

Floating unit and system for producing a modular floating structure including such floating units

BACKGROUND OF THE INVENTION

Field of the invention

5 The present invention relates to a floating unit and to a system for producing a modular floating structure including such floating units.

 The invention further concerns a floating structure of variable configuration formed by assembling such units. This floating structure can be a ship, a floating catwalk or a floating platform.

Technological background

10 There are known floating containers which, when they are moored to one another, make it possible to construct a boat for fighting an accidental spillage of hydrocarbons at sea.

 These containers advantageously allow very rapid deployment by aircraft or by ship of means for containment of oil slicks.

15 In the latter case, and if the ship that is the cause of the accidental spillage of hydrocarbons is a container ship, these floating shipping containers can already be on board it.

 However, the time necessary for assembling the various containers constituting the boat is particularly long and bothersome, whereas the
20 intervention of containment means must be as rapid as possible to circumscribe the area contaminated by the hydrocarbons as soon as possible.

 Moreover, it is necessary to place these containers in the sea in the immediate proximity of one another and sheltered by the container ship in order to be sure that the operatives can moor them to one another.

25 The assembly of these containers at sea can therefore be carried out only under favorable sea state conditions.

 In fact, in a heavy swell, these containers are subject to large pitching and rolling movements, which compromise the maneuvers carried out by the operatives to bring together and connect to one another the plane faces of
30 these containers and their safety.

Moreover, it is seen that the containers then tend to move away from one another, thereby preventing the operative moving from one container to another to connect them to each other.

5 Containers that have drifted a great distance may be out of the immediate reach of the operative, the incomplete modular boat therefore being rendered inoperative.

Now, the use of such modular boats is typically made necessary following an incident or a shipwreck occurring under unfavorable
10 meteorological conditions.

Moreover, each container is often functionalized, one carrying the propulsion system of the boat, the other the wheel house of the boat, the third constituting a storage area, and so on.

It is therefore necessary to assemble these containers in a precise
15 order, which renders the operation of assembling these containers at sea even more constraining for the operatives.

These boats also have a particular length and width, which correspond to assembling a limited number of containers in a given direction thereof.

Now, there exists a need for a modular boat the dimensions of which
20 can be varied at will in the longitudinal and/or transverse direction thereof.

There also exists a need for such a modular boat to be able to assume a particular geometric shape, temporary or not, at one of its ends at least (bow or stern) and/or on at least one of its sides as a function of technical or logistical requirements or of the wishes of the operative.

25 The present invention aims to alleviate these various drawbacks of the prior art by proposing a system for producing a modular floating structure, temporary or not, of simple design and simple use, ensuring facilitated assembly of floating modules to one another to construct this floating structure, and without risk to the operatives, even if such assembly must be
30 carried out under unfavorable meteorological conditions.

Another object of the present invention is such a system allowing evolution in terms of the shape and/or the dimensions of the floating structure.

BRIEF DESCRIPTION OF THE INVENTION

To this end, the invention concerns a method for assembling at least
35 two floating units in order to produce a floating structure.

According to the invention, the following steps are performed:

a) a projectile placed at the end of a mooring line is launched from a first floating unit in the direction of means for receiving and retaining said projectile placed on a second floating unit,

5 b) said projectile being received in a non-destructive manner in said receiving-retaining means, said mooring line is positioned along or substantially along a traction axis of said second floating unit and traction is exerted on said mooring line from said first floating unit to move said second floating unit toward said first floating unit,

10 c) said first floating unit including at least one male and/or female coupling element placed on the external surface of its hull and said second floating unit including at least one female and/or male coupling element complementary to said male and/or female coupling element of said first floating unit, said at least one male and/or female coupling element of said
15 first unit and said at least one complementary coupling element of said second unit are coupled to immobilize degrees of freedom of movement between said floating units coupled in this way,

 d) the assembly comprising said first and second floating units is locked.

20 The projectile of the connection system can therefore be launched or projected from the first floating unit in order to couple this first floating unit with another floating unit without an operative needing to intervene on this second floating unit during this coupling phase. Once these two units have been coupled, the respective coupling elements cooperating to immobilize degrees
25 of freedom of movement between these floating units, the assembly formed in this way is stable, and the operative can then, if necessary, move on to the other floating unit to carry out maneuvers or operations there.

 By way of illustration only, those operations may aim to couple this assembly with a new floating unit or to fasten these floating units coupled in
30 this way to complementary fixing members such as bolts, anchor ring chains or other locking devices intended to be received in lugs or housings placed so that they can still be manipulated or accessed from the upper portion of the floating units.

 The present invention therefore advantageously makes it possible to
35 couple floating units placed at a distance from one another without risk to the

operative, the latter remaining on the first floating unit, or with no personnel on board, the operations being remote-controlled.

To this end, the projectile is received in the housing of receiving-retaining means of a floating unit after being launched or projected from another floating unit, and is retained therein without necessitating any step of manual assembly or fastening of this projectile in this housing.

Moreover, when the floating units are placed in the water, the various forces generated on these floating units by the water tend to move them relative to one another vertically and/or in rotation. The shape of the coupling elements advantageously makes it possible to immobilize these various movements, which could for example lead to a fault affecting the fixing members for fastening together the floating units coupled in this way or the mooring line that is tensioned to fasten them together.

In various particular embodiments of this method for producing a floating structure, each having its specific advantages and being open to numerous possible technical combinations:

- said at least one complementary female and/or male coupling element of said second floating unit is guided toward said at least one male and/or female coupling element of said first floating unit when moving said second unit toward said first floating unit.

By way of illustration only, this guiding can be achieved by the flared shape of a female coupling element and the complementary shape of the male coupling member.

- said means for receiving and retaining said projectile are placed on said or one of said complementary female and/or male coupling elements of said second floating unit,

- at least steps a) to d) are repeated with another floating unit to enlarge said floating structure, said other floating unit including means for receiving and retaining a projectile from said first floating unit or from said second floating unit, said projectile being placed at the end of a mooring line so that it can be launched from said first floating unit or from said second floating unit assembled in this way to said first floating unit and at least one female and/or male coupling element complementary to another male and/or female coupling element of said first floating unit or of second floating unit,

- the hull of at least one of said floating units including at least one watertight compartment defining a housing that can be at least partly flooded in which is placed a male coupling element fastened to a base able to float and said hull including an opening for the passage of said male coupling element, said watertight compartment is at least partly flooded so that said male coupling element moves from its stowed position in which it is entirely placed inside said compartment to its deployed position in which it is placed projecting from said hull to couple said floating unit with another floating unit including a complementary female coupling element,

- each receiving-retaining means includes an opening for the passage of said projectile, at least one wall including a face forming a stop for immobilizing the projectile when the latter, having passed through said opening, is placed in contact with said face forming a stop, said wall including a passage freeing at least a portion of the end of the mooring line connected to said projectile, said passage not allowing the passage of said projectile.

The present invention also concerns a system for implementing the method as described above of producing a floating structure including a first floating unit and at least one second floating unit intended to be assembled together to form said floating structure.

According to the invention,

- said first floating unit including a hull, it includes at least one system for connecting it to said second floating unit, said at least one connecting system including a projectile connected to a free end of a mooring line, and at least one male and/or female coupling element placed on said hull of said floating unit,

- said second floating unit includes at least one means for receiving and retaining at least said projectile from said first floating unit, said receiving-retaining means including an opening for the passage of said projectile, at least one wall including a face forming a stop to immobilize the projectile when the latter, having passes through said opening, is placed in contact with said face forming a stop, said wall including a passage freeing at least a portion of the end of the mooring line connected to said projectile, said passage not allowing the passage of said projectile, and a female and/or male coupling element complementary to said male and/or female coupling element of said first floating unit, said at least one complementary female and/or male

coupling element being separate from said projectile, so that said at least one male and/or female coupling element of said first floating unit engages and cooperates with the complementary female and/or male coupling element of said second floating unit when coupling said floating units to immobilize degrees of freedom of movement between said floating units coupled in this way.

In various specific embodiments of this system for producing a floating structure, each having its specific advantages and being open to numerous possible technical combinations:

- at least said first floating unit includes a first male and/or female coupling element at a first end of said first floating unit and at least one second male and/or female coupling element placed on the perimeter of said first floating unit at a location separate from said first end for coupling it with a third floating unit, said third floating unit including a female and/or male coupling element complementary to the second coupling element of the first floating unit so as to immobilize degrees of freedom of movement between said first and third floating units when coupling these floating units.

The first floating unit can then include a second connecting system including a projectile connected to a free end of a mooring line for connecting it to said third floating unit or means for receiving and retaining a projectile from said third floating unit, said receiving-retaining means including a housing for receiving said projectile, the shape of said projectile ensuring its placement in said housing in a non-destructive manner.

- the hull of at least said first floating unit including at least n faces where $n \geq 3$, at least one of said faces includes a male and/or female coupling element for coupling said first floating unit with a complementary female and/or male coupling element of another floating unit so as to couple said floating units and to immobilize degrees of freedom of movement between said floating units coupled in this way, and in that said first floating unit includes for each face of said hull including a male and/or female coupling element, a connecting system including a projectile connected to a free end of a mooring line for connecting it to the corresponding floating unit, or means for receiving and retaining a projectile from the corresponding floating unit, said at least one complementary female and/or male coupling element of said other floating unit being separate from said projectile,

- said projectile is a hollow or solid spherical body,

- said or each of said means for receiving and retaining said at least one projectile opens into the upper portion of said corresponding floating unit, said upper portion being placed opposite the lower portion of said floating unit intended to be at least partially immersed and providing the buoyancy of said floating unit.

Said or each of said means for receiving and retaining said at least one projectile preferably includes an orifice placed in the upper portion of said corresponding floating unit, said orifice being in communication with said housing placed inside said floating unit, said orifice being delimited over at least a portion of the latter by a wall having a funnel shape to guide said at least one projectile toward said housing.

This funnel can have any appropriate shape, such as pyramidal, conical or frustoconical. The upper end of this funnel is preferably flush with the upper surface, or deck, of the corresponding floating unit.

The passage advantageously leads on the one hand to the orifice placed in the upper portion of the corresponding floating unit and on the other hand to the perimeter of this corresponding floating unit, this passage being intended to receive a portion of said mooring line.

The lower end of this passage may be centered on a corresponding coupling element or on the face of said floating unit carrying said at least one corresponding coupling element.

This embodiment advantageously enables orientation of the mooring line and consequently movement of the floating units toward one another in a preferential direction.

- at least one of said floating units including means for receiving and retaining said projectile further includes means for diverting said projectile toward said receiving-retaining means, these diverting means being retractable between an inactive position and an active position in which they are placed projecting from the deck surface of said floating element.

These diverting means advantageously make it possible, when deployed, to intercept the launched or projected projectile and divert the latter toward the orifice of the receiving-retaining means.

By way of illustration only, these diverting means may be formed by a deck portion of the corresponding floating unit, which is raised and lowered by means of at least one remote-controlled actuator.

- 5 - said housing has a hollow cylindrical shape.

The internal surface of this housing may be smooth.

The receiving-retaining means may include a retractable partition for immobilizing the projectile in this housing. This partition may then include an opening for the passage of the mooring line that is connected to the projectile.

- 10 This partition may be moved in the orifice to close the housing by means of an actuator such as a cylinder.

- the mooring line or said or each of said connecting systems has its other end connected to a device for winding up or unwinding out said mooring line and passes through a coupling element of said floating unit, preferably at

15 the center of said element.

This winding in/paying out device advantageously makes it possible to tension the mooring line and to immobilize the floating units coupled together in this way, forming a rigid structure.

- 20 - at least one of said floating units including a connecting system includes a device for launching and/or a device for depositing said projectile.

It preferably includes in addition to the launching device an aiming device facilitating the launching or firing of the projectile by the operative toward the receiving-retaining means of another floating unit.

- 25 Alternatively, if this operative remote-controls the firing or the launching of the projectile, the launching device and/or the depositing device may be coupled to a video camera.

- 30 Said launching device and/or said depositing device are advantageously placed in the upper portion of said at least one of said floating units, said upper portion being placed opposite the lower portion of said floating unit intended to be at least partly immersed and providing the buoyancy of said floating unit.

- 35 - said male coupling element is prism-shaped with an isosceles triangle base, the lateral faces of this prism being rectangular or trapezoidal, the female coupling element having a complementary shape so that said elements fit together when coupled,

- at least one of said floating units includes a propulsion system of said floating structure, said propulsion system being attached or not.

Thus a propulsion system is preferably attached to at least one of the floating units, not initially provided with such propulsion means, which advantageously makes it possible not to require these floating units to be assembled in a particular order.

- at least some of the coupling members may have a geometrical shape that is variable in at least one of their dimensions, which could for example result from the combination of at least two distinct geometrical shapes.

By way of illustration only, the male coupling member could therefore be divided into two parts arranged along its longitudinal dimension, a first part placed at its free end and a second part fastened to the body of the corresponding floating unit.

This first part would have a shape ensuring guidance thereof in the complementary female coupling member, such as a conical shape. For its part, the second part would include a cylindrical body of smaller section and provided with at least two fins placed to project laterally from this cylindrical body in a horizontal (and/or vertical) plane.

The female coupling member complementary to this male member would also comprise two parts:

- * a first part receiving the male member including an opening delimited by two jaws mobile so as to be able to move away from each other during the passage of the first part, these jaws defining a funnel when they are in contact with each other, and

- * a second part forming a housing to receive and rigidly retain the first part of the male coupling member, such as a cavity having a shape complementary to that of the first part.

Once the first part of the male coupling member is engaged in this housing, there would then no longer be any obstacle to the jaws urged toward their initial position by compression springs closing onto the second part of the male coupling member, thereby trapping the first part of the male coupling member and also immobilizing pivoting of one floating unit relative to the other. Another alternative is for at least some floating units to be able to include on the same face two coupling members each intended to immobilize the movement of the ship in a given direction.

By way of illustration, one of these members could immobilize vertical movement of the floating units relative to one another while another coupling member would immobilize pivoting of these floating units.

- 5 - at least some of said floating units include a hydraulic and/or electric circuit including at least one connection port the end of which is placed at the level of the external hull surface of said corresponding floating unit, said port engaging end-to-end with a connection port of another floating unit when they are coupled to ensure the continuity of the hydraulic and/or electric circuit of
10 said units coupled in this way.

These connection ports may advantageously be configured so that the hydraulic and/or electric connection between two ports is established automatically on coupling the corresponding two floating units.

- said means for receiving and retaining said projectile are placed on
15 said or on one of said complementary female and/or male coupling elements of said second floating unit,

 - the hull of at least one of said floating units includes:

- * at least one watertight compartment defining a housing that can be at least partly flooded in which is placed a male coupling element fastened
20 to a base able to float,

 * an opening leading into said compartment for the passage of said male coupling element if said watertight compartment is at least partly flooded with water, and

 * means for at least partly flooding said compartment with water,

- 25 - at least one of said floating units has a shape different from the other floating unit or units.

The present invention also concerns a modular floating structure including at least two floating modules assembled together. In accordance with the invention, at least some of said floating modules are floating units of
30 the system as described above.

This floating structure, which may be temporary or permanent, can thus form a boat, a floating catwalk, a floating bridge or a floating platform for receiving installations.

The invention further concerns a floating unit including:

- 35 - at least one connecting system including a projectile connected to a free end of a mooring line, the shape of said projectile ensuring its placement

in means for receiving and retaining said projectile in a non-destructive manner,

- at least one means for receiving and retaining at least one projectile
5 from another floating unit, said receiving-retaining means including an opening for the passage of said projectile, at least one wall including a face forming a stop for immobilizing said projectile when the latter, having passed through said opening, is placed in contact with said face forming a stop, said wall including a passage freeing at least a portion of the end of the mooring line
10 connected to said projectile, said passage not allowing the passage of said projectile,

- at least one male and/or female coupling element placed on the hull of said floating unit,

- said at least one male and/or female coupling element being intended
15 to engage and cooperate with a complementary female and/or male coupling element of another floating unit when coupling said floating units to immobilize degrees of freedom of movement between said floating units coupled in this way.

The projectile is preferably a hollow or solid spherical body. This body
20 may be made of wood, plastic or metal.

Said or each of said means for receiving and retaining at least one projectile advantageously opens at a first of its end into the upper portion of the corresponding floating unit, said upper portion being placed opposite the lower portion of the floating unit intended to be at least partially immersed and
25 providing the buoyancy of said floating unit.

Accordingly, said at least one receiving-retaining means include an orifice placed in the upper portion of the floating unit, this orifice being in communication with said housing placed inside this floating unit, said orifice being delimited over at least a portion of the latter by a wall having a funnel
30 shape to guide said at least one projectile toward said housing.

Moreover, said at least one receiving-retaining means may include at least one groove, this groove leading on the one hand to this orifice placed in the upper portion of said floating unit and on the other hand to the perimeter of this floating unit, this groove being intended to receive a portion of the mooring
35 line of a connecting system of another floating unit.

The bottom of this groove is advantageously centered on a corresponding coupling member or on the face of said floating unit carrying said at least one corresponding coupling member.

- 5 In order to increase the efficacy of the coupling member described here, the latter is preferably centered on the faces intended to enable the coupling.

This floating unit preferably includes a parallelepipedal body having the dimensions of all or part of a 10-foot, 20-foot, 30-foot, 40-foot or 45-foot ISO shipping container, or any other dimension of a standard container defined by
10 the standards ISO 668 and ISO 1496-1 or any other reference system or standard used in multimode transportation by sea, river, road, rail or air, this body including arrangements for holding, manipulating and fixing said unit, each of said arrangements being placed at a corner of said body.

BRIEF DESCRIPTION OF THE DRAWINGS

- 15 Other advantages, objects and particular features of the present invention will emerge from the following description given by way of non-limiting explanation with reference to the appended drawings, in which:

- figure 1 represents diagrammatically a system for constructing a floating structure in accordance with a first embodiment of the invention, the projectile from the first floating unit being represented in different phases of its
20 movement toward the receiving-retaining means of the second floating unit,
- figure 2 is a partial view in longitudinal section of the system from figure 1 to a larger scale,
- figure 3 is a partial perspective view of the system from figure 1
25 showing the floating units in the process of being coupled, the projectile being represented in its final position in the housing of the receiving-retaining means of the second floating unit,
- figure 4 is a part-sectional elevation view of the system from figure 3,
- figure 5 is a partial plan view of the system from figure 1 showing the
30 floating units assembled,
- figure 6 shows diagrammatically a system in accordance with a second embodiment of the invention for constructing a floating structure, the projectile from the first floating unit being represented in different phases of its movement toward the receiving-retaining means of the second floating unit,
- 35 - figure 7 is a partial perspective view of the system from figure 6 showing the floating units in the process of being coupled, the projectile being

represented in its final position in the housing of the receiving-retaining means of the second floating unit,

- figure 8 is a partial view to a larger scale of the second floating unit of a system in accordance with a third embodiment of the invention for constructing a floating structure,
- figure 9 shows the projectile received in the housing of the receiving-retaining means of the second floating unit of the system from figure 8,
- figure 10 is a partial sectional view of a floating unit of a system in accordance with a fourth embodiment of the invention for constructing a floating structure, the male coupling element being in its rest position,
- figure 11 shows the male coupling element of the floating unit from figure 10 in its deployed position.

15 **DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION**

First, note that the figures are not to scale.

Figures 1 to 5 show a system in accordance with a preferred embodiment of the present invention for forming a modular boat.

This modular boat includes a first floating unit 10 and a second floating unit 11 each having the shape of a hexahedron defining a hollow body with six quadrilaterals. Here these bodies are made of steel.

The first floating unit 10 includes a male coupling member 12 placed at one of its ends. This male coupling member 12 has a prism shape with an isosceles triangle base, the lateral faces 13 of this prism being trapezoidal. Alternatively, these lateral faces 13 could be rectangular.

The second floating unit 11 includes a female coupling member 14 having a shape complementary to that of this male coupling member 12 so that these members 12, 14 fit together when they are coupled.

This particular shape of the coupling members 12, 14 of the units advantageously ensures progressive coupling of the floating units 10, 11 to each other to form the modular boat.

When these floating units 10, 11 are coupled, these coupling members 12, 14 moreover immobilize vertical movements and movements in rotation of the floating units relative to each other.

The first floating unit 10 also includes a weight 15 fastened to a sling 16 and placed at the free end of the latter. This sling 16 has its other end

connected to a winding in/playing out device 17, passing through the center 18 of the apex of the male coupling member 12, this member itself being centered on the rectangular front face of the body of the first floating unit 10.

5 This weight 15, which here is a hollow steel sphere, is advantageously sufficiently heavy not to be diverted from its trajectory by a weak puff of wind whilst being sufficiently light so that it can be launched by an operative placed on the first floating unit 10 at a distance from the second floating unit 11 in the direction of means 19 for receiving and retaining it.

10 By way of illustration only, and as a function of the strength of the operative, this weight 15 of approximately 1 kilogram may be launched by the operator to a distance of several meters, for example ten (10) meters, with very good accuracy.

 These receiving-retaining means 19 include an orifice 20 opening onto
15 the deck 21 of this second floating unit 11. This orifice 20 is in communication with a housing 22 placed in the body of this floating unit 11 so that the weight 15, once introduced into the orifice 20, falls by gravity into this housing 22.

 This orifice 20 is delimited in its upper portion by a wall having a funnel shape to guide the weight 15 toward the housing 22, the upper end of this
20 funnel being flush with the surface of the deck 21.

 These receiving-retaining means 19 also include a groove 23 opening on the one hand into this orifice 20 placed in the upper portion of the second floating unit 11 and the housing 22 and on the other hand onto the perimeter of this floating unit at the level of the central portion of the complementary
25 female coupling member 14.

 This groove 23 receives a portion of the sling 16 after positioning of the weight 15 in its housing 22 and advantageously make it possible when the floating units 10, 11 are moved toward each other by winding in the sling 16 onto the winding in/playing out device 17 to steer the coupling members 12,
30 14 toward each other.

 The housing 22 includes a cavity off-center relative to the orifice 20 enabling the weight 15 to be placed in a stable position when the sling 16 is tensioned and preventing this weight from escaping from its housing 22.

 At least one of these floating units 10, 11 advantageously includes a
35 propulsion system (not shown). This propulsion system may be attached to or form an integral part of the corresponding floating unit 10, 11.

Figures 6 and 7 show diagrammatically a system in accordance with a second embodiment of the invention for constructing a floating structure.

5 The elements from figures 6 and 7 bearing the same references as those from figures 1 to 5 represent the same objects, which are not described again hereinafter.

10 This system differs from that from figures 1 to 5 in that the second floating unit includes means for guiding the mooring line 16 toward the groove or passage 23 so as to ensure the positioning of this mooring line 16 along a preferential direction which is that of a traction axis of the second floating unit 11. These guide means take the form of oblique cut-outs 24 in the structure of the second floating unit 11 that converge toward said groove 23.

15 Figures 8 and 9 are partial views to a larger scale of the second floating unit of a system in accordance with a third embodiment of the invention for constructing a floating structure.

The elements from figures 8 and 9 bearing the same references as those from figures 1 to 5 represent the same objects, which are not described again hereinafter.

20 The second floating unit differs from that from figures 1 to 5 in that the means 19 for receiving-retaining the projectile 15 are provided directly on the complementary male coupling element or member of the second floating unit 11. To this end, this male coupling member is partly hollowed out so as to feature in its upper portion an opening 25 allowing the passage of the projectile 15 which becomes progressively smaller toward a passage or groove 26 so as to define a funnel enabling the projectile 15 to be trapped when that projectile is received in the bottom of this groove 26 and the mooring line 16 is tensioned. This groove 26 nevertheless has dimensions allowing the passage of this mooring line 16 to free it. The lower extremity of this groove 26 is centered on the corresponding coupling member.

30 This therefore optimizes the surface of the deck of the second floating unit 11, no space being lost to receive the receiving-retaining means 19.

Figures 10 and 11 are partial sectional views of a floating unit of a system in accordance with a fourth embodiment of the invention for constructing a floating structure.

The elements from figures 10 and 11 bearing the same references as those from figures 1 to 5 represent the same objects, which are not described again hereinafter.

5 The hull of the floating unit includes a watertight compartment 27 defining a housing that can be partly flooded in which is placed a male coupling element 28 fastened to a base 29 able to float. The hull also includes an opening 30 leading into said compartment 27 for the passage of said male
10 coupling element when this watertight compartment is at least partly flooded with water. The floating unit further includes means (not shown) for partly filling this compartment 27 with sea water 31. These compartment filling means may comprise a pump, the compartment preferably including a sensor controlling this pump so as to stop the flooding of the compartment as soon as
15 the water level has reached a particular threshold 32 set by the position of the sensor in this compartment 27. This level may be the waterline of the floating unit.

 The male coupling element 28 can therefore be deployed without human intervention. The base 29 able to float tilts this male coupling element 28 from its stowed position in which no part of the coupling element projects
20 out of the floating unit to a deployed position in which the male coupling element 28 is in position to be assembled with a female coupling element of a corresponding other floating unit in order to form a floating structure.

CLAIMS

1. A method for assembling at least two floating units in order to
5 produce a floating structure, characterized in that the following steps are performed:

a) a projectile (15) placed at the end of a mooring line (16) is launched from a first floating unit (10) in the direction of means (19) for receiving and retaining said projectile (15) placed on a second floating unit (11),

10 b) said projectile (15) being received in a non-destructive manner in said receiving-retaining means (19), said mooring line (16) is positioned along or substantially along a traction axis of said second floating unit (11) and traction is exerted on said mooring line (16) from said first floating unit (10) to move said second floating unit (11) toward said first floating unit (10),

15 c) said first floating unit (10) including at least one male and/or female coupling element (12) placed on the external surface of its hull and said second floating unit (11) including at least one female and/or male coupling element (14) complementary to said male and/or female coupling element (12) of said first floating unit (10), said at least one male and/or female
20 coupling element (12) of said first unit and said at least one complementary coupling element of said second unit are coupled to immobilize degrees of freedom of movement between said floating units (10, 11) coupled in this way,

d) the assembly comprising said first and second floating units (10, 11) is locked.

25 2. The method as claimed in claim 1, characterized in that said at least one complementary female and/or male coupling element (14) of said second floating unit (11) is guided toward said at least one male and/or female coupling element (12) of said first floating unit (10) when moving said second unit (11) toward said first floating unit (10).

30 3. The method as claimed in claim 2, characterized in that said means (19) for receiving and retaining said projectile (15) are placed on said or one of said complementary female and/or male coupling elements (14) of said second floating unit (11).

35 4. The method as claimed in any one of claims 1 to 3, characterized in that at least steps a) to d) are repeated with another floating unit to enlarge said floating structure, said other floating unit including means (19) for

receiving and retaining a projectile (15) from said first floating unit (10) or from said second floating unit (11), said projectile (15) being placed at the end of a mooring line (16) so that it can be launched from said first floating unit (10) or from said second floating unit (11) assembled in this way to said first floating unit (10) and at least one female and/or male coupling element complementary to another male and/or female coupling element of said first floating unit (10) or of second floating unit (11).

5. The method as claimed in any one of claims 1 to 4, characterized in that the hull of at least one of said floating units including at least one watertight compartment defining a housing that can be at least partly flooded in which is placed a male coupling element fastened to a base able to float and said hull including an opening for the passage of said male coupling element, said watertight compartment is at least partly flooded so that said male coupling element moves from its stowed position in which it is entirely placed inside said compartment to its deployed position in which it is placed projecting from said hull to couple said floating unit with another floating unit including a complementary female coupling element.

6. The method as claimed in any one of claims 1 to 5, characterized in that each receiving-retaining means (19) includes an opening for the passage of said projectile (15), at least one wall including a face forming a stop for immobilizing the projectile (15) when the latter, having passed through said opening, is placed in contact with said face forming a stop, said wall including a passage freeing at least a portion of the end of the mooring line (16) connected to said projectile (15), said passage not allowing the passage of said projectile (15).

7. A system for implementing the method as claimed in any one of claims 1 to 6 of producing a floating structure, including a first floating unit (10) and at least one second floating unit (11) intended to be assembled together to form said floating structure, characterized in that

- said first floating unit (10) including a hull, it includes at least one system for connecting it to said second floating unit (11), said at least one connecting system including a projectile (15) connected to a free end of a mooring line (16), and at least one male and/or female coupling element (12) placed on said hull of said floating unit,

- said second floating unit (11) includes at least one means (19) for receiving and retaining at least said projectile (15) from said first floating unit (10), said receiving-retaining means (19) including an opening for the passage of said projectile, at least one wall including a face forming a stop to immobilize the projectile when the latter, having passes through said opening, is placed in contact with said face forming a stop, said wall including a passage freeing at least a portion of the end of the mooring line (16) connected to said projectile (15), said passage not allowing the passage of said projectile (15), and a female and/or male coupling element (14) complementary to said male and/or female coupling element (12) of said first floating unit (10), said at least one complementary female and/or male coupling element being separate from said projectile (15), so that said at least one male and/or female coupling element (12) of said first floating unit (10) engages and cooperates with the complementary female and/or male coupling element (14) of said second floating unit (11) when coupling said floating units to immobilize degrees of freedom of movement between said floating units (10, 11) coupled in this way.

8. The system as claimed in claim 7, characterized in that the hull of at least said first floating unit (10) including at least n faces where $n \geq 3$, at least one of said faces includes a male and/or female coupling element (12) for coupling said first floating unit (10) with a complementary female and/or male coupling element (14) of another floating unit so as to couple said floating units and to immobilize degrees of freedom of movement between said floating units coupled in this way, and in that said first floating unit (10) includes for each face of said hull including a male and/or female coupling element, a connecting system including a projectile (15) connected to a free end of a mooring line (16) for connecting it to the corresponding floating unit, or means (19) for receiving and retaining a projectile (15) from the corresponding floating unit, said at least one complementary female and/or male coupling element (14) of said other floating unit being separate from said projectile (15).

9. The system as claimed in either one of claims 7 or 8, characterized in that said or each of said means (19) for receiving and retaining said at least one projectile (15) opens into the upper portion of said corresponding floating unit, said upper portion being placed opposite the lower portion of said floating

unit intended to be at least partially immersed and providing the buoyancy of said floating unit.

10. The system as claimed in claim 9, characterized in that said or each
5 of said means (19) for receiving and retaining said at least one projectile (15) includes an orifice (20) placed in the upper portion of said corresponding floating unit, said orifice (20) being in communication with said housing (22) placed inside said floating unit, said orifice being delimited over at least a
10 portion of the latter by a wall having a funnel shape to guide said at least one projectile (15) toward said housing (22).

11. The system as claimed in claim 10, characterized in that said
passage (23) leads on the one hand to said orifice (20) placed in the upper
portion of said corresponding floating unit and on the other hand to the
perimeter of said corresponding floating unit, said passage (23) being
15 intended to receive a portion of said mooring line (16).

12. The system as claimed in claim 11, characterized in that the lower
end of said passage (23) is centered on a corresponding coupling element or
on the face of said floating unit carrying said at least one corresponding
coupling element.

20 13. The system as claimed in any one of claims 9 to 12, characterized
in that at least one of said floating units including means (19) for receiving and
retaining said projectile (15) further includes means for diverting said projectile
(15) toward said receiving-retaining means (19), said diverting means being
retractable between an inactive position and an active position in which they
25 are placed projecting from the deck surface of said floating element.

14. The system as claimed in any one of claims 7 to 13, characterized
in that the mooring line (16) or said or each of said connecting systems has its
other end connected to a device for winding up or unwinding out said mooring
line (16) and passes through a coupling element of said floating unit,
30 preferably at the center of said element.

15. The system as claimed in any one of claims 7 to 14, characterized
in that at least one of said floating units including a connecting system
includes a device for launching and/or a device for depositing said projectile
(15).

35 16. The system as claimed in any one of claims 7 to 15, characterized
in that said male coupling element (12) is prism-shaped with an isosceles

triangle base, the lateral faces of this prism being rectangular or trapezoidal, the female coupling element having a complementary shape so that said elements fit together when coupled.

5 17. The system as claimed in any one of claims 7 to 16, characterized in that at least some of said floating units include a hydraulic and/or electric circuit including at least one connection port the end of which is placed at the level of the external hull surface of said corresponding floating unit, said port engaging end-to-end with a connection port of another floating unit when they
10 are coupled to ensure the continuity of the hydraulic and/or electric circuit of said units coupled in this way.

 18. The system as claimed in any one of claims 7 to 17, characterized in that said means (19) for receiving and retaining said projectile (15) are placed on said or on one of said complementary female and/or male coupling
15 elements of said second floating unit (11).

 19. The system as claimed in any one of claims 7 to 18, characterized in that the hull of at least one of said floating units includes:

- at least one watertight compartment defining a housing that can be at least partly flooded in which is placed a male coupling element fastened to a
20 base able to float,

- an opening leading into said compartment for the passage of said male coupling element if said watertight compartment is at least partly flooded with water, and

- means for at least partly flooding said compartment with water.

25 20. A modular floating structure including at least two floating modules assembled together, characterized in that at least some of said floating modules are floating units of the system as claimed in any one of claims 1 to 19.

 21. A floating unit for the system as claimed in any one of claims 1 to
30 19 including:

- at least one connecting system including a projectile (15) connected to a free end of a mooring line (16), the shape of said projectile (15) ensuring its placement in means (19) for receiving and retaining said projectile (15) in a non-destructive manner,

35 - at least one means (19) for receiving and retaining at least one projectile (15) from another floating unit, said receiving-retaining means (19)

including an opening for the passage of said projectile, at least one wall including a face forming a stop for immobilizing said projectile (15) when the latter, having passed through said opening, is placed in contact with said face
 5 forming a stop, said wall including a passage freeing at least a portion of the end of the mooring line (16) connected to said projectile (15), said passage not allowing the passage of said projectile (15),

- at least one male and/or female coupling element (12) placed on the hull of said floating unit,

10 - said at least one male and/or female coupling element (12) being intended to engage and cooperate with a complementary female and/or male coupling element (14) of another floating unit when coupling said floating units to immobilize degrees of freedom of movement between said floating units coupled in this way.

15 22. The floating unit as claimed in claim 21, characterized in that said unit includes a parallelepipedal body having the dimensions of all or part of an ISO container, said body including arrangements for holding, manipulating and fixing said unit, each of said arrangements being placed at a corner of said body.