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(54) **ANCHORING SYSTEM FOR A FLOATING CONSTRUCTION**

VERANKERUNGSSYSTEM FÜR EINE SCHWIMMENDE KONSTRUKTION

SYSTEME D'ANCRAGE POUR CONSTRUCTION FLOTTANTE

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Description

[0001] The invention relates to an anchoring system for a floating construction and provided with elongated elements, with which a mass is suspended from the floating construction and the floating construction is connected with anchoring members. In order to keep a floating construction in place in horizontal direction, the anchoring system needs to be able to absorb environmental forces resulting from wind, current, waves and the like on the floating construction and be able to provide a resetting force. These forces have a part which is constant in time and a part which is variable in time, which moves the floating construction, such as by gusts, current changing due to wind and tide and waves moving back and forth as well as dispersing waves.

[0002] An anchoring system can be made to be so strong and stiff that movement of the floating construction is largely prevented, yet anchoring systems are often designed such that movement of the floating construction is allowed and the average environmental forces can be absorbed. Such an anchoring system, which is sufficiently strong to absorb environmental forces and sufficiently flexible to allow movements, provides a connection between the floating construction and the sea bottom. The attachment to the bottom under the floating construction can be realized with the aid of an anchoring element, such as for instance a heavy object, a classic anchor, a driven-in pile or a suction anchor, while the connection between the anchoring element and the floating construction is often realized by means of elongated elements, such as for instance ropes, chains, steel cables or plastic cables.

[0003] Here, absorbing the forces attempting to move the floating construction, and generating the desired resetting force may be realized by providing the elongated elements with the flexibility and strength sufficient for this purpose. Here, the flexibility is determined by the spring characteristic of the elongated elements and the shape assumed by the elongated elements. Factors playing a role in this are the weight and the length of the elongated element, the water depth and the variable stress in the elongated element. In addition, the elongated element may further be composed of different materials and embodiments. Thus, an anchoring system can be geared to a specific use. However, such a gearing remains problematic in an anchoring system for relatively shallow water and relatively large horizontal movements. In particular if a permanent anchoring system, such as for instance for floating windmills, in shallow sea, such as for instance the continental shelf in the North Sea, is involved, this can only be realized at high costs.

[0004] As is known from US-A-5,107,784, which is considered to be the closest prior art, it is also possible to generate the resetting force with the aid of a mass being suspended from the floating construction. Here, the elongated elements run over pulleys such that, upon displacement of the floating construction from its starting position, the mass moves upwards, so that, upon dropping of the moving force by moving the mass downwards, the floating construction is again moved towards its starting position. However, by using pulleys, and more particularly pulleys under water, and elongated elements running over them, the anchoring system becomes expensive, maintenance-prone and complicated. This is the more so since, for a good resetting action, use is made of elongated elements crossing one another, and particularly at the location of the suspended and moving mass.

[0005] The invention contemplates an anchoring system which obviates the above-mentioned problems by providing a relatively simple system which is not maintenance-prone, which, in addition, provides an optimal resetting after both a horizontal displacement and a rotation about the vertical axis.

[0006] This is achieved according to the invention with an anchoring system of the type described in the opening paragraph and known from US-A-5,107,784 by suspending the mass from the floating construction by means of an elongated carrying element having a fixed length, which elongated carrying element is further provided with attachment points for at least two elongated anchoring elements, wherein at least one elongated anchoring element extends, at least in the starting position, substantially horizontally from an attachment point to a connection point with a further elongated auxiliary element, which extends, at least in the starting position, substantially vertically downwards between an attachment point on the floating construction and the connection point with the elongated anchoring element, which extends downwards at an inclination from the connection point to an anchoring member provided on or in the bottom under water. Through these measures, it is achieved that, upon a horizontal displacement of the floating construction, a mass suspended from an elongated carrying element is, due to its flexible anchoring, initially pulled upwards at a slight inclination by means of the elongated anchoring elements, and after dropping of the force causing the horizontal displacement, it falls downwards to its starting position, guided by the elongated elements, and thus the horizontal displacement that occurred is undone. Further, upon a rotation of the floating construction, the elongated carrying and auxiliary elements will assume an inclined position rotated relative to one another, so that, as a result of the mutual coupling, via the elongated anchoring elements, a mass suspended from an elongated carrying element is pulled upwards and thus a resetting moment is provided which undoes the rotation when the cause causing the rotation is removed or drops. In order to optimize this resetting, it is preferred that the force vector generated by the weight of the mass or the combined masses runs through the center of gravity of the floating construction.

[0007] If use is made of one mass, which is preferably suspended centrally, i.e. perpendicular under the center of gravity of the floating construction, then it is, according

to a further embodiment of the invention, preferably provided that at least two elongated anchoring elements extend, at least in the starting position, substantially horizontally from an attachment point to a connection point, with in each case a further elongated auxiliary element and extend vertically downwards at an inclination from the respective connection point to in each case an anchoring member provided on or in a bottom. Thus, upon a rotation of the floating construction, at least two elongated auxiliary elements are rotated relative to one another and thus a resetting moment is generated.

[0008] If use is made of more than one mass, then this can be realized in that at least one elongated auxiliary element carries a mass in the manner of an elongated carrying element, so that the one elongated carrying element forms an elongated auxiliary element for the elongated carrying element, and vice versa. A particularly advantageous embodiment can be realized if at least three elongated carrying elements are present, while in each case at least two elongated carrying elements acts as elongated auxiliary elements for a further elongated carrying element, while the masses suspended from the elongated carrying elements then preferably have equal weights and are arranged in a radially symmetrical manner around the center of gravity of the floating construction. Here, in the case that three elongated carrying elements are present, it is preferred that they are in each case connected two by two by an equal-length elongated element, so that the three masses suspended from the elongated carrying elements are arranged in the shape of an equilateral triangle, whose center of gravity is, at least in the starting position, located right under the center of gravity of the floating construction.

[0009] In case use is made of one elongated carrying element with mass suspended therefrom, a similar rotationally symmetrical construction can be obtained if further three elongated auxiliary elements are present, while each elongated carrying element is in each case connected by an equal-length elongated element with a connecting point of an elongated auxiliary element.

[0010] In order to make the displacement of a mass as large as possible upon a rotation of the floating construction, it is further preferred that an attachment point of an elongated element is in the proximity of an attachment point of the mass. Here, it is noted that a mass needs to be suspended at such a height above the sea bottom that, even with the expected maximum vertical displacements, it will not contact the sea bottom, in order to thus prevent impact loads in the system.

[0011] If, depending on the conditions, it is preferred to provide the anchoring system with a greater rotational stiffness, this can be provided according to a further embodiment of the invention if a part of an elongated anchoring element running downwards at an inclination from an attachment or connection point in each case continues in a split, for instance V-shaped, manner to an anchoring member.

[0012] With reference to embodiments shown in the drawing, albeit exclusively by way of non-limiting examples, the anchoring system according to the invention will now be discussed in more detail. In the drawing:

Fig. 1 shows a first embodiment of an anchoring system according to the invention in side elevational view;
Fig. 2 shows a cross section along line II-II in Fig. 1;
Fig. 3 shows a second embodiment of an anchoring system according to the invention in side elevational view;
Fig. 4 shows a cross section along line IV-IV in Fig. 2;
Fig. 5 shows a third embodiment of an anchoring system according to the invention in side elevational view;
Fig. 6 shows a cross section along line VI-VI in Fig. 5;
Fig. 7 schematically shows a fourth embodiment; and
Fig. 8 schematically shows a fifth embodiment.

[0013] Figs. 1 and 2 show a floating construction in the form of a pontoon 1 which is kept in place by means of an anchoring system. The anchoring system is provided with a mass 3 suspended from a carrying element 2 centrally under the pontoon 1, which mass 3 is kept in place by three anchoring elements 4, which are, as Fig. 2 shows, arranged in a rotationally symmetrical manner around the mass 3 and are, on the one side, connected with the carrying element 2 directly above the mass 3 and are, on the other side, fixed in a bottom under water by means of an anchor 5. Further, from the pontoon 1, three auxiliary elements 6 extend, which are each connected with one of the anchoring elements 4 at a point between the mass 3 and an anchor 5. All this has been chosen such that, in a neutral starting position, as shown in Fig. 1, the carrying element 2 and the auxiliary elements 6 extend substantially vertically, the parts of the anchoring elements 4 between the connection with the carrying element 2 and that with the auxiliary element 6 run substantially horizontally and the parts of the anchoring element 4 incline downwards from their connection with the auxiliary element 6 to the anchor 5.

[0014] It is noted that the carrying, anchoring and auxiliary elements are indicated as wires. However, they may also have any different suitable and desirable design, such as ropes, chains, plastic or steel cables and the like, or combinations of such embodiments. If desired and depending on the conditions in which the anchoring is to take place, floats or weights may be attached to these elements. Also, at least parts of the elements may consist of one or more stiff or rigid elements. Further, the Figures only show a schematic view of the anchoring system. Thus, the inclined parts of the anchoring elements 4 may be considerably longer than shown in the Figures. Fig. 1 shows these parts as somewhat sagging under their own weight. This, and the elasticity of these elongated elements 2, 4 and 6 provides the anchoring system with a certain flexibility, besides further factors, such as water

depth and stress in the elongated elements.

[0015] If a force is exerted on the pontoon 1, for instance by wave action, wind or current, which force pushes the pontoon 1 to the right in Fig. 1, then the inclined part of the anchoring element 4, designated by reference numeral 4a, will be under more stress than the inclined parts designated by 4b and 4c of the two other anchoring elements 4. By this flexible retaining, the mass 3 will be able to move less to the right than the pontoon 1, which causes the mass 3 suspended from the carrying element 2 then assuming an inclined position to move upwards. Upon dropping of the force which attempts to push away the pontoon 1 to the right, initiated by the weight of the mass 3 and supported by the interplay of forces in the various elements 2, 4 and 6, the pontoon 1 will return to its force-neutral position of equilibrium, i.e. to the position shown in Fig. 1.

[0016] If the exerted force (also) results in the pontoon 1 starting to rotate about a vertical axis, then the flexible retaining of the lower ends of the auxiliary elements 6 and the rotation relative thereto of the attachment points on the pontoon 1 will result in the auxiliary elements 6 assuming an inclined position and thus pulling the elements 4 and 4A and optionally mass 3 upwards. After the dropping of the force which attempts to rotate the pontoon 1, initiated by the weight of the mass 3 and supported by the interplay of forces in the elements 4 and 6, the pontoon 1 will again return to its force-neutral position of equilibrium, i.e. to the position shown in Fig. 1.

[0017] If desired, the anchoring system can have a stiffer design by in each case mutually connecting two connection points of the auxiliary elements 6 with the anchoring elements 4 with an elongated supporting element 7, as shown by dashed lines in Fig. 2. Then, two surfaces connected by the auxiliary elements 6 are created, as it were, which are rotated relative to one another upon rotation of the pontoon 1.

[0018] Figs. 3 and 4 show a floating construction in the form of a platform 11 with a deck which is kept at a distance above a water surface by means of three floating bodies. The platform 1 is kept in place with an anchoring system provided with three masses 13a, 13b and 13c, which are each suspended from a carrying element 12a, 12b and 12c, which are mutually connected by supporting elements 17a, 17b and 17c engaging just above the masses 13a, 13b and 13c, while, from the points of engagement of the supporting elements 17a, 17b and 17c, in each case two anchoring elements 18a1, 18a2 and 18b1, 18b2 and 18c1 and 18c2 extend to an anchor 15. As Fig. 4 shows, in each case two anchoring elements are in line with one supporting element.

[0019] The operation of this anchoring system is essentially the same as the one described with reference to Figs. 1 and 2. Upon a lateral displacement or a rotation of the platform 11, mass will be pulled upwards and elongated elements will be put under more stress. Upon dropping of the force causing the displacement or rotation, the platform 11 will again be returned to its force-neutral starting position in the manner as discussed hereinabove.

[0020] It is noted that, due to the use of multiple masses, the anchoring system actually consists of a number of parts which are mutually integrated and interrelated. Thus, the mass 13a suspended from the carrying element 12a can be considered as being fixed by four anchoring elements, namely the anchoring element 18a1, the anchoring element 18a2, the supporting element 17a with the anchoring element 18b2 being in line therewith and the supporting element 17c with the anchoring element 18c1 being in line therewith. The carrying elements 12b and 12c, which each carry a mass 13b and 13c themselves, additionally also act as auxiliary elements, as described hereinabove, for the mass 13a suspended from the carrying element 12a. Further, the carrying element 12b will not only also be auxiliary element for the mass 13a suspended from carrying element 12a, but also auxiliary element for the mass 13c suspended from carrying element 12c. Thus, each carrying element also acts twice as an auxiliary element. If we consider the anchoring elements and the supporting elements, then they are all found to have a dual function. Thus, the supporting element 17c forms, together with the anchoring element 18c1, an anchoring element for the mass 13a and with the anchoring element 18a2 an anchoring element for the mass 13c, while the anchoring element 18c1 in itself also forms an anchoring element for the mass 13c and the anchoring element 18a2 can in itself also be considered as an anchoring element for the mass 13a.

[0021] It is further noted that two anchoring elements starting from a mass can also be combined to one single anchoring element which will then extend along the bisector of these two anchoring elements. It will be clear that such a combined element will have a threefold function, just like the carrying elements.

[0022] In Figs. 5 and 6, as a floating construction a pontoon 21 is chosen which is provided with projecting arms 21a to which carrying elements 22 are attached from which masses 23 are suspended. The carrying elements 22 are mutually connected by supporting elements 27, while, to an connection point between a carrying element 22 and a supporting element 27, in each case the ends of two anchoring elements 28 connect, whose other ends are in each case locked by an anchor 25 with respect to a bottom under water. The construction and operation of this anchoring system are essentially the same of those of the anchoring system according to Figs. 3 and 4, albeit use is now made of four masses.

[0023] Fig. 7 shows a variant of the anchoring system in which use is made of two masses 33, which are each suspended from a carrying element 32 starting from a floating construction (not shown). The two carrying elements 32 are mutually connected by a supporting element 37. From each connection point of the supporting element 37 with in each case a carrying element 32, two anchoring elements 38 in each case extend to an anchor 35. In this anchoring system, the two carrying elements

32 have a dual function: besides as a carrying element, they also act as an auxiliary element. This also holds true for the anchoring elements 38 and the supporting element 37. With two anchoring elements 38 starting from a mass 33, a supporting element 37 in each case forms an anchoring element for the other mass, while the anchoring elements 38 each further independently form an anchoring element for the mass from which they start.

[0024] Fig. 8 shows a variant of the anchoring system shown in Fig. 7 in the sense that now a mass 43 suspended from a carrying element 42 is present, while two supporting elements 47 extend from the carrying element 42 to a connection point with in each case an auxiliary element 46 and two anchoring elements 48, which are each fixed with an anchor 45. Just like the anchoring system shown in Fig. 7, the basis of the operation of this anchoring system is the above-described pulling upwards of the mass and the putting under more stress of a number of elongated elements upon displacement or rotation of the floating construction, and the return to the force-neutral starting position initiated by the weight of the mass.

[0025] It goes without saying that, within the framework of the invention as set forth in the appended claims, many further modifications and variants are possible in addition to the ones already mentioned. For instance, for the anchoring in the bottom under water, in each case an anchor is used in the drawings. It is of course also possible to use any other suitable anchoring member, such as for instance a heavy object resting on the bottom, a driven-in pile or a suction anchor for this purpose. In the embodiments shown, always more or less symmetrical arrangements are used. Depending on the construction of the floating construction, a more asymmetrical arrangement can also be chosen.

Claims

1. An anchoring system for a floating construction (1) and provided with elongated elements (2), with which a mass (3) is suspended from the floating construction and the floating construction is connected with anchoring member (5) provided on or in a bottom under water, **characterized in that** the mass (3) is suspended from the floating construction by means of an elongated carrying element (2) with a fixed length, which elongated carrying element is further provided with attachment points for at least two elongated anchoring elements (4), wherein at least one elongated element extends, at least in said starting position, substantially horizontally from an attachment point to a connection point with a further elongated auxiliary element (6), which extends, at least in said starting position, substantially vertically downwards between an attachment point on the floating construction and the connection point with said elongated anchoring element (4), which extends downwards at an inclination from the connection point to an anchoring member (5) provided on or in a bottom under water.

2. An anchoring system according to claim 1, **characterized in that** at least two elongated anchoring elements extend, at least in said starting position, substantially horizontally from an attachment point to a connection point with in each case a further elongated auxiliary element and extend downwards at an inclination from the respective connection point to in each case a anchoring member provided on or in the bottom under water.

3. An anchoring system according to claim 1 or 2, **characterized in that** at least one elongated auxiliary element carries a mass in the manner of an elongated carrying element.

4. An anchoring system according to any one of the preceding claims, **characterized in that** at least three elongated carrying elements are present, wherein in each case at least two elongated carrying elements act as elongated auxiliary elements for a further elongated carrying element.

5. An anchoring system according to claim 4, **characterized in that** three elongated carrying element are present, which are in each case connected two by two by an equal-length elongated element.

6. An anchoring system according to claim 1 or 2, **characterized in that** one elongated carrying element and three elongated auxiliary elements are present, wherein the elongated carrying element is in each case connected by an equal-length elongated element with a connection point of an elongated auxiliary element.

7. An anchoring system according to any one of the preceding claims, **characterized in that** an attachment point of an elongated element is in the proximity of an attachment point of the mass.

8. An anchoring system according to any one of the preceding claims, **characterized in that that** the force vector generated by the weight of the mass or the combined masses runs substantially through the center of gravity of the floating construction.

9. An anchoring system according to any one of the preceding claims, **characterized in that** a part of an elongated anchoring element running downwards at an inclination from an attachment or connection point in each case continues in a split, for instance V-shaped, manner to each anchoring member.

10. An anchoring element according to any one of the

preceding claims, **characterized in that** an attachment or connection point is connected with another attachment or connection point by means of an elongated supporting member.

Patentansprüche

1. Verankerungssystem für eine schwimmende Konstruktion (1), welches langgestreckte Bauelemente (2) aufweist, mit welchen eine Masse (3) an der schwimmenden Konstruktion aufgehängt wird, und wobei die schwimmende Konstruktion mit Hilfe von Verankerungsbauteilen (5), welche auf oder in einem Kielraum unter Wasser vorgesehen sind, verbunden ist, **dadurch gekennzeichnet, dass** die Masse (3) an der schwimmenden Konstruktion mit Hilfe eines langgestreckten Tragebauelements (2) mit einer festgelegten Länge aufgehängt ist, wobei das langgestreckte Tragebauelement des Weiteren Befestigungspunkte für mindestens zwei langgestreckte Verankerungsbauelemente (4) aufweist, **dadurch gekennzeichnet, dass** sich zumindest ein langgestrecktes Bauelement zumindest in der Ausgangsposition im Wesentlichen horizontal von einem Befestigungspunkt zu einem Verbindungspunkt mit einem weiteren langgestreckten Zusatzbauelement (6) erstreckt, welches sich zumindest in dieser Ausgangsposition im Wesentlichen vertikal nach unten zwischen einem Befestigungspunkt auf der schwimmenden Konstruktion und dem Verbindungspunkt mit dem langgestreckten Verankerungsbauelement (4), welches sich nach unten mit Schräge von dem Verbindungspunkt zu einem auf oder in einem Kielraum unter Wasser vorgesehenen Verankerungsbauteil (5) erstreckt, erstreckt.

2. Verankerungssystem nach Anspruch 1, **dadurch gekennzeichnet, dass** sich mindestens zwei langgestreckte Verankerungsbauelemente zumindest in der Ausgangsposition im Wesentlichen horizontal von einem Befestigungspunkt zu einem Verbindungspunkt mit Hilfe jeweils eines weiteren langgestreckten zusätzlichen Bauelements erstrecken, und sich nach unten mit einer Schräge von dem jeweiligen Verbindungspunkt zu jeweils einem Verankerungsbauteil erstrecken, welches auf oder in dem Kielraum unter Wasser vorgesehen ist.

3. Verankerungssystem nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** zumindest ein langgestrecktes zusätzliches Bauelement eine Masse in der Art und Weise eines langgestreckten Tragebauelements trägt.

4. Verankerungssystem nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** zumindest drei langgestreckte Tragebauelemente vorhanden sind,
wobei jeweils mindestens zwei langgestreckte Tragebauelemente als langgestreckte zusätzliche Bauelemente für ein weiteres langgestrecktes Tragebauelement wirken.

5. Verankerungssystem nach Anspruch 4, **dadurch gekennzeichnet, dass** drei langgestreckte Tragebauelemente vorliegen, welche jeweils paarweise mit Hilfe eines gleich langen Bauelements verbunden sind.

6. Verankerungssystem nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** ein langgestrecktes Tragebauelement und drei langgestreckte zusätzliche Bauelement vorhanden sind, wobei das langgestreckte Tragebauelement jeweils mit Hilfe eines gleich langen langgestreckten Bauelements mit einem Verbindungspunkt eines langgestreckten zusätzlichen Bauelements verbunden ist.

7. Verankerungssystem nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** ein Befestigungspunkt eines langgestreckten Bauelements in der Nähe eines Befestigungspunkts der Masse liegt.

8. Verankerungssystem nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** der durch das Gewicht der Masse oder der kombinierten Massen erzeugte Kraftvektor im Wesentlichen durch den Schwerpunkt bzw. Massenmittelpunkt der schwimmenden Konstruktion verläuft.

9. Verankerungssystem nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** sich ein Teil eines langgestreckten Verankerungsbauelements, welches sich nach unten mit einer Schräge von einem Befestigungs- oder Verbindungspunkt erstreckt, sich jeweils in einer gespaltenen bzw, zweigeteilten Art und Weise, beispielsweise V-förmig, zu jedem Verankerungsbauteil weiter erstreckt.

10. Verankerungssystem nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** ein Befestigungs- oder Verbindungspunkt mit einem weiteren Befestigungs- oder Verbindungspunkt über ein langgestrecktes Stützbauteil verbunden ist.

Revendications

1. Système d'ancrage pour construction flottante (1) et pourvu d'éléments allongés (2), avec lesquels une masse (3) est suspendue à la construction flottante et la construction flottante est connectée avec des éléments d'ancrage (5) prévus sur ou dans un fond

sous-marin, **caractérisé en ce que** la masse (3) est suspendue à la construction flottante au moyen d'un élément porteur allongé (2) de longueur fixe, lequel élément porteur allongé est en outre pourvu de points de fixation pour au moins deux éléments d'ancrage allongés (4), où au moins un élément allongé s'étend, au moins dans ladite position de démarrage, substantiellement horizontalement d'un point de fixation à un point de connexion avec un autre élément auxiliaire allongé (6), qui s'étend, au moins dans ladite position de démarrage, substantiellement verticalement vers le bas entre un point de fixation sur la construction flottante et le point de connexion avec ledit élément d'ancrage allongé (4), qui s'étend vers le bas avec une inclinaison du point de connexion à un élément d'ancrage (5) prévu sur ou dans un fond sous-marin.

2. Système d'ancrage selon la revendication 1, **caractérisé en ce que** au moins deux éléments d'ancrage allongés s'étendent, au moins dans ladite position de démarrage, substantiellement horizontalement d'un point de fixation à un point de connexion avec dans chaque cas un autre élément auxiliaire allongé et s'étendent vers le bas avec une inclinaison du point de connexion respectif à dans chaque cas un élément d'ancrage prévu sur ou dans le fond sous-marin.

3. Système d'ancrage selon la revendication 1 ou 2, **caractérisé en ce que** au moins un élément auxiliaire allongé porte une masse à la manière d'un élément porteur allongé.

4. Système d'ancrage selon l'une quelconque des revendications précédentes, **caractérisé en ce que** au moins trois éléments porteurs allongés sont présents, dans lequel dans chaque cas au moins deux éléments porteurs allongés agissent comme éléments auxiliaires allongés pour un autre élément porteur allongé.

5. Système d'ancrage selon la revendication 4, **caractérisé en ce que** trois éléments porteurs allongés sont présents, qui sont dans chaque cas connectés deux par deux par un élément allongé de longueur égale.

6. Système d'ancrage selon la revendication 1 ou 2, **caractérisé en ce que** un élément porteur allongé et trois éléments auxiliaires allongés sont présents, dans lequel l'élément porteur allongé est dans chaque cas connecté par un élément allongé de longueur égale avec un point de connexion d'un élément auxiliaire allongé.

7. Système d'ancrage selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**un point de fixation d'un élément allongé est au voisinage d'un point de fixation de la masse.

8. Système d'ancrage selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le vecteur de force généré par le poids de la masse ou des masses combinées passe sensiblement par le centre de gravité de la construction flottante.

9. Système d'ancrage selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**une partie d'un élément d'ancrage allongé orienté vers le bas avec une inclinaison depuis un point de fixation ou de connexion dans chaque cas continue de façon divisée, par exemple en V, jusqu'à chaque élément d'ancrage.

10. Système d'ancrage selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**un point de fixation ou de connexion est connecté avec un autre point de fixation ou de connexion au moyen d'un élément de support allongé.

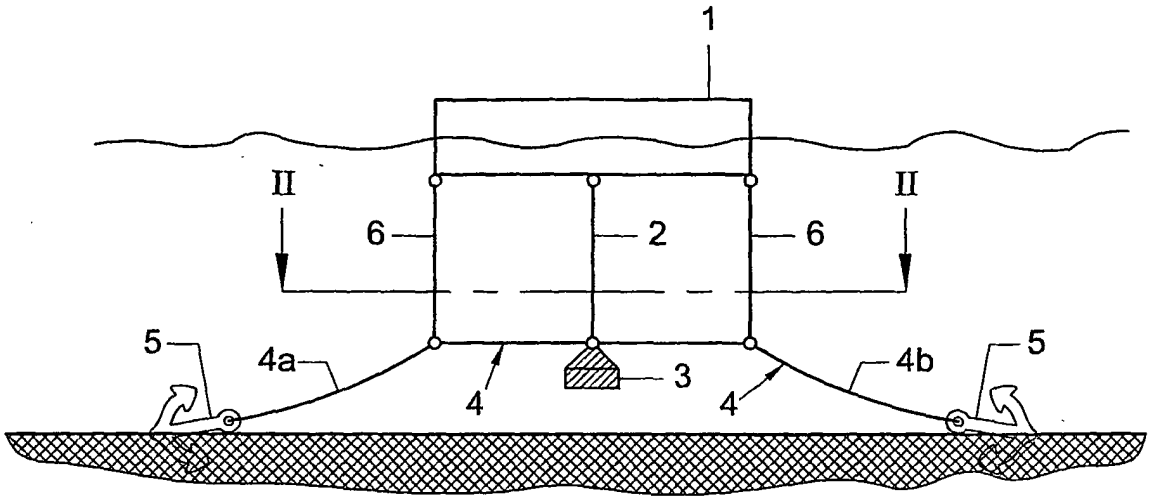

Fig. 1

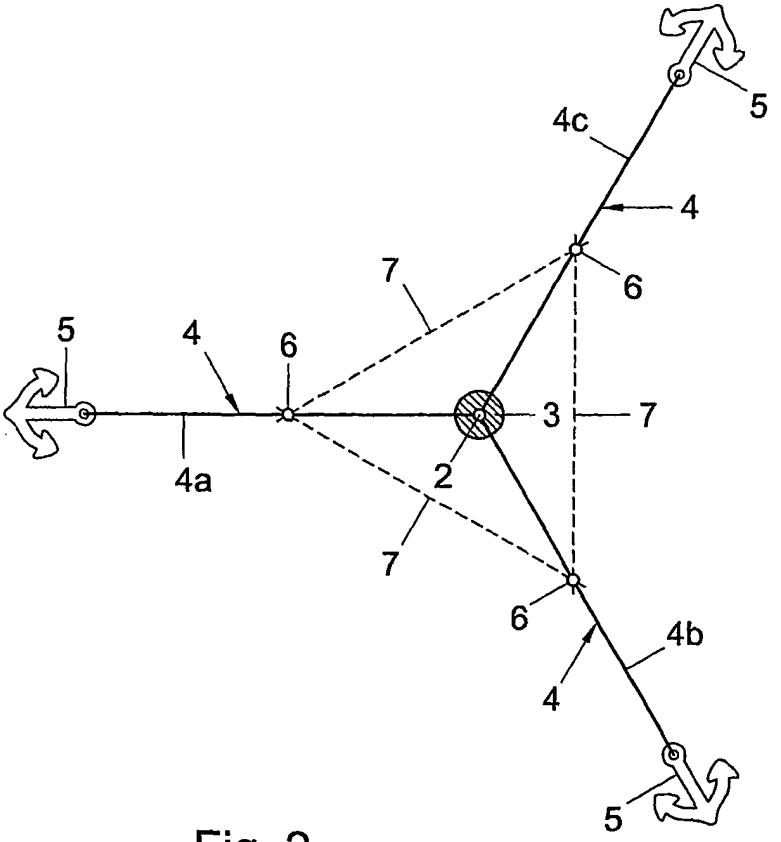

Fig. 2

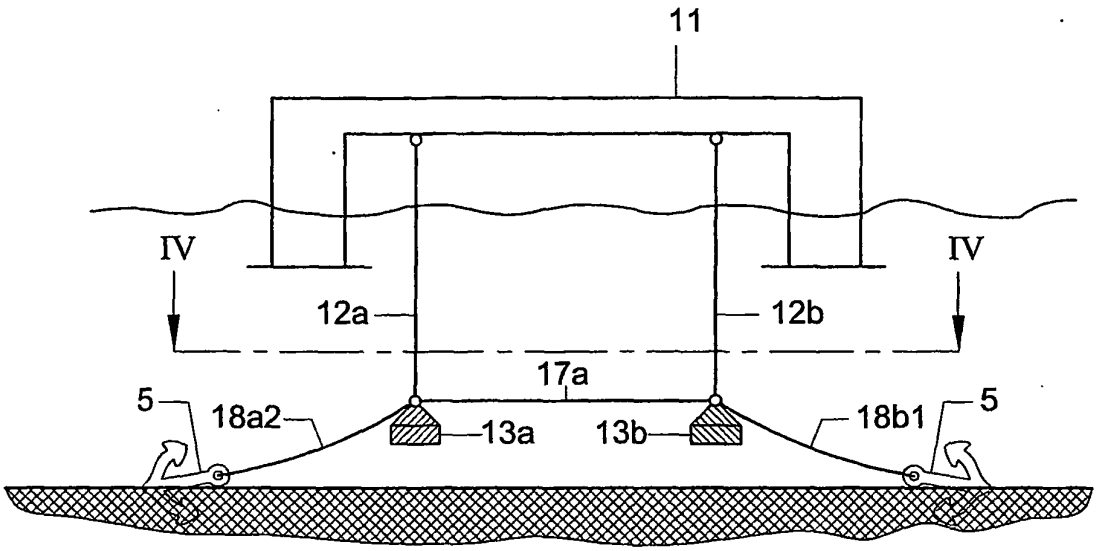
11
IV
IV
12a
12b
17a
5
18a2
13a
13b
18b1
5

Fig. 3

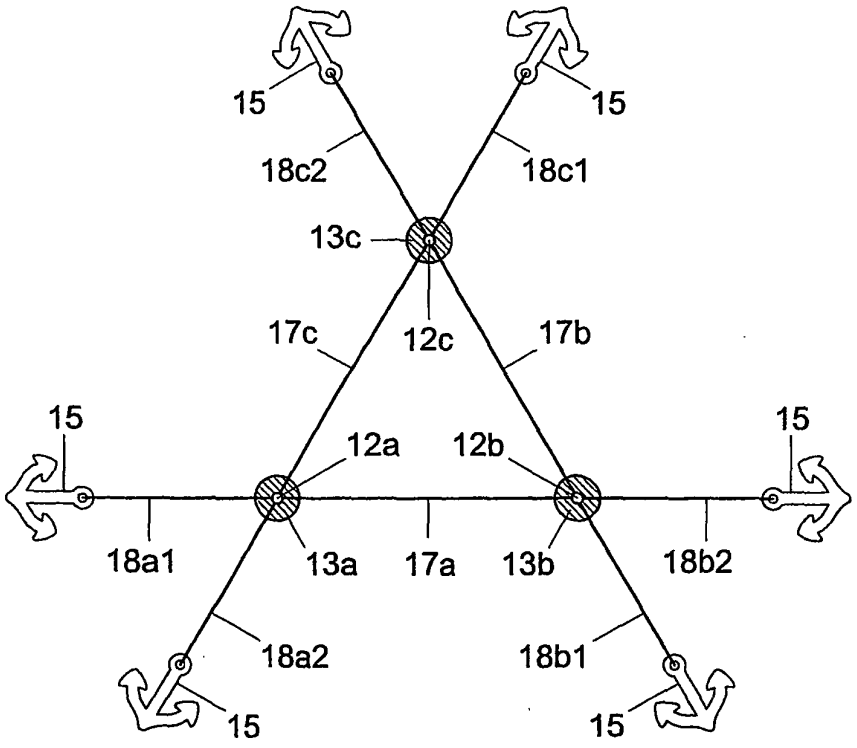
15
15
18c2
18c1
13c
17c
12c
17b
15
15
12a
12b
18a1
13a
17a
13b
18b2
18a2
18b1
15
15

Fig. 4

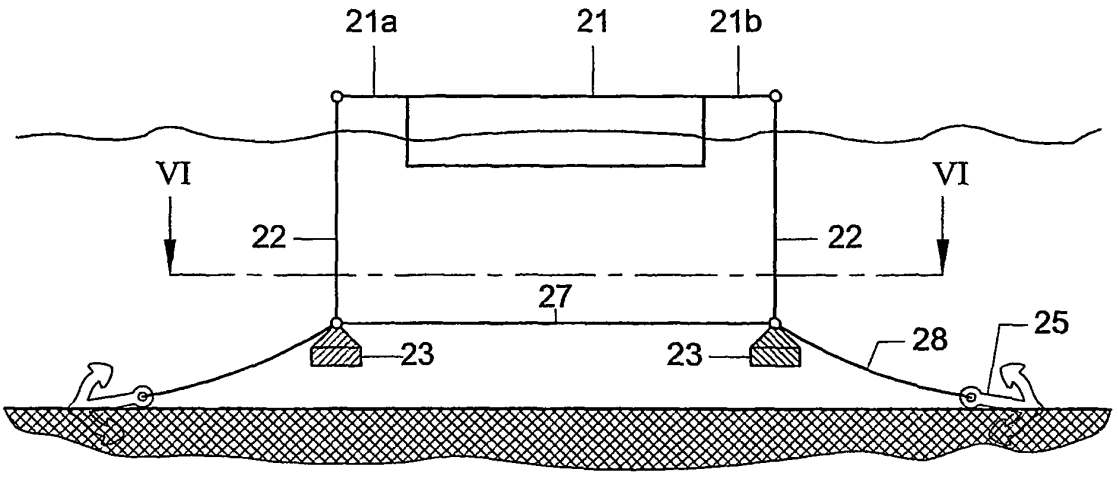

Fig. 5

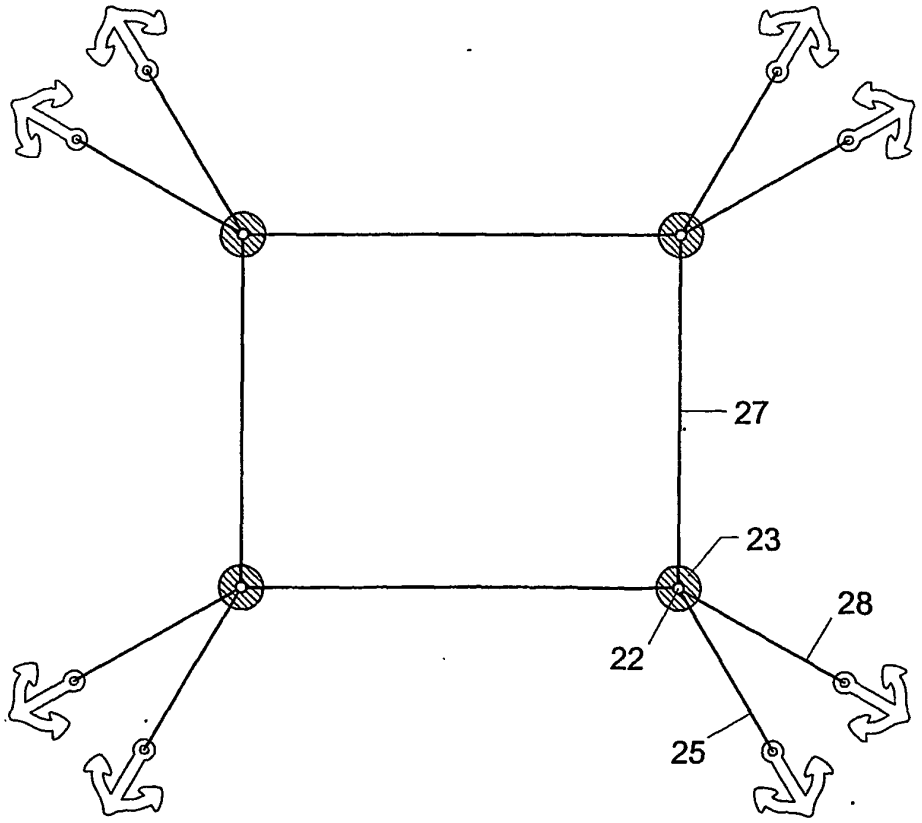

Fig. 6

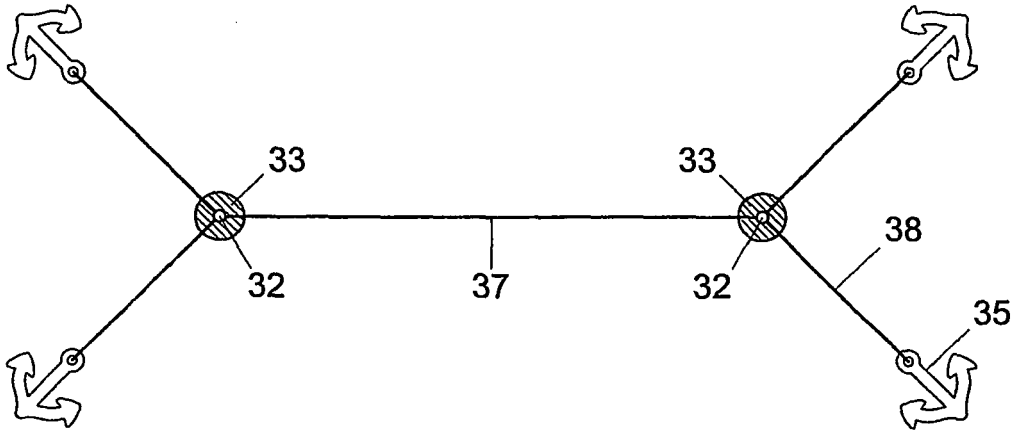

Fig. 7

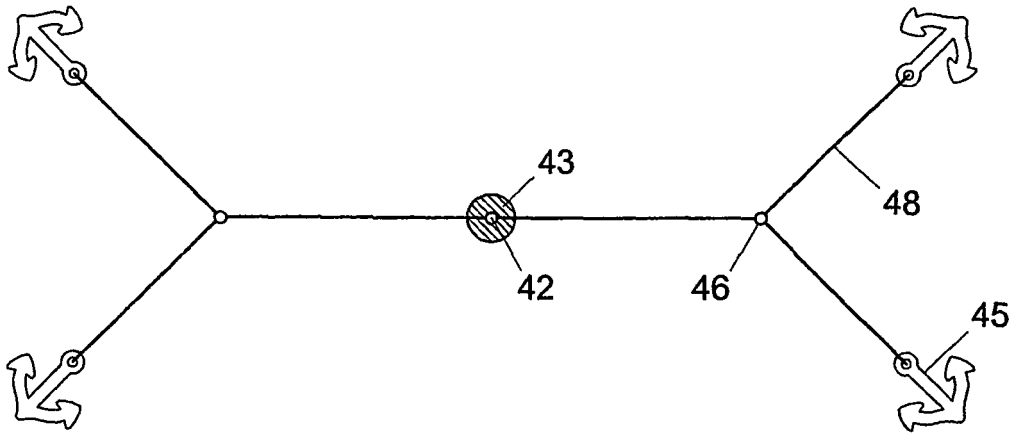

Fig. 8

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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