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(71) Applicant

Bluewater Terminal Systems N.V.

(Incorporated in Netherlands Antilles)

Theaterstraat 17, Willemstad, Curacao,
Netherlands Antilles

(72) Inventors

Marinus Uittenbogaard

Jacob de Baan

(74) Agent and/or Address for Service

Haseltine Lake & Co

Hazlitt House, 28 Southampton Buildings,
Chancery Lane, London, WC2A 1AT(51) INT CL⁴

B63B 21/00

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B7V FB

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None

(58) Field of search

B7V

Selected US specifications from IPC sub-class

B63B

(54) Resilient mooring system

(57) A device for mooring a vessel (1) to a mooring tower (2) or a buoy or suchlike, there being an additional means of force (7) to absorb excessive mooring forces.

So long as a particular mooring force is not exceeded, the distance which the vessel (1) travels relative to the mooring tower (2) or buoy in a direction away therefrom is shorter than or equal to the distance which the vessel (1) would cover if no additional means of force were present.

If the particular mooring force is exceeded, the vessel (1) can travel a distance away from the mooring tower (2) or buoy which is greater than or equal to the distance which it could travel if no additional means of force were present.

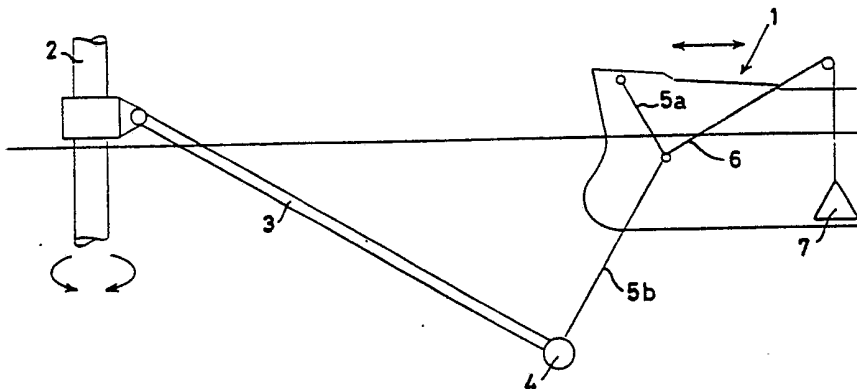


FIG. 1

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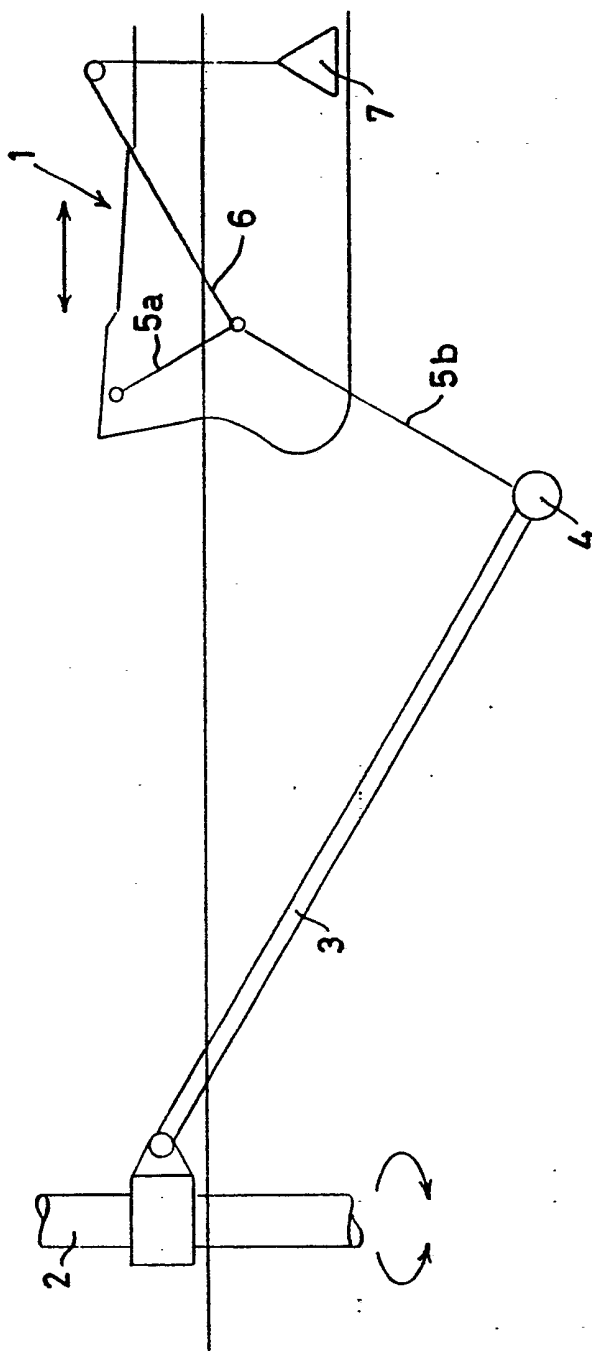


FIG. 1

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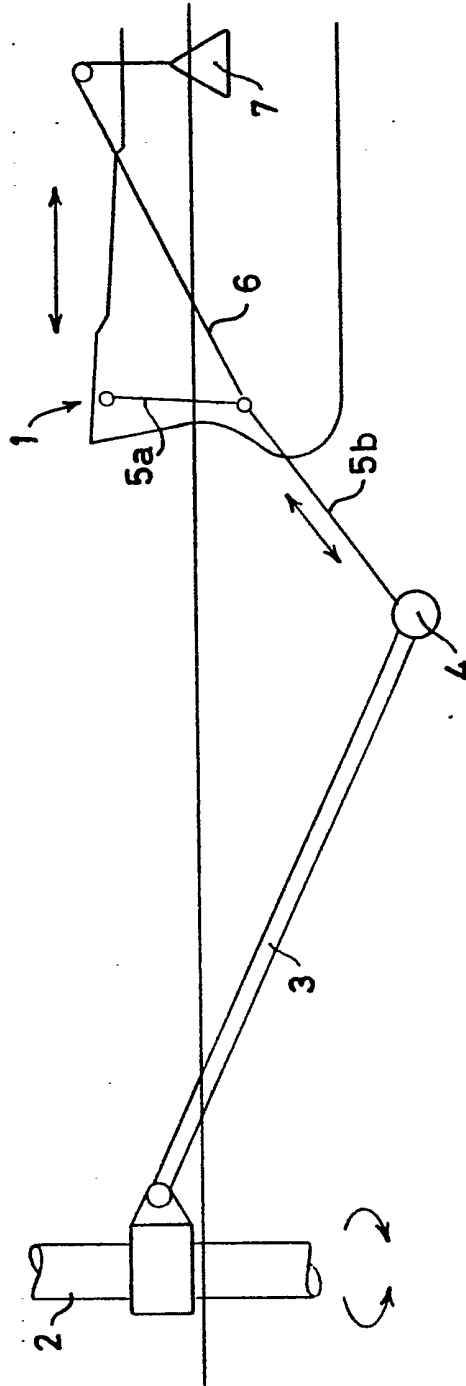


FIG. 2

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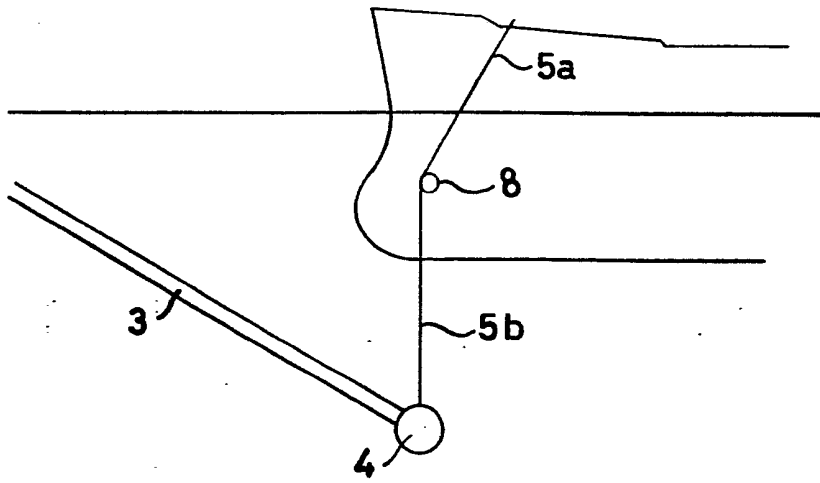


FIG. 3

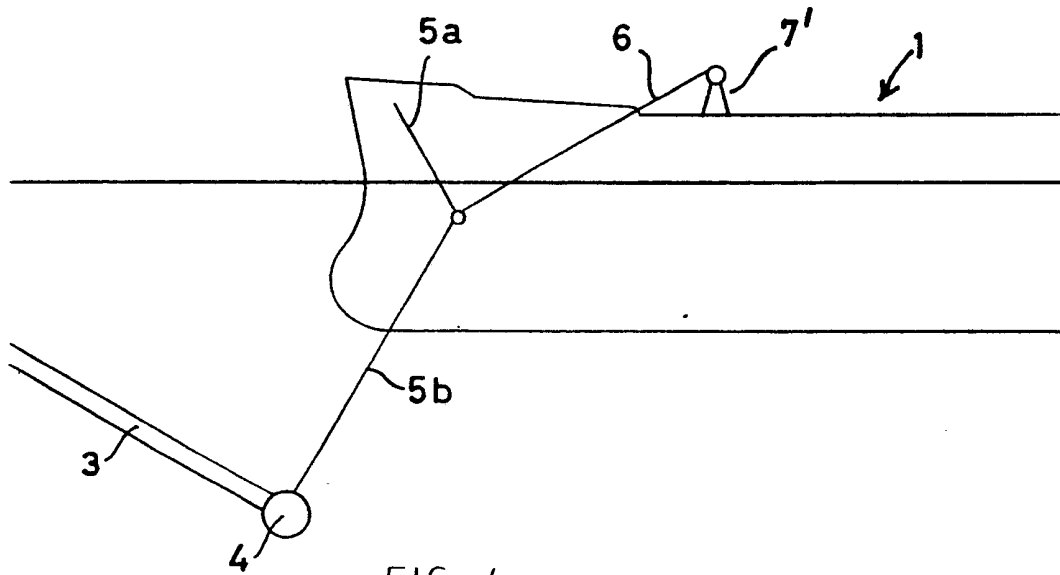


FIG. 4

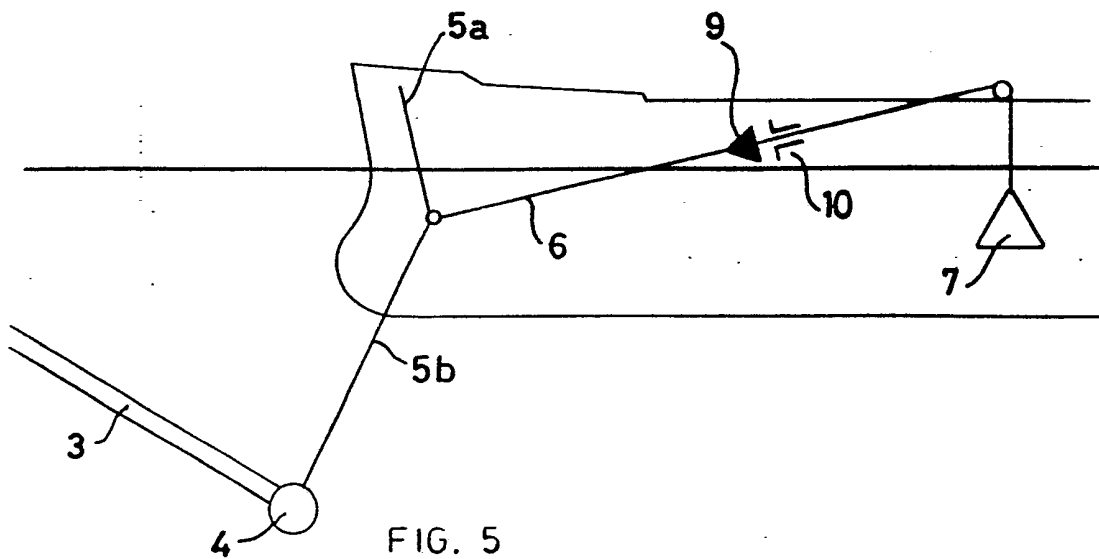
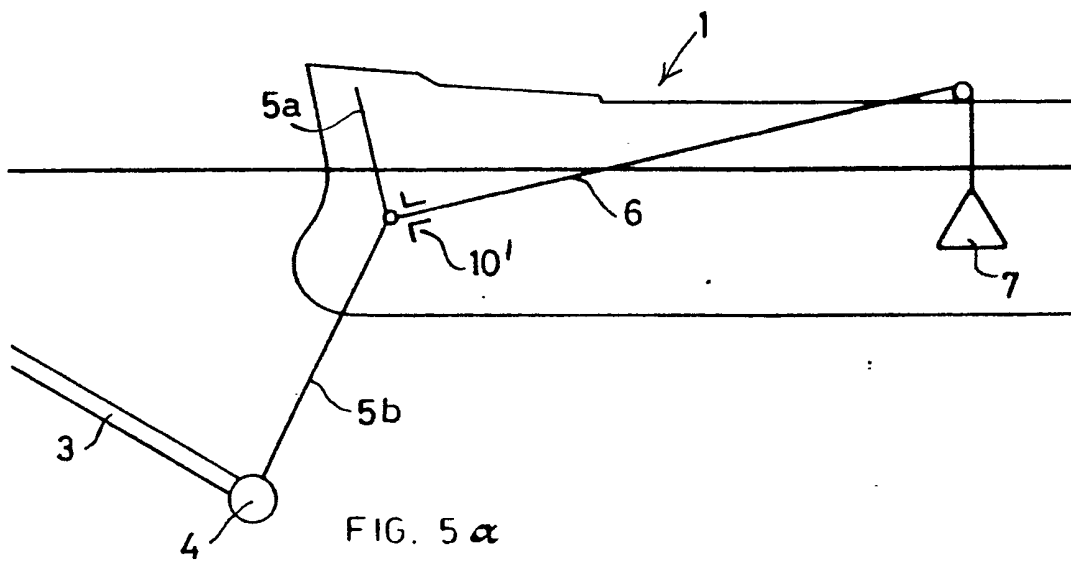


FIG. 5

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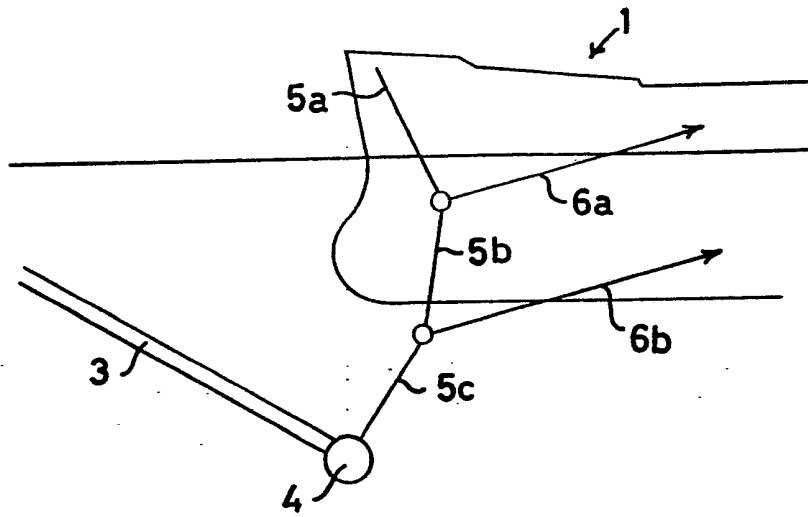


FIG. 6

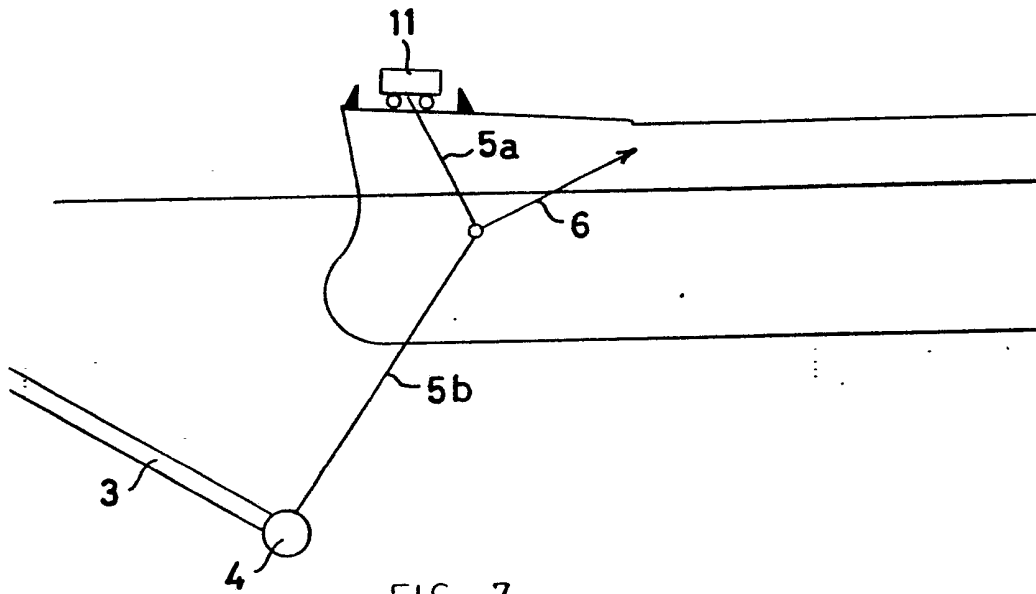


FIG. 7

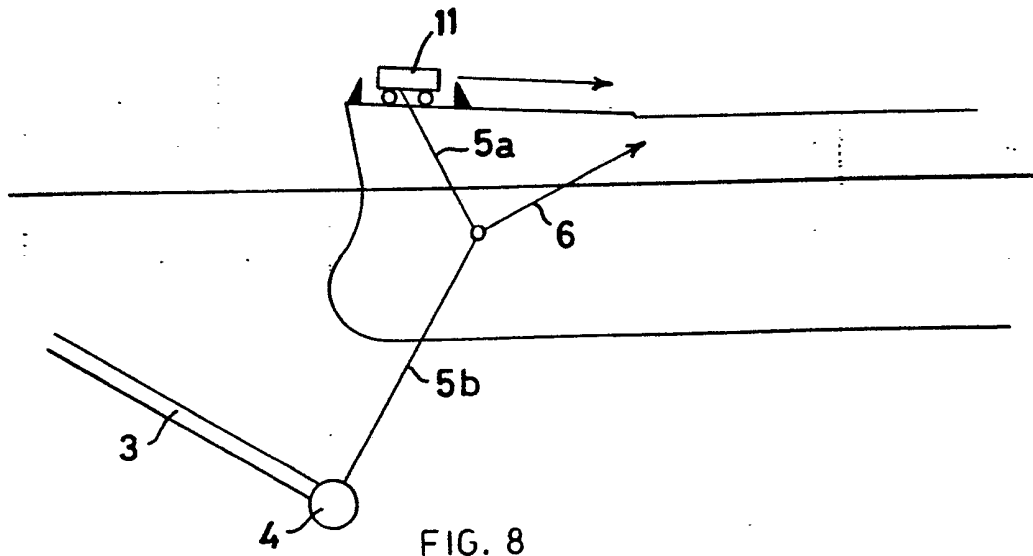


FIG. 8

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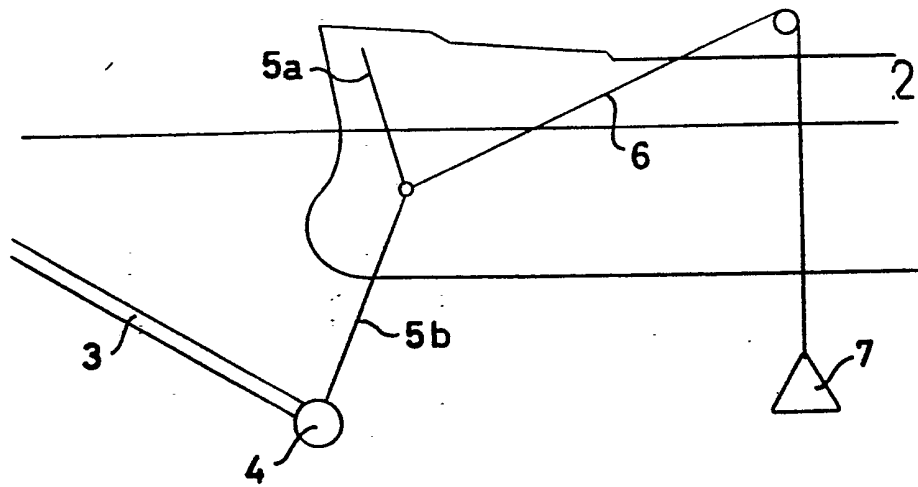


FIG. 9

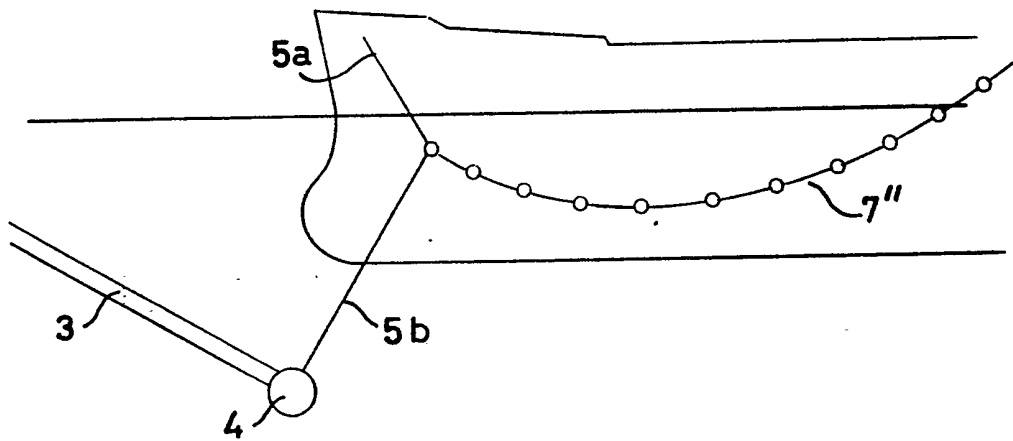


FIG. 10

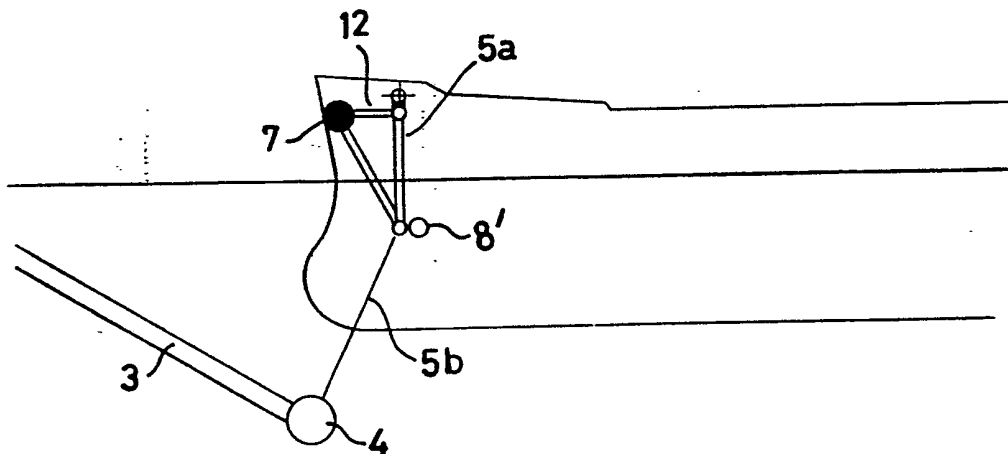


FIG. 11

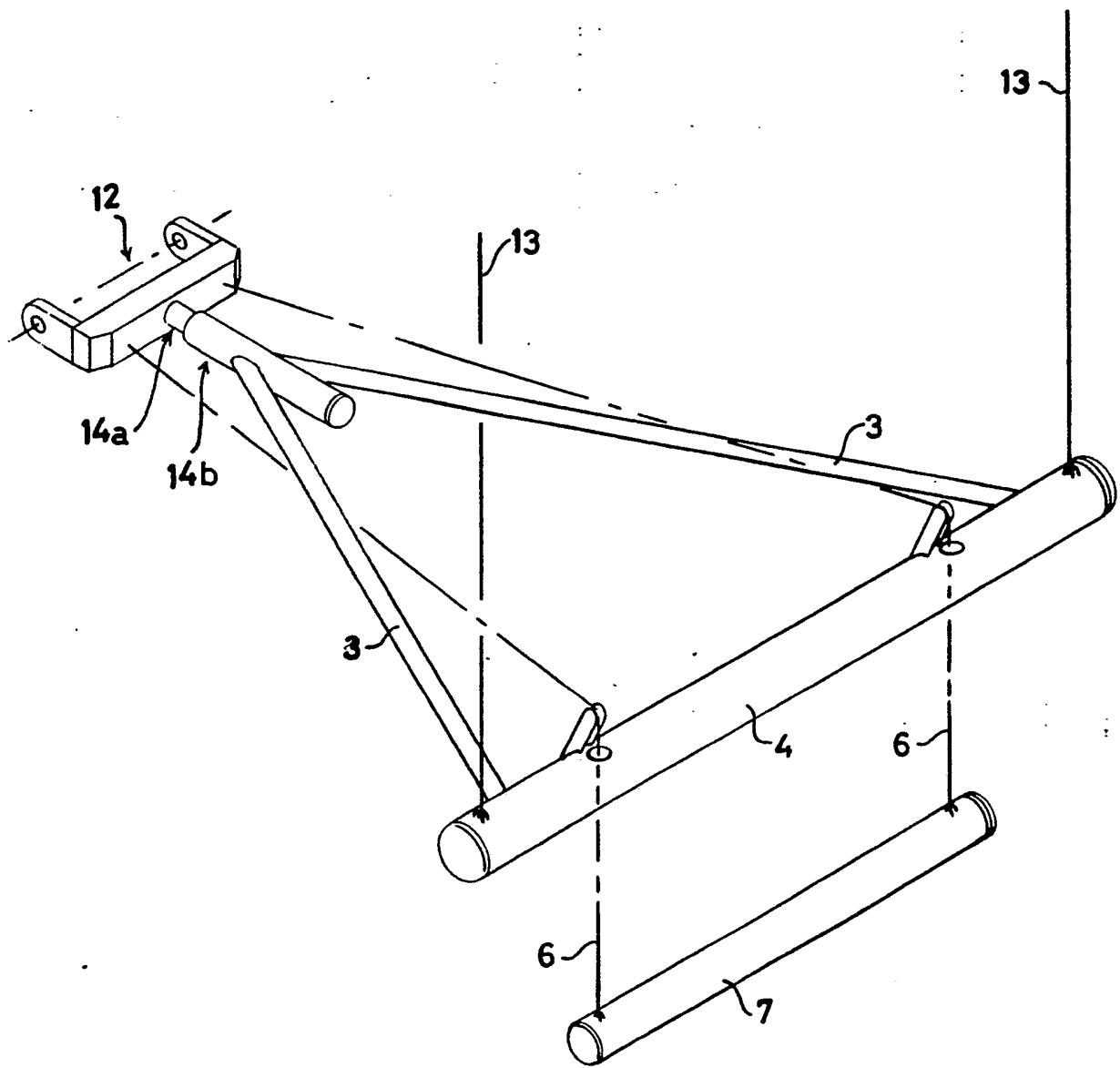


FIG. 12

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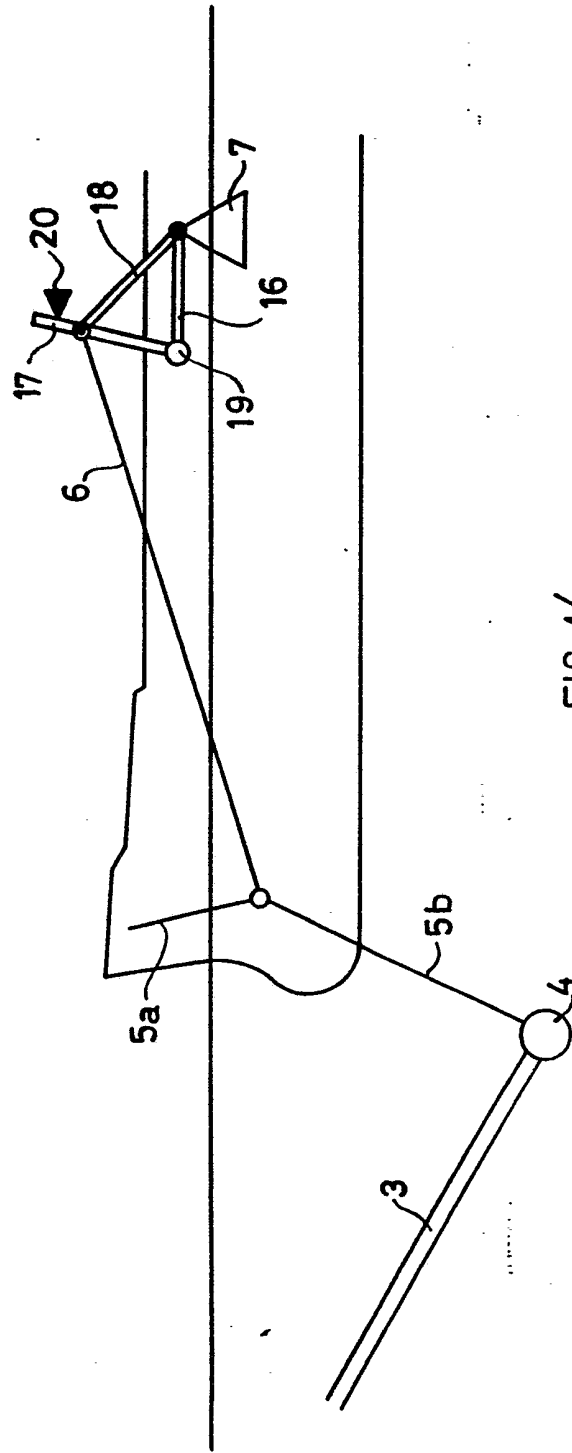


FIG. 14.

Device for mooring a floating body

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Our invention relates to a device for mooring a floating body, such as a ship, comprising a device anchored to the seabed, such as a mooring tower or a mooring buoy, or a second floating body, at least one
5 rigid arm, at least one weight connected by means of a tension member to the floating body or the device anchored to the seabed, and an additional means of force.

Such a device is known from, inter alia, French Patent 2,420,475 (EMH).

10 Devices of the above-mentioned type are generally used for mooring tanker vessels at sea to offshore terminals. These offshore terminals can consist of, for example, a mooring tower or a mooring buoy, on which there can be means for loading or unloading the tanker
15 with oil.

In areas where very strong winds and currents and currents and high waves can occur, the mooring device must be capable of absorbing as gradually as possible the movements of the tanker vessel away from and towards the
20 mooring device. For this, the device as a whole must have considerable elasticity. Attempts in this direction have consisted of using very heavy anchor chains, weights on the anchor chains, the use of rigid arms with a weight on the end etc.

25 The object of our invention is to produce such a device with improved elasticity.

To that end, the invention provides a device of the above-mentioned type, in which so long as a particular mooring force is not exceeded, the distance which the
30 floating body travels relative to the device anchored to the seabed or the second floating body in a direction away from the said device or the said second body is shorter than or equal to the distance which the floating body

would cover if no additional means of force were present, while if the particular mooring force is exceeded, the floating body can travel a distance in the above-mentioned direction which is greater than or equal to the distance
5 which it could travel if no additional means of force were present.

The effect of the measure according to our invention can be compared with connecting in series various springs, with the proviso that not all "springs" are "stretched" at
10 the same time, but that first the first "spring" is "stretched", after which the next "spring" is "stretched". In normal circumstances of waves, wind and tide, no such great mooring force will occur that the additional means of force is activated: but if in exceptional circumstances
15 such forces are exerted on the vessel, a new dynamic equilibrium arises within the field of action of the additional means of force through the fact that the vessel is capable of travelling a greater distance.

In other words, until a certain mooring force is
20 reached, the vessel is held relatively close to the mooring system through the action of the first "spring", but if the vessel is driven a greater distance from the mooring device through the action of, for example, an accumulation of higher waves (wave group), then such
25 displacement can be produced without great forces in the system through the use of an additional "spring".

Depending on the embodiment chosen, the invention can be used either on a mooring buoy or on a tower.

Further embodiments are described in the subclaims.

30 The invention will be explained below with reference to the attached drawing.

Fig. 1 shows an embodiment of the invention in which the additional means of force is a weight.

Fig. 2 shows the embodiment according to Fig. 1, in
35 which the mooring force is so great that the weight exerts forces on the system.

Fig. 3 shows a mooring device according to the invention in which the tension member comprises a cable or chain resting against a stop fastened to the vessel.

Fig. 4 shows a mooring device according to the invention in which the additional means of force is an automatic winch.

Fig. 5 shows a mooring device according to the invention in which the additional means of force is a weight, and disposed on the cable is a stopping or blocking element which rests on a stop fastened to the vessel.

Fig. 5a shows an embodiment of the invention in which the tension member is resting against a stop.

Fig. 6 shows an embodiment in which two cables run from the tension member each to a means of force.

Fig. 7 shows an embodiment in which the connection of the tension member to the vessel is made horizontally displaceable.

Fig. 8 shows a mooring device according to Fig. 7, but in which a force is exerted in the horizontal direction on the connection between the tension member and the vessel.

Fig. 9 shows an embodiment in which the additional means of force is a weight hanging outside the vessel.

Fig. 10 shows an embodiment in which the additional means of force is a length of chain hanging outside the vessel.

Fig. 11 shows an embodiment in which the first component of the tension member is rigid, and in which the additional means of force is fixed to a transversely projecting arm which is in turn fixed to the first component of the tension member.

Fig. 12 shows an embodiment in which the first and second component are fastened to each other in such a way that they can slide out, and in which the additional means of force is a weight which is connected to the vessel or the mooring tower or mooring buoy by means of cables

which are led over the weight fixed to the end of the rigid arm.

Fig. 13 shows an embodiment in which the component of the tension element fixed to the vessel is formed by a boom fixed to the outside of the vessel.

Fig. 14 shows an embodiment in which the additional means of force is attached near the end of a first rigid arm, the other end of which is fixed to a second rigid arm, both rigid arms pivoting together around a common pivot point fixed to the vessel.

In Fig. 1 a vessel 1 is moored to a mooring tower or mooring buoy 2. The mooring device comprises a rigid arm 3, at the end of which there is a weight 4. The weight 4 is connected to the vessel 1 by means of a tension member, comprising two components 5a and 5b. The tension member is connected by means of a cable 6 to the additional means of force, in this example a weight 7. In the figure the weight 7 is at rest and is lying on the flat of the bottom of the vessel. No such forces are exerted through wind, current or waves that the weight is lifted from the flat of the bottom. The distance which the vessel can cover is determined by the elasticity of the system comprising the rigid arm 3, the weight 4 and the component 5b of the tension member.

In Fig. 2 such forces are exerted on the vessel that the elasticity of the system comprising the rigid arm 3, the weight 4 and the component 5b is insufficient to allow the vessel to carry out the movement which it "wants" to make. The mooring force is now greater than the weight force of the weight 7, which is now lifted from the flat of the bottom of the vessel. Added to the elasticity of the system comprising the rigid arm 3, the weight 4 and the component 5b we now have the elasticity of the system comprising the component 5a, the cable 6 and the weight 7. The distance which the vessel can cover is now greater.

In Fig. 3 the tension member comprises a cable resting against a stop fastened to the vessel. So long as

the mooring force is not too great, the distance which the vessel can cover depends on the elasticity of the system comprising the rigid arm 3, the weight 4 and the part 5b of the cable which is beneath the stop. If the vessel
5 wants to move further away from the mooring tower or the mooring buoy, the cable comes away from the stop, and the distance to be travelled by the vessel is determined by the elasticity of the system comprising the rigid arm 3, the weight 4, the two components 5a and 5b, and the vessel
10 itself.

In Fig. 4 the additional means of force is an automatic winch 7'. The additional means of force can also be a hydraulic piston cylinder device, or an elastic pulling component or the like.

15 In Fig. 5 the additional means of force is a weight which at rest hangs free. The position of the weight at rest is determined by a stop component 9 disposed on the cable 6 and abutting a stop 10. Said stop can be, for example, a guide eye or a hawse pipe in the vessel.

20 In Fig. 5a the weight also hangs free, but the height at which the weight hangs is determined by the fact that the tension member - the components 5a and 5b - rests against a stop 10', possibly a guide eye or hawse pipe here too.

25 In Fig. 6 the tension member is divided into three components 5a, 5b and 5c. Running from the connections between two successive components are cables 6a, 6b, each to additional means of force (not shown). The effect of this is of three successively coupled "springs", so that
30 the movements of the vessel are absorbed even more gradually.

Fig. 7 shows an embodiment in which the fastening of the component 5a to the vessel is made horizontally displaceable by means of a fastening 11 suitable for the
35 purpose.

Fig. 8 shows an arrangement which corresponds to that of Fig. 7, the difference being that a force can be

exerted on the fastening 11 in the horizontal direction by a second additional means of force. The effect of this is comparable with that of the embodiment according to Fig. 6.

5 In Fig. 9 the additional means of force is a weight 7 which hangs outside the ship.

 In Fig. 10 the additional means of force is a length of chain 7. Said chain is fastened directly to the tension member 5a-5b and thus at the same time replaces the cable 10 6.

 In Fig. 11 the first component 5a of the tension member is rigid and lies with its bottom end against a stop 8'. The additional means of force is a weight 7 at the end of an arm 12, which is in turn fastened to the 15 component 5a near its top end.

 Fig. 12 shows a mooring device of the "wishbone" type. This device is connected at 12 to the mooring tower, and the weight 4 is connected to the vessel by means of cables 13. The fastening of the rigid arm 3 to the mooring 20 tower or mooring buoy is made slidable at 14a and 14b. The additional means of force comprises a weight 7 which is connected by means of cables 6 to the mooring tower or mooring buoy. So long as a particular mooring force is not exceeded, the parts 14a and 14b are telescoped together ; 25 but if such forces are exerted on the vessel that the vessel wants to move a greater distance than the device at rest permits, the parts 14a and 14b slide out of each other, and the weight 7 is lifted. The vessel can now cover a greater distance, which is limited by the lengths 30 of the parts 14a and 14b and of the cables 6.

 In Fig. 13 the components of the tension element which are connected to the ship consist of rigid booms 5a' which can rotate about a vertical axis at 15.

 In Fig. 14 the weight 7 is attached near the end of 35 a first rigid arm 16, the other end of which is fixed to the lower end of a second rigid arm 17. The upper end of the second rigid arm 17 is connected to the connection of

the two components 5a, 5b of the tension member . A strut (tie) 18 takes up the tension caused by the weight 7. Both rigid arms 16,17 pivot together at 19 around a pivot point fixed to the vessel. The position at rest of the rigid arms 5 16,17 and the weight 7 is determined by the stop 20 against which the rigid arm 17 comes to rest.

It goes without saying that the invention is not restricted to the embodiments shown here. For instance, it is possible within the scope of protection of the 10 claims in all cases for the additional means of force to be fastened to the device anchored to the seabed, instead of to the floating body. Further, either of the weights could, in some embodiments, be located above the waterline. In addition, the additional means of force could be 15 provided with a damping mechanism.

CLAIMS

1. Mooring device for a floating body, such as a ship, comprising a device anchored to the seabed, such as a mooring tower or a mooring buoy, or a second floating body, at least one rigid arm, at least one weight
5 connected by means of a tension member to the floating body or the device anchored to the seabed, and an additional means of force, characterized in that so long as a particular mooring force is not exceeded, the distance which the floating body travels relative to the
10 device anchored to the seabed or the second floating body in a direction away from the said device or the said second body is shorter than or equal to the distance which the floating body would cover if no additional means of force were present, while if the particular
15 mooring force is exceeded, the floating body can travel a distance in the above-mentioned direction which is greater than or equal to the distance which it could travel if no additional means of force were present.
2. Device according to claim 1, characterized in that
20 the tension member comprises at least two separated components and the force to be exerted by the additional means of force acts upon the connection between two components.
3. Device according to claim 2, characterized in that
25 the additional means of force comprises a weight which is connected in a suitable manner to the connection of the two components of the tension member.
4. Device according to claim 1, characterized in that
30 the additional means of force is formed by the floating body itself, and so long as, in consequence of the particular mooring force being exceeded, the floating body does not exceed a distance dependent thereon, the tension member rests against a stop at the level of the connection between the two components.

5. Device according to claim 2, characterized in that
the additional means of force comprises a hydraulic
piston-cylinder device which is connected in a suitable
manner to the connection of two components of the tension
5 member.

6. Device according to claim 2, characterized in that
the additional means of force comprises an automatic
winch which is connected in a suitable manner to the
connection of the two components of the tension member.

10 7. Device according to claim 2, characterized in that
the additional means of force comprises an elastic
pulling component which is connected in a suitable manner
to the connection of the two components of the tension
member.

15 8. Device according to claims 1-3 or 5-7, characterized
in that the additional means of force, so long as it
exerts no force on the tension member, is inside the
floating body or the device anchored on the
seabed at the end of a chain or cable, the position at
20 rest of the additional means of force being
determined by a stopping or blocking component
disposed on the chain or cable.

9. Device according to claims 1-3 or 5-7, characterized
in that the additional means of force is inside the
25 floating body or the device anchored on the seabed
at the end of a chain or cable, the position at rest
of the additional means of force being determined
by a stop against which the tension member
comes to rest.

30 10. Device according to any preceding claim,
characterized in that the tension member comprises at
least three components and several additional
means of force engage with at least two connections
between two individual components.

35 11. Device according to any preceding claim,
characterized in that the fastening of the tension member
to the floating body or the device anchored

to the seabed can be displaced approximately horizontally.

12. Device according to claim 11, characterised in that that the force can be exerted by the additional means of force also acts upon the said fastening.

13. Device according to claim 2, characterised in that horizontal displacement of the connection between the two components is obtained by means of suspension means rotatable about an essentially vertical axis.

14. Device according to claim 3, characterised in that the weight is inside the floating body or the device anchored on the seabed.

15. Device according to claim 14, characterised in that so long as it is exerting no force on the tension element, the weight lies on an essentially horizontal surface.

16. Device according to claim 3 or 6-13, characterised in that the weight hangs outside the floating body or the device anchored to the seabed.

17. Device according to claims 6-13 or 16, characterised in that the weight and the means for connection thereof to the tension member are integral and comprise a length of chain or cable.

18. Device according to claim 2, characterised in that the upper component of the tension member is rigid, said component rests near its bottom against a stop so long as the said mooring force is not exceeded, and disposed on the top end is an arm, on the end of which the additional means of force is fixed.

19. Device according to claim 1, characterised in that the rigid arm is fixed to the floating body or the device anchored on the seabed so that it can slide out against the additional means of force, and the additional means of force hangs from suitable suspension means, such as cables or chains, which are

fastened to the device anchored on the seabed or to the floating body to urge the rigid arm to its retracted condition.

20. Device according to any preceding claim,
5 constructed on either side of the floating body or the device anchored on the seabed.

21. Device according to any preceding claim,
characterised in that at least one weight is above the waterline.

10 22. Device according to any preceding claim,
characterised in that the additional means of force is provided with a damping device.

23. Device according to claim 2, characterised in that the additional means of force is attached near the
15 end of a first rigid arm, the other end of said first rigid arm being fixed to an end of a second rigid arm the other end of which is fixed to the connection of the two components of the tension member, both arms pivoting together around a pivot point fixed to the
20 floating body or the device anchored to the sea bed, the position at rest of the additional means of force being determined by a stop against which one of the arms comes to rest.

24. Device substantially as described herein with
25 reference to any of the accompanying drawings.