flowline it must be assured that the flowline stays within the space delimited by the anchor chains, with the result that the buoyant body must be a considerable distance below the surface of the water. As, however, the section of the flexible pipe between the stationary member and the buoyant body is dynamically loaded, due to vessel movement, this part needs regular checking and maintenance which, in view of the deep level at which the buoyant body is positioned, is a difficult and expensive task.

The invention aims to provide an alternative arrangement of the submerged flowline layout which obviates the disadvantages of the known layout. According to the invention, the stationary part carries an outrigger to which the flowline is to be connected. This simple measure makes it possible to locate the dynamic portion of the flowline outside the periphery of the anchor chains, eliminating any possibility

of chafing or physical contact between the anchor chains and the flexible pipe, and greatly facilitating maintenance of this dynamically loaded flowline part.

To obtain an equal loading of the stationary part, the latter preferably carries more than one outrigger.

According to the invention, the buoyant body is preferably positioned at a short distance under the keel of the vessel, which of course greatly facilitates its maintenance. As the part of the flowline between the buoyant body and the floor shows very little dynamic motion, maintenance or repair of this part is practically nil.

Furthermore each outrigger can be individually connected by one or more chains to the buoyant body.

The invention will be elucidated on the face of the drawings in which:

Fig. 1 shows a schematic side view of the mooring system according to the invention;

Fig. 2 shows a detail of Fig. 1 on a much enlarged scale;

Fig. 3 shows a top view of the stationary part of the mooring; and

Fig. 4 is a view of this part on a much enlarged scale.

The vessel 1 is fitted to the rotatable part 2 of the turret mooring 4 which in the shown embodiment is integrated with the

bow 3 of the vessel 1. The stationary part 5 is interconnected with the rotatable part 2 in a basically vertical direction so that the vessel 1 can swing around the centre axis of the stationary part 5 to take the position of least resistance due to weather.

To the stationary part 5 are connected the anchor chains 6 and the flexible flowline 7. The flexible flowline 7 is connected to the stationary part 5 via an outrigger 8. The length of the outrigger 8 is such that the flexible flowline remains clear of touching the anchor chains 6 in all circumstances. Thereto the flexible flowline 7 is connected to the buoyant body 10 and the configuration of the flexible flowline 7 is a catenary shape.

The buoyant body 10 is anchored to an anchor on the seafloor 12 via a taut mooring line 14. The vertical position of the buoyancy tank 10 is just below the keel of the vessel 1 so that it can freely rotate over this buoyant body 10. The flexible flowline 7 continues from the buoyant body 10 down to the seafloor 12 via a free-hanging section 16. At the outrigger 8 the flowline 7 continues with a rigid pipe 18 to the stationary part 5 upto deck level of the vessel 1. In order to allow the fluid to flow continuously to the vessel 1 a swivel joint 20 is incorporated in the rigid pipe 18.

In Fig. 3 the top view shows again the vessel 1, the anchor chains 6, the stationary part 5, the rotatable part 2 and

the outrigger 8. The outrigger 8 could be extended into a triangular frame 9 so that between the outrigger 8 and the buoyant body 10 a certain offset can be obtained so that the flowline 7 can be maintained and lifted over the side of the vessel 1 in the particular heading of that vessel 1. To that extent, one or more tension chains 11 are fitted between the triangular part of the outrigger 9 and the buoyant body 10.

Fig. 4 in more detail shows a typical configuration of the outrigger 8, the triangular frame 9, the flexible flowlines 7, the rigid pipe 18 and the anchor chains 6 which are supported by the stationary part 5 via chainstoppers 15. Also shown are the tension chains 11, the number and weight of which are dependent on the size, weight and number of flowlines 7.

An alternative design for more flowlines could comprise two or more outriggers to the stationary part, positioned such that an equilibrium is obtained.

It is observed that the reference numerals in the claims are not intended to restrict the scope thereof, but are only denoted for clarification.

Claims:

1. Mooring system comprising a turret of which the stationary part 5 is anchored to the seabed 12 and to which is to be connected the end of a flexible flowline 7 which is subsequently connected to an underwater buoyant body 10 anchored to the seabed, characterised in that the stationary part (5) carries an outrigger (8) to which the flowline (7) is to be connected.

2. Mooring system according to claim 1, characterised in that the stationary part (5) carries more than one outrigger (8).

3. Mooring system according to claim 1 or 2, characterised in that the buoyant body (10) is positioned a short distance below the vessel keel.

4. Mooring system according to claim 1 - 3, characterised in that each outrigger (8) is individually connected by one or more chains (11) to the buoyant body (10).

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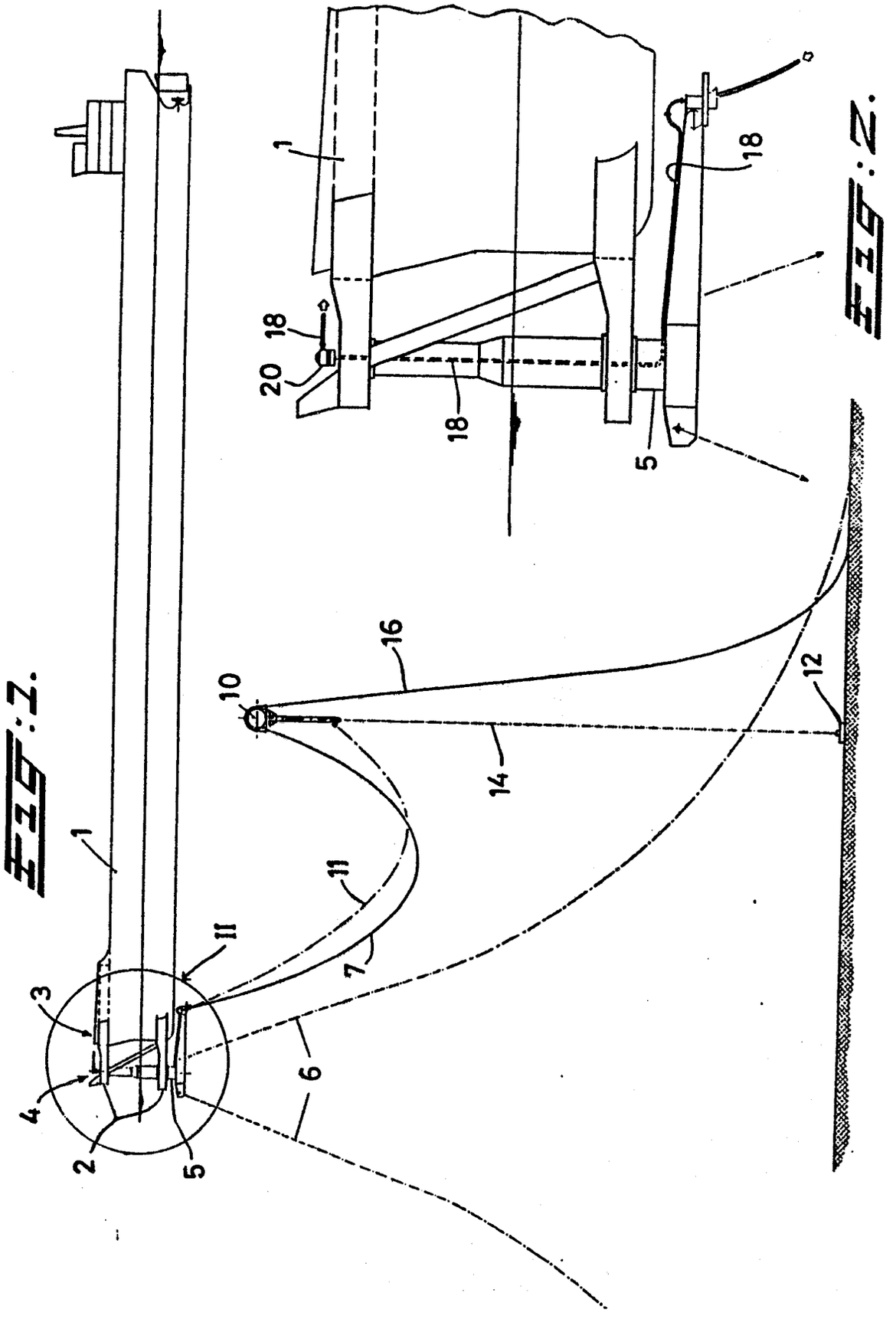

Fig. 2.

Fig. 2.

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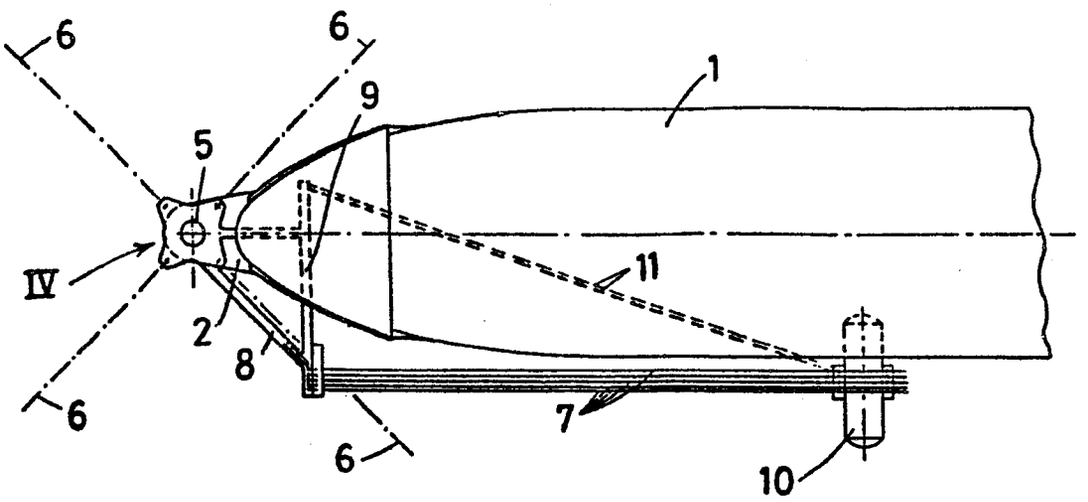

Fig: 3.

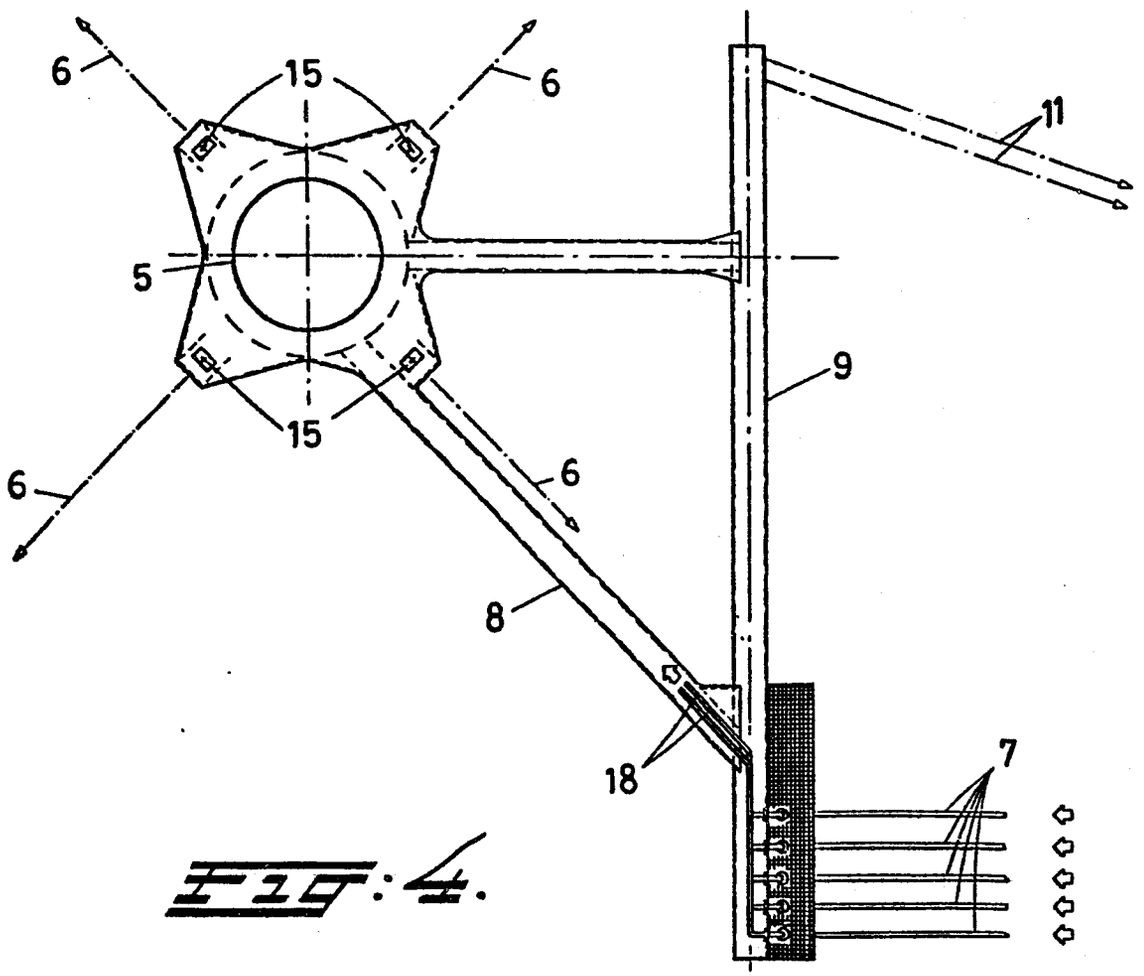

Fig: 4.

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EUROPEAN SEARCH REPORT

0134313
Application number

EP 83 20 1114

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl. ³)
Y	US-A-4 019 213 (BEHAR et al.) * Column 5, lines 1-32; figure 1 * ---	1,3	B 63 B 21/50
Y	US-A-4 301 840 (JANSEN) * Column 2, line 64 - column 3, line 28; figure 1 * -----	1	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

B 63 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	28-03-1984	BRUMER A.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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& : member of the same patent family, corresponding document

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