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(54) **SET OF ELEMENTS AND PARTS FOR THE ASSEMBLY, EXTENSION AND RAPID MODULAR CONVERSION OF VESSELS, RAFTS, FLOATING GANGWAYS AND BRIDGES AND TEMPORARY FLOATING STRUCTURES WITH MULTIPLE FLOATS, IN PARTICULAR FOR AQUATIC EMERGENCIES**

BAUSATZ UND BAUTEILE FÜR DIE ZUSAMMENSETZUNG, ERWEITERUNG UND SCHNELLE MODULARE UMWANDLUNG VON SCHIFFEN, FLÖSSEN, SCHWIMMENDEN DURCHGÄNGEN UND BRÜCKEN SOWIE TEMPORÄREN SCHWIMMENDEN STRUKTUREN MIT MEHREREN SCHWIMMERN, INSBESONDERE FÜR NOTFÄLLE IN GEWÄSSERN

ENSEMBLE D'ÉLÉMENTS ET DE PIÈCES POUR LE MONTAGE, L'AGRANDISSEMENT ET LA RECONVERSION MODULAIRE RAPIDE ET RÉVERSIBLE D'EMBARCATIONS, DE RADEAUX, DE PASSERELLES, DE PONTS FLOTTANTS ET DE STRUCTURES FLOTTANTES PROVISOIRES COMPRENANT PLUSIEURS FLOTTEURS, PARTICULIÈREMENT POUR DES URGENCES DANS UN ENVIRONNEMENT AQUATIQUE

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(56) References cited:

EP-A1- 0 279 740	WO-A2-2007/036310
DE-U1- 29 702 620	ES-U- 1 063 665
ES-U- 1 064 408	ES-U- 1 064 408
ES-U- 1 065 789	ES-U- 1 066 432
US-A- 4 856 446	US-A- 4 919 632
US-A1- 2009 084 303	US-B1- 6 948 443

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Description

SCOPE OF THE INVENTION

[0001] The present invention belongs to the field of small or medium detachable watercrafts composed of at least two parallel floats, arranged all of them in mutual lateral contact or having at least a gap between two of them, being these floats joined perpendicularly to at least two crossbars.

BACKGROUND OF THE INVENTION

[0002] The Utility Model ES1064408U, also European Patent Application EP20070822879, describes a set of parts and structural components for modular construction of custom small watercrafts with multiple floats, mainly for recreational and leisure purposes, which take the form of small removable pedal boats whose number of floats and seats can be increased laterally by repeated addition of the same modular structural units. The invention is characterized in that each passenger is placed on a seat, which is always placed between each pair of adjacent floats and rests over two longitudinal bars bent into U shape, which in turn are simultaneously coupled and fixed through their respective longer central straight longitudinal segments to the crossbars, and at the same time through their respective twin shorter transverse ends to the main floats. Therefore it consists of three main structural parts: crossbars, floats and U-shaped longitudinal bars. Because of its simplicity, this structure is good for obtaining an expandable main frame for a watercraft to accommodate a higher or lower number of passengers depending on the need or circumstances, until reaching a limit because practical and technical reasons, being usually the suitable number of passengers of one of two if such watercrafts are manufactured in small size for enhancing portability. This expandable main frame is easy and quick to assemble, disassemble and reconfigure, and has an increased structural strength with respect to the case where there is only a coupling between floats and crossbars, due to the fact that such three parts are mutually joined by three types of screws in a intercrossed triple coupling. It also allows assembling of short pontoons.

[0003] However, it lacks of enough structural strength to join with this same simple assembly system larger watercrafts or larger floating structures, especially for professional purposes, being this invention limited to small recreational watercrafts for use only in flat waters with human-powered or underpowered mechanical propulsion systems for giving a very low speed. This is because all U-shaped longitudinal bars are not joined between them by intermediate pieces. They can touch mutually sideward between them by their transverse ends when they share a float in multi-seated watercrafts, but they can not touch mutually sideward between them by their longer middle longitudinal straight segments for opposing to compression or shearing. So the single pieces which oppose to structural distortions and impedes structural collapse are the mounting screws.

[0004] This main frame structure is characterized by an intertwined coupling of three main structural pieces in three stacked horizontal parallel layers, that is, floats down, crossbars in middle, and U-shaped longitudinal bars above. If these U-shaped longitudinal bars could be joined among them by an additional piece to add, the main frame structure obtained would have more cooperating fastening elements to be added to the mounting screws to endure better distortions, breakages and collapses of the structure. With some additional anchoring elements with which join rigidly the U-shaped longitudinal bars on the same plane parallel to the horizontal plane of the crossbars, it would be more difficult the collapse of the assembled structure because many reasons: continuous deformation by water movements, accumulated metal fatigue, corrosion, load excess, excessive wear, hits, among many others. So this type of improved structure could be applied to larger, longer, wider, tougher detachable watercrafts, or for use in harder waters, being resistant but at the same time detachable, and therefore it may lead to some new designs of transportable, modular, customizable and expandable watercrafts.

BRIEF DESCRIPTION OF THE INVENTION

[0005] The invention as claimed is characterized by a main frame which is detachable, modular and expandable through a series of attachable and removable structural groups, equal to each other in the most of the cases, which are repeated in the direction of the crossbars and are joined to them. Such detachable main frame has a length or width which can be chosen depending on the type and size of the structure to assemble, well by selecting crossbars of the correct length, well by coupling in series several crossbars until completing the desired length. Such length of crossbars can be relatively short for assembling catamarans, boats or rafts, or relatively long for assembling large or long structures like floating pontoon bridges, barges or floating platforms. In these structures the floats, according to their anchoring positions to the crossbars, can be placed all of them together in mutual side contact (continuous segmented hull) or leaving gaps between two adjacent of them while there are free positions along the length of the crossbars (pontoons, catamarans). Each structural module added increases the floating structure in direction of the crossbars, each structural module removed makes the contrary. Such addition or removal of modules increases or decreases along this direction simultaneously the length or width of the structure, the accessible surface of the top platform, the buoyancy, the cargo capacity, as well as the number of repeated coupling positions and locking devices, so that the structural strength will increase as modules are added to the assembly or to the contrary, or at least it will partly compensate its decrease when length increases. The structures, totally or partially assembled, may not only be linear, but also horizontally and vertically branched thanks to branched linking pieces, rigid, foldable, articulated by intermediate hinges between rigid sections, fully flexible through cables that join the different detached modules, as well as the structures can be wound or unwound around reel middle pieces for shaping a chain of floats that can be transported rolling on ground or over soil.

[0006] Each modular structural group comprises at least a float on which two twin U-shaped longitudinal bars are coupled, which are attached slightly above the same, symmetrically on both sides of the vertical longitudinal plane of symmetry passing through the center of the float, touching them mutually by their transverse ends that reach to this same plane of symmetry, forming both two an horizontally elongated rectangular frame whose longer side is in the same direction than the float on which is coupled, and on which in turn a rectangular horizontal platform or plate can be attached, adjusting and fitting exactly over the external or internal perimeter of such rectangular frame in order to obtain a walking expandable surface section where to stand, to walk and to place objects justly above this same float. Below the horizontal plane defined by these two U-shaped longitudinal bars, on top of the float, at least two twin transverse grooves are practiced in the same horizontal plane, in a way that they traverse completely the float perpendicularly. Its cross section coincides exactly with the cross section of the crossbars, fact which gives to each crossbar capacity of introduction, perfect coupling without clearance, relative sliding and subsequent screwing in the desired position within each one of such transverse grooves. Thus, two or more of these crossbars of equal length, each one positioned inside one of these transverse grooves, are in contact with no clearances with these transverse grooves of the floats by bottom and side sides and with the longitudinal U-shaped bars by the top side, whether if such grooves are only from the same float or from several or many equal floats arranged in parallel with all of their grooves also mutually aligned. With this arrangement, the crossbars are always sandwiched between the top U-shaped longitudinal bars and the floats below with a triple interlocking, so that the displacement of each crossbar is limited to a single direction coincident with the symmetry axis of its respective transverse groove where it is placed, until such crossbar is screwed up and locked in the desired transverse position.

[0007] Each one of these three main structural elements is attached and locked to one from the other different two ones by a set of screws, so that by having a total of three different sets of mounting screws, the larger number of these ones is distributed through the structure and can drain loads and distortions that the structure can suffer in a more efficient way. Furthermore, since to extract and to release from the assembly one of the three types of said main elements (crossbars, floats or U-shaped longitudinal bars) joined to the other two it is necessary to completely remove two of the three sets of screws, it is difficult that the structure can accidentally break or being dismantled except by clear negligence, wrong assembly or by choice. If the two twin U-shaped longitudinal bars are mutually joined over its corresponding float, the transverse grooves of such same float are in practice holes due to be inaccessible from above, so that on this structural module with coupled U-shaped longitudinal bars a crossbar only can be attached by inserting it by one of their ends coaxially to the transverse groove and sliding it in the same direction until desired position for fixing with screws. Conversely, by removing the two twin U-shaped longitudinal bars from a float, the transverse grooves are accessible from above, so it is possible to couple this float at any free position in a crossbar, both in intermediate as in terminal positions, and then coupling the two U-shaped longitudinal bars over them.

[0008] This arrangement improves and reinforces the structure markedly. In first, in the different structures the U-shaped longitudinal bars from two adjacent modules with floats can be arranged in mutual touch and can support to each other by their central longer longitudinal segments, thereby alleviating from the mounting screws many of the distortion moves, efforts and burdens as a result of compression strokes in the direction of the crossbars. Second, by adding joining and linking elements which join each two twin U-shaped longitudinal bars from the same float and / or from adjacent floats in touch, all U-shaped longitudinal bars, with their respective docked platform or plates, remain in the same horizontal plane with extreme stiffening, docked and screwed also to the crossbars, all of them in the same parallel plane, and to the floats, in an expandable sandwiched structure for a strong expandable main frame for assembly of expandable custom watercrafts and floating structures. Such joining and linking elements are two twin small transverse bars for joining in a whole each two twin U-shaped longitudinal bars attached to the same float, and several hinges and bolts for joining two adjacent U-shaped longitudinal bars from adjacent floats also in a whole, but allowing their mutual folding if no crossbars are threaded crossing the transverse grooves of the involved floats. With these two new elements reinforcing the expandable main frame, all constructible structures are strengthened against shear movements which are perpendicular to the crossbars, traction movements in the direction of the crossbars, torque movements also according to an axis parallel to the crossbars, and bending movements of the crossbars.

[0009] To allow that the U-shaped longitudinal bars from those floating modules which are adjacent in the float arrangements can be in touch by their central longer longitudinal straight segments once screwed to the crossbars, the lengths of all the involved parts (crossbars, floats and U-shaped longitudinal bars) in the direction of the crossbars must be divided into sections of a same standardized length both for coupling and for spacing, so lengths of all elements in this direction are always a multiplier equal or greater than the unit of a certain length which is chosen and taken as the most optimized suitable unitary length by practical and technical reasons. This unit length is matched to the transverse separation distance between the two outer edges of the two twin U-shaped longitudinal bars engaged to the same float. Thus, two different rectangular frames shaped from two different pairs of twin U-shaped longitudinal bars docked over a float each, can be in mutual touch each other when screwed into adjacent screwing positions, and do not touch each other if one or more gaps between them are left. As the different pieces and elements must have always a length measured in the direction of the crossbars that is a multiplier equal or greater than the value of this unitary chosen length, addition or removal of the modular pieces along the crossbars increases or decreases, also in a modular way by incremental units, length and / or width of the structures, platform surface, buoyancy, cargo capacity, total number of possible docking positions for floats, and number of anchoring and locking mechanisms available. This chosen unit length is called hereafter as "segment".

[0010] "Segment" (a single one) also may refer in the text to the minimum possible increment or decrement in either of these properties in mounting or dismantling of structures, but it is mainly referred to the length measured in the direction of the crossbars, as such properties are obviously proportional to the length in the direction of the crossbars. "x segments" is then a number of x times this minimum increment or decrement in all of these properties cited. Obviously, a "segment" is also the minimum transverse distance separation posible between the two outer edges of the two twin U-shaped longitudinal bars engaged to a same float, being the length of this "segment" and of this float in this same direction the most suitable optimal for handling, assembling, storing and transporting operations, that is, not too big but also not too small.

[0011] It is obviously necessary that over each of the parts and pieces from the set of pieces in their same relative spatial orientation for coupling to the crossbars and in the same direction, all the coupling, anchoring and locking devices must be repeated in this direction on each segment periodically, independently of the size of the piece or its dimension measured in the same direction that the crossbars. By this way each segment from the crossbars can be occupied by a docking piece or be left free, and also such segment can be screwed to such docking piece, so standardization in segments is applied on lengths and on locking and coupling elements. So pieces of different lengths / widths can be coupled and screwed segment by segment, even if there are free gaps. Therefore, distributions of all anchoring and locking mechanisms on each one of the parts and pieces from the set are symmetrical with respect to a vertical longitudinal plane of symmetry passing through the center of each respective part and perpendicular to the axis of the each one of the crossbars, as well as they are also symmetrical with respect to a vertical longitudinal plane of symmetry passing through the center of each separate unitary distribution segment of all anchoring and locking mechanisms on each one of the parts. That allows to some parts to be coupled in left or right positions indifferently, and to use them in interchangeably way on left and right sides.

[0012] After standardizing the dimensions of the parts and pieces and the distribution of coupling and locking devices in the same relative direction than the crossbars in the assemblies, to the set of pieces two twin small transverse bars for each float are added, which have an outer cross-section that is the same that the inner cross-section of the metal tube the U-shaped longitudinal bars is made from. Such small twin transverse bars have a length that is equal or, for practical reasons, slightly less than twice the length of one of the two twin shorter transverse arms from an U-shaped longitudinal bar for coupling to the float, and therefore they have a standardized value in length slightly smaller than a positive integer number of segments. Thanks to its outer cross-section, each one can be introduced without space or clearance inside the tubular ends of any U-shaped longitudinal bar, standing symmetrically between each pair mutually coupled of them, which is in turn coupled to the same float. The twin transverse bars act as a linking piece between each two coupled U-shaped longitudinal bars in a whole in the form of a rectangular frame, as the screws that cross and fix the U-shaped longitudinal bars to the float are used also for crossing and fixing each transverse bar inside its coupled pair of U-shaped longitudinal bars and then both to the float.

[0013] Each two of these twin transverse bars held together each two paired U-shaped longitudinal bars as two joined halves of a rectangular horizontal frame, which can be removed from the float where it is coupled by loosening the fixing screws, but this rectangular frame still remain in a single whole, with its composing U-shaped longitudinal bars still joined by the same fixing screws which are not completely removed and still cross both these pieces and the inner twin transverse bars. This feature was not possible before due to the lack of any joining element between the twin coupled U-shaped longitudinal bars (with exception of the float when joined to it). In addition, this assembly is structurally much stronger than a simple rectangular frame made of a single tube bent and welded, despite of having two separable parts. This is because such transverse bars may be solid or made in tube of thick wall, giving to the corners and short sides of the rectangular frame much more resistance to bending or breaking in any direction horizontal or vertical, to strokes, to excessive weights or excessive compressions in the direction of the crossbars and transverse bars. In lack of these transverse bars such rectangular frame, split into two halves, could finish with breakage of fixing screws and U-shaped longitudinal bars released from the assembly or partially out from their coupling positions and out from their common horizontal plane, being mounted one above the other and collapsing the structure. The transverse bars aid to transmit and distribute effectively the compressive stress applied in the direction of the crossbars among all different structural modules in the assembly, freeing the screws of part of this duty. Furthermore, two twin transverse bars allow to each coupled twin U-shaped longitudinal bars to be assembled as a rectangular frame without necessarily having a float below, allowing to complete continuous platforms on long structures with floats spaced with gaps between them as floating pontoon bridges.

[0014] Once achieved the strengthening of the composing parts of each independent structural module, now composed each by a float, two twin U-shaped longitudinal bars, two twin small transverse bars, and usually a rectangular top platform, we are to proceed to add a second refinement enabling the strong coplanar binding, in turn, of two U-shaped longitudinal bars belonging to two adjacent different structural modules (with different floats) which are in mutual contact by their middle longitudinal longer straight sections in lateral contact and screwed to the crossbars. Such second refinement achieves further to immobilize the structural modules between each other and on a same plane parallel to the crossbars.

[0015] This improvement is a series of longitudinal hinges, in the form of straight metal coaxial tubes, welded, screwed or bolted, which are positioned slightly above the outer edge of the central longer longitudinal linear section of each U-shaped longitudinal bar, in a way that these tubes are placed consecutively aligned in assembly position but they belong alternately to each one of the two U-shaped longitudinal bars to link together. This allows, by introducing a robust pin or bolt inside of the aligned series of aligned coaxial tubes, to strengthen the structure as well as to add hinges between two adjacent U-shaped longitudinal bars and two adjacent structural modules in touch for mutual folding in case that no crossbars are inserted crossing inside the transverse grooves of the floats.

[0016] On one hand, the addition of these longitudinal hinges allows that the structural modules of all the set of pieces and parts are not only removable, but also foldable as a choice, so that besides the option of storage, transport and assembly of them by detached pieces or separate modules, there is the additional option of building more or less long chains of structural modules previously longitudinal linked by hinges, and preserved and transported folded, bent or wound around reel pieces for further unrolling and unfolding operations in deployment and structure strengthening by coupling and screwing of the crossbars to the deployed structure, whether if they are short chains (boats) as if they are long chains (rafts or floating walkways sections).

[0017] This is particularly interesting not only for building folding watercrafts that can fit in the width of a vehicle box of normal dimensions (such as a van, an ATV or a small truck), but also for not to be dependent of the use of a trailer, especially in cases of cut paths, ravines or rough roads to overcome in distress call situation. Also for quick and easy deployment of a floating pontoon walkway or bridge, so that if this large and heavy structure is preassembled in a compact provisional wound assembly, being all structural modules provisionally linked by their hinges, the whole bridge can be transported rolling on ground or soil to the deployment point on the shore, and the bridge is deployed to the opposite shore by unwinding and unfolding in a faster, safer and easier way than if assembling it piece by piece, especially if the water is turbulent and the stream can easily drag pieces or the own crew.

[0018] Moreover, such a system of longitudinal hinges is an additional strengthening device for the structure on the same plane when they are bolted with pins, which act in cooperation with the crossbars once they are placed. It is also safer and more versatile than the use of locks, latches or hooks, which in addition to not providing the above advantage of the ability of folding, as they can have hooked shapes, projections or spikes that can be released, loosen or broken, losing their effectiveness, and they can hurt hands and fingers during hasty fast assembly and transport steps or become hooked with objects at inopportune times. In comparison, the strength and toughness of such longitudinal hinges is greater the greater the thickness and length of their tubes are, as well as their hinge pins, and they have smoothed and rounded shapes with no burrs which are safer for handling and assembly.

[0019] This detachable expandable main frame, which can be enlarged by adding successively structural modules especially reinforced, constitutes the core of the invention, which allows build a very broad range of floating structures, either for watercrafts or pontoon bridges, among many others. To this invention, along herein, successively a number of additional parts and pieces are added, which are going perfecting, completing, expanding or specializing functions of the elements previously described and claimed in succession, for the reasons explained later, pointing the objective of the invention. The invention does not include propulsion or steering control systems, of which it is assumed outboard motors will be responsible for, as well as oars or paddles, but it incorporates elements for nailing or for pinning to anchor the structure to the soil below water, elements to tow by other watercrafts, or elements to pull the assemblies throughout guide cables.

[0020] The various types of assemblies and structures, both foldable and removable, which in principle can be built with this invention include these structures with detachable sectional hulls composed of parallel floats:

- Watercrafts having floats arranged both with gaps (pontoons) and with no gaps (continuous hull).
- Watercrafts having continuous hull equipped with a detachable front prow.
- Rafts having floats arranged both with gaps (pon-

toons) and with no gaps (continuous hull).

- Long linear barges.
- Nonlinear barges or floating platforms which are diamond in shape or arrowhead in shape.
- Linear and branched floating platforms having floats arranged both with gaps and with no gaps.
- Watercrafts and rafts having high secondary platform or deck or more (floating scaffolding).
- Floating pontoon walkways / bridges to access to different levels (shores, slopes, uneven terrains).
- Rigid floating pontoon walkways / bridges.
- Articulated floating pontoon walkways / bridges with rigid sections linked by hinges.
- Flexible floating pontoon walkways / bridges with modules or rigid sections linked by cables.
- Rigid floating pontoon walkways / bridges of average compaction (accordion-folded).
- Rigid floating pontoon walkways / bridges of average compaction (wound).
- Rigid floating pontoon walkways / bridges of high compaction (wound and accordion-folded).
- Large wheels for transportation of large wound and wound-accordion-folded structures.
- Large brackets for standing on ground of large wound and wound-accordion-folded structures.
- Rigid floating pontoon walkways / bridges having fix rigid angle between floats and crossbars.
- Short rigid floating pontoon walkways / bridges with rotatory bottom floats (limited rotation range).
- Long rigid floating pontoon walkways / bridges with rotatory bottom floats (full rotation range).
- Capsizing-proof rafts or which are resistant to capsizing by lack of default vertical direction.
- Oblique rafts having oblique floats in relation to the crossbars for crossing rivers and strong water streams by using the same water flow drag force for propelling the craft in the desired direction with no motors, no physical effort.
- Tsunami emergency capsules having peripheral detachable prismatic hull.
- Emergency rotating capsules having peripheral detachable prismatic hull for crossing rivers and strong water streams by using the same water flow drag force for propelling the capsule in the desired direction with no motors, no physical effort.

OBJECTIVE OF THE INVENTION

[0021] There are many previous inventions describing both detachable watercrafts and detachable pontoon bridges.

[0022] In first case they usually have detachable floats in hydrodynamic shape mounted around a resistant strong detachable main frame, while in second case they usually have pneumatic inflatable floats or box-shaped plastic floats that allow to build pontoon floating bridges of high traffic, people transit or cargo capacities by maximizing buoyancy, which are joined in a flexible or rigid arrangement, depending on its assembly mechanism. The shape and characteristics of these floats on each case is different and appropriate or fully optimized for their specific function in a watercraft or in a pontoon bridge, maximizing hydrodynamics or buoyancy. So it seems pointless to pretend to build different types of structures and assemblies very different in function, either a watercraft or a pontoon walkway, by using the same floats and other types of structural parts, since none of these parts, in their shapes and characteristics, will be fully specialized and fully optimized in a particular function to give full performance or excellent behavior for its pretended purpose, but rather discreet when having to average performance and behavior characteristics to each one and every one of the types of structures to assemble.

[0023] However, there is a specific type of application in which this purpose has all the logical sense, practical and economical, which is quick, fast response to water emergencies such as flash, massive, huge, extensive floods. In these cases flood fighter crews have to make a strong logistical effort for transporting as fast as possible a certain number of strong, reliable but heavy, bulky watercrafts (Rigid Inflatable Boats) using ground or aerial vehicles, usually limited because the budget, lack of time or lack of storing and parking spaces at the headquarters. They may also find difficult terrains and soils, cuts in paths or roads, land obstacles or ravines to overcome, as well they may have little time for gathering of good information if no forecasts were made in time or the event has happened by surprise. If they do not know the situation well because lack of data or there are no informers in the place, they also do not know what kind of assemblies or devices will be required once they reach to the flooding site. And they do not know if over time it will be necessary to change strategies because changing conditions or shortage, lack, or unavailability of necessary means despite all transported materials and equipment. In these cases it may be fully appropriate to have something based on the same structural elements which allow assembling different devices easily for different functions and purposes, starting from the same structural modules transported, for easy change between different watercrafts and other different devices as may be floating pontoon bridges or capsules depending on the needs in real time.

[0024] When a strong emergency condition because hard flooding happens (flash, intense, widespread, extensive, massive), people resorts to special corps inside the army for these purposes, which have the materials, equipment, training and adequate enough logistical and deployment capacity to make a response proportional to the intensity of the flooding event, but unfortunately its response time is always delayed and the army can take hours or one day to get to the flooding place, so if the episode has been particularly sudden and there has been no prior warning or forecasts, the army arrives when everything has already happened, and all it can do is to seek and to rescue missing, stranded persons and to rebuild infrastructures.

[0025] In the waiting time, many people may have died because drowning, hypothermia or trauma. Only in certain cases, such as rivers overflows, floods can be predicted well in advance, but often can not predict the exact geographic area where the army presence will be required in advance. As in most cases of sudden, flash water emergency, the response time is only a few hours or even several minutes, the only skilled crew found near the scene, with the preparation, training and proper equipment, are fire fighter and flood fighter crews and civil protection corps, whose budget and logistic, transport and deployment capabilities are smaller than the army, but arriving from different points, places and towns nearby to the flooding scene they can unite and coordinate among them for giving a proportional response if they may have or gather reliable tools for flood fighting.

[0026] These corps, as the army, usually have for their actions in flood fighting R.I.B.s (Rigid Inflatable Boats), commonly named by the well-known brand name Zodiac. These boats are designed in such a quality and performance that has not been improved substantially since its invention and have demonstrated its full practical utility for decades. The only problem is that they are precisely boats, and they can only be used as boats. They can not change its own shape or size, they can not be transformed into something else, they can not be divided into detached parts to partition the size or weight to transport and carry, and they can not be divided or split to be in more than a single place at a time. If it is necessary to have another assembly or device different from a boat, like a floating pontoon bridge, it is necessary to wait to arrival of the army, or to make multiple trips with the available rescue boats until rescue of all the people, spending more time and taking on more risk to crews, or to use handmade, improvised devices as hand ladders. The inflatable boats are very compactable and very portable, but they need an air compressor for fast inflation, or they must be transported inflated draining big space from transport vehicles, and they may be not suitable for use in shallow draft areas having strong water stream where they can finish being ripped, punctured by sharp or pointed submerged objects as those that can be found in natural and urban places.

[0027] No matter how good is a boat in water, if such boat is not on time where it is needed and when it is needed, it is useless for its rescue purpose. It would have therefore a best role another kind of boat that even having worst performance in water it may arrive on time overcoming distances by land faster. Each R.I.B. needs a trailer for transportation on land, and therefore a vehicle for each trailer and R.I.B. to transport and to deploy. Due to its length and width, typically they do not fit within the boxes and trunks of standard vehicles such as small trucks, ATVs or vans and can not be lifted to and be lowered from car roof racks by muscle. The trailer is an element that reduces speed, maneuverability and stability on road and on cross-country, and it can make difficult to enter and to pass through narrow, close country access roads, and they can not overcome ravines or road cuts, so sometimes they have to make a long detour that means wasted time. Also the trailer needs access to get close or get into the water to release the boat by human strength or by a cable and a crank, and this good deployment point may be hard to find or to reach sometimes.

[0028] If these boats were detachable to split their size and weight in separate parts, smaller vehicles could transport it faster to the deployment point, or in case of a road cut or land obstacle, several people could carry it by hand to save time through the shortest path to the water even though the terrain would be difficult, which may be quite normal for a flood situation. In addition to R.I.B.s, if it were available a set of elements and pieces as described herein, in these flood events it would be possible to achieve these practical advantages:

- Vans, small trucks and vehicles of usual normal length can transport a single or several folded or detached watercrafts inside, stacked in two or more layers, as well as over the car roof rack if convenient, as such detached parts or folded structural modules allow a better exploitation of vehicle spaces. Therefore, each vehicle can carry more than a single boat or equivalent parts with no need of a trailer, so carry more boats, more equipment in less time and with greater safety in displacement.
- If once at the deployment place it is necessary at some point to build a different structure than a watercraft, it is possible to make this from detached parts and modules not assembled in structures, or by dismantling assembled boats if they are not needed or if they are in excess, and vice versa.
- All assemblies and structures, including the larger and the successively more specialized ones, use the most of the same parts and pieces that the simpler structures use, so it is needed to carry or to order for delivery only these additional necessary parts, not a whole structure or complete device.
- The pieces from several crews can come together to build jointly more or larger, more specialized or more complex structures. In turn, large sets of pieces can be split and scattered across multiple places, each of which could allow to assemble different structures depending on the available pieces on each.
- Large structures such as floating bridges can be assembled in many types and in many attemate mounting procedures to choose among them, so it is possible to select the safest, faster or less bad option possible, depending on the conditions, available time, process safety, availability of parts and available personnel.
- The pre-assembled floating bridges can be carried and transported in compact forms (folded in accordion, wound, wound-folded) and deployed by unfold-

ing and / or unwinding faster and safer than if placing structural modules one by one. These structures can be brought in larger trucks or cargo helicopters, and / or pushed over ground by human strength if necessary through almost all soils and terrains. In this last case, it is possible to dock twin large side wheels several meters in radius to make easier such moves through hard terrain with no damage on the floats by hitting on rocks or hard ground. Once the bridge is at the deployment point, such side wheels can be converted into side supporting brackets from which the floating walkway unrolls and / or deploys with safety and stability.

[0029] While the core of the invention is a removable, expandable, strong structural main frame which allow to build quickly and safely short or long linear or branched structures, it may have little practical utility. To carry out its role effectively this main frame should be complemented with other items, parts, accessories and pieces that allow the invention to face and cope successfully many random conditions and scenes that it is possible to find in a real flooding situation: strong water currents, banks and shores at different levels from water level, available points for placing a pontoon bridge which are not in perpendicular direction in relation to the water stream, need of transporting and building a floating walkway in very little time, road closures, flash floods, tides or hydrodynamic tides which may need flexible or hinged non-rigid structures, and thousands more. Throughout this document all elements and parts constituting this invention will be presented and explained.

DESCRIPTION OF FIGURES

[0030]

Figure 1 shows, in perspective and in top and side views, a floating structural module composed of a float with its front sliding front cover, a pair of U-shaped longitudinal bars and a pair of crossbars, as well as its mutual coupling way is also shown.

Figure 2 shows, in perspective, the reversible process of assembling an example of floating structure with three parallel floats in mutual contact starting from an initial floating structure of a catamaran with two parallel floats separated by a middle gap with no float, either by process **(a)** of addition by side of a floating structural module (composed of a float and two joined U-shaped longitudinal bars) and later compaction of the three floating structural modules sideward and fixing to the crossbars, and by the process **(b)** of interleaving and insertion of the middle floating structural module by separate docking of the float from below and of the U-shaped longitudinal bars from above, so once screwed in this position they trap the crossbars between them.

Figure 3 shows, in perspective, the reversible substitution sequence of the crossbars three segments long from a floating structure having three parallel twin floats a segment wide each in mutual contact for other different crossbars five segments long, and later addition of other two side floating structural modules a segment wide each.

Figure 4 shows, in perspective, the reversible lateral extension process of a floating structure by binding to a similar one, using as connecting elements between the two crossbars two inner crossbars, which are screwed and fit perfectly inside the two previous ones from the starting floating structures. Also two sections are shown, first showing a set consisting of an inner crossbar inserted and screwed inside a normal, outer crossbar, as well as a set of split crossbars each one consisting of two bars in U-shaped section, appropriate for being mutually coupled surrounding a tied cable or cable which is fixed to the floor, trees or similar objects, which can not obviously be inserted inside through tubular non-split crossbars.

Figure 5 shows, in perspective, the reversible addition process by each side of a floating structural module a segment wide each, to a starting floating structure with three twin parallel floats in mutual contact, giving the same result than **Figure 3** but faster.

Figure 6 shows a cross section of different hull configurations of self-propelled, towable or anchorable floating structures as examples, that can be assembled by repeating sideward the same flotation structural units, placed at certain distances along several transverse crossbars different in length, using in some cases floats having hollows for accommodation within of cargo, ballast or passengers.

Figure 7 shows an example of the types and number of different floating structures (boats, rafts, floating walkways) of varying sizes by use of different number and arrangement of floats, which can be constructed having only ten twin floating structural modules available, consisting each one in a float with two twin U-shaped longitudinal bars (and their inner transverse bars) docked, and two pairs of crossbars of some of all the lengths possible from one to twenty segments. No more structures obtained from joining two or several from those shown are included.

Figure 8 shows the use of a hooked front bar for towing of a raft or floating structure with no engine docked, as well as the introduction therein of a cable for its transverse displacement thereof in a direction perpendicular to a water stream, by use of terminal pieces for passing of cables inside.

Figure 9 shows the use of the front (and rear) transverse grooves of the floats for fixing workpieces with a transverse cylindrical bar which serves as a shaft for coupling a front (or rear) pivotable accessory as may be a folding accessing ramp to the watercraft, or for assembling barges which can work as self-propelled floating foldable bridges.

Figure 10 shows possible accessories to be coupled at sides for making easier handling and drag operations of assembled structures, such as single handles, rod handles, and racks over wheels or sleds.

Figure 11 shows the arrangement of terminal pieces which can be inserted inside the crossbars in the same direction of them, such as the case of float-embracing terminal pieces **(a),** the pointed terminal pieces for penetration and self-centering of the crossbars through inside series of aligned consecutive transverse grooves of stacked floats in mutual contact during the joining and strengthening processes of series of floats for rigid floating bridges construction by consecutive coupling of flotation structural units on the growing end **(b),** and terminal pieces with a vertical hole for the introduction of a bar intended for subsequent immobilization of the floating structure on submerged soft soil in shallow landscapes **(c).**

Figure 12 shows the arrangement of assembly and joining elements specialized in connecting two adjacent floating structures by a linear rigid link, such as in case **(a)** of inner crossbars one or two segments long and as in case **(b)** of a linear connecting piece having two consecutive coaxial crossbar sections a segment in length each which are separated and joined by a middle middle piece with a vertical hole for the introduction of a bar intended for subsequent immobilization of the floating structure on submerged soft soil in shallow landscapes.

Figure 13 shows the arrangement of assembly and joining elements for obtaining link connections in vertical angles in relation to the lines of the crossbars, either by rigid angular pieces standardized according to certain fixed angles **(a)**, as by hinged angular pieces via a horizontal transverse hinge which is centered on the piece, which allows symmetrical turning angles above and below the horizontal plane of the main crossbars and the platform of the floating structure **(b),** as by hinged angular pieces via a horizontal transverse hinge which is off-centered on the piece displaced to a side, which allows rotation angles between about 0 ° and 180 °, for coupling accessories at different levels or structures such as pivoting or foldable ladders, foldable side panels and similar things **(c).**

Figure 14 shows examples of convex polygonal frames for assembly of watercrafts, rafts, floating containers or floating cages which are resistant to capsizing or dumping **(a),** indifferent to that (c), or which have free rotation **(b).**

Figure 15 shows the assembly and joining elements which allow assembly of ramified branched floating structures in two or three dimensions, using for the coupling with other elements outer crossbar sections **(a)** or inner crossbar sections **(b)** a single or several segments in length each, all of them welded radially from a cubic middle piece, as well as outer crossbar sections a single or several segments in length each welded radially but in lack of such middle cubic middle piece **(c).** It is visible that the cases **(a)** and **(c)** allow the inclusion of reinforcing plates between the arms that are mutually perpendicular, which may have holes for coupling oblique strengthening bars or rods between different parts of the three-dimensional structure constructed. Below an example of a floating structure branched horizontally **(d)** and other one vertically **(e)** are shown from the many that can be assembled.

Figure 16 shows, comparatively, the top, side and front views of the different types of floats, including shorter ones with three grooves and longer ones with four grooves, symmetrical and asymmetrical floats, solid floats and floats having upper openings for shaping hollows inside. The figure also shows the top, side and front views of the U-shaped longitudinal U bars and rectangular frames, all of them from one to three segments in width. It is also shown, in perspective, a comparison of three floats with upper openings of the same type but of different widths of one, two and three segments, together with their corresponding top covers for such top openings.

Figure 17 shows graphically a comparison of the relative ease of movement in relation to water in different watercrafts (and floating walkways) depending on the cargo weight and arrangement of the floats, such as floats stacked in mutual contact or separated but supporting low weight **(a)** where the watercraft slides above water, heavy weights supported by floating structures having separate floats where the floats split the water flow between them **(b),** arrangements with stacked floats in mutual contact supporting heavy weight and producing water flow retentions in front of the sawtooth-shaped prow which slows the watercraft **(c)** and the same case than **(c)** but inverting the watercraft's hull direction and docking position of the outboard motor with the same floats for improving speed **(d).** This illustrates the usefulness of the asymmetrical floats with sharp and blunt ends, to choose the most appropriate end for the prow or the stern on each case depending on the structure and cargo.

Figure 18 shows the usefulness of those floats which are symmetric in relation to a transverse vertical symmetry plane where both twin blunt ends are swappable, in cases as **(a)** the construction of long barges of any length, which are constructed with these symmetric floats placed together in mutual contact arranged perpendicularly to the direction of advance of the boat and with aid of the float-embracing terminal pieces for strengthening, and in cases as **(b)** the construction of a floating barge of expandable structure both in length and width, by using the four positioning transverse grooves of the crossbars of all the floats, but assembling the side floats always displaced one or two grooves in relation to each other. Case **(b)** is only possible with the geometrical condition that the separation distances between the crossbars, transverse grooves and the ends of prow and stern are as illustrated.

Figure 19 shows the usefulness of a supplementary rounded-shaped float for docking over both flat sides on an assembled watercraft, so that two twin ones of them coupled to both sides symmetrically may improve the ease of turning, maneuverability and displcement speed of that watercraft in water.

Figure 20 shows examples of floats longer than normal ones, manufactured in one piece for any specific use where it is desirable to increase its length. Over them transverse grooves which are not covered by the platform constituted by the U-shaped longitudinal bars may appear **(a),** or two or more consecutive U-shaped longitudinal bars along the length of the float may appear **(b)**, or additional transverse grooves placed below fore and aft sliding covers may appear.

Figure 21 shows examples of hull structures constituted by sectional detachable floats composed of three types of transverse sections, (in concrete prow, stern and middle sections), which can be coupled longitudinally in a row in some combinations, for giving short arrangements prow-prow **(a)** or stern-stern **(b)** as well as structures with a number of middle sections placed between two prow and / or stern sections **(c),** having a total length expandable successively by the number of middle sections intercalated. It is observed that in all cases the pairs of U-shaped longitudinal bars serve as a connecting element between the different float transverse sections.

Figure 22 shows the form of a floating element that combines a bottom inflatable pneumatic section with a top solid section, last one of which incorporates the transverse grooves of the same standardized cross sections and respective longitudinal positions than in all other floating elements for coupling the crossbars and U-shaped longitudinal bars in compatible way with all other elements and pieces from the set.

Figure 23 shows the optional replaceable rubber or plastic seals as spacers and dampers to place between the metal tube elements (crossbars and U-shaped longitudinal bars) and their respective transverse grooves in the floats, which can protect the transverse grooves against wear by its friction on the metal parts and on soil or sand particles.

Figure 24 shows a comparison of several possible embodiments of the sliding covers for the prow and stern of the floats with several different practical applications, such as to cover the upper longitudinal guideways and transverse grooves placed at prow and stern of the floats while providing a good-looking finish **(a),** in addition to provide a rectangular plate section for adding in prow and / or at stern a platform section of the same width as the longitudinal U-shaped longitudinal bars or rectangular frames to extend the accessible surface to one or both ends of the same float and / or to attach accessories **(b),** in addition to provide a vertical panel, surface or overboard as a forward and / or rear protection against waves or splashes due to the advance of the boat **(c),** or even a seat section laterally expandable with each float and floating structural module added to the structure, leaving the center for placing cargo or for other uses **(d).**

Figure 25 shows an example of several dockable selectable prows having variable widths, shapes and materials, each one of which embraces all the floats where it is docked over on the prow of the watercraft, providing to the watercraft better performance in water or additional features because the shape or materials.

Figure 26 shows the different ways in which two adjacent floating structural modules of the floating structure can be found arranged each in relation to the other one, and different parts and elements that can be added to them or between them, in order to supplementing or reinforcing the structure.

(a) With the twin U-shaped longitudinal bars in mutual side contact.

(b) As in **(b)** but with the U-shaped longitudinal bars joined and reinforced bonded together by vertical U-shaped pins or X-shaped pins against traction, pulling and shear movements.

(c) With a rectangular frame or a coupled pair of U-shaped longitudinal bars positioned between the two pairs of U-shaped longitudinal bars of the two adjacent floating structural modules, with no float below, so screwed to the crossbars.

(d) As in **(c)** but with vertical U-shaped or X-shaped pins placed to protect against traction, pulling and shear movements.

(e) As in **(c)** but with a reinforcement rectangular frame different from usual rectangular frames or coupled pair of U-shaped longitudinal bars, as may be a modular accessory or element or docked over that segment or segments.

(f) As in **(e)** but with vertical U-shaped or X-shaped pins against traction, pulling and shear movements.

(g) With one or more rectangular frames or U-shaped longitudinal bars between each pair of consecutive non-adjacent floats adding oblique reinforcing straps, below and between the crossbars in long structures.

(h) As in **(g)** but with vertical U-shaped or X-shaped pins placed to protect against traction, pulling and shear movements.

Figure 27 shows ways of attachment of modular accessories with standardized dimensions by docking over the U-shaped longitudinal bars, such as **(a)**

vertical placement and bolting to the U-shaped longitudinal bars, or **(b)** the same but including small bottom rolling wheels for moving or sliding the element or accessory longitudinally from using the U-shaped longitudinal bars as guideways, and further bolting.

Figure 28 shows in **(a)** an example of a detachable motorized boat among the many which are feasible, consisting of a central middle float three segments wide having top openings and inner hollows, which is flanked by two side shorter twin floats, arranged inverting prow and stern for exploiting spare leftover parts in this assembly, using the front hollow compartment for ballast or cargo and the rear other two for placing of passengers. In **(b)** figure shows the result of the coupling of inflatable or cushioned linear elements placed at front and at sides for best passenger protection in troubled waters.

Figure 29 shows four methods of deployment and growth of a rigid floating pontoon walkway or bridge, strengthened with crossbars and constituted by floating structural modules with a single float each, placed alternatively with rectangular frames between each two floating structural modules with no float below and screwed to the crossbars. In first case **(a)** it is by using guide cables to secure growth of the floating walkway, adding each new floating structural module on the soil from the shore and pushing a single step all the assembled chain toward the opposite shore along the cables. In second case **(b)** it is the same, but adding the floating structural modules in pre-assembled short chains of several of them, pushing the assembled chain the same added length to the opposite shore. In third case **(c)** it is as case **(a),** but adding each new floating structural module in the chain end over the water with no need of pushing the structure along the guide cables. In case **(d)** it is as case **(c)** but adding pre-assembled short chains of several floating structural modules on each step. It is necessary in the latter.

Figure 30 shows a comparison of the rectangular frames and U-shaped longitudinal bars having longitudinal hinges, fitted both in symmetric and antisymmetric arrangements, as well as the way of linking them with pins and their mutual folding way in the two cases.

Figure 31 shows the basis with which consecutive floating structural modules can be successively linked in the growing end a floating walkway over the water with increased safety for the crew, by linking with pins the tubes of each longitudinal hinge pins belonging to the U-shaped longitudinal bars in touch from adjacent floating structural modules for further stiffening by gradual introduction of the crossbars along all coaxial consecutive transverse grooves of the floats.

Figure 32 shows a more realistic operational procedure for the same operation than in previous figure for assembly of long linear structures, well rigid structures **(a)** or articulated structures **(b),** in which an operator carries a float by a wheeled cart provided with hooks and puts it in position for linking, while other operator places the pins with appropriate tools as a precaution to avoid using fingers and hands directly, before releasing the floating structural module and locking it by introducing the crossbar an additional step (a), as well this same operation can be performed with short chains of several pre-assembled floating structural modules to link between, joining the chain sections here by joining hinges **(b).**

Figure 33 shows how to fold two layers of flotation structural units linked laterally sideward by their longitudinal hinges, thus reducing the width of rafts or long structures to the half, as well as for transporting pre-assembled chains for fast assembly of long floating structures.

Figure 34 shows examples of several structures of chained floating structural modules (in these cases having always six of them with one of two possible widths), which are linked laterally by their longitudinal hinges of their U-shaped longitudinal bars or rectangular frames in prismatic arrangements having as twin bases closed polygons (in these cases regular hexagons). They use for obtaining such prismatic shapes without being folded by its own weight, various types of convex polygonal racks acting in twin pairs joined by transverse bars to shape over a reel central piece, around of which the chained and linked floating structural modules are rolled and shaped in prismatic shape. For that, each pair of coupled convex polygonal racks must have the same number of sides than the chain of linked floating structural modules to roll, and also the same respective lengths for their sides than the chain of linked floating structural modules to roll in the same sequence if they are different along it. Convex polygonal racks may be polygonal frames with a perpendicular central ring or hole and radial supporting spokes **(a)**, or they can be changed by big rings or tubes of suitable diameter for shaping the prism around **(b).** On the adjustable radial racks the fixed edges are replaced by supporting wedges that can be adjusted in distance relative to the center of the piece to fit to the inner corners of the prism to shape around and holding the vertices or inner surfaces of the floats in a cyclic prismatic structure **(c).** Such later elements can add adjustable sliding telescopic legs, being moved and fixed inside the spokes of the piece. Also it is possible to add a foldable version of the adjustable radial racks around a central shaft, having always an even number of spokes, wedges and telescopic legs.

Figure 35 shows, for those cases in which the transport vehicle transporting parts and pieces can not access to the deployment area because the impracticability of the terrain, an approximate comparison of the transport efficiency of floating structural modules by several methods which use own human strength: Bringing the pieces in shoulders, dragging the pieces on ground, or rolling on ground closed prismatic cyclic structures.

Figure 36 shows the approximate steps in procedure of anchoring to ground and quick deployment by unrolling of a temporary floating pontoon walkway or bridge, or at least the first "coil" fragment to further connection to other consecutive ones if there is too much distance to cover over water. Once by dragging on the soil the prismatic structure reaches the shore, the chain is opened and unrolled, and it is finally rigidly strengthened by introduction of the crossbars inside the channel formed by all the consecutive aligned grooves of all the floats. The length of the floating pontoon walkway can be extended by adding more floating structural modules, one by one **(a)** or adding a second prismatic chain to the unrolled strengthened first one by previous linking of their two extremes by its ending longitudinal hinges and repeating the process several times if necessary **(b).**

Figure 37 shows various possible ways of complete or incomplete folding and unfolding of structures linked with longitudinal hinges but that alternate two twin mutually foldable rectangular platforms between each two floating structural modules, as in case **(a),** in which each platform consists of two twin U-shaped longitudinal bars, one of them screwed to the other one through their transverse inner bars in vertical inverted position for swapping position of their longitudinal hinges and allowing the mutual folding of each two platforms in opposite directions than normal for hinges from floating structural modules, thus alternating folding directions for shaping an accordion, or in case **(b),** in which each platform consists of a rectangular frame which is hinged inversely to a twin counterpart thanks to have the longitudinal hinges of one of their longer sides also welded or bolted in vertical inverted to the hinges on other longer side, thus making the same action.

Figure 38 shows mixed rolled and accordion-folded prismatic cyclic structures (in this example always with six floating structural modules) shaped and supported around two twin middle supporting adjustable radial racks placed in parallel vertical planes by transverse linking bars. The floating structural modules are not linked to each other with their longitudinal hinges but with intermediate twin platform sections with reverse folding direction for folding inwards the prismatic structure, which allows that this starred-in-shape structure when unfolded may have an overall length three times with respect to the only rolled shaped structures. This value is five times if instead of twin two platform sections foldable inwards between each two sides, there are four, increasing only a little radius and weight of the prismatic structure.

Figure 39 shows the approximate stages of unrolling and unfolding in deployment of a mixed rolled and accordion-folded structure shaped around two twin six-side adjustable radial racks, which is arranged like a six-floats waterwheel over twin supporting brackets over the soil of the shore. These procedures can be by pushing the platforms and floating structural modules for partial unfolding and going completing unfolding step by step while crossbars are being introduced inside the transverse grooves of all the floats **(a),** and / or also by pulling from the other side with cables, ropes, cables or chains **(b).**

Figure 40 shows the approximate alternative procedure, suitable for shallow water streams of not very strong dragging force, which can grow a floating walkway from the shore by unrolling and unfolding it like a carpet, using the own adjustable radial rack with telescopic adjustable legs as a rolling ballasted piece held to the submerged soil which moves rolling step by step while the chain is unrolled and unfolded, and using a cable for each transverse groove on the floats as guidelines for unfolding the floating structural modules and linking them to the shore.

Figure 41 shows a similar procedure to the previous one, but in which all the folded / rolled structure shaped around two twin adjustable radial racks as central reel, is transported by air on a cargo helicopter for deploying a floating pontoon walkway or floating pontoon bridge in the air from a shore to the opposite one by unrolling or unwinding gradually step by step the floating chain by suitable electric releasing and retention mechanisms for braking the spin of the structure because the weight of the unfolded parts, crossing a water stream which can be too wide or impracticable by other means in a short time.

Figure 42 shows a rolled / folded structure similar but longer to the previous one, but instead of being shaped in a prismatic shape to make spin, it is shaped in a two-layer ribbon for higher capacity in floating structural modules and longer deployed floating pontoon bridge. Once traction cable end falls to ground, the floating structural modules, transported inside an air transport deployment rack, and running carried by a series of horizontal guidelines and guiding trays are unfolding one by one and falls by gravity along the guide cables to the soil of the shore, controlled by a locking and unlocking mechanism that regulates their slow release one by one. The structure can also be folded in reverse in the air if the if the guide cables are connected to a coil engaged to an electric motor to roll up and drag the chain reversely to the air, since the floats when going reaching its displacement end stop on horizontal trays and intercalated platforms automatically fold.

Figure 43 shows the use of closed prismatic structures of three flotation structural units, or shaped around central convex polygonal racks if having more than three ones, which can be used as floating supply containers droppable from cargo planes with outer protecting shells made by floats, in a way that such containers can be collected and removed, for reusing such outer shells as boats or rafts by people.

Figure 44 shows prismatic cyclic structures shaped around twin central adjustable radial racks, consisting of floating structural modules linked by angled connecting elements with central hinge, which can be inserted inside or in the same line that the transverse grooves of the floats, therefore without interleaved twin folded platforms **(a),** as well as it is possible to nest a prismatic cyclic structure inside other bigger one in the same twin central adjustable radial racks **(b),** as well as it is possible to mix in a same cyclic structure floating structural modules linked both by longitudinal hinges from their rectangular frames or U-shaped longitudinal bars and by central **(c).**

Figure 45 shows flexible floating walkways composed of rigid stable elements composed of pairs of twin floating structural modules having a float each connected by crossbars **(a),** or linked by guide cables or cables anchored to both shores, which allow an easy and fast placement and removal as a blind by guiding and traction elements **(b),** or its assembly or disassembly element by element **(c)** in both straight and Y-branched or X-branched arrangements with no mutually perpendicular arms **(d).**

Figure 46 shows two models of floats having oblique transverse grooves not perpendicular with respect to the float itself, appropriate for those cases where it is necessary to construct, a floating pontoon walkway or bridge following a direction which is not perpendicular to the water flow because land obstacles, so normal floats may be useless. So for assembling floats in parallel to the water flow with minimum resistance **(a),** the floats can have transverse grooves shaped in certain standardized angles **(b),** or they can be coupled to the crossbars through intermediate selectable pieces having the grooves at those standardized oblique angles **(c).**

Figure 47 shows the elements **(a)** that allow construction of straight floating walkway sections, whose floats are joined through vertical shafts to the top walking platform, so they can pivot around it a limited angle around them in relation to the top platform, and the floats can swing or rotate freely between those turning limiting angles for following automatically the water flow direction, for instance, if the walkway is built on the shore and for deployment it must be pivoted from the shore to a final direction, not necessarily perpendicular to the water stream.

Figure 48 shows the elements **(a), (b)** that allow the construction of straight sections of floating walkways and bridges that can be chained together consecutively by using robust supporting racks with a strong vertical shaft each one, on which a set of symmetrically arranged floating structural modules having an even number of floats can be inserted for being freely rotatable a full 360 ° turning with respect to the top walkway platform, allowing to such freely pivotable floating groups to be aligned automatically in the direction of water flow, whether if this has its own direction changes **(c),** as if the floats must rotate to keep in parallel to it while the walkway is pivoted from its assembly position over the shore or over another bottom floating walkway straight section to the desired direction, or if it is towed by water by one or several watercrafts to its final fix position.

Figure 49 shows examples of long floating walkways built using straight sections linked together that use and are supported on floating supports with robust vertical shafts mounted in symmetrical sets of an even number of floating structural modules with a free rotatable 360 ° turning, through the use of several different elements, and different methods of joining of these sections.

Figure 50 shows the scheme and basics of oblique rafts for transference of cargo, passengers or evacuees from a shore to the opposite one in case of having a strong water stream, in a way that such oblique rafts are linked to transverse guide cables and are built with floats having oblique transverse grooves, so that the parallel floats form a certain angle with respect to the water flow and they can work as passive propulsion elements that use, without energy or oil consumption, the transverse component of the water stream force for pushing the watercraft from one side to the other one, usually reversing the whole watercraft by turning it as well as the guide cables for reversing the pushing direction, removing and reattaching the upper basket or pallet **(a)** or with all parallel floats mounted in pivotable vertical shafts whose angle can be varied with bars, cranks or any element able of changing the inner angles of the rhomboidal raft and the angles of their floats in relation to the water flow **(b).**

Figure 51 shows the scheme and basics of rotational rotating capsules **(a)** and rotating tubular floating walkways **(b),** both of them having detachable prismatic rotating hulls, and able of enabling protection of passengers placed inside and transfer them, with greater margin of protection and safety, from a side to the opposite one through a water stream enough strong and turbulent for making useless all watercrafts and floating pontoon bridges in those conditions, as these devices can roll over the water and over floating dragged objects and debris while usual watercrafts and bridges could be capsized, dragged and collapsed.

DESCRIPTION

[0031] The main structural elements of the invention and its mutual coupling way can be seen in **Figure 1**. The invention consist of, firstly, in at least one pair of twin crossbars (1) in tube of square or rectangular cross-section, preferably made of metal or alloy resistant to corrosion, both of them of the same length, which is not specified but it may be selected by the user. These crossbars (1) join at least two floats (2) arranged in parallel longitudinally in mutual contact or separated between them (in the figure only one is shown for clarity), all of them symmetrical with respect to a vertical longitudinal plane of symmetry that passes through its own center. The assembly is completed for now by two U-shaped longitudinal bars (3) for each float (2) in tube of square or rectangular cross-section, also preferably made of metal or alloy resistant to corrosion. All the floats (2) have at least five transverse grooves on its top surface flat horizontal which cross it perpendicularly and completely. At least two of such transverse grooves (4), which are located on top flat surface in the central part of each float (2), serve for joining, coupling and screwing of the crossbars (1), thus they have the same cross section that them. There are other two transverse grooves (5) that serve for joining, coupling and screwing of the transverse shorter ends of said U-shaped longitudinal bars (3), also having the same cross section that these transverse ends, with the characteristic on all the floats (2) that the transverse grooves (4) are always placed between the two transverse grooves (5), so that the crossbars (1) coupled inside the transverse grooves (4) are always placed between the two transverse ends of each one of both twin U-shaped longitudinal bars (3).

[0032] Thus, once assembled the structure as shown in **Figure 1**, whether if there is a single float (2) as if they are multiple floats (2) repeated sideward, the central longitudinal longer segment of all the U-shaped longitudinal bars (3) always are in the same horizontal plane resting and touching over the crossbars (1), all of them placed in the same horizontal plane parallel to the previous one, while the shorter transverse ends of those U-shaped longitudinal bars (3) always are in the same horizontal plane parallel to the previous ones, resting and touching on the floats (2), inserted, hosted and screwed into the transverse grooves (5) practiced on those floats(2). Then, such U-shaped longitudinal bars (3), once coupled and screwed to the other pieces can distribute and disperse weights and load forces from the top platform of the structure of watercraft or whatever structure, simultaneously both to the crossbars (1) as to the floats (2). An additional last transverse groove (6) is near the prow of all the floats (2), with the same cross section as the transverse grooves (4) for placement of a third crossbar (1), which increases the strengthening of the structure when coupled and screwed, and prevents that the prows in the watercrafts tend to be separated and deformed by the continued impact on the water because the own displacement of the watercraft, as well as to place further accessories for many practical applications to perform at the prow.

[0033] All these elements of each type are equal and symmetrical with respect to a longitudinal vertical symmetry plane passing through the center of the piece in the same spatial orientation that in coupling position to the assemblies, with exception of U-shaped longitudinal bars (3) where this plane is transverse) for using the pieces either on right or left sides, simplifying and reducing manufacturing costs and facilitating assembly and disassembly.

[0034] These three types of main structural parts are mutually joined together by thick and strong crossbars-floats fixing screws or bolts (7), crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8) and floats-U-shaped longitudinal bars fixing screws or bolts (9).

[0035] The triple linkage between each two of the three types of main sandwiched structural parts achieves a greater structural strength and endurance than in the case of having only the usual coupling between crossbars (1) and floats (2), and the structural tensions are supported and distributed to a higher number of screws or bolts. It also enables greater versatility in assembly, disassembly and conversion operations, since by removing two of these types of connecting screws, threaded rods or bolts (7), (8) and (9), it is possible to release one of these three types of structural main parts with respect of the other two, which remains joined by the third not removed set of connecting screws.

[0036] Each float (2) with two twin U-shaped longitudinal bars (3) screwed over by strong floats-U-shaped longitudinal bars fixing screws or bolts (9), is an independent modular floating structural module that can be attached or detached to an assembly in construction or conversion by fixing and screwing it over the common crossbars (1) that join all modules together in common assemblies. This independent modular floating structural module also can be moved sliding along the same crossbars (1) for changing or adjusting its transverse position in relation to them but without releasing from them. With this relative arrangement of the three main structural elements, there are two coupling procedures for coupling or removal of the floats (2) which are immediately obvious from **Figure 2**, from the sides or from above and below.

[0037] The screwing of said U-shaped longitudinal bars (3) to the floats (2) has the practical effect of converting their transverse grooves (4) in holes, and its removal the opposite effect. Being the two types of main structural elements connected to a single one or more independent floating structural modules, each one of them can be perfectly inserted laterally on (or being threaded through) the crossbars (1), with relative transverse sliding capability along the same without releasing and without spaces or clearances between both pieces, so the floating structural module may be finally fixed on a desired transverse convenient position with crossbars-floats fixing screws or bolts (7) and crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8), as seen in case **(a).**

[0038] Thanks to this lateral insertion procedure, while there are spaces left or free in those crossbars (1) (according to its length initially chosen) for more additional floats (2), it is possible to add more floating structural modules laterally by sides, well until mutual contact of all floating structural modules and / or until completing all the length of the crossbars (1), resulting in a compacted structure of floats (2) and floating structural modules in mutual side contact, resembling a monohull boat but divided into longitudinal strips or sections in touch. It is also possible to leave free gaps with no float (2) and floating structural module on desired positions for building gapped structures as rafts, pontoons or catamarans. Floating structural modules can be removed by the reverse process to reduce the number of floats (2) and platform sections joined to the crossbars (1) and / or to redistribute them transversely if necessary.

[0039] By removing or detaching such U-shaped longitudinal bars (3) from its corresponding float (2) as in shown case (b), the transverse grooves (4) are now freely accessible from above, so that in this case each detached float (2) can now be intercalated in a gap enough wide between two side floats (2) and screwed or bolted to the joining crossbars (1), placing, coupling and screwing it from below with respect to the horizontal plane of the crossbars (1) in the floating structure. After the float (2), the U-shaped longitudinal bars (3) can be coupled to its corresponding float (2) and screwed or bolted from above to it as to the crossbars (1) in a sandwiched arrangement by means of the crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8) and the floats-U-shaped longitudinal bars fixing screws or bolts (9). Such structural elements can also be removed by the reverse process, to reduce the number of floats (2) and floating structural modules joined to the crossbars (1) and / or to redistribute transversely them if necessary.

[0040] The first insertion procedure by sides is more suitable for construction of large or long floating structures, since there is no need to completely lift them, but slightly tilting them to insert, to slide and to stack the floating structural modules to their final positions, compacting the series if necessary. By having this capability, many gapped detachable watercrafts can be compacted transversely for reducing its width in preassembled arrangements for fast deployment by expanding the floats (2) and floating structural modules to the sides, as in case of catamarans, trimarans or small pontoons. For reasons of weight and handling, the second intercalation process top-bottom can be faster and suitable for completing small watercrafts or rafts with the maximum number of floating structural modules, coupling and fixing the crossbars (1) over the floats (2) disposed on ground, then coupling and fixing twin U-shaped longitudinal bars (3).

[0041] U-shaped longitudinal bars (3) have the characteristic that, once screwed or bolted to the floats (2) in coupling positions, their shorter transverse ends of each one reach exactly to the vertical longitudinal symmetry plane of its corresponding float (2) where it is attached on, so that both two twin U-shaped longitudinal bars (3) touch mutually between them by their transverse shorter ends and share a common float (2), making a rectangular frame which provides rigidity to the structures of more than two floating structural modules in mutual side contact. Furthermore, since at least all longitudinal longer linear sections of all U-shaped longitudinal bars (3) are always assembled in the same horizontal plane on their coupling positions, above and in direct contact resting over the crossbars (1), after obtaining a rigid structure by mutual screwing of the three types of main structural elements, the frame upon which to place a horizontal platform (or several of them consecutively) over the watercraft or floating structure, where placing elements for steering, propulsion, cargo placement and passenger accommodation. Weights and forces that tend to distort the main frame structure due to the movements of water are dispersed from the main platform constituted by said U-shaped longitudinal bars (3) simultaneously to the floats (2) and to the crossbars (1).

[0042] In case that it would be necessary to construct a floating structure with a different width than the length of the crossbars (1) used, or to attach a number of floating structural modules which is higher than the maximum allowed by length of those crossbars (1), their change by other ones of appropriate length can be achieved by several methods. Best one is to change the crossbars (1) one after the other, without having to dismantle the whole preassembled structure into separate detached pieces, making the expansion and contraction of the structures by modules easier and quicker than in case of complete dismantling.

[0043] An example can be seen in **Figure 3**. Just by removing of the crossbars-floats fixing screws or bolts (7) and the crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8) corresponding to only one of the crossbars (1), such single crossbars (1) can be released, extracted and changed by other one different in length. Once repositioned the same connecting screws previously removed on the replaced crossbar (1), it is proceeded to repeat the process with the other or other crossbars (1). At least one crossbar (1) holds the structure mounted in the crossbar (1) change with the different accessories that may be coupled above, proceeding, after the complete replacement, to add the additional floats (2) needed or removing those that were in excess.

[0044] All the floats (2) have a fifth transverse groove (6) made in the top flat horizontal surface on the prow of the floats (2). A top sliding cover (10) on each float (2), which is placed and removed sliding along the longitudinal direction, covers the prow's top flat horizontal surface including this transverse groove (6), using for its coupling and movements one or several twin longitudinal guideways or flanges (11), which are shaped or placed longitudinal on this top flat horizontal surface on the prow of the floats (2), to slide only in longitudinal direction when it is inserted on them. Each top sliding cover (10) can be fixed by at least a floats-sliding covers fixing screw (12) to the prow of its corresponding float (2). So that this transverse groove (6) is covered or uncovered by the user with great ease, in order to couple and lock or to release different elements which can be coupled inside it, especially a crossbar (1) for joining the floats (2) among them by their prows.

[0045] The crossbars (1) are always manufactured in different selectable lengths to choose among them, being such possible selectable lengths a positive integer multiple of an unitary length which is a constant value in the invention, or at least in each possible format or version of the invention due to the size or dimensions of the manufactured pieces (for example, for handling and lifting by human power or by lifting machinery). This unitary length is matched with the maximum width of each one of the narrowest floating structural modules possible for practical use, that is, the transverse distance measured perpendicularly between the parallel outer edges of the two twin U-shaped longitudinal bars (3) coupled together over each float (2). In addition, this transverse distance is previously calculated for a optimized transport, storage, assembly and handling operations, that is, it is those width for floating structural modules that is fully optimal, so narrower floating structural modules are less practical or less manageable, or simply, they are too small. Then, the positive integer multiple may vary between one (to accommodate a single floating structural module with a single float (2) and two twin U-shaped longitudinal bars (3), coinciding exactly with its maximum width), to a limit determined by the size, strength and handling of both the floating structural modules and the assembled structures with them.

[0046] From now, as the lengths or widths of the watercrafts and floating structures are specified in discrete units that are positive integer multiples of this said unit length, this is named from now as "segment", but it may be defined by any other name ("units", "widths", "bodies", etc.). To achieve a standardization of the dimensions of all the coupling parts and pieces, the length of all of them, measured in a direction parallel to the lines of the crossbars (1) in their same spatial orientation for coupling to them, always have a number positive integer in segments, with several exceptions in several pieces in which this length is a little less than the exact value for fitting inside or docking over other pieces and elements.

[0047] A crossbar (1) of a number n of segments may therefore be coupled exactly, without excess or lack of length on such crossbar (1), over a number n of segments of floats (2), regardless of whether this is achieved with a single float (2) of n segments in width or with several floats coupled with an overall width of n segments stacked in series. This allows to the set of parts and pieces to be joined together not only piece by piece but segment by segment, so that it is possible to multiply the number of structures possible to be built, and a great freedom of choice for engaging or not one piece over another even if they have different lengths or widths, for leaving a gap vacant or not, for choosing the dimensions and the coupling position thereof, is provided.

[0048] However, to achieve this goal of standardization and quantification of lengths in discrete incremental units, this also have to be extended to the fixing and locking devices on all the different parts and pieces, so that they are periodically repeated in the piece for each segment of length in the direction of the crossbars (1) in the same relative spatial orientation for coupling to the crossbars (1) and structures in assembly process, obviously with a constant spacing of one segment. Each one of the segments of the crossbars (1) is completely traversed vertically by the same two different groups of holes which allow, respectively, that the crossbars-floats fixing screws or bolts (7) and the crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8), pass through the crossbar (1) from above to reach to the float (2) below in assembly, being introduced inside it.

[0049] Each one of these two sets of holes are drilled in all and each one of the segments of all the crossbars (1), symmetrically at both sides in relation to the transverse vertical plane of symmetry passing through the center of said segment (which is parallel to the vertical longitudinal plane of symmetry passing through the center of each float (2) in the mounting coupling arrangement and same spatial relative orientation between crossbars (1) and floats (2)). The set of crossbars-floats fixing screws or bolts (7) tighten the crossbars (1) to the floats (2) when placed, having their ends screwed into female threaded metal parts firmly housed or embedded inside the body of the floats (2) at matching positions over the horizontal surface of the transverse grooves (4). The crossbars (1) do not have necessarily threads but necessarily the same diameter hole or slightly greater, and are optionally countersunk for hiding the head of each one of the crossbars-floats fixing screws or bolts (7) with no protruding. The set of connecting screws, threaded rods or bolts (8) tighten the U-shaped longitudinal bars (3) to the crossbars (1), if necessary with the aid of nuts, but as they are long they can be better substituted by long thick bolts or pins, so this simple change can streamline assembly processes and also avoids the presence of nuts that can be lost as there are no bottom nuts or female threaded metal parts in the float (2) for hosting these elements.

[0050] For making possible this modular assembly, the floats (2) must have, obligatorily, exactly the same width, or just slightly a little less width than a positive integer number of segments. Thanks to that, it has (or best said, it can have, as it depends on the pieces coupled by the user) in almost all occasions the same or slightly less width than the rectangular frame constituted by the coupled pair of two twin U-shaped longitudinal bars (3) assembled above it. So that in stacked arrangements where the floating structural modules touch sideward between them, these rectangular metal frames are in mutual side contact, reinforcing and strengthening the structure, but not the floats (2), fact which would wrongly strain, damage or wear each two of them by mutual grazing, or preventing of a concordance in vertical direction of the different groups of holes between the crossbars (1) and the floats (2) for the sets of crossbars-floats fixing screws or bolts (7) and crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8).

[0051] As improvement, to the set of pieces, new inner crossbars (13) are added as important new assembly elements. The have exactly all the same characteristics that the crossbars (1), but with the distinction of having an outer cross section whose shape and dimensions are such that these inner crossbars (13) can be inserted snugly inside the hollow tubular usual outer crossbars (1) and be displaced along all its length also snugly, and be fixed to them or together with them with the same sets of fixing screws. For that, they are also manufactured in standardized lengths of a positive integer number of segments, and they have performed the same sets of holes in the same coincident standardized positions for the sets of crossbars-floats fixing screws or bolts (7) and crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8), for being crossed by them. The main function of these inner crossbars (13) is to serve as a lateral connection element between two crossbars (1) for increasing their length by connecting both two in series and / or s for achieving a longer or doubled thickness than the original crossbars (1) to make them more resistant to bending, as well as for connecting two assembled floating structures by coupling in series each crossbar (1) of one of them with the other corresponding crossbar (1) from the other one sequentially in the same line, making possible to assemble longer or larger floating structures as rafts or pontoon bridges plugin sideward smaller ones, which are more easy to mount and to transport, as shown in **Figure 4** and in **Figure 5.** For attaching laterally more floating structural modules, or preassembled structures, to a previously assembled floating structure in conversion procedures, it is necessary to loosen first from the crossbars (1) from the last one the sets of crossbars-floats fixing screws or bolts (7) and crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8), but only from the terminal segments involved, and once the additional structure(s) or floating structural module(s) has / have been plugged using inner crossbars (13) as bridging linking pieces, to re-tighten them to the enlarged floating structure. Obviously, the procedure is reversible for shrinking the floating structure if it has been enlarged previously by this way. By its joining function, inner crossbars (13) are usually manufactured in an even number of segments in length.

[0052] The fifth transverse groove (6) of the floats (2) has the same cross section as the transverse grooves (4) have, so a third crossbar (1) can be coupled, hosted and screwed to the prow of each float (2) and the prow of any watercraft assembled with them, or to the considered side of any assembled structure with floats (2) arranged in parallel having all their transverse grooves (4) y (6) consecutively aligned. The upper sliding cover (10) covers and locks such front crossbar (1) hosted and screwed inside the transverse groove (6), and by not being under the main frame constituted by the U-shaped longitudinal bars (3) in the assemblies, the access, opening and closing of this transverse groove (6) is easy, quick and immediate, thanks to the aid of said upper sliding cover (10). This third crossbar (1) aids to increase structural strength at this side, especially if this is the prow of a watercraft that impacts to the water due to its own displacement move.

[0053] With the parts and elements described so far, and combinations thereof, they can be constructed a big number of structures and assemblies with varying length and width, over which subsequently to attach accessories to delimit its practical function, examples of which can be seen in **Figure 6.** Likewise, **Figure 7** illustrates the enormous number of possible combinations for mounting different floating structures in the example of having ten twin detached floating structural modules a single segment wide available, and a sufficient number of crossbars (1) (from two to six segments long) of all possible lengths between two to twenty segments in length. Still they are not shown the possible additional possibilities for connections of these structures later into larger ones by use of inner crossbars (13). However, it is possible to extend still more structural mounting possibilities with new connecting elements and additional parts that can be attached and linked over the previous ones. Most of the new parts that are described as follows are modifications of these crossbars (1) and inner crossbars (13), and therefore include segments or fractions of segments coupled or attached to them in terminal or intermediate positions, as well as in angular fixed or angular variable linking pieces, as well as in linking pieces branched into two or three dimensions.

[0054] Other terminal coupling parts that can be attached laterally inserted into the crossbars (1) are the pieces for cable passage (15). These short pieces, in two versions, have always the same outer cross section than the inner cross section of the crossbars (1) in first version, and the same outer cross section than the inner cross section of the inner crossbars (13) in second version. So such pieces for cable passage (15) can be introduced inside the tubular hole of both linear linking elements and displace along all their length coincident with its main axis for being fixed at terminal or intermediate fixing positions. Each one of said pieces for cable passage (15) have several longitudinal parallel complete holes that cross them side to side in parallel to the central symmetry axis of symmetry of crossbars (1) or inner crossbars (13) when coupled to them. Such longitudinal complete parallel holes are always drilled or shaped in the same preset positions, so that when several pieces for cable passage (15) are inserted a crossbar (1) or inner crossbar (13) in whatever positions, such holes are coaxially aligned in parallel to crossbars (1) and inner crossbars (13). Then, a cable or rope can be placed passing through a single row of these aligned consecutive holes, so it is possible thanks to these pieces for cable passage (15) to pass several resistant guide cables or ropes inside each crossbar (1) or inner crossbar (13) on a floating structure or floating structural module. Such longitudinal holes are drilled or shaped at preset positions in a way that the cable or rope that pass through its holes row does not bump or rub with any element from the sets of crossbars-floats fixing screws or bolts (7) and crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8) for safety reasons. By the same reason of preventing breakage or damage of the ropes or cables for guiding, the longitudinal holes are drilled or shaped with no sharp edges or burrs. This has full utility for transporting floating structural modules or preassembled structures and overcoming ravines or hard terrain slopes by gravity, by making them to fall down sliding through those guide cables. Also for transferring a watercraft or floating structure crossing a water stream or water body through a single or several guide cables, by using of the same water stream force, human force, or mechanical traction devices, as shown in **Figure 8**. These pieces for cable passage (15) can be fixed on terminal and intermediate positions thanks to a series of vertical holes drilled crossing them which are in coincident positions and diameter with the set of holes drilled in crossbars (1) and inner crossbars (13) for the set of connecting screws, threaded rods or bolts (8), so that these elements can also fix the pieces for cable passage (15) when docked.

[0055] Another terminal piece especially designed to be placed easily on the transverse grooves (6) and locked with the help of the sliding covers (10) and the sets of crossbars-floats fixing screws or bolts (7) from these transverse grooves (6), is shown in **Figure 9**. It is a piece for attaching forward swinging accessories (16), which has the same outer cross section of the transverse grooves (4) and (6), so also the same than crossbars (1), with the feature that it is traversed in the direction of its main axis, either with a single complete cylindrical hole or two aligned coaxial twin terminal cylindrical holes, always avoiding positions of the sets of crossbars-floats fixing screws or bolts (7) from the transverse groove (6). By this way, along such hole or consecutive aligned cylindrical hole it is possible to inserted in parallel to these transverse grooves (6) a horizontal transverse shaft for allowing the attachment and docking of swinging elements at the prow of the watercraft or at this side of the floating structures, as may be a swinging front panel or a front swinging accessing ramp for detachable small ferries. Also it is possible to link two or more boats or rafts consecutively in the direction of the floats (2), joining them in a flexible chain for being towed by a powerful motorboat, or for acting as a portable pontoon bridge yhat can be split into separate boats.

[0056] A further group is to facilitate transport and drag by hand of floating structural modules and assembled floating structures. They are simple handles (17) for use with a single hand each, for instance in molded plastic, each one able of being introduced in terminal positions into a crossbar (1) perfectly, having for that inner and outer coincident cross sections respectively, and with a series of vertical holes drilled crossing them which are in coincident positions and diameter with the set of holes drilled in crossbars (1) for the set of connecting screws, threaded rods or bolts (8), so that these elements can also fix simple handles (17) when docked.

[0057] Instead of simple handles (17), it is possible to attach a handle bar (18), with the same characteristics than previous element, but where the handle is substituted by a longitudinal bar that connects two pieces similar to the simple handles (17) but with no handle shaped on, being this element able of being introduced in terminal positions of two adjacent crossbars (1), one more advanced than the other in longitudinal position. Obviously, with the same philosophy of attachment through inside the crossbars (1), twin wheeled supporting racks (19) and twin sled supporting racks (20) are also possible to add to the set of pieces for transport on ground by human force. All these elements can be seen in **Figure 10.** Obviously all such handling elements can be fixed to the crossbars (1) by having the same sets of holes in coincident positions for the sets of crossbars-floats fixing screws or bolts (7) and the crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8).

[0058] A series of three terminal pieces which engage over the ends of the crossbars (1) can be seen in **Figure 11.** The first is a piece for embracing the floats (21), a modification of the inner crossbars (13) that engages always in opposite pairs to both ends of the same crossbar (1) to embrace, as a jaw, a series of stacked floats (2) in mutual contact with no gaps that occupy all its length, retaining them against traction movements to the sides, so that they can be coupled optionally by the user. Each piece for embracing the floats (21) consists of a inner crossbar (13), usually a segment long, which ends in an outer protruding larger section which has such a shape that it can adapt perfectly to the external shape of the floats (2) like a wedge, for a good embracing action, preventing the floats (2) of the floating structure from be separated from each other by the watercraft movement itself. Obviously they can be fixed to the crossbars (1) by having the same sets of holes in coincident positions for the sets of crossbars-floats fixing screws or bolts (7) and the crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8).

[0059] Other terminal coupling parts are pointed terminal pieces for penetration and self-centering of the crossbars (22) on the transverse grooves (4) and (6) of the floats (2). It is a piece made of hard plastic or metal and finished in conical or pyramidal tip which engages and is screwed onto the end of the crossbars (1) by having the same sets of holes in coincident positions for the sets of crossbars-floats fixing screws or bolts (7) and the crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8). It greatly facilitates the operations of centering and inserting of the crossbars (1) along all the series of aligned consecutive transverse grooves (4) and (6) in a package or pile of a large number of floating structural modules arranged in a row, allowing a fast placing of such crossbars (1) and strengthening of the structure by giving a pointed shape to the crossbars (1) with which skewering through all consecutive aligned transverse grooves (4) and (6).

[0060] Other terminal coupling parts are terminal pieces for spiking to the shallow soil (23). These are a segment of crossbar (1) or inner crossbar (13) with the standardized sets of holes for the usual fixing screws previously said, with an extended thicker end finished in a vertical hole or horizontal ring with enough diameter, inside of which it is possible to insert a vertical bar or peg for spiking and immobilizing the floating structure to shallow soft soil. As the bars are nailed vertically, the floating structure can follow variations in water level, as in tides or in slow flooding of a place.

[0061] A modification of last piece is in the form of intermediate linking pieces for spiking to the shallow soil (24). They are the same than the terminal pieces for spiking to the shallow soil (23), but instead of having a single arm of crossbar (1) or inner crossbar (13) a segment long, they have two twin ones, with the second one symmetrically disposed in the opposite direction than the first one, that is, coaxially aligned in the same line. So this element makes the same function than the terminal pieces for spiking to the shallow soil (23), but at the same time allowing each one to join two floating structures through two consecutive crossbars (1) or inner crossbars (13).

[0062] Last terminal coupling parts are crossbars split in two U-shaped pieces (25) and inner crossbars split in two U-shaped pieces (26), which can be seen in **Figure 12** and in **Figure 4.** Such elements can be disassembled into two unequal halves in form of bars of U-shaped cross-section, one that can fit inside the other with no clearances by their open sides, but having when coupled the same outer cross section than crossbars (1) and inner crossbars (13), respectively, having also the same standardized length of an integer positive number of segments and the same distributions of sets of holes for the sets of crossbars-floats fixing screws or bolts (7) and crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8), so they can be swapped by the crossbars (1) and inner crossbars (13) respectively. Before the two parts of each element are joined to each other and / or the floats (2), they can flank from both sides and close inside of them, along all its length, a cable, rope or chain whose extremes are far or are tied or hooked to a tree, lamppost, post, rock, or any elements from the environment where both extremes of the cable must be fixed, for instance, for passing a guide between two opposite shores. As such elements are splittable, they can flank such cable, cable or rope and a complete watercraft or floating structure can be built around it, feature impossible to perform with usual crossbars (1) and inner crossbars (13) as they are made in a single piece. The two halves can joined together by means of a series of spaced holes, either if vertical or horizontal, which cross both pieces to join in coincident positions by pins.

[0063] Finished the exposition of terminal coupling parts and intermediate linear coupling parts, it is turn for elements for angular joining, which allow the union of two floating structural modules or two floating assembled structures in mutual angle, being such angular pieces in rigid angle or in variable flexible angle thanks to a middle hinge that allows its folding. Such parts can be seen in **Figure 13.**

[0064] The rigid angled pieces (27) are just two sections of crossbars (1) or inner crossbars (13), or one of each, usually a segment in length, which are rigidly mutually linked, bent or welded at one of its ends in one of several possible standardized angles between 0 ° and 180 ° and different from them. Both arms in all these rigid angled pieces (27) have the same standardized length of an integer positive number of segments and the same distributions of sets of holes for the sets of crossbars-floats fixing screws or bolts (7) and crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8), for standardized coupling with other parts in the same way. But both arms have also a preset additional distance close to the corner to be calculated previously for each standardized angle, for allowing that the elements and pieces coupled to the segment or segments of each arm can fit and match in angle with the elements and pieces coupled to the segment or segments of the opposite arm, usually in this case the U-shaped longitudinal bars (3) without interfering or colliding but touching mutually for strengthening the assembly. For greater rigidity, the rigid angled pieces (27) may have at least a reinforcing rod or adjustable drilled plate (28) that obliquely connects both arms, which can be fixed by pins crossing through holes on both arms. The rigid angled pieces (27) permit the coupling on a floating structure of oblique or vertical side panels or floating structural modules. An example is to build an V-shaped or U-shaped cage or case over a floating structure or watercraft for transporting bulky cargo and avoiding they can fall or slide by sides to water, as may be sacks or tubes.

[0065] The variable angled pieces (29) and (30) are similar to the rigid angled pieces (27), also two sections of crossbars (1) or inner crossbars (13), or one of each, usually of a segment in length, each one of which is rigidly linked to the half of a centerpice which is split in two foldable halves, which can pivot each in relation to the other thanks to a middle transverse hinge, horizontal in relation to the same spatial orientation of coupling to the crossbars in the assemblies, that links both middle piece halves and therefore allow the folding of the two arms. The difference between them is that in the variable angled pieces with centered hinge (29), the transverse hinge is centered vertically with respect to the two articulated arms, allowing them to freely take symmetrically angles in both directions, as much as the shape of the piece may allow until touch between the two halves, while in the variable angled pieces with off-centered hinge (30), the transversal hinge is displaced from the center of the arms and middle pieces to the upper or lower extreme, allowing to their arms to freely take angles between 0° and 180° (or little less than 180°, depending on the shapes of the pieces and touches), and be folded one over the other. Both arms in all variable angled pieces (29) and (30) have the same standardized length of an integer positive number of segments and the same distributions of sets of holes for the sets of crossbars-floats fixing screws or bolts (7) and crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8), for standardized coupling with other parts in the same way. Although these parts are less strong than rigid angled pieces (27), they are more versatile as a single one of them can adopt a wide range of possible angles. For fixation on a specific angle, the variable angled pieces (29) and (30) may have at least a reinforcing rod or adjustable drilled plate (28) that obliquely connects both arms in the same piece, which can be fixed by pins crossing through holes on both arms.

[0066] Those variable angled pieces with centered hinge (29) allow to build safer long flexible floating structures formed by rigid short sections hinged together, which adapt to the waves, water movements, tides and swinging movements because displacement of cargo along the top deck or platform (as may be case of a vehicle in movement). And those variable angled pieces with centered hinge (30) enable the construction and coupling of lateral tilting, swinging or folding accessories or devices such as foldable bridge sections, foldable side ladders, foldable side accessing ramps, foldable side panels, etc. Such folding capabilities may be by having several identical pieces in parallel in a V-shape or L-shape folding arrangement with a common folding axes, or two consecutive ones in U-shape or Z-shape folding with two common folding axis, for larger foldable retractile sections. As a possible application seen in **Figure 14,** there is the possibility to build, especially with rigid angled pieces (27) coupled in several arrangements, watercrafts or rafts modified to deal with rough waters, provided with side panels, side inflatable sections, or side floating structural modules which give to the watercraft a U-shape or V-shape when seen from the front or rear, in order to defend the main deck, cargo and passengers from waves, splashes and water hits, as well as for quick recovering of horizontally and making harder that the craft could capsize.

[0067] For dealing with extremely hard waters is better to remove crossbars (1), rigid angled pieces (27) and variable angled pieces (29) and (30) from the floating structures and substituting them by stronger convex polygonal frames (32), which are made in a single piece. They are made of the same metal tube as that used for the crossbars (1), and therefore with its same cross section, but with shape of a flat closed polygon of straight sides, symmetrical in two planes mutually perpendicular (horizontal and vertical with respect to the floating structure to be built with them), as well to the third perpendicular symmetry plane as these pieces are flat. To make them, a section of the same metal tube that the used for the crossbars (1) with the same length than the perimeter of the convex polygonal frames (32) to make, is bent preset angles on preset longitudinal positions for shaping exactly such cyclic polygonal frame (32) desired, welding the free extremes together for closing the polygon. For avoiding tube deformation in the bent positions, it may be convenient to make preset diagonal triangle-shaped cuts in the metal tube itself in correct positions and inclinations for removing those leftover metal remnants, bending mutually both sides flanking each cut in the correct angle and welding both sides in this position, making the same on all corners of the polygon to shape and closing the polygon by welding of their ends, ending with the drilling of sets of holes for the sets of crossbars-floats fixing screws or bolts (7) and crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8), for standardized coupling with other parts over convex polygonal frames (32) in the same way. With at least two identical of these convex polygonal frames (32) equal, it is possible to assemble a floating structure with floats (2) placed in a peripheral arrangement approximately radial (more correctly said arranged in the direction of the apothems of all convex polygonal frames (32)), giving a partial or complete prismatic arrangement of the floats (2), leaving a prismatic tubular longitudinal opening in which to place, secure and immobilize cargo and passengers by means of the adequate fixation and accommodation elements. Each one of the sides of the polygonal cyclic frames (32) must have a length of an integer positive number of segments to permit standardized engagement of the same number of segments of floats (2) and floating structural modules over each one of the polygon sides, with the caution of adding to each polygonal side two additional small lateral distances on each of the two side ends, previously calculated for each angle, thus leaving on each vertex sufficient additional space for allowing the two floating structural modules docked flanking each corner to touch and to support mutually in angle on their two respective U-shaped longitudinal bars (3). Each cyclic polygonal frame side (32) has their corresponding standardized sets of holes in the direction perpendicular thereto contained in or in parallel to the plane of the cyclic polygonal frame (32) itself for the sets of crossbars-floats fixing screws or bolts (7) and crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8).

[0068] To this set of linking elements cited, it is added an additional set for building ramified structures, both in vertical branching (two-deck watercrafts, floating scaffolding, floating shelving) or horizontal branching (branched horizontal platforms, branched piers), consisting in ramified T-shaped and X-shaped linking pieces. These pieces consist of at least three sections of crossbars (1) and / or inner crossbars (13), usually a segment in length each, all of them mutually joined together by one of their ends, in an arrangement where they are aligned along the three main spatial mutually perpendicular directions, so arranged radially from the central common vertex, with at least two of them aligned coaxially in the same direction, sharing a common symmetry axis. Depending on the number of crossbars (1) sections and inner crossbars (13) sections used on each type of piece, they are obtained T-shaped branching pieces (34), (35), (45), (46), (55) and (56), X-shaped branching pieces (36), (37), (47), (48), (57) and (58), corner branching pieces (38), (39), (49) and (50), edge branching pieces (40), (41), (51), (52), (59) and (60), middle standing pieces (42), (53), (61) and (62), and finally core orthogonal pieces (43), (54), (63), (64). Each one of the crossbars (1) sections and inner crossbars (13) sections has their corresponding standardized sets of holes for the sets of crossbars-floats fixing screws or bolts (7) and crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8). Such parts are easily understood visually in **Figure 15.** In **Figure 15a** it can be observed an embodiment of some of these parts where all the arms are made with crossbars (1) sections which depart from a cubic middle piece, or from a cubic middle piece that can be inscribed inside a cube, having this cube a side length coincident or larger than the transverse perpendicular thickness of the crossbars (1) measured in their thicker side. Such cubic middle piece may have a hole or several orthogonal holes for introducing bars through and spiking the floating structures to shallow soil. In those branching pieces there are also a series of welded reinforcing metal braces with holes for fixing with pins or bolts diagonal braces or bars between two of these branching pieces mounted in the structure in the same vertical or horizontal plane but in opposite corners. In **Figure 15b** it can be observed an alternative embodiment of some of these parts which is identical to embodiment from **Figure 15a,** with the exception that instead of arms made with crossbars (1) sections, the pieces are made with inner crossbars (13) sections, and with the consequence that no welded reinforcing metal braces with holes for fixing diagonal braces can be added, as these arms are introduced inside the ends of crossbars (1) or inside ends of pieces having sections of those, so they are weaker in comparison with the previous embodiment. In **Figure 15c** is seen a last embodiment, made with crossbars (1) sections, where the pieces lacks of a central cubic middle piece, so it is possible to introduce completely an inner crossbar (13) through all the tubular hole of a single one of the arms, constituting stronger assemblies than in previous embodiments.

[0069] Some T-shaped vertical coupling elements (33), (33 '), (44) and (44') are added, which consists of a horizontal metal plate a segment wide or less on its longer side, with vertical holes practiced coincidentally with the positions of the set of holes for the sets of crossbars-floats fixing screws or bolts (7) and crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8) for standardized coupling over a segment of a crossbar (1), inner crossbar (13) or float (2) in any of their transverse grooves (4) or (6). Over this horizontal drilled plate there is a crossbar (1) section or an inner crossbar (13) section of at least a single segment in length, welded vertically. Such vertical arm (in the coupling position over a floating structural module or a floating structure) has also the same standardized set of holes for the sets of crossbars-floats fixing screws or bolts (7) and crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8) for standardized coupling of a vertical crossbar (1) or inner crossbar (13) perpendicularly to the horizontal plane of the main deck of all the detachable structures. Those T-shaped vertical coupling elements (33), (33 '), (44) and (44') are useful for attaching a second platform of deck over the floating structure (as may be in two-deck watercrafts, floating scaffolding, floating shelving, among others), being used in opposite pairs on each end of each vertical crossbar (1) or inner crossbar (13) used for raising the second deck from the main one. They also enable quick and easy assembly and disassembly operations of such elevated decks or platforms without removing all or part of the main floating structure as happen with other prior elements, as they are coupled and screwed directly over the main crossbars (1) without being inserted or interspersed in their same lines and therefore without disassembly, but only with simple unscrewing and screwing operations. On bottom of **Figure 15** it can also be seen two of the many examples of ramified or branched structures in horizontal and vertical directions, in both cases including some oblique reinforcing straps to the structure, joining opposite adjacent corners located in the same plane, which can be set by taking advantage of vertical holes in the cubic middle pieces and / or of welded reinforcing metal braces usually practiced of these elements.

[0070] Concluded exposure of elements, parts and refinements for linking and joining of floating structures, a second group of pieces, parts and improvements refers to the buoyancy elements, starting from the floats (2).

[0071] The bottom of the floats (2) is flat or slightly convex, with a little prominent keel and / or middle longitudinal fin, for sliding on water but being tough and durable against shocks and abrasion due to submerged objects, stones or hard soil during transport or assembly. Because of the need for standardization of dimensions and lengths of the parts and pieces, and of positions of the different coupling devices and mechanisms, like the crossbars (1), inner crossbars (13) and related pieces composed of sections from those, the floats (2) are manufactured in several different selectable widths that are a positive integer multiple of the unitary length of a segment. The positions of the sets of holes located at the top flat surface of transverse grooves (4) and (6) (best said the female threaded metal bodies embedded in the body of the floats (2) that contains such sets of threaded holes) for screwing the sets of crossbars-floats fixing screws or bolts (7), and the positions of the sets of holes located at the top flat surface of transverse grooves (5) (best said the female threaded metal bodies embedded in the body of the floats (2) that contains such sets of threaded holes) for screwing the sets of floats-U-shaped longitudinal bars fixing screws or bolts (9), are both repeated transversely sideward in the direction of the transverse grooves (4), (5), (6) and the crossbars (1) at each segment, so repeated as many times as segments the float (2) has in width. This periodic repetition of locking devices and mechanisms at each segment in length sideward is also applied on each set of several equal longitudinal guideways or flanges (11) shaped or placed longitudinal on top flat horizontal surface at the prow of the floats (2), and to each set of vertical holes (best said the female threaded metal bodies embedded in the body of the floats (2) that contains such sets of threaded holes) for screwing the set of floats-sliding covers fixing screws (12). All of those being disposed symmetrically with respect to the vertical longitudinal plane of symmetry passing through the center of the float (2), as well as in relation to the vertical longitudinal plane of symmetry passing through the center of each unitary set a segment wide of all locking and fixing devices (as they are repeated sideward on each segment).

[0072] This standardization by fixing widths of the pieces to several incremental discrete values, multiple of the unitary length of a segment, is also exactly applied to the width of front sliding covers (10), their bottom slots for docking and sliding over each set of several equal longitudinal guideways or flanges (11), as well as for each one of their sets of vertical holes for allowing pass and tighten action for each set of floats-sliding covers fixing screws (12).

[0073] These floats (2) two, three, four, or more segments wide if they were to make, allow the construction of large floating structures (as those that must withstand heavy loads or more people over) in less time and with less screwing operations, at the cost of more size, weight, more operating crew and less portability and handling easiness. Also wider floats (2) allow that hulls can be less segmented, so their watercrafts should be stronger than the same one built with narrower floats (2). It is clear the desirability of various possible sizes of floats (2) to choose among, to pick them smaller, lighter and more portable for building small, maneuverable, light, fast watercrafts, or bigger, heavier, less transportable for building big, heavy, slow, high-capacity watercrafts and rafts. This is the same case for building shorter or longer pontoon bridges and pontoon walkways.

[0074] Despite they are suitable for detachable watercrafts, the floats (2) have the problem that although they are suitable for construction of pontoon-type floating structures with floats separated with gaps between all or several of them, whether if it is a watercraft as if it is a pontoon floating bridge or pontoon floating walkway, in case of assembled watercrafts they can easily suffer pontoon effect, due to the fact that the main deck or platform for cargo and passengers is placed above the floats, so that the buoyancy center can be very close or even below the gravity center. Therefore, those watercrafts built with floats (2) must be enough wide to increase its stability, so reducing its speed, or being limited simply to catamaran-type or pontoon-type watercrafts. This problem is not found in almost all other watercrafts, as in dinghies or rigid inflatable boats, as the hull is hollow and the deck or walking platform is very close to the float bottom, so cargo and people are placed at a lower height and buoyancy center is above gravity center, giving stability to the watercraft.

[0075] By this reason, floats (2) should be improved with a new version of hollow counterparts. An alternative enhanced embodiment of the floats (2) are the hollow floats (67), which are exactly as the floats (2) on its dimensions, materials and shapes, but having upper openings on its top horizontal surface that shape and give access to a series of inner compartments (68). A comparison of the floats (2) and (67), and some of the improved models of floats, from one to three width segments can be seen in **Figure 16**. Such top openings in floats (67), as well the inner compartments (68), both having coincident or similar perimeters and shapes in the horizontal plane, are practiced on the float (67) from above without reaching to the bottom, obviously for impeding entry of water, but arranged inside the perimeter formed by the two twin U-shaped longitudinal bars (3) when coupled to the float (67), so also avoiding the occupied surfaces by the transverse grooves (4), so that there are three separated top openings and there may be also from one to three inner compartments below, depending if such inner compartments are fused together or not. Those top openings are provided with top covers (69) to close the inner compartments (68) of them with corresponding locks, latches and locks. These compartments (68) can be filled with ballast, with which to keep the gravity center of the watercraft as low as possible to increase stability and placing it below the buoyancy center, or use them to store tools, accessories, supplies, water or fuel tanks, electric batteries, and any element which, being within the floating element, so in practice inside of a floating structural module, can be added or removed from the different structures within the same with noi need of removing it if the overall weight is light and manageable. Also, the main feature of floats (67) is that they allow to make the same than floats in rigid inflatable boats, by lowering the deck height for placing people in a more stable position and protected against fall by the inner faces of the float (67). Passenger may sit on detachable seats and backrest dockable along perimeter of U-shaped longitudinal bars (3).

[0076] Despite the resulting deck is smaller for walking, those inner compartments (68), especially if they are not fused together, allow to confine ballast and cargo in a smaller spaces than in other usual watercrafts, so they are retained on their place even if the watercrafts is shaken with hard water, and if covered by top covers (69) they can not be released or lost anyway. Meanwhile, prow and stern in the floats (67) have "solid" sections which can be filled, as the floats (2) should do, with unsinkable foam to make the same with said floats (67). Floats (67) have also inner transverse vertical walls or transverse beams (70) separating each two adjacent inner compartments (68) and hosting also on their top surface, coincident with the same of the float (2), the transverse grooves (4) with the set of holes for screwing the sets of crossbars-floats fixing screws or bolts (7), and inside their bodies the female threaded metal bodies that contains such said sets of threaded holes, for obtaining the same coupling capabilities than floats (2).and the same structural strength.

[0077] Other new perfected floating elements to add to the set of elements and pieces for adding versatility and practical functionality are new modified versions (71), (72) and (73) from floats (2), and other new different modified versions (74), (75) and (76) from floats (67), lacking first ones of inner compartments (68) as the floats (2) lack of them, and having second ones inner compartments (68) as the floats (67) have. All of them are characterized of being longer than floats (2) and (67) by being provided of a extended stern that protrudes exactly to the rear the same distance than the prow to the front in floats (2) and (67), measuring the distance from the closer transverse groove (5) to the extreme considered. In the same way that the prow, those extended stern in all new floats (71), (72), (73), (74), (75) and (76) has a rear transverse groove (77), symmetrically placed respect to the front transverse groove (6) in relation to the center of the floating element, and exactly having the same standardized sets and distributions of fixing elements for coupling and tightening of crossbars (1) as the front transverse groove (6) has. In the same way, all these extended sterns always have rear longitudinal guideways or flanges (78) which are symmetrical and opposite to the front longitudinal guideways or flanges (11), and rear sets of vertical holes for allowing pass and tighten action for the corresponding sets of floats-sliding covers fixing screws which are symmetrical and opposite to the front sets of vertical holes for allowing pass and tighten action for the corresponding sets of floats-sliding covers fixing screws (12), all of them respectively symmetrically arranged them in relation to a transverse vertical symmetry plane passing through the center of the floating element. They also have rear sliding covers (79) for making the same work than the front sliding covers (10).

[0078] Those floats (71), (72), (73), (74), (75) and (76) differ among them in if their prow and stern are equal and symmetrical or are different. Floats (71) and (74), (closed and open, respectively) have a pointed end and the other is blunt, rounded or completely straight seen from above, making it possible to choose, depending on the duty that is to do, one of the two ends as prow in a watercraft, so having two possible orientations of the floats (71) or (74) when assembling watercrafts. However, the floats (72) and (75) (closed and open, respectively), and the floats (73) and (76) (closed and open, respectively), have both ends equal and symmetrical to each other, with the distinction that when seen from above, in the first pair both ends are pointed and in the second pair they are blunt, rounded or completely straight. First pair is especially for assemblies where it is necessary to cut or split the water flow at both sides of the floating element, while the second pair is especially for assemblies where it is necessary to deviate water flow below the floating element, as well as for assembling of continuous multihull long or large watercrafts, as linear barges expandable in length to see later.

[0079] **Figure 17** illustrates clearly the practical advantage of using asymmetrical floats (71) and (74) having different pointed and blunt ends for choosing between. In case (a) there is a detachable watercraft with a multiple-float sectional hull in compact arrangement that carries little cargo, so it slides smoothly above water surface and can reach high speed. In case (c) there is the same watercraft than in case (a) but carrying very much cargo, so the hull is sinking lower, and the saw-teeth shape of the prow retains water flow in front water flow pockets, so the watercraft slows. Simply by reversing the docking position of the outboard motor for swapping the watercraft's extremes as seen in case **(d),** the prow is now blunt seen from above but curved when seen from the side, so with this same watercraft the water flows beneath the hull when the watercraft is moving forward, raising the prow even with a heavy cargo. In case of hull arrangements with separate floats **(b),** as in catamarans, pontoon watercrafts and floating pontoon bridges and walkways, it is best to choose the pointed ends faced to the incoming direction of water, for either sliding over water with little cargo or cutting water with heavy cargo. So these asymmetrical floats (71) and (74) saves space in transport vehicles but allow choose the coupling direction of the floating elements in the assemblies.

[0080] **Figure 18** illustrates two examples of useful uses of symmetric floats (73) and (76), both with symmetric blunt ends. In **(a)** a long modular expandable barge is shown, being such barge built with floats (73) and / or floats (76) which are arranged perpendicularly to the direction of advance of the barge, which moves in the same direction than the crossbars (1), so perpendicularly to the normal direction in almost all watercrafts assemblies. As symmetric floats (73) and (76) have both equal indifferent ends, those can be the symmetric port and starboard sides in the barge. If floats (73) are used, the main platform or main deck is placed over its top. If floats (76) are used, ballast or part of the cargo can be loaded inside their inner compartments (68), fully exploiting cargo capacity and improving stability of the barge. In addition, while in usual watercrafts arrangements the added floating structural modules expand the width, in this other arrangement is the length the one which is expanded with no theoretical but practical limits, so barges can be very long, which enhances speed, and can have highest cargo capacity. Case **(b)** is only possible in case that the separation distance d between the main symmetry axes of each pair of contiguous crossbars (1) and therefore between the main symmetry axes of each pair of contiguous transverse grooves (4), (6) and (77), that is, its spacing, is constant, but at the same time the distance from the symmetry axes of both crossbars (1) coupled inside the transverse grooves (6) and (77) and the symmetry axes of these last ones to the extreme of the closest end of the float (73) or (76), is half the said constant distance d. With these two geometrical conditions it is possible to mount the floats (73) and (76) in horizontal two-dimensional arrangements, able of growing in length but also in width. To make so, the floats (73) and / or (76) can be assembled in longitudinal rows touching mutually by their extremes (shorter sides), not by their sides (longer sides) for growing the structure in a single direction. For growing the structure in the other horizontal perpendicular direction, the successive rows at side are displaced relatively to the previous one or two crossbars (1), so they interlace. In case of displacing a single crossbar (1) the successive rows symmetrically at both sides from a central row, obtained structure is or can be arrowhead-staggered in shape. In case of displacing two crossbars (2) the successive rows symmetrically at both sides from a central row, obtained structure is or can be diamond in shape or cushion in shape with staggered sides. In case of displacing of displacing either one or two crossbars (2) the successive rows only to a single side, obtained structure is rhomboidal with staggered sides.

[0081] Both floats (73) and (76), as well as all floating elements seen for now, have flat vertical sides for coupling exactly to another one with no gaps or clearances and fusing all of them consecutively in a single detachable but continuous hull. Such flat vertical sides are not suitable for maneuvering of watercrafts as they oppose to turns. To enhancing maneuverability in certain detachable watercrafts, an additional supplementary rounded side float (80) is added to the set of pieces, shown in **Figure 19**. It is docked in symmetric twin pairs at both sides of a watercraft or at the prow and stern of a linear barge, smoothing and rounding corners and hull shapes, besides providing additional buoyancy and lateral stability. This supplementary side float (80) is preferably of a segment of width, and is symmetrical in relation to a vertical symmetry plane transverse to the forward direction of the watercraft that passes through its own center, but unlike all other floating elements it is asymmetric with respect to a vertical symmetry plane parallel to the forward direction of the watercraft that passes through its own center. It can be laterally coupled perfectly the direction of the crossbars (1) on either equal vertical flat side faces of the floats (73) and (76), so for that its vertical flat face has exactly the same matching section for a seamless junction with them, while the other opposite side is parallel to the anterior surface and much smaller, both being joined by continuous curved surfaces that aid to round and to smooth the hull shapes when two twin supplementary side floats (80) are docked. For coupling to the floating structures by means of the crossbars (1), such supplementary side floats (80) have their corresponding transverse grooves (4), (5), (6) and (77) arranged symmetrically to its vertical transverse plane of symmetry, each one with the corresponding sets of holes located at the top flat surface of them (best said the female threaded metal bodies embedded in the body of the supplementary side floats (80) that contains such sets of threaded holes) for screwing the sets of crossbars-floats fixing screws or bolts (7), crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8) and floats-U-shaped longitudinal bars fixing screws or bolts (9). By the asymmetric shape of their ends, they lack of longitudinal guides (11) and (78) and sliding covers (10) and (79).

[0082] The shorter floats (2) and (67) of three transverse grooves (4) and (6) have the advantage of fitting better inside boxes of smaller vehicles as small trucks, vans and car roof racks of ATVs, being particularly suitable a length of about 3 meters with a spacing between their transverse grooves (4) and (6) of about a meter. Moreover, longer floats (71), (72), (73), (74), (75) and (76) which have an extended stern with respect to those shorter ones (2) and (67), fit in larger vehicles such as trucks, large vans, trailers and car roof racks in long ATVs, due to the fact that if the spacing between two consecutive transverse grooves (4), (6) and (77) is about a meter, such floating elements have a suitable length of about four meters. However, apart from these two possible lengths given for having an idea of sizes, it is possible to make longer floats to give longer watercrafts and wider floating pontoon bridges with the same spacing between all two consecutive transverse grooves (4), (6) and (77) for a compatible coupling system with the other pieces, but in this case the length of the floating elements, which have an additional meter in length for each of each transverse groove (4), (6) or (77) added, make it very difficult to transport, to storage, to handling and to assembly except for the military, which already has a large number of rigid inflatable boats and extensible bridges that can carry with their numerous logistical and transportation means. Moreover, the coupled pairs of U-shaped longitudinal bars (3) pose a problem, since their interlacing with the crossbars (1) for producing the strengthening of the structure, and as they constitute the main platform or the perimeter for the top openings in the hull for placement of cargo and passengers.

[0083] So increasing the length of the floating element means to add successively in longitudinal row coupled pairs of two additional U-shaped longitudinal bars (3), one after the other docked over two crossbars (1) each, so two additional transverse grooves (4) are needed for each additional coupled pair of them, or instead of this solution, leaving as the only one the default coupled pair of U-shaped longitudinal bars (3) in the center of the floating element above the two default crossbars (1) docked on the two default transverse grooves (4), and extending the prow and / or the stern the necessary length, in a way that more transverse grooves (4) and (77) will appear, and the sliding covers (10) and (79) may become excessively long. Some illustrative examples are shown in **Figure 20.** Therefore, increasing the length of the floating elements in a single piece is not practical unless these floating elements are composed of detachable cross sections, such that the length increases with the number of cross sections added to the series. This would facilitate the transport and handling, as such sections are shorter, and gives no theoretical limit to the length of the constructible watercrafts, as well those sections would be easier to fabricate by not being excessively large or long. An example would be for special applications for cargo or freight transport in lakes, reservoirs, rivers or flooded extensive areas where the watercrafts need to reach a certain speed, so that the hull must be narrower than the linear barges allow.

[0084] As seen in **Figure 21,** a practical solution is to add to the set of pieces and parts three selectable sliced float sections (82), (83) and (84). These have the respective geometric shapes that result from severing an asymmetrical float (71) for each one of their standardized widths in segments, with one or two cuts according to a vertical plane perpendicular to its vertical symmetry longitudinal plane that passes through its center on calculated longitudinal preset positions, to obtain a bow sliced section (82) containing the pointed prow end, the transverse groove (4) and closest transverse groove (5), a stern sliced section (83) containing the straight blunt end, the transverse groove (77) and closest transverse groove (5), and an intermediate sliced section (84) containing none of the two ends with constant cross section, with exception of the upper transverse grooves (4) and the only modification of two additional adjacent transverse grooves (5) in middle, separated by a thin wall or fused in a single one. In this last intermediate sliced section (84) the flat vertical surfaces resulting from vertical cuts are exactly equal and coincide with each other, as well as with their counterparts in bow sliced section (82) and stern sliced section (83), to enable the construction of floats consisting of two or more sliced sections consecutively aligned without discontinuities in hydrodynamic profile and shapes, so longitudinal positions of those vertical cuts are calculated for giving these geometrical results. Thus, each coupled pair of U-shaped longitudinal bars (3) join longitudinally two consecutive sliced sections (82), (83) or (84) and their respective crossbars (1), which before this coupling were independent and were kept separate. Thus possible combinations are of two bow-bow sliced sections (82) + (82), two stern-stern sliced sections (83) + (83), or with at least one intermediate sliced section flanked by two terminal sliced sections in arrangements bow-bow sliced sections (82) + m · (84) + (82), stern-stern sliced section (83) + m · (84) + (83), or bow-stern (82) + m · (84) + (83), where m a positive integer greater than or equal to unity.

[0085] Last additional floating element to add, seen in **Figure 22**, is a pneumatic inflatable float (85) which combines a solid top non-deformable section (86), which has an integer number of segments in width, with a bottom inflatable pneumatic section (87) in approximately cylindrical symmetry, so in shape of capsule or banana, which is fastened to the previous solid top non-deformable section (86) through a series of hooks and buttonholes (88) or straps (89) at intervals around it, thus facilitating rapid replacement when damaged, ripped or punctured, with no need of changing top solid non-deformable section (86). Its main practical use is to build catamarans, rafts floating pontoon walkways or floating pontoon bridges or high cargo or traffic capacity, with the disadvantage of shorter life because fabric wear, which limits them to use in relatively calm waters with no floating dragged sharp pointed debris, and they can only be assembled into structures with separate floats since their rounded cross sections do not have the same flat vertical faces for perfect lateral coupling as all other floating elements have Said top solid non-deformable section (86) has the same transverse grooves (4), (5), (6) and (77), the same longitudinal guideways or flanges (11) and (78), and the sliding covers (10) and (79) as almost all other floating elements in in the same relative positions for compatible coupling operations, having also obviously over the top flat horizontal surface of transverse grooves (4), (5), (6) and (77) the same respective sets of holes, drilled vertically, for introduction of sets of crossbars-floats fixing screws or bolts (7), crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8) and floats-U-shaped longitudinal bars fixing screws or bolts (9), as well as their corresponding female threaded metal bodies embedded in the body of the solid top non-deformable section (86).

[0086] All floating elements have been described. But besides of all of them, in order to increase the lifespan of all described expensive solid floats (2), (67), (71), (72), (73), (74), (75) and (76), float sliced sections (82), (83) and (84), and non-deformable sections (86), a new protection element is added. The hours of continuous use and movements of distortion of the structure, with abrasion due to mud and small stones can cause that the plastic area surrounding these transverse grooves (4), (5) and (77) resulted deformed and worn, leading to the appearance of clearances incompatible with a stable and safe structure. So all the transverse grooves (4), (5), (6) and (77) can be completely coated or covered by thin wall U-shaped protection spacers (91), seen in **Figure 23,** made of a hard or flexible material (either metal, hard plastic, rubber or any one) which can be placed between crossbars (1) and transverse grooves (4), (6) and (77) and between U-shaped longitudinal bars (3) and transverse grooves (5) making contact with both and separating them by a thin wall. These U-shaped protection spacers (91) are those who suffer the most wear and may be replaced with ease, besides being much less expensive than the flotation elements themselves.

[0087] As seen in several examples in **Figure 24,** the sliding covers (10) and (79) may also be manufactured in many alternative custom shapes and embodiments with additional useful practical custom functions in addition to its main function of locking of front crossbar (1) inside the transverse groove (6) and / or locking of rear crossbar (1) inside the transverse groove (77) . In the normal case **(a),** the sliding covers (10) and (79) are applicable only to this function, providing a smooth, rounded aesthetic shape that continues the smooth surfaces of prow and / or stern from the floating element where they are placed. Depending if the floating element has equal ends or not, such sliding covers (10) and (79) can be equal or different in shape, but always having the same bottom slots for sliding and docking on the longitudinal guideways or flanges (11) and (78). As seen in (b), both may be replaced by sliding covers whose embodiment is a rectangular platform section (92), of one or more segments of width, which are provided with non-slip textures for safety on its top horizontal surface. Those extend forward and backward (or laterally, depending on the orientation of the floating structure) the main deck or walking platform above the ends of the floating elements as they are added to the floating structure in assembly. As seen in **(c)** and **(d),** those can also be replaced by sliding covers with sections one or more segments in width, where each one incorporates a vertical or inclined panel (93) or handrail, railing or similar thing, as well can have shape of a molded seat and backrest (94), with which easily build in row an expandable gunwale or seat row at the sides, respectively. With these embodiments such elements are added as each floating structural module is added to the assembly, giving an expandable walking platform at sides and / or expandable seat rows or expandable gunwales, defending the interior of the watercraft or floating pontoon bridge against water shocks or splashes and protecting walkers or passengers from falling to water.

[0088] In **Figure 25** a new important element for assembly of watercrafts is shown, which is a combination between a floating element and a sliding cover for changing shape and / or materials of the watercraft's prow for practical purposes, and increasing also its structural strength, in concrete an attachable front prow (95) of two or more segments in width, which is selectable, removable and interchangeable and can docked if necessary. It is a cap-shaped or hood-shaped detachable bulky element having the hydrodynamic external shape of a watercraft's prow which is docked by sliding and docking over the front longitudinal guideways or flanges (11), in the same way as front sliding covers (10), being coupled to the front of the watercraft, but as it is in a single piece, it encompasses and embraces as a big cup with no clearances all the outside of the watercraft's prow and all its composing parallel floats in mutual contact at the same time. As it holds together by embracing all of them, they are unable to separate each other even if the watercraft moves at high speed, as this piece is the one which receives all or almost all water impact in advance movement. By selecting the correct or most suitable external hydrodynamic shape, this element can improve buoyancy, speed or both.

[0089] Each attachable front prow (95) has variable custom external shape, length, width, material and hydrodynamic profile, being obviously symmetrical in relation to a vertical symmetry plane that pass through the center of the watercraft and through the center of the same in coupling position, and has a cavity, recess or hollow which is also symmetrical in the same way in relation to said symmetry planes. This hollow is practiced in longitudinal horizontal direction and is open only to the rear for docking on the floating elements, but closed to all other sides, for avoiding to be filled with water when the watercraft floats or moves. This cavity, recess or hollow has the same transverse width and segments in width than the pile or stacking of all floating structural modules of the watercraft where those attachable front prow (95) is to be docked, so overall width of the complete piece is a little more due to both two opposite walls that flanks the central cavity, recess or hollow. As seen in the figure, as all anchoring, fixing, locking and sliding devices from the invention are repeated in direction of the crossbars (1) a time for each segment in length present along of all present floating devices, irrespective of the distribution of floating elements and its width in segments of each separated one, the longitudinal guideways or flanges (11) and holes for the sets of floats-sliding covers fixing screws (12) remain then irrespective of the distribution, types and widths of all involved joined floating elements, with the only condition that always the number of segments of them must be the same than the width of the inner recess or hollow the concrete chosen attachable front prow (95) has, for fitting inside exactly as in a cup piece. In other words, each attachable front prow (95) can be docked indifferently on homogeneous or heterogeneous floating structural modules, on symmetric or asymmetric arrangements of them, but preferably on homogeneous and symmetric ones for stability. The surface of the recess or inner hollow matches and fits to the outer surfaces at prow of the different floating elements involved in the assembly, both their top flat surfaces as their other rounded smooth surfaces, so the attachable front prow (95), once coupled and fixed, is supported but also held and tightened backwards to the floating elements by the compression due to the forward move of the watercraft, as the bottom of the attachable front prow (95) extends and inserts below the floating elements in the watercraft some longitudinal distance, causing the water flow to continue under the hull without they receive the force impact, so that it prevents this attachable front prow (95) can be peeled from its position and also protects, embraces holds together the longitudinal floating elements.

[0090] For being docked and fixed each attachable front prow (95) has a series of slots practiced on the top surface of its inner hollow in matching coincident positions for obviously match with all the longitudinal guideways or flanges (11) and avoiding to the piece to slide longitudinally in relation to the floating structure when landing over the top horizontal surface of the floating elements, guided by those longitudinal guideways or flanges (11) to a stop position, where the attachable front prow (95) is screwed or bolted to the floating structure by using the sets of floats-sliding covers fixing screws (12) usually used for sliding covers (10). For this, the attachable front prow (95) has a set of vertically drilled holes in coincident positions with the holes found below over the top surface of the floating elements for said fixing screws that cross completely the top wall of the piece for being crossed by them. Obviously said longitudinal slots and said vertical holes are also in sets whose relative distribution is repeated sideward at each segment for standardization and for following the same compatible coupling system with other pieces. For coupling even more strongly the attachable front prow (95), their twin side walls are symmetrically pierced along a horizontal transverse direction in preset position, in a way that when the piece is docked and screwed to the floating structure, said holes are coincident in shape, dimensions and position with the consecutive aligned transverse grooves (6) of all stacked floating elements, so the attachable front prow (95) can be also held to the watercraft by means of a crossbar (1) that goes through said side holes and said consecutive aligned transverse grooves (6), as a kind of big bolt for fixing the whole piece on the watercraft main body.

[0091] These attachable front prows (95) allow change and to improve modularly and interchangeably shapes, materials, lengths, mechanical properties and hydrodynamic shape of almost any modular watercraft's prow without changing the main composing longitudinal floating elements in docking and undocking operations. For example, among the many custom possibilities, it is possible to dock a hard prow for working in shallow landscapes with hard, rocky, abrasive soils, floating debris, or even a metal saw-teeth blade (98) for cutting thin ice layers or ice blocks as an icebreaker ship does, protecting the softer longitudinal floating elements, especially if made in plastic.

[0092] Once described the elements related to the hull and buoyancy, it is time for full description of U-shaped longitudinal bars (3) and modifications and related pieces with these elements.

[0093] The two twin coupled U-shaped longitudinal bars (3) attached to each float or float sliced section (2), (67), (71), (72), (73), (74), (75), (76), (82), (83), (84) or (85) constitute, once joined together, a rectangular horizontal frame which is elongated with its longer side in parallel to the main longitudinal floating elements. As commented before, they allow the distribution of weights and forces from the platform above the floating structure assembled both to the floats or float sliced sections (2), (67), (71), (72), (73), (74), (75), (76), (82), (83), (84) or (85) and to the crossbars (1). Also provide an interlaced sandwiched expandable main frame with increased structural rigidity against compression and shear forces, by being simultaneously screwed to the other two main structural parts in a same, as well as by touching sideward by their longer central linear sections to other two twin coupled U-shaped longitudinal bars (3) belonging to adjacent floating structural modules, or other intermediate elements or accessories interposed therebetween.

[0094] Each pair of coupled U-shaped longitudinal bars (3) have the problem that they are not linked together directly, needing to be connected through the same float or float section (2), (67), (71), (72), (73) , (74), (75), (76), (82), (83), (84) or (85) where both are screwed or bolted, acting such floating element as a joining intermediate piece between them. Therefore, if both are coplanar it is because they are fixed only by the transverse grooves (5) and the sets of thick and strong crossbars-U-shaped longitudinal bars connecting screws, threaded rods or bolts (8) and floats-U-shaped longitudinal bars connecting screws or bolts (9), as happens with mutual coplanarity of all coupled pairs of U-shaped longitudinal bars (3). So any enough strong hit, any enough continuous wear, any excessive deformation could break said fixing screws or bolts, removing U-shaped longitudinal bars (3) from their positions of assembly on the transverse grooves (5), dismantling the main platform and part of the floating structure, perhaps collapsing it. This expandable main frame is then vulnerable to excessive shear movements which are both parallel and perpendicular to the crossbars (1), to traction movements in the direction of the crossbars (1), to twisting movements also according to an axis parallel to the crossbars (1) that separate them from the same common horizontal plane, as well as to bending movements on the crossbars (1).Such efforts are mainly supporting by the screws. Furthermore, when removing one or both U-shaped longitudinal bars (3) from a floating structural module, they remain separated between them, so they should be handled compulsorily separately unless both were connected by a common rectangular plate or platform section.

[0095] For avoiding those problems, as seen in **Figure 23,** to each coupled pair of U-shaped longitudinal bars (3) two twin small, simple transverse crossbars (100) are added, which are preferably made of metal, stainless steel or alloy resistant to corrosion for obtaining structural strength, being solid or hollow tubular, with the same outer cross section than the inner cross section that the metal tube with which the U-shaped longitudinal bars (3) are made, or slightly smaller than last one. Each one of said small transverse crossbars (100) can fit and being inserted easily with no clearances by inside the tubular openings of the transverse ends of tubular U-shaped longitudinal bars (3), in a way that when assembled, half of each of these small transverse crossbars (100) is introduced inside a transverse end of a single U-shaped longitudinal bar (3), and the opposite half can also fit inside a transverse end of another opposite single U-shaped longitudinal bar (3) in mirrored arrangement in relation to the first one, precisely as U-shaped longitudinal bars (3) are arranged when coupled and fixed to the transverse grooves (5) sharing a common float or float sliced section (2), (67), (71), (72), (73), (74), (75), (76), (82), (83), (84) or (85). Both transverse ends of both coupled U-shaped longitudinal bars (3) and both twin small transverse crossbars (100) placed inside them are drilled with the same coincident consecutive vertical holes (in coupling position) with the vertical holes practiced on top horizontal surface of transverse grooves (5) for placing the sets of floats-U-shaped longitudinal bars connecting screws (9), so these fixing screws cross both types of structural metal pieces. As the holes in the small transverse crossbars (100) are threaded for retaining these fixing screws (9) into them, the sets of floats-U-shaped longitudinal bars connecting screws (9) can join together both coupled U-shaped longitudinal bars (3) in a single whole linked by the said middle twin small transverse crossbars (100), even if they are not screwed to any floating element, but increasing enormously structural strength of detached floating structural modules and assembled floating structures when they are screwed to any floating element, as they maintain all U-shaped longitudinal bars (3) in the same plane, especially if said small transverse crossbars (100) are solid, made in metal, and fill completely hollow transverse ends of U-shaped longitudinal bars (3).

[0096] Some or all pairs of coupled twin U-shaped longitudinal bars (3) can be replaced by rectangular frames (99), characterized by having exactly the same shape, dimensions and perimeter than each one of said pairs of coupled twin U-shaped longitudinal bars (3), thus both can be swapped indifferently in all the assemblies. So these rectangular frames (99) have standardized dimensions as all pairs of coupled twin U-shaped longitudinal bars (3), with the sides that are perpendicular to the crossbars (1) in coupling positions of the same constant length, and with the sides that are parallel to the crossbars (1) in coupling positions of a series of possible standardized lengths in a positive integer number of segments. By the same reasons, all holes drilled on each pair of coupled twin U-shaped longitudinal bars (3) are replicated exactly in diameter and coincident positions on their counterparts, those rectangular frames (99) having the same dimensions and perimeter. As these rectangular frames (99) can not be split in two smaller, lighter halves as their counterparts, they have more difficulties in storage and transport, not in assembly operations, but are weaker as they are shaped by bending the tube right angles in preset positions and welding at some point in the perimeter, which can be corroded or be broken with time.

[0097] As seen in **Figure 16**, above a single floating element a segment in width, one of the two said elements for constituting a section of platform can be coupled indifferently (a pair of coupled U-shaped longitudinal bars (3) or a rectangular frame (99) of the same dimensions and perimeter), with same results with exception of the structural strength. But if the floating element has n segments in width, or there are several of them stacked in mutual side contact in a pile with n overall segments in width, both different elements can be coupled indifferently or in mixed coupling until completing said n segments in width, as the coupling operations are based in the match of the number of overall segments between the two different types of pieces to couple, not in the match of the same value of segments of width between two different pieces to couple, as second case is a particular situation inside first case. In other words, each coupled pair of U-shaped longitudinal bars (3) and each rectangular frame (99) can be coupled over a floating element with the same width in segments, for constituting a floating structural module, or well be coupled over a floating element, or several ones, having different width. In first case the floating structural modules can be coupled or uncoupled to a floating structure in assembly detachedly one by one, including all their possible docked accessories and contents inside their inner compartments (68), while in second case this is not possible, but as the main structural elements are interlaced even more, resulting structure is even stronger by intercrossing of different pieces with different width. So for example, a pontoon bridge can be built using big floating elements three segments wide, but the platform coupled above is made with rectangular frames (99) a single segment wide, obtaining triple number of crosspieces in the bridge for supporting more weight on the platform (for example, for passing vehicles), or two segments wide, being interlaced with bottom floating elements and raising rigidity, as the widths of both elements individually do not match. This operation is the same for sliding covers (10) and (79), rectangular platform sections (92), and other possible accessories.

[0098] Over each one of the pairs of coupled U-shaped longitudinal bars (3) and over each one of the rectangular frames (99), a modular rectangular platform (101) can be screwed or bolted along their respective metal tube perimeters through drilled holes, for giving a walking platform or main deck which is expandable with each floating structural module added, each coupled pair of coupled U-shaped longitudinal bars (3) added, and each rectangular frame (99) added, so main deck expands or shrinks modularly. So they have standardized dimensions of an integer positive number of segments in length in one of their sides, for always matching with size and dimensions of the different standardized coupled pairs of U-shaped longitudinal bars (3) and rectangular frames (99), matching well with their external perimeter for being screwed or bolted over them, or matching with their internal perimeter for being screwed or bolted fitting inside, resting over the top surface of the floating element below if it is present. They also have drilled holes in matching positions with those two elements for screwing or bolting operations. Those modular rectangular platforms (101) can be made in any resistant material for supporting weight and load with no breakage (perforated stainless steel plates, hard plastic, wood), always with rough textures or anti-slip surfaces for safety when walking, standing and stepping.

[0099] All of these platform rectangular modules, made of coupled pairs of U-shaped longitudinal bars U (3) or rectangular frames (99), cooperate with the other elements by supporting each other to each other to withstand better compressive and shear forces in transverse direction, but they are relatively ineffective against transverse tensile and longitudinal shear forces that tend to separate them or to slide them longitudinally in parallel to each other, so that these types of deformations will be fully supported by the sets of thick and strong crossbars-floats fixing screws or bolts (7), crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8) and floats-U-shaped longitudinal bars fixing screws or bolts (9). Therefore, several anchoring elements for additional reinforcement against these movements are added. **Figure 26** shows the different ways in which two adjacent floating structural modules or platform rectangular modules (that is, with no floating element below) may be in mutual side contact. In long structures is would be convenient to attach, in those positions along crossbars (1) where there are no floating element underneath, some metal oblique braces (102) for reinforcement, which can be secured with convenient screws or bolts to the holes present in crossbars (1), that are free. Such elements would be essential in very long structures, especially if they are experiencing strong water currents, since the ends and the central sections would be subjected to differential thrust forces which would tend to bend the crossbars (1) in the same direction. For those watercrafts or rafts where no oblique metal braces (102) can be placed because all the length in crossbars (1) is full with floating elements, additional fixation elements are added. Those new elements are for bolting two adjacent U-shaped longitudinal bars (3) in mutual contact that belong to two adjacent different floating structural modules. For that, U-shaped longitudinal bars (3) can be provided with vertical holes or anchoring vertical side tubes (103) in the same predetermined positions along some points on its perimeter, for inserting through them thick strong anchoring U-shaped pins (104) or X-shaped pins (105) of vertical insertion, being the most effective action if the coupling positions of said elements are placed near the corners and center of longitudinal sides of each pair of U-shaped longitudinal bars (3) or rectangular racks (99) to bolt. Obviously, rectangular platforms (101) are drilled with the same coincident holes for allowing these bolting operations.

[0100] Other possibility for reinforcing the structure is the placement of modular accessories that fit inside the perimeter of each coupled pair of U-shaped longitudinal bars (3) or each rectangular frame (99) and can be screwed or bolted to them, so in addition to their specific functions they can cooperate to the structural strength. As shown in **Figure 27,** wide accessories such as baskets or trays **(a)** may be dropped vertically to fit into the inner perimeter of a coupled pair of U-shaped longitudinal bars (3) or of a rectangular frame (99), using the sets of holes in the crossbar (1) for the sets of crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8) for fixation by bolting with no sliding capability. Those elements may be wide and occupy all surface delimited by said perimeter, or only a part. In this last case, the accessories can have the ability of slide longitudinally forward or backward for commodity or for adjusting position of cargo in parallel direction to the straight linear sections of U-shaped longitudinal bars (3) or rectangular frames (99) that are transverse to the crossbars (1), resting and sliding above them, between two stopping positions delimited by their sides parallel to the crossbars (1). For that, some horizontal wheeled pins (107) can be useful when bolted to said accessories docked inside a rectangular perimeter of two coupled U-shaped longitudinal bars (3) or of a rectangular frame (99), as they allow sliding until stopper positions resting on these elements but they prevent their accidental release in vertical direction due to water movements. The sliding can be obviously avoided by insertion of a single or several vertical pins, exactly as the previous case.

[0101] A kind of new necessary element to greater accommodation and safety for passengers in a watercraft are lateral supports (108) providing with cushioned or inflatable sections (109) for attaching a soft, safe gunwale, similar to those that rigid inflatable boats have but detachable. Said elements can be anchored vertically arranged in parallel direction to the floating elements above the U-shaped longitudinal bars (3) or rectangular frames (99) and being bolted to them, or well, for saving space, they can be provided with at least two twin inner crossbar (13) stumps for being inserted and fixed inside the tubular ends of crossbars (1) of the watercraft. Said lateral supports (108) have a series or rings, straps or belts for embracing inflatable or cushioned section. **Figure 28** shows an example of a modular detachable motorboat constructible with parts and pieces of the invention already seen (with exception of the attached outboard motor) for moderate speeds as it lacks of a attachable front prow (95). Cushioned and inflatable elements (109) are supported by said side lateral supports (108). For serving also as illustrative example of the constructive possibilities of the invention, this watercraft has been built with floating elements different in length but symmetrically arranged (as it can happen in case of pieces shortage), being the side floating elements two twin short floats (2) coupled in inverted position with their pointed extreme placed at the stern of the watercraft, shaping a staggered prow but avoiding to have a saw-teeth prow which could retain water flow in water bags at prow.

[0102] Concluded exposition of structural reinforcement elements for platform of the floating structures, a new group of elements and refinements allow the side linking of two adjacent floating structural modules by hinges, so two of them can fold mutually along its common hinge, as well as several or many floating structural modules can be linked in flexible chains of varying lengths. Said hinges also are important structural reinforcement elements but are included in this other different group for best clarity in exposition. It is necessary to argue the necessity of these new type of structures possible to assemble thanks to said hinges.

[0103] The transport of preassembled rigid structures to elsewhere can be difficult depending on the size, weight and linear dimensions of the structure, terrain and environmental conditions, transport means and many factors. For example, if it was necessary to place a pontoon bridge in middle to a far streamline converted into a wild overflowed river because the hard rains for evacuating a crowded town in short time, it could be needed a cargo helicopter for its transport and placement by air, as its assembly piece by piece can take not only time but also danger for the constructing crew. If no helicopter is available, placement of said pontoon bridge could not be possible in due time. So far, all the elements and parts exposed are inserted each other and coupled together by movements that follow always the three perpendicular directions of space, which poses practical limitations in certain cases, being necessary to incorporate new elements to eliminate said limitations, discussed as follows.

[0104] As seen in **Figure 29,** with the parts and pieces already described and available, there are few possible alternative methods for constructing floating walkways or floating bridges crossing perpendicularly a water stream of certain width, dragging force and torque applied on the said walkway or bridge. In method (a) a single or preferably at least two parallel cables or cables are placed crossing the water stream and fixed to both shores firmly tied to posts, trees, pegs, rocks or any firmly steady terrain features, using a spear gun to overcome the distance. Said cables serve as guideways for holding by opposing water dragging force of several floating structural modules which are to going filling the gap between shores at intervals by being attached along the parallel cables and being displaced by sliding along them to get close to the opposite shore, in a way that each floating structural module is intercalated with a platform section with no floating element. These cables pass through the transverse grooves (6), (4) or (77) of the floating elements used. In case of using middle transverse grooves (4) the modules are harder to build but stronger, as the cables are retained with no possibility of releasing (with only exception of cable breakage) by the structural frames constituted by coupled pairs of U-shaped longitudinal bars (3) or rectangular frames (99). In case of using ending transverse grooves (4) or (77) the modules are easy to build but weaker, as it is only necessary to open and to close sliding covers (10) and (79) for placing and retaining the cable inside. In this case, each new floating structural module or platform section is added at the shore, linked to the last one of the growing chain, and all the chain is pushed to the opposite shore one step along the guide cables. The floating walkway grows in stages, one with each floating structural or platform section added. As only two transverse grooves (4), (6) or (77) are crossed by the guide cables, the other free two are for going placing through, along of them, twin lines of crossbars (1) rigidly connected in series by middle inner crossbars (13) sections, so these lines are for giving stiffness to the floating structure. So from the beginning, each time a new floating structural module is added to the growing chain, a section of crossbars (1) is coupled and screwed and / or bolted to it, so all of them in the chain are joined to the crossbars (1) line. By pushing said crossbars (1) in direction of the guide cables, for instance by hitting on them in its same direction with rubber mallets, al the assembled chain can displace slowly along guide cables to the other shore. At intervals twin middle inner crossbar (13) are placed for joining in series two consecutive crossbars (1) and multiplying its length. We should remember that use of pieces for cable passage (15), pointed terminal pieces for penetration and self-centering of the crossbars (22), and crossbars split in two U-shaped pieces (25) and inner crossbars split in two U-shaped pieces (26) instead of crossbars (1) and inner crossbars (13) may be fully useful for the duty. At the end detachable handrails, side panels or similar security items for evacuation or supply path are to be added. It is clear that in this method crew is safe at the shore, but the time spent, and the physical effort to perform may be excessive. An alternative method (b) does not involve coupling on the guide cables of the floating structural modules and platform sections one by one, but in preassembled sets of several of them. In this case considerations to do are similar to previous case, but probably with greater physical effort, so it only would be practical in case of having a mechanical or electrical traction device from the opposite shore with an additional traction cable.

[0105] In an alternative method (c) the placing of the elements from the growing chains is performed one by one on the growing end on water of the floating pontoon bridge. In this case there are no guide cables, as if they were present the elements could not be coupled in this position, or at least with a reasonably difficulty. So the different floating structural modules and platform sections are transported one by one over the platform of the constructed section to the growing head on the extreme over the water, and linked and bolted to it in terminal position. So the extreme at the shore is firmly fixed to the soil, and at some intervals twin or twin pairs of terminal pieces for spiking to the shallow soil (23) or intermediate linking pieces for spiking to the shallow soil (24) are intercalated in terminal or middle positions along the lines of crossbars (1) to fix or anchor the floating pontoon bridge to the shallow soil, in case that water stream is not very strong. Obviously, this method requires less physical strength than two first ones, but the floating pontoon bridge is not fixed as firmly as in these cases by supporting guide cables, and the elements are transported to and placed one by one on the extreme over the water, so crew may be in risk situation. But also there is the problem that, as there are no supporting cables, with the characteristics and features of the parts and pieces, there are no easy way of attaching or fastening a float (2), (71), (72), (73) or (85) on the water surface but resisting the drag force, and even less of maintaining it with the transverse grooves (4), (6) and (77) consecutively aligned with the row of those from the stacked aligned floating structural modules already assembled, before they could be thread by the crossbars (1). Alternative method (d) is similar to (c), except that the elements are coupled to the growing chain in preassembled and stiffened straight short sections from the shore, to be towed through the water to final binding position or transported over the platform of already assembled part of the structure.

[0106] This important limitation, which could endanger assembly crews, is because all the elements and parts exposed are inserted each other and coupled together by movements that follow always the three perpendicular directions of space, with no rotation movements allowed.

[0107] To solve this problem and for strengthening even more the expandable main frame of the invention, a series of coaxial equal longitudinal hinges (110) are added to all or all pairs of U-shaped longitudinal bars (3) and rectangular frames (99) for obtaining hinged U-shaped longitudinal bars (111) and hinged rectangular frames (112) respectively, as seen in **Figure 30**. Said longitudinal hinges (110) allow hinge in longitudinal direction over a common folding axis two of these structural elements, so also two adjacent floating structural modules. They consist of equal thick cylindrical metal tubes which are joined by any method (as may be welded, screwed or bolted), longitudinally, coaxially, consecutively exactly on the top outer edge of the linear sections of a usual U-shaped longitudinal bar (3) or usual rectangular frame (99) that in coupling positions on a floating structure are arranged in parallel to the floating elements, and perpendicularly to the crossbars (1), so they are not joined to any of their surfaces or faces, but exactly on this edge, protruding slightly upward and sideward a little additional preset distance. This little preset distance places the symmetry central axis and folding axis of each longitudinal hinge (110) and each row of some aligned of them coincidently with the edge between two hinged U-shaped longitudinal bars (111) and hinged rectangular frames (112) but slightly above from their top surfaces for allowing the mutual folding, with the caution of placing gaps between each two consecutively aligned longitudinal hinges (110) in the same row for matching, coupling and hinging with other row from an adjacent hinged U-shaped longitudinal bar (111) or hinged rectangular frame (112) symmetrically arranged to the previous one in relation to its common folding axis defined by said aligned longitudinal hinges (110). The joining position of said longitudinal hinges (110) does not introduce additional distances sideward due to touch between adjacent hinged U-shaped longitudinal bars (111) and / or hinged rectangular frames (112), so coupling positions of these two elements over the crossbars (1) are coincident with usual U-shaped longitudinal bars (3) and rectangular frames (99). Then it is possible to swap indifferently all of them in the assemblies, with the difference that hinged versions can fold one over each other or being linked in more or less long chains through said longitudinal hinges (110), as well as the floating structures composed by these hinged elements with their floating structural modules assembled together in mutual contact and hinged by inserting hinging bolts, are much stronger, as said longitudinal hinges (110) constitute a new linking element that impedes the relative separation of adjacent floating structural modules, relieving an important portion of the task from the sets of crossbars-floats fixing screws or bolts (7), crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8) and floats-U-shaped longitudinal bars fixing screws or bolts (9). Pins or bolts (113) are responsible of joining each two rows of longitudinal hinges (110) in a common folding axis.

[0108] In addition to this important task of reinforcement of structure, another simple practical utility, compatible with previous one, is to allow to link laterally side tilting or swinging accessories as side foldable panels; side foldable accessing ramps or side foldable bridge sections, which swing around a row of said longitudinal hinges (110) in one or both free ends of floating structure. But also important is possibility is that when the stack or series of floating structural modules are not still impaled by any stiffening crossbar (1) but they are mutually linked each two by their longitudinal hinges (110), they remain joined in a chain of floating structural modules whose links have a certain degree of mutual rotational freedom, so said chains are flexible and can be folded or curved only to the folding direction that longitudinal hinges (110) allow, as the other direction is impeded because touch between all the elements.

[0109] This feature is fundamental for construction of long structures as pontoon bridges quickly and safely. As seen in the process of **Figure 31,** one of the main utilities of longitudinal hinges (110) is to facilitate lateral linking of additional floating structural modules to the growing end over water on a floating pontoon walkway in construction both a single one each time as in sets of two, three, or even more, depending on the size and weight of the resulting final short chains, the number of assembly workers, and conditions. In lack of longitudinal hinges (110), for linking a new floating structural module to the growing end over the water body or water stream, those should to be dropped to water and being kept in correct position with hands, ropes or other means, despite the water dragging force, while introducing or attempting to introduce the crossbars (1) through transverse grooves (4), (6) or (77), with risk for operators and risk of losing the piece. Instead, with this improvement, said floating structural module can be linked to the growing end by said longitudinal hinges (110) and fixing pins (113) without dropping it to water, and once linked, it can be dropped freely to water with no risk of being lost dragged by the stream. Then, it is easier to impale this new floating structural module with crossbars (1) provided of pointed terminal pieces for penetration and self-centering of the crossbars (22) hitting with rubber mallets on their opposite side at the shore, as all series of transverse grooves (4) (6) or (77), are now much better aligned in the right direction.

[0110] Instead of adding flotation structural modules one by one, they can also be added in short chains of several of them, which can be in turn partially flexible by being linked together by their respective longitudinal hinges (110), or rigid by being impaled by crossbars (1), as seen in **Figure 32.** In **(a)** the new rigid section is added to the growing structure through their respective longitudinal hinges (110) and terminal pins (113), so thereafter stiffness is obtained by further impalement by crossbars (1) and screwing to them. In **(b),** the new rigid section is added to the growing structure through intermediate variable angled pieces with centered hinge (29), to obtain a long floating structure composed of short rigid straight sections liked by hinges, so these sections are previously rigid as they have mounted already with crossbars (1) before this operation. We should notice that in this case the structure is more flexible than previous one, as longitudinal hinges (110) do not allow the folding below the horizontal plane of the platform because touching among pieces, while in second case said variable angled pieces with centered hinge (29) allow symmetrical angles above and below, as well as they introduce gaps in the structure for making possible this feature, being this structure suitable for long floating structures in wavy water. For safe transport and safe linking, it would be suitable some kind of hooked trolley, with which an operator places the bolts (113) with appropriate tools to maintain a certain distance hands and fingers from the pieces, while other operator maintains the new section to add in correct position comfortably using his own body as counterweight.

[0111] As not only a single floating structural module but several of them at the same time can be linked, in certain circumstances a lot of time could be saved by transporting them in pre-assembled arrangements to strengthen and stiffen later in short time by impalement with crossbars (1) As seen in **Figure 33,** watercrafts and rafts, as short floating pontoons, can be folded in two layers reducing its width by half, in addition to which in turn they can be stacked in successive double layers one above the other, exploiting to maximum spaces in storing facilities and vehicles.

[0112] Another important practical application of longitudinal hinges (110) is to allow assembly of preassembled arrangements of easy and quick transport and deployment of long, large floating structures, exploiting the feature that the floating structural modules can be chained, folded, curled, wound, shaped for further impalement and strengthening with crossbars (1). So that said preassembled arrangements give new methods of transport, deployment and collecting of structures as may be long floating walkways or bridges much faster than previously seen.

[0113] Several flotation structural units can be linked by their longitudinal hinges (110) of their hinged U-longitudinal bars (111) and / or hinged rectangular frames (112) with the help of fixing pins (113). All of said modules can be folded in the same direction of rotation, but not to the other or in alternating directions, curving part or all of the flexible chain to a single side. So always all floats or float sliced sections (2), (67), (71), (72), (73), (74), (75), (76), (82), (83), (84) or (85) are on convex side of the curved chain, and all hinged U-longitudinal bars (111) and / or hinged rectangular frames (112) are inwardly on concave side. With no crossbars (1) impaling and giving rigidity to the floating structure linked with longitudinal hinges (110), each one of the flotation structural modules may be disposed in relation to an adjacent one freely at any angle between 0 ° (the two flotation structural modules are aligned in the same plane), and close to 180 ° (the flotation structural modules are completely folded). With three floating structural modules linked mutually by their longitudinal hinges (110), the floating structure can be closed in a prismatic shape with two twin polygonal bases, being said structure in shape of triangular prism, regular or irregular, depending on the width in segments of each one of the three floating structural modules linked. Obviously, the more floating structural modules in the closed chain, the more close is the shaped prism to a cylinder, so these cyclic prismatic structures, having enough number of sides, so enough number of floating structural modules linked, would aid to transport rolling on ground large or long preassembled structures, either by vehicles as by human force, easy to transport and fast to deploy by simple unwinding, in a similar way as a carpet or a blind does. But if there are more than three, such prismatic structures fold because its own weight. These cyclic prismatic structures are useful only when they are wound previously around a central reel piece for supporting its own weight and maintaining it in open disposition for rolling on ground, but also maintaining tighten the chain around them with no clearances.

[0114] In **Figure 34** ssome examples of reel middle pieces are seen, being the most useful and simple convex polygonal racks (114) in **(a)**.They are constituted by a flat metal tube frame with a shape of convex polygon, usually regular, so having the same angles and sides, because in this way it is possible to wind chained floating structural modules around, shaping cyclic regular prisms, suitable for being transported rolling or stepping-rolling on ground is they are enough close to a cylinder in shape. They do not need to be as thick as convex polygonal frames (32) as they do not pass through transverse grooves (4), (6) and (77) as those, so they do not need to have their same cross section, but they are made in a metal tube enough strong. Side lengths have always standardized values of a positive integer number of segments in length for allowing matching and coupling. Almost all of their structural strength is due to a series of radial reinforcing rods that connect opposite vertices and / or opposite points as a bicycle wheel, but also having a central ring or central tube, which is centered on the piece and is coplanar in relation to it. At least two twin convex polygonal racks (114) can be arranged coaxially in vertical parallel planes in they are joined by transverse bars that connects respective vertex, and also optionally edges from both two. This shapes a cage in form of polygonal prism, which has twin bases constituted by both twin convex polygonal racks (114) and lies resting over one of their rectangular faces. This cage is the reel middle piece around of which it is possible to wind the chain of floating structural modules, previously linked by their longitudinal hinges (110) as explained. Given a chain of floating structural modules, linked each two consecutive of them by their longitudinal hinges (110), a pair of twin convex polygonal racks (114) is chosen for assembling the said cage for that chain, but having necessarily such twin convex polygonal racks (114) the same number of sides than the number of floating structural modules linked in the chain, as well as the length of each one of their sides is matched with the width of each one of the floating structural modules linked in the chain. In other words, if all sides on each convex polygonal rack (114) are equal, all floating structural modules linked in the chain must have the same width than the side length of those sides, so usually being identical. If sides on each convex polygonal rack (114) have different lengths, widths from each floating structural modules linked in the chain must be matched in the same sequence, matching one by one when winding over the reel cage middle piece. Then, it is possible to wind the chain around said reel cage middle piece following and matching its perimeter, obtaining a prismatic shape with outer floating structural modules when terminal longitudinal hinges (110) are linked by fixing bolts (113). As each different prismatic geometry needs a specific reel cage middle piece, so two specific twin convex polygonal racks (114), most suitable ones for manufacturing may be regular hexagonal racks (114) or regular octagonal racks (114).

[0115] If it is necessary to assemble a prismatic structure for transporting a pontoon bridge, but there are no convex polygonal racks (114) because lack or shortage of pieces, it may be possible to use rings or tubes with enough diameter **(b)** for maintaining the chain open but loosen, so they would roll on ground with more effort. As advantage, any floating structural modules can be linked in any order, only taking care of matching with radius of central elements used.

[0116] In **(c)** tthere is an example of an alternative element for shaping prismatic arrangements of chained floating structural modules in which the prism shaped around have always the same number of sides, but their lengths may vary, and can be used for shaping prisms with regular polygonal bases (equilateral and equiangular sides), with bases in form of convex equilateral non-equiangular polygons, with bases in form of convex equiangular non-equilateral polygons, or with irregular convex polygonal bases. This element allows built a reel cage middle piece whose shaping ability is adjustable but weaker than in previous convex polygonal racks (114). These elements are star-shaped adjustable racks (116), which consists of at least three tubular spoke arms of the same length and same square or rectangular cross section, which are welded at their ends to a common center in a same plane, giving to the piece a star-shaped look. As convex polygonal racks (114) have, on its center all star-shaped adjustable racks (116) have a central hole that crosses it completely in a direction that is perpendicular in relation to its main plane that serves for introduction of a cylindrical cross-bar, along rotation axis of the assembly for pulling or pushing on ground all the structure wound around the reel cage middle piece in prism-shaped form. Such tubular spokes are distributed symmetrically around the center, with the same angle between each adjacent two of them, and are drilled with identical holes in a direction that is perpendicular in relation to the piece's main plane, being those holes arranged in rows of constant spacing centered and aligned on each spoke, so each hole on a concrete spoke always has other counterparts in other spokes at the same radial distance from the center than theirs. Then, a movable wedge (117) for each spoke can be moved radially and be placed on a concrete radial position by a bolt or pin that crosses the piece and one of those holes on the spokes. Said movable wedges (117) can be placed then at the same or at different radial distances from center independently. For that, each one of them has an U-shaped guide piece that fits and slides over the outer surfaces of the spokes, having also the hole for its fixation pin or bolt along its corresponding spoke. In a same way than movable wedges (117), each spoke has a telescopic leg (118), which can also move along its corresponding spoke and can be fixed on a desired radial position thanks to a fixing pin or bolt independent from the others, but in this case displacing inside the tube the spokes are made with, for not colliding with movable wedge (117) from its same spoke.

[0117] Two identical star-shaped adjustable racks (116) can be arranged coaxially in parallel vertical planes, and can be joined by transverse bars for constituting a star-shaped reel cage middle piece. Around this element it is possible to wind, in a similar way as described for convex polygonal racks (114), a chain of linked floating structural modules which can adapt a prismatic shape with the same number of floating structural modules than number of spokes of the twin star-shaped adjustable racks (116) chosen, being possible with these to fit chains having different width among them with no problem, in difference with convex polygonal racks (114). In this case the chained floating structural modules are not supported in prismatic shape by tube straight sections (the sides of convex polygonal racks (114)) by a side-side touch, but by a corner-corner touch. The movable wedges (117) have angular shape, so along its displacement along its respective radial spokes they can be placed on a radial distance each (either if the same than if different, depending on the structure to shape around) for fitting and matching to a inner corner of the tubular prismatic hollow of the prismatic structure of chained floating structural modules to shape and to maintain with no falling because its own weight. For this purpose, said movable wedges (117) have a section which is perpendicular to the main plane of the star-shaped adjustable rack (116) with which can reach and hold the structure in a prismatic shape. In these prismatic structures both star-shaped adjustable racks (116) are arranged in vertical planes outside all the outer perimeters of all coupled pairs of hinged U-shaped longitudinal bars (111) or hinged rectangular frames (112), so said perpendicular protruding section of each movable wedge (117) elongates and reaches to inside said perimeters, touching each one a corner between two hinged U-shaped longitudinal bars (111) or hinged rectangular frames (112), flanking middle row of longitudinal hinges (110). Therefore, the ends of the spokes of star-shaped adjustable racks (116) protrude radially slightly from the prismatic structure on the gaps formed at prow and stern between each two partially folded adjacent floating elements, so each telescopic leg (118) has free path with no collision with other elements for being moved radially.

[0118] Whether using convex polygonal racks (114) or star-shaped adjustable racks (116), the floats or float sliced sections (2), (67), (71), (72), (73), (74), (75), (76), (82), (83), (84) and (85) are always arranged outside, so they are the elements that touch the ground. In case of waterlogged, muddy, sandy, soft soils or full of vegetation, it is no problem, but if terrain is hard, floating elements can be damaged or broken when rolling, so it is fully suitable use of star-shaped adjustable racks (116) with telescopic legs (118), so they may make contact with the ground instead of floating elements, allowing an adjustable-in-height standing base or bracket for holding the prismatic structure, that also allow to place it horizontally, correcting irregularities in the soil, as well to going advancing rolling by consecutive steps. Changing the type or feet on said telescopic legs (118) it is possible to roll over soft soils without dipping because the weight by increasing feet's surface, to have best grabbing by adding feet with hooks or rough surfaces, or to build a detachable big wheel for rolling all prismatic structure through country paths, rails or roads by extending said feet in form of a detachable wheel rim (119). Such detachable wheel rims (119) are composed of identical detachable wheel rim sections, in a way that when docked to spokes on a same the star-shaped adjustable racks (116) they constitute a circular wheel with spokes. Two twin ones of these assemblies can give a two-wheeled cart for transporting a fast-deployment big, heavy, bulky pontoon bridge rolling on ground pulled by a motor vehicle or by human force. Those big side wheels can be built coupled on the star-shaped adjustable racks (116) used for shaping the chain of floating structural modules around, so all the structure spins as a whole and has a big rotation momentum, or coupled to two twin additional side star-shaped adjustable racks (116) sharing a common horizontal shaft with the prismatic structure supported, so transport is enhanced as the bulky prism does not spin with the side wheels.

[0119] Case (d) is a foldable version of star-shaped adjustable racks (116), in which spokes are replaced by a certain number of bars threaded through a central common axis where a shaft is inserted. Movable wedges (117) and telescopic legs (118) works exactly in the same way. Despite a lower structural strength and not allowing odd numbers of chained floating structural modules, they are easily transportable on vehicles.

[0120] In **Figure 35** an example of the comparative effectiveness of various forms of land transport through difficult terrains are seen, involving transport by human force or small motor vehicles.

[0121] Thanks to these prismatic structures, it is possible a quicker and easier transport of long wound structures rolling on ground, but also its quicker deployment than in case of assembling them piece by piece, by unwinding, unfolding and stiffening with crossbars (1). It is also possible to split the wound floating chain into several parts, so these procedures may allow transport to a difficult place either a long floating pontoon bridge, as several detachable watercrafts in a single whole. As seen in **Figure 36,** once at the deployment point, in this case a shore at side of a water stream to cross with a floating pontoon bridge to deploy, chain of linked floating structural modules is open by unlinking a row of longitudinal hinges (110). If some pieces are transported inside the prismatic structure when rolling on ground, secured by brackets or any suitable fastening methods, they are removed and prepared for use and docking, as may be crossbars (1). Once set and anchored to the soil from shore one of the ends of the chain of linked floating structural modules, in this example using nailed bars and chains, the reel cage middle piece composed of twin convex polygonal racks (114) is pushed in direction to water, unwinding the chain, giving a flexible straight section of floating pontoon bridge, still to stiffen with crossbars (1). Then, it is possible to continue adding, one by one, more floating structural modules until completion of all floating pontoon bridge length by methods described above. Along all aligned consecutive transverse grooves (4), (5) and (77), the crossbars are introduced (1), suitably lubricated externally, for impaling, fixing and strengthening all the pontoon bridge, using elements described above for making these procedures easier. Alternatively, if the floating pontoon bridge should be very long, it is also possible to link a second prismatic structure (a second spool of floating structural modules) to the first one, linking them by the same row of longitudinal hinges (110), doubling the length of pontoon bridge, and performing unwinding and strengthening operations. By practical reasons, a third spool of floating structural modules is hard to be moved along a section of pontoon bridge because size and weight reasons, so additional floating structural modules must be added one by one, or said third spool of floating structural modules should be moved to the extreme on water floating for linking and unwinding. In addition, it is not suitable to build rigid floating pontoon bridges too long with crossbars (1) because structural reasons.

[0122] The more important limitation to notice is that in these pontoon bridges, the floating elements have no gaps between each two of them. But if leaving gaps, prismatic structures formed can not roll easily on ground, except if they are mounted over twin big side wheels. It is therefore necessary to find a suitable way to attach intercalated platform sections between each two floating structural modules, in a kind of mixed wound-folded prismatic structures. **Figure 37** shows how two twin platform sections can be linked at both sides of a floating structural module, using their longitudinal hinges (110) for linking. Repeating this assembly multiple times, an accordion-shape foldable structure is obtained, well linear if all floating structural modules are in the same plane, well curved if those are gradually turned a certain angle around their consecutive longitudinal hinges (110) in a curved arrangement. But this device has two platform sections whose folding direction is inverted in relation to the normal direction allowed with normal position of longitudinal hinges (110), which are above the platform horizontal plane when the structure is completely unfolded or unwound. For allowing shaping of a chain in accordion, each floating structural module has two coupled hinged U-shaped longitudinal bars (111) or a hinged rectangular frame (112), but the twin platform sections are not made with those elements, as the middle hinge that folds mutually them must invert its folding direction. This alternation of folding directions allow to platform sections to be folded upwards or inwards in the prismatic mixed wound-folded arrangements, where there is enough free space in the central tubular hollow to accommodate them. As seen in said **Figure 37,** the two twin platform sections mutually foldable can be built with three types of elements to choose depending on the circumstances and availability or shortage of pieces. In an imperfect arrangement **(a),** they are made with two coupled pairs of hinged U-shaped bars (111), only inverting vertically in coupling position on each coupled pair the hinged U-shaped bar (111) that links both platform sections mutually foldable, reversing then the direction of the folding movement. This is perfect in case that U-shaped longitudinal bars (3), hinged U-shaped longitudinal bars (111), rectangular frames (99) and hinged rectangular frames (112) are flat, but not in case that they may present a not flat embodiment with curves or bent sections for structural reasons. If this is so, unfolding is not complete because collision between those inverted U-shaped bars (111) and crossbars (1) when they will be coupled, but may be a solution in case of pieces unavailability or shortage. In difference, arrangements **(b)** and **(c)** allow a complete folding and unfolding for complete screwing in concordance with holes for fixing elements in the crossbars (1) when coupled. However, they use new parts to be manufactured exclusively for this particular application, but usually they are only for exclusive use on prismatic wound-folded assemblies.

[0123] In case **(b)** each rectangular platform section is constituted by a modified hinged rectangular frame (120), which is exactly the same than a hinged rectangular frame (112), but having a row of their longitudinal hinges (110) inverted vertically in relation to the other one, so allowing inversion of folding direction. In case **(c)** each rectangular platform section is constituted by a hinged U-shaped longitudinal bar (111) coupled with a modified hinged U-shaped longitudinal bar (121) for obtaining the same result, being said modified hinged U-shaped longitudinal bar (121) a modification of a hinged U-shaped longitudinal bar (111) where the row of longitudinal hinges is vertically inverted for allowing inversion of folding direction. In this last case, only practical utility of modified hinged U-shaped longitudinal bar (121) is to split the size and width of a modified hinged rectangular frame (120) in two halves for easy handling and storage.

[0124] So an accordion-foldable arrangement, having two twin foldable platform sections between each two consecutive floating structural modules linked through their respective longitudinal hinges (110), can be arranged in a prismatic wound-folded assembly starting from four floating structural modules. Really, this is possible only in case that the floating structural modules are wider than the platform sections because geometrical considerations, that is, the four triangles in which a square can be divided with their diagonals are not equilateral but isosceles. This is the same case with five floating structural modules. But in case of having an prismatic wound-folded assembly of six floating structural modules, an special geometrical feature happens, as a regular hexagon can be divided into six smaller regular equilateral triangles having sides of the same length, so widths from their composing floating structural modules and platform sections can be the same.

[0125] In **Figure 38** there is an example of a prismatic wound-folded assembly with six identical floating structural modules and six twin foldable rectangular platform sections folded inwards which are intercalated between each two floating structural modules. This structure is supported without folding because its own weight by a reel cage middle piece built with transverse bars joining two twin coaxial star-shaped adjustable racks (116) in vertical parallel planes. The perspective view allows better overview of the elements that are slightly clarified in previous two-dimensional figures, such as movable wedges (117) and telescopic legs (118), as well transverse bars (122) for shaping the reel cage middle piece. In smaller size there are additional figures showing a comparison of two-dimensional projections, in the direction of the main symmetry axis of the prismatic wound-folded assemblies, of structures having two twin and four twin foldable platform sections folded inwards. In case of having two, the overall length of the completely unwound and unfolded pontoon bridge is eighteen times the width of the floating structural modules used. In case of having four, the overall length of the completely unwound and unfolded pontoon bridge is thirty times the width of the floating structural modules used.

[0126] So it is obvious the extremely high compaction ability those prismatic wound-folded assembly feature. Therefore, when constructing a mixed prismatic wound-folded assembly it is possible to choose nearly all: composing parts, overall length after unfolding and unwinding, diameter, weight, length, presence of gaps between floating structural modules, number of sides, supporting bracket, side wheels, etc.

[0127] The deployment procedure of these prismatic wound-folded assemblies is similar to that seen in **Figure 36** for wound structures, but in this case, immediately after release of each floating structural module, each pair of two twin rectangular platform sections linked is unfolded and introducing the crossbars (1) therethrough, so that the unfolded platform sections can rest on them and does not bend or break fatally by excess of weight, making the deployment process slow. In **Figure 39** an alternative procedure is seen, in which the floating structure grows as a blind, by maintaining the prismatic wound-folded assembly in fix position on the shore supported by a bracket made with telescopic legs (118) and two twin side star-shaped adjustable racks (116) at a certain height for not touching with the soil or any other object, as a waterwheel, and extending the growing end. Firstly, it proceeds to completely unwind the prismatic wound-folded assembly, leaving resting on the soil or water surface all floating structural modules with their intercalated twin foldable platform sections folded upwards. Then the crossbars (1) are introduced along all or some transverse grooves (4), (6) or (77), which are now aligned consecutively, and they are screwed to the floating element farthest from shore. Then, by pushing crossbars (1), all other floating structural modules are dragged and all folding sections unfolded, for further screwing, bolting and other procedures. This procedure is safer as the floating pontoon bridge is deployed from a structure anchored to the shore in safety, but also has the advantage of being reversible, being relatively easy to perform the inverse process of folding and winding the floating chain, especially with mechanical or electric devices. It is therefore suitable for temporary or permanent fixed placement in points where a portable detachable pontoon bridge is needed, for example in frequent flood zones or seasonal river overflow, where there are no bridges or similar infrastructures have been destroyed. To wind / fold and unwind / unfold faster and easier it is suitable to pass cables along through all transverse grooves (4), (6), (77) for pulling from the other side if accessible and if necessary, being then easier to impale with the crossbars (1) by using said cables as a guide.

[0128] A similar process to that summarized in **Figure 36** but safer is shown in **Figure 40,** although it can not be used in deep water for avoiding to float above water but making to rest and to advance all structure standing over the shallow soil. In this case the structure is unwound and unfolded like a carpet, keeping fix and taut the end on the shore and making advancing all prismatic wound-folded structure to the opposite shore, step by step, standing over the four telescopic legs (118), being possible to ballast all structure for opposing to drag water force. Also optionally detachable wheel rims (119) can be used for having more surface on the shallow soil, but in this case telescopic legs (118) can not be adjusted separately for adapt to shallow soil irregularities. The growth is slow and must be done carefully in consecutive four-legged steps, so that, with effort and good coordination among team members, they are going releasing with caution each floating structural module to drop it, leaving it floating above water, then they push upward prying on the telescopic legs (118) that are not in contact with the soil to roll all structure over the two more advanced telescopic legs (118) from the four ones where the assembly is supported to the next four-legged standing step. Instead of pushing the prismatic structure for making it to roll, it is also best suitable to pull with cables or wires from the opposite shore if possible, for unwinding and unfolding all structure with safety and less risk for the crew, but someone must be on the same for releasing and unfolding the elements and for going adapting the more advanced telescopic legs (118) to possible shallow soil irregularities. A cable spool (123) freely rotating, positioned transversely inside the reel cage middle piece, for example spinning on the central shaft from the prismatic wound-folded structure, unwinds at least two cables which pass through all chosen rows of aligned transverse grooves (4), (6) or (77). If the floating elements are provided with crossbars (1) sections with terminal pieces for passing cables (15) on said transverse grooves (4), (6) or (77), a flexible floating pontoon bridge is obtained, supported by said cables, tighten and taut between the opposite shores. If this is not the case, those cables can serve as a guideways for pulling the crossbars (1) and go impaling all consecutive floating structural modules in a rigid structure to bolt, or several ones joined by flexible cables (for example, if two transverse grooves (4), (6) or (77) rows are filled with crossbars (1) and the other one or two with said cables). At the same time, other operators are behind for ensuring the already extended pontoon bridge section with crossbars (1), nailed bars, ballasts, and other elements, as well placing the railings and security features. Many assemblies and constructive options are possible, so only a few illustrative examples are commented.

[0129] These accordion-folded structures, prismatic wound structures, and prismatic wound-folded structures can be preassembled in advance and stored in warehouses and headquarters, and shipped in appropriately sized vehicles quickly in distress call, or if forecast or magnitude of the event makes it advisable their immediate use or their availability in enough number for further use on need. As seen in **Figure 41,** one possibility to consider is not only the transport of these structures by cargo helicopters, but also perhaps the possible fast and quick laying and deploying in serious distress call, being the cargo helicopter itself responsible of transporting and unwinding and / or unfolding the long floating structure on the air, well completely or dropping a section over water, in minutes or seconds. Existing enough powerful cargo helicopters and air cranes being able of lifting several tons, only availability of pieces and aircraft, weather conditions, water conditions, fuel supply, aircraft's range and pilot's skill are critical matters. Procedure is to suspend hanging from the cargo helicopter, with an appropriate supporting frame or rack, a freely spinning reel cage middle piece wrapped by a prismatic wound-folded structure or prismatic wound structure to deploy. An electric drive system (124) controls releasing of floating structural units and rectangular platform sections from the spool, which fall guided through at least two cables that pass each one along a row of aligned transverse grooves (4), (6) or (77) that are provided with crossbars (1) sections with terminal lubricated pieces for passing cables (15) for good sliding of the chain along the guide cables, so the chain unwinds and unfolds by gravity but step by step slowly. The rotation of the spinning shaft may be also controlled by an engaged electric motor and / or brake (125) to better control the chain unwinding speed, which also could be able or rewinding and refolding the same for picking up of the structure when unnecessary using said cables as guideways. A cable spool (123) placed inside the device unwinds (or winds in reverse mode) said guide cables, being their extremes previously dropped to the shore, for being fixed firmly to elements as trees, posts, rocks, streetlights, bollards, or any similar thing to keep cables tensed and make fall the chain along them.

[0130] As seen in **Figure 42,** longer chains are possible to be deployed with larger hanging racks and powerful cargo helicopters. In this case, floating chain does not have a prismatic wound-folded arrangement, but a similar longer ribbon-folded structure, which is similar to an accordion-folded arrangement, but with at least a 180° curve at one of their extremes, being possible to obtain ribbon-folded structures with two or three layers for deploying a long floating pontoon bridge on air, or for delivering by air a supporting frame with a long floating chain inside for cutting sections of desired of needed length. In those ribbon-folded structures, the floating chain does not wrap a reel cage middle piece, but their floating structural modules rest on or hang from horizontal flat guides or shelves horizontally along they can be displaced, while all intercalated twin foldable rectangular sections are folded perpendicularly, reducing overall length in relation of unfolded structure.

[0131] As additional important use of longitudinal hinges (110), as shown in **Figure 43,** it is possible to build droppable floating supply containers, both by parachute drop or by direct drop at very low height. Said supply containers are prismatic wound structures where the floating structural modules are wrapping a reel cage middle piece composed of at least two twin convex polygonal racks (114), but including inside the tubular longitudinal cavity appropriate cases containing supplies, tools or any other deliverable necessary item, as well as crossbars (1). Once picked up those devices by people on water or on shallow water, they can be opened and supply cases removed, so the outer shell can be split and be rigidified by the crossbars (1) for converting the container into rafts, boats or small straight pontoon bridges, especially in case of severe high-destruction catastrophes related to water, as tsunami or dam breakage episodes, where deliverable pontoons may be needed.

[0132] We should notice that all elements that can be linked together by longitudinal hinges (110) can be hinged or not. Those longitudinal hinges (110) give rigidity and a link between each two adjacent floating structural modules and / or rectangular platform sections which force to them to remain in the same plane. This situation is good in structures to strengthen with crossbars (1), but if this is not the case, the different sections can move with water movements, so in enough wavy water or enough strong water stream the longitudinal hinges (110) can be broken if no care. In some cases it would be better to unlink longitudinal hinges (110) for giving flexibility to the floating structure if it is long, as seen in **Figure 44,** for obtaining a long floating structure supported by taut cables with independent movable floating structural modules, or as seen in **Figure 45**, to assemble an articulated long floating structure hinged by stronger variable angled pieces with centered hinge (29) in wavy waters.

[0133] Another set of elements allow to dispose of parts and pieces for long structures, especially floating pontoon bridges and floating pontoon walkways, in which the floating elements do not couple in perpendicular direction to the line of crossbars (1) so also main platform or deck as before, but they can be arranged with respect to them in a fixed or variable angle, to keep them in parallel to the flow of a stream of water, especially if it is very strong. As seen in section (a) of **Figure 46**, the parts available so far do not allow a practical solution to the problem that would be presented in case where the floating elements of the structure could not be arranged in parallel to the direction of water flow, but forming with it a certain angle. That problem may arise if the only available points on the two opposite shores were positioned on a line which is not perpendicular to the water flow. If a usual floating pontoon bridge or walkway were deployed and too much cargo or traffic pass through it, their floating elements may sunk partially into water flow and oppose much greater resistance than normal, so that the structure would be much more difficult to build and to maintain stable in position, as well as parts could suffer fatigue, bend or break (especially the screws and bolts), and the structure could collapse. Use of flexible floating structures by unlinking of longitudinal hinges (110) supported by cables is not a solution, as the floating elements remain also in angle in relation to the water flow, and the cables will suffer then the action. As these situations may be very frequent in flood situation, a new set of pieces for allowing place the floating elements in angle in relation to the crossbars (1) must be added, as they could be determinant in a critical rescue situation. A first approach to solve the problem can be seen in (b), and consists of manufacturing floating elements that can be coupled at various standardized fixed angles to the crossbars (1) so that, as far as possible, they are compatible with all other remaining structural parts for assembly. Two selectable sets to choose between, depending on the practical need and situation, are presented. Two additional sets to see later allow to the floating elements to freely turn below the plane of the platform around vertical shafts, being able of reaching all or many possible angles, instead of having to select a piece for each fixed angle.

[0134] A first set of units (c) consists of some additional modified floats (127), (128), (129), (130) and (131), which are respective modifications of those floats (2), (71), (72), (73), (85) which do not have top openings and inner compartments (68), and therefore are completely closed. These modified floats (127), (128), (129), (130), (131) are characterized in that their transverse grooves (4), (6) and (77) are modified in form of oblique transverse grooves (132), (133) and (134), respectively, being all of them mutually parallel and exactly with the same cross section than previous ones for a compatible coupling with crossbars (1), but being all of them molded on the body of its corresponding floating element following a single one from a set of possible selectable standardized non-right oblique angles in relation to the longitudinal direction of that floating element. These oblique transverse grooves (132), (133) and (134) allow the crossbars (1) to be coupled to such modified floats (127), (128), (129), (130), (131) in that same angle. For allowing that compatible coupling, all sets of holes located at the top flat horizontal surface of oblique transverse grooves (132), (133) and (134), as well as their corresponding female threaded metal bodies embedded in the body of the modified floats (127), (128), (129), (130) that contains such sets of threaded holes for screwing the sets of crossbars-floats connecting screws or bolts (7) and crossbars-U-shaped longitudinal bars connecting screws, threaded rods or bolts (8) are turned the same angle in the same direction around a central vertical axis in relation to their original counterparts on usual transverse grooves (4) and (6) and (77). Thanks to that, all coupling and fixing elements are arranged in parallel to the main axis of oblique transverse grooves (132), (133) and (134) for matching perfectly with the sets of drilled holes in the crossbars (7). U-shaped longitudinal bars (3) and rectangular frames (99) can not be rotated this same angle for coupling perpendicularly to the crossbars (1), due to the fact that in this case the sets of holes, as well as their corresponding female threaded metal bodies embedded, for screwing of the sets of floats-U-shaped longitudinal bars connecting screws or bolts (9) could exit from the floating element "staying in the air" even with small rotation angles. So that transverse grooves (5) in modified floats (127), (128), (129), (130) and (131) are maintained exactly as in original floats (2), (71), (72), (73), (85). In contrast, the screw holes drilled in U-shaped longitudinal bars (3) and rectangular frames (99) for the sets of crossbars-U-shaped longitudinal bars connecting screws, threaded rods or bolts (8), do not match with their counterparts in crossbars (1) due to the angled arrangement, so in these assemblies they must be drilled in new positions.

[0135] Modified floats (127), (128), (129), (130), (131) give strong floating oblique pontoons, but they have several important drawbacks. As crossbars (1) are coupled in angle to the modified floats (127), (128), (129), (130), it is not possible to arrange two or more floating structural units in mutual side contact because the separation distances between them, measured perpendicularly to the floating elements, is reduced in relation to the case of perpendicular usual coupling. So those structures assembled with said modified floats (127), (128), (129), (130) are only suitable for assembly of oblique floating pontoons (bridges, walkways, rafts), so always having their floating elements separated with a gap between each adjacent two ones along the crossbars (1), and gaps in discontinuous platform must be completed with any custom elements conveniently screwed, riveted or bolted. More further, different versions from those are required for each one of the standardized angles in each of the two directions, left or right, since the two elements of the same standardized angle are symmetrical-mirrored images and can not be obtained with a 180 ° rotation of the same part along a vertical axis. Additionally, the only realizable floats for geometrical reasons will be those of a single or very few segments in width with angles between floating elements and crossbars (1) in the range from 90° to approximately 45°, because crossbars (1) can not get smaller angles for being more in parallel to the floating elements as they can get into transverse grooves (5). This subset of pieces requires an excessive number of additional pieces of large size, obtaining very few practical benefits in compensation.

[0136] A better solution, although still with certain geometrical constraints and practices, can be seen in **(d).** It is a modification on the transverse grooves (4) of the floats (2), (71), (72), (73) and (85) which causes modified floats (136), (137), (138), (139) and (140), respectively. Crossbars (1) do not couple directly to these new floating elements, but through some selectable and interchangeable intermediate pieces for crossbar coupling (141) or (142) for choosing one between both two possible types available. All of said intermediate pieces for crossbar coupling (141) or (142) are box-shaped and have the same outer shape and dimensions for swapping among them compatibily, as well each one of them is crossed by an oblique transverse groove or hole (143) that pierces it completely with a hole of the same inner cross section than the outer cross section from crossbars (1) for a compatible coupling with them. Said oblique transverse groove or hole (143) is practiced in the horizontal plane at the same height in all identical intermediate pieces for crossbar coupling (141) and (142), following a series of different standardized angles with respect to the modified floats (136), (137), (138), (139), and (140) when said intermediate pieces for crossbar coupling (141) or (142) are coupled to them, to allow engagement thereon of the crossbars (1) according to the same standardized angles, perfectly and with no gaps or clearances. Thus, selection of the correct intermediate pieces for crossbar coupling (141) or (142) to couple over the modified floats (136), (137), (138), (139), and (140) allow to adjust the mounting angle between them and the crossbars (1), with no need of storing and carrying multiple floating items for each angle and for each of the two possible directions, so this solution is better than previous one for transport at long distances, while previous one is better for assembly in fix position at specific points. The two intermediate pieces for crossbar coupling (141) and (142) differ in that first ones are pierced with oblique transverse holes (143), and second ones are pierced with oblique transverse grooves (143), exactly with the same outer cross section for coupling on crossbars (1). Modified floats (136), (137), (138), (139) and (140) have exactly the same shape and characteristics as their respective original versions (2), (71), (72), (73) and (85), with the exception that transverse grooves (4) are here expanded from original size largely along the top flat horizontal surface of modified floats (136), (137), (138), (139) and (140) for giving at least two expanded transverse grooves (144), on which the crossbars (1) do not couple, but intermediate pieces for crossbar coupling (141) and (142), exactly and with no gaps or clearances. The expanded transverse grooves (144) have greater height than the original transverse grooves (4), and are considerably longer, so that they can occupy all or most of the distance between the twin transverse grooves (5), which remain with no changes in the same relative positions as in almost all floating elements described. This occupied distance is then divided equally among all the intermediate pieces for crossbar coupling (141) or (142) present (usually two) for giving them the same shape and dimensions, with a narrow transverse wall separating each two consecutive intermediate pieces for crossbar coupling (141) or (142) coupled along top flat horizontal surface of modified float (136), (137), (138), (139) or (140) , or without said transverse wall or walls, being all expanded transverse grooves (144) fused on a single one that occupies almost all space between twin transverse grooves (5). All intermediate pieces for crossbar coupling (141) and (142) are firmly coupled to the modified floats (136), (137), (138), (139), (140) through a series of floats-intermediate pieces for crossbar coupling connecting screws or bolts (145), which are screwed vertically inside respective female threaded metal bodies embedded in the body of said modified floats (136), (137), (138), (139), (140), which are arranged in sets placed inside and near the outer perimeter of each expanded transverse groove (144) and are symmetrical in relation to the vertical longitudinal symmetry plane that passes through the center of said modified floats (136), (137), (138), (139), (140) and said intermediate pieces for crossbar coupling (141) and (142) when coupled to last ones. In turn, crossbars (1) are coupled to the intermediate pieces for crossbar coupling (141) and (142) by sets of usual crossbars-floats fixing screws or bolts (7) that are not arranged perpendicularly to the floating elements, but to the crossbars (1) (with exception of cases where expanded transverse grooves (144) are pierced perpendicularly over its intermediate pieces for crossbar coupling (141) and (142). In all other cases, where the crossbars (1) are turned a certain standardized angle different from 90° when placed each one inside an oblique transverse groove or hole (143), the sets of holes for the sets of crossbars-floats fixing screws or bolts (7) are also the same standardized angle value in the same direction in relation to the modified floats (136), (137), (138), (139) and (140). To allow screwing into these positions that are rotated with respect to the normal orientation, all intermediate pieces for crossbar coupling (141) and (142) have other sets of threaded complete holes vertically drilled for being crossed for respective sets of crossbars-intermediate pieces for crossbar coupling fixing screws (146), in a way that they are arranged aligned with the corresponding oblique transverse groove or hole (143) and coincidentally with positions of the sets of holes for the sets of crossbars-floats fixing screws or bolts (7) and crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8) when the crossbar (1) is coupled in the right position and displacement.

[0137] Thus, changing the angle of the oblique floating pontoon bridge or walkway is only a matter of changing all intermediate pieces for crossbar coupling (141) and (142) for other ones of the correct angle. It should be seen that if intermediate pieces for crossbar coupling (141) with oblique transverse holes (143) are used, the same one serves for both mirrored directions, to the right and to the left, simply reversing vertically the piece swapping top and bottom faces, but said elements must be impaled by the crossbars (1) laterally, so it is not possible to intercalate a floating structural modue in middle of a structure in assembly if using intermediate pieces for crossbar coupling (141), but if intermediate pieces for crossbar coupling (142) with oblique transverse grooves (143) are used, then the same piece serves only for as ingle one from the two possible mirrored directions, but it is possible to intercalate a floating structural module in middle of a structure in assembly.

[0138] Although there is the advantage of less number or parts and pieces in comparison with previous solution, this one is also limited as well, for geometrical reasons, to angles not too close to the direction of floating elements, since the more deviated from the original direction perpendicular to floating elements the crossbars (1) are, the more fraction from top flat horizontal surface from modified floats (136), (137), (138), (139), (140) is lost, so there is a limit after which the expanded transverse grooves (144) and the transverse grooves (5) overlap, being interpenetrated crossbars (1) and U-shaped longitudinal bars (3) or rectangular frames (99). Moreover, in this solution only central crossbars (1) are suitable, as prow and stern are needed for placing sliding covers (10), (79), (92), (93) , (94), or other different modified custom versions of them.

[0139] A better solution may be to use floating elements which can turn over a vertical shaft, then they can adopt any angle or at least many angles form an angle range in relation to the crossbars (1) lines. To do so, floating structural modules must be separated from the platform, as their elements are rigidly joined, in two different horizontal planes with said shafts as linking element between them, so that the floating structural modules can rotate freely below and in relation to the horizontal plane defined by the platform of deck. In this way the floating structural modules are oriented automatically at all times in the direction of the water stream, being an example when the floating structure changes its orientation relative to the to the water stream when towed by a watercraft or when pivoted from one end at the shore after having been assembled on land. **Figure 47** shows a number of elements that incorporate a robust short vertical shaft, which allow to assemble quickly small straight sections of floating walkways in which at least two floating structural modules can rotate independently to each other pivoting on a vertical shaft each below the horizontal plane defined by the platform, usually an angle range which is limited in most cases for practical reasons to a value of more than 90 ° and less than 180 °. It is a crossbar with central vertical shaft (147) that can be engaged in any transverse groove (4), (6) or (77), but preferentially in the forward transverse groove (4) of any floating element, using the corresponding usual crossbars-floats fixing screws or bolts (7). It is made from a crossbar (1) at least one segment in length, in whose exact center a wide vertical hole is drilled to insert inside a strong cylindrical shaft (148), either solid or thick-walled tubular, which passes it vertically reaching exactly to the underside without protruding from the same, for an exact coupling on said transverse groove (4). Said cylindrical vertical shaft (148) is tightly welded to the crossbar (1), and optionally some reinforcing elements as triangle-shaped reinforcing plates or supplementary tube jackets or washers can be welded to the joint areas between both parts for strengthen against strong bending movements that could break said cylindrical vertical shaft (148). On this crossbar with central vertical shaft (147) usual U-shaped longitudinal bars (3), hinged U-shaped longitudinal bars (111), rectangular frames (99), hinged rectangular frames (112) couple in compatible way, and the corresponding rectangular modular platform section (101) has a hole for protrusion of cylindrical vertical shaft (148) upwards.

[0140] Now a piece in form of crossbeam (149), that engages and embraces all crossbars (1) from top platform keeping them above the floating elements and cylindrical vertical shaft (148), is added. Such crossbeam (149) can pivot freely around a cylindrical vertical shaft (148) by being threaded by it through a vertical hole with coincident diameter, so it can pivot freely in relation to the floating structural module where the crossbar with central vertical shaft (147) is coupled, resting its weight, and weight from top walkway platform section, over the flat top horizontal surface of bottom rectangular modular platform section (101). Said crossbeam (149) is made in metal, stainless steel or alloy resistant to corrosion, and can be a single thick robust metallic bar, or several of them in parallel welded, riveted, bolted or screwed together in order to achieve greater size and structural strength. On its top, by cutting and / or welding, riveting, bolting or screwing of right metal parts, at least two transverse metal grooves (150) are added, arranged symmetrically at both sides of said crossbeam (149) in relation to its own center and perpendicularly in relation to the direction of their longest side, being these transverse metal grooves (150) arranged horizontally in parallel, and having the same cross section than transverse grooves (4), (69, (77), so that over them crossbars (1) can fit and be coupled perfectly with no gaps or clearances. Because in this assembly the walkway top platform is not locked and intertwined with floating structural modules, it is possible to have four metal transverse grooves (150) on each crossbeam (149) for strengthening the structure, or to get wider or narrow walkways depending on if two or four of those are engaged with crossbars (1) lines.

[0141] As said metal transverse grooves (150) play the role of the usual transverse grooves (4), they also have the usual standardized sets of holes the usual transverse grooves (4) and crossbars (1) always have in coincident positions and distributions, so that they also should have the minimum length of one segment to place these crossbars (1). Along the main longitudinal vertical symmetry plane of each crossbeam (149) avoiding positions of metal transverse grooves (150) and central hole, a row of vertical cylindrical tubes or holes (151) with the same diameter than central hole (this one really belongs to said row) is practiced. Said vertical cylindrical tubes or holes (151) are selectable for inserting vertical shaft (148) through one of them which snugly, which is secured to not vertically get out from position by a ferrule (152) horizontally traversed by a pin (153), which in turn also simultaneously passes through the top of cylindrical shaft (148) , so it has for this purpose a horizontal hole along its diameter near its upper end. Once inserted and these cylindrical shaft (148) on the inside of one of the vertical cylindrical tubes or holes (151) from crossbeam (149), the platform constituted by the crossbars (1) screwed to the latter with corresponding rectangular frames (99) or any compatible elements with these ones, rotates with respect to the floating structural modules, and vice versa. To facilitate rotation, the crossbeam (149) has a flat bottom face for resting and sliding with as little friction as possible, but at the same time distributing the most weight on the top flat horizontal surface from modular rectangular platform (101), the latter being suitable to be constituted by perforated high-strength metal sheet.

[0142] The crossbeam (149) can also rest on a high-diameter intermediate lubricated washer arranged between the two surfaces, or it can incorporate, along its outer perimeter, a series of wheels or rollers (154), fastened by small plates (155), to facilitate sliding and then rotation with high weight on the walkway platform section, and to also greatly increase the buckling resistance of the cylindrical shaft (148) with increasing distance lateral support all orientations. Each floating pontoon walkway straight section rests over at least two side floating structural modules, provided each one with a crossbar with central vertical shaft (147) and vertical cylindrical shaft (148) and a crossbeam (149) in the arrangement said. It is possible to mount pontoon walkways having more than two of these rotating floating structural modules, but these always must be placed greater distances than twice their turning radii to not collide each other in their rotational movements. There is a limitation because possible bending of crossbars (1) in non-flat wavy waters in case of long straight pontoon walkway sections. These rotating floating structural modules can rotate a limited angle range from about +45° to about -45° in relation to a direction perpendicular to crossbars (1), that is, about 90° in total, but this depends on the overall width of the single floating structural module or series of them used in the arrangement. This is because on its turn the crossbeam (149) can get out from them if they are too narrow. Anyway, if the floating structural modules gets parallel to the crossbars (1), all structure may be unstable if first ones are not enough wide. The choice of a cylindrical tube or hole (151) from the row of them found on each crossbeam (149) allows to adjust position of the cylindrical vertical shaft (148) for centering, advancing or delaying its position on the pontoon walkway in all floating structural modules separately. The obvious and most important reason is for obtaining a wider sustentation base for better stability, as well as for trying to compensate the applied torque on the floating pontoon walkway because water stream force, and recover balance and horizontality. **Figure 47b** is an example of a short floating straight rigid pontoon walkway, which is easily built up on the shore, made and assembled in the aforementioned way. After assembly, it is easy to move all the floating structure to its end position floating above water by pivoting it around its end on the shore, using ballast or a thick nailed peg as rotation shaft from the shore. By prying on the crossbars (1), and / or by using the water stream force itself, the short floating straight rigid pontoon walkway turns to the desired end direction, but all the time the floating structural modules are aligned with water flow, minimizing resistance and drag. And the same happens in reverse process.

[0143] This system can be improved with new elements that allow construction of straight sections of floating pontoon bridges, having bottom pivotable floating assemblies, which can be chained by common vertical shafts for giving long articulated floating pontoon bridges, longer than those previously cited.

[0144] As seen in **Figure 48**, this system can be improved with new elements with which to assemble long floating articulated pontoon bridges composed by straight rigid short sections mutually joined each two through vertical shafts where on each one a floating arrangement can turn freely 360° below the horizontal plane of the top straight platform sections. In this system each one of said floating arrangements are composed by symmetrical groups of at least two floating structural modules. Floating structural modules, constituted by solid floats in a single piece (2), (67), (71), (72), (73), (74), (75) or (76), are screwed in even-numbered sets to them to at least two identical crossbars (1) which have more than two segments in length each, in a way that these sets of floating structural modules are screwed leaving a central symmetrical gap with no floating structural modules coupled. This gap should be from one segment in width to as much three segments in width, but always all arrangement, including the central gap, must be symmetric in relation to a vertical longitudinal plane of symmetry that passes through its own center. Each side of this arrangement has the same number and symmetrical arrangement order of floating elements. The number and width of the floats (2), (67), (71), (72), (73), (74), (75), (76) used in the assembly determines its cargo capacity and stability, therefore usually it is more suitable it they are relatively wide, several segments in width to ensure side stability. In the middle gap a number of new elements is coupled, in the form of an assembly which gives a common strong vertical shaft for turning freely in relation to the floating pontoon bridge section to place above later, suspended over said vertical shaft. On the free segment or segments of said gap in the assembly with no floating structural modules coupled, a box-shaped supporting frame for shaft (156) is fitted and coupled. It consists of a robust box-shaped parallelepiped frame, made of tubular metal with square or rectangular cross section, with a series of oblique struts or braces welded or riveted joining corners of their vertical faces, and being its upper and lower faces covered by respective thick metal plates (157) and (158). This box-shaped supporting frame for shaft (156) fits perfectly from above and without clearances between the two floating structural modules that flank the crossbars (1) central gap in the assembly, fitting exactly on the rectangular hollow that remains between the two central crossbars (1) coupled to transverse grooves (4) of all floating elements used, and the two U-shaped longitudinal bars (3), hinged U-shaped longitudinal bars (111), rectangular frames (99) or hinged rectangular frames (112) used that are placed at sides. As said box-shaped supporting frame for shaft (156) touches with those elements, this placement provides greater stiffness against shear movements or bias on the assembly structure. For being supported without dropping, this box-shaped supporting frame for shaft (156) rests its weight on the free central segment or segments of both crossbars (1), front and back, with which it is in contact, so the top metal plate (157) thereof extends forward and backward to fit the entire top surface of the free segment or segments of crossbars (1).

[0145] For fixing the box-shaped supporting frame for shaft (156) to the floating assembly, such protruding surfaces from the top metal plate (157) are drilled with vertical holes groups at coincident positions with their counterparts on the crossbars (1) below, for using the same standardized fixing or bolting elements already described lots of times. In order to achieve a better anchoring and fastening the front and rear edges of said top metal plate (157) may be bent downward, or be bonded or welded to transverse U-shaped beams placed below, providing twin pieces which fit exactly on the crossbars (1) surrounding and embracing them from their top and sides, leaving its bottom free for extracting vertically the box-shaped supporting frame for shaft (156) in disassembly. Obviously, the width of said box-shaped supporting frame for shaft (156) measured in parallel to the crossbars (1) when coupled to them, is a positive integer number of segments, being preferable and sufficient a single segment for a robust, compact, strong assembly. This element incorporates on its vertical longitudinal symmetry plane that passes through its own center, a row of vertical strong thick tubes for shaft housing (159), all of them of the same large diameter and thick wall, so one of them can be chosen for placing the rotation pivoting axis of all floating assembly, so for centering or for displacing it forwards or backwards in relation to the floating pontoon bridge platform section to place above later and achieving balance or torque compensation in a water stream. The top metal plate (157) is drilled with holes matching in diameter and position to each one of said tubes for shaft housing (159), allowing introduction of a shaft from above on one of them, while the thick bottom metal plate (158) is not normally drilled to support said shaft with no falling down, or drilled with a smaller centered hole for crossing it with a vertical bar or peg for nailing or anchoring the floating structure to shallow soil. The pivot shaft (160) is a cylindrical strong robust thick-walled tube of large diameter that achieves robustness and high resistance against bending, which fits exactly or with little clearance to allow the surfaces to be oiled, inside each of the tubes for shaft housing (159), resting its lower end and weight on the bottom metal plate (158), thus transmitting a fraction of weight from the upper platform section to the center bottom of the pivoting floating assembly. Optionally a thick rotation bushing (161) may be interposed between the pivot shaft (160) and bottom metal plate (158), to facilitate smooth rotation once greased. The pivot shaft (160) can be attached optionally to the supporting frame for shaft (156) to prevent accidental loss or releasing due to wide water vertical oscillations by using a thick horizontal pin (162) which passes through and holds together simultaneously the pivot shaft (160) and the tube for shaft housing (159) in which it is housed, so for that rotation shaft (160) and each and every one of tube for shaft housing (159) have practiced horizontal holes at the same height in the direction of their diameters, to allow said horizontal pin (162) housing. After placing the rotating shaft (160) in one of the tube for shaft housing (159) and fixed with its horizontal pin (162), a horizontal circular plate (163) is placed. It is a circular thick metal plate, able of withstanding great weights above, with a central hole of diameter slightly larger thand the pivot shaft (160) to be inserted on the latter resting on the greased top metal plate (157). While allowing the rotation, this element receives and distributes the weight of all top assembled structure so indifferent to the angular orientation of all pivoting floating structure. Such horizontal circular plate has large diameter, both to cover the whole or almost all surface of the top metal plate (157) as well as to provide in all orientations a good radial supporting distance to counteract movements that tend to flex or to break pivot shaft (160).

[0146] The horizontal circular plate (163) receives the weight of the platform section placed above through a intermediate big crossbeam piece (164). This approximately box-shaped element, made of metal, has similar functions than the crossbeam (149) but it is stronger and larger, is symmetrical with respect to two own vertical planes, longitudinal and transverse, respectively. It has two flat horizontal surfaces, top and bottom, where the top one is interrupted by transverse metal grooves (150) and bottom one may be smaller than the top one to concentrate weight and load from the upper platform section on the horizontal circular plate (163) on which it rests. On its top flat horizontal surface, by cutting and / or welding, riveting, bolting or screwing of right metal parts, at least two transverse metal grooves (150) are added, arranged symmetrically at both sides of said big crossbeam piece (164) in relation to its own center and perpendicularly in relation to the direction of their longest side, being these transverse metal grooves (150) arranged horizontally in parallel, and having the same cross section than transverse grooves (4), (69, (77), so that over them crossbars (1) can fit and be coupled perfectly with no gaps or clearances. Because in this assembly the walkway top platform is not locked and intertwined with floating structural modules, it is possible to have four metal transverse grooves (150) on each crossbeam (149) for strengthening the structure, or to get wider or narrow walkways depending on if two or four of those are engaged with crossbars (1) lines. As said metal transverse grooves (150) play the role of the usual transverse grooves (4), they also have the usual standardized sets of holes the usual transverse grooves (4) and crossbars (1) always have in coincident positions and distributions, so that they also should have the minimum length of one segment to place these crossbars (1). The big crossbeam piece (164) has internally a thick vertical cylindrical tube (165) which passes through its center connecting top and bottom flat horizontal surfaces and can host inside it the pivot shaft (160), so said top and bottom flat horizontal surfaces has holes of the same diameter than thick vertical cylindrical tube (165) which are centered on it. By this way, the big crossbeam piece (164) can pivot around the pivot shaft (160), which is inserted inside its inner thick vertical cylindrical tube (165), resting its weight over the greased horizontal circular plate (164). The thick vertical cylindrical tube (165) has larger diameter thand the pivot shaft (160), so that it is introduced with some play to allow the introduction of supplementary lubricated sleeves (166) or thick washers, which can be placed or not depending on the need. Such supplementary lubricated sleeves (166) are all identical and introduced greased, stacked in column and making contact between the thick vertical cylindrical tube (165) and the pivot shaft (160), surrounding this last one, so that they smooth rotation and strengthen said pivot shaft (160), impeding this could swing when placed inside the thick vertical cylindrical tube (165), so limiting movement to only rotation along a vertical axis. The top end of pivot shaft (160) protrudes slightly above the top surface of big crossbeam piece (164), so it has the required length for this feature and the two pieces are fastened together, for not getting out vertically one from the other, through a horizontal pin (167) which simultaneously pass through horizontal consecutive drilled holes practiced at the top end of pivot shaft (160) and a top sleeve (168). Said top sleeve (168) outer diameter larger than the hole in the top horizontal surface of big crossbeam piece (164), acting as a top upright confinement stopper. So each pivoting float assembly is freely rotatable 360° about its pivot shaft (160) in relationto the top pontoon bridge platform section.

[0147] For following better the water flow direction, the floating structural modules can incorporate a series of rear vertical fins (169) that are introduced vertically in water acting as a rudder. These vertical fins (169) can be joined to a detachable rear supporting rack, symmetric in relation to the vertical symmetry plane of the arrangement and can dock over the rear crossbar (1), either if placed on a row of transverse grooves (4) or (77). Said detachable rear supporting rack can be telescopic for prying better and align automatically the floating elements to the water flow direction.

[0148] Thus it is possible to assemble straight pontoon walkway sections and supporting them over at least two of these pivoting floating arrangements at sides, which can pivot each one freely in a horizontal plane around its own pivot shaft (160). It is also possible to place one end of a straight pontoon walkway section resting over a box-shaped supporting frame for shaft (156) and this in turn being secured to the soil by a standing bracket made of crossbars (1) and a set of pedestal parts (40), (41), (42), (59), (60), (60), (62), aided by wedges to obtain the horizontal, and weights, ballasts, planks, pillars, pegs and the like for complete immobilization, for buliding a straight pivotable pontoon bridge which pivots from the shore. The choice of tubes for shaft housing (159) allow to place the pivot shaft (160) centered on the box-shaped supporting frame for shaft (156), or moving it forward or backward along it and in relation to the symmetric floating assembly of floats (2), (67), (71), (72), (73), (74), (75) or (76) used on the same, thus adjusting the stability and / or compensating the torque applied to the floating pontoon bridge due to a water stream drag force. movements applied to the structure may tend to force and drag these elements, so pivoting shafts (160) may deviate from verticality in an independent way, so they could be broken even if thick and robust. It can also happen that there may be a significant height difference between land and water, and after building a floating pontoon bridge on the safety of the shore, when pivoting it from its shore end to move the other one on the water, problems could arise because the pivot shafts (160) placed over water remain arranged vertically in parallel but the pivot shaft (160) on the shore appear in relative angle with latter ones, so this one may come to be bent or broken. For compensating this fact, it is only necessary to add an additional piece for giving a second strong angular articulation with a little freedom degree of movement in a vertical axis, for allowing the pivot shafts (160) remain in parallel despite vertical movements in water or height differences between water and shore.

[0149] Placed above and resting over the horizontal circular plate (163), an additional piece is added optionally depending on the need for giving said additional strong articulation, docked below the big crossbeam piece (164) and in intermediate position between those. Below to the bottom flat horizontal surface of each big crossbeam piece (164), a supplementary rocking piece (170) with rounded bottom surfaces is docked, which allows to the upper big crossbeam piece (164) to tilt a limited angle range in a vertical plane as a rocking chair does, so the floating pontoon bridge section coupled above said latter piece makes the same. Thanks to this supplementary rocking piece (170) each straight platform section from the articulated floating pontoon bridge can tilt slightly in relation to each other with no danger for pivot shafts (160). Said supplementary rocking piece (170) has a top part in form of a thick rectangular plate of exactly or approximately the same size and dimensions than the bottom flat horizontal surface of each big crossbeam piece (164) for good coupling between both pieces, being joined with the help of a series of supplementary rocking piece fixing screws (171), which are inserted and tightened from below through vertical screw holes drilled in matching positions in both pieces for joining them firmly. The rectangular plate has a central hole with a diameter greater thand the pivot shaft (160) so that this can pass through said hole with enough perimetral space to spare. To allow tilting movement, this rectangular plate from supplementary rocking piece (170) has on its underside in coupling position, disposed below their short sides and avoiding the middle area of the center hole, twin symmetric curved surfaces which rest and touch on the horizontal circular plate (163). Each of said twin symmetric curved surfaces has the shape of a cylinder chopped along a plane which is perpendicular to their bases, passing through its center or not. When these twin symmetric curved surfaces roll over the horizontal circular plate (163) allow to the big crossbeam piece (164) to tilt a little a limited angle range disposed in a vertical plane parallel to the short sides of said supplementary rocking piece (170). If the supplementary lubricated sleeves (166) are not placed or removed, a tubular gap remains between the pivot shaft (160) and the thick vertical cylindrical tube (165) from each big crossbeam piece (164), so these two can adopt a certain relative angle before colliding between, so the tilting angle range is determined mainly by the diameters ratio between these two elements and by the arc length of the twin symmetric curved surfaces. On top of the pivot shaft (168) the top sleeve (168) is changed by a single torus-shaped or conical sleeve (173) with rounded surfaces that touch the inner perimeter top edge of the thick vertical cylindrical tube (165), so due to its shape said torus-shaped or conical sleeve (173) tends to maintain at all times mutually centered the thick vertical cylindrical tube (165) with the pivot shaft (160) inside, so also tends to automatically align pivot shaft (168) and the big crossbeam piece (164). The torus-shaped or conical sleeve (173) must have then the same horizontal hole for insertion of the horizontal pin (167) that top sleeve (168) has. A good convenient modification is that the horizontal pin (167) is not used, but instead of it a transverse tilting shaft (175) is used. This element is a strong cylindrical horizontal bar that acts as strong horizontal pin and tilting shaft. This elements crosses through convenient holes the supplementary rocking piece (170) through its center in the direction of their long sides, and coincidentally with the rotation axis of its tilting movement, as well as it crosses also with a coincident horizontal hole the pivot shaft (160), being suitable that this latter would be changed by a short pivot shaft (172), identical to the pivot shaft (160) but shorter, which does not protrude upwards from the thick vertical cylindrical tube (165), allowing a wider tilting angle range. If it is desirable to limit the tilting angle or fixing it to a certain angle, supplementary rocking piece fixing screws (171) can be used by this purpose, provided they are thick and sturdy enough, or present in enough number for scattering deformation efforts among them. Simply their vertical screwing positions are adjusted to desired touching positions to the bottom horizontal circular plate (163), so the length of their screw studs added to the screw head (being suitable that said head is finished in a hemispherical shape for best function) determines such angle or angle range.

[0150] Other alternative pieces allow change the supplementary rocking piece (170) by a joint ball in the same way as a trailer ball, giving a weaker assembly but faster in mounting and dismounting. These pieces consist of a pivot shaft stump finished in a spherical ball (177) which replaces the pivot shaft (160) and short pivot shaft (172), which engages on a female receiving socket (178) which has a spherical cavity or receptacle that can be opened and closed by a suitable locking mechanism secured with a pin or similar. This last piece is positioned below the bottom flat horizontal surface from the big crossbar piece (164) by means of the supplementary rocking piece fixing screws (171), while the first one is inserted into a selected one of the thick vertical cylindrical tubes (165). The fitting of the spherical ball end of the socket cavity gives a joint capable of rotating 360 degrees in azimuth and an limited angle range in height, but with the drawback that it concentrates all the weight from the platform section on the ball and socket, so these pieces are suitable for not very much load or cargo. With the elements described so far it is possible to join two or more consecutive straight floating pontoon bridge platform sections in two basic ways, as shown in **Figure 49.**

[0151] First ones is to support each end of each straight platform section over a single symmetric pivoting floating assembly for stabilized flotation over water and / or over ground, then towing or pivoting from shore this straight platform section to final position, and then additional straight platform sections to coupling to the previous one are joined by means of linear linking elements following the lines of crossbars (1), either flexible ones (cables) or articulated ones (variable angled pieces with centered hinge (29). This way only allows assembly of linear straight articulated long floating pontoon bridges.

[0152] The second way is to support each end of an initial straight platform section over a single symmetric pivoting floating assembly for stabilized flotation over water and / or over ground, then building the following straight platform sections successively over the previous one, having each (starting from second one) only a single symmetric pivoting floating assembly on its farthest end and sharing a symmetric pivoting floating assembly with a common pivot shaft (168). After completion of each straight platform section over the previous one, it is dropped to water and pivoted until straight direction to the previous one, or in the desired angle, fixing to the soil by nailing, ballasting or anchoring elements already exposed, repeating the process as many times as needed for reaching th the other shore. By this sharing of common pivot shafts (168) and common symmetric pivoting floating assemblies between each two consecutively stacked linked straight platform sections, the structure is deployed, dismantled or folded as a carpenter's rule does, as well as this system allow to branch the floating pontoon bridge in Y-shaped or T-shaped bifurcations by sharing in three straight platform sections. Mixed arrangements are also possible.

[0153] Concluded the group of elements that allow the construction of floating pontoon walkways and floating bridges, it only remains for concluding the description of the invention, to describe a relatively miscellaneous last group of elements and pieces which makes possible the construction of some unorthodox floating structures which are useful in extremely hard flooding conditions or extremely strong water streams, even with dragging debris present, where almost all existent watercrafts and pontoon structures can not work or may result capsized, smashed or collapsed. If the populated area to evacuate is surrounded by strong water streams that usual watercrafts can not cross because dragging or hits with debris and no air means are available, it may be possible to place crossing cables for evacuating people with harnesses with pulleys, but this process is performed person by person and can be slow. With the new elements present in such situation it is possible, as last resort, assembling some types of watercrafts and capsules which can move, guided through a transverse transference cable which is placed and firmly fixed crossing that water stream, using the component parallel to such transference cable from the same pushing force due to the water stream, in addition to the fact that several of such assemblies (case of rotating capsules) roll over water surface and also can roll over any colliding floating dragged objects or debris, even trees, so they can overcome them, protecting at the same time the passengers who are placed inside the hull in rotation around them. The most part of these assemblies are parts and pieces already described, so addition of these new parts and pieces does not mean to spend very much additional space in vehicles, but the possible duty said unorthodox assemblies may perform may be important in severe, hard situations where there are no other choice. The main requirement is that it is possible to place a strong cable, or several parallel cables, between the two sides, by using of a wire gun, hook launcher rifle or similar device. If a member of the rescue team can cross by any mean possible to reach the other side, it is best. Then, said strong cable is fixed taut and tighten by their ends to any strong elements placed on the shores, for example, trees. Once that operation has been performed, the device for crossing the water stream with evacuees inside depend on the hardness ow the waters stream. If water flow is strong but laminar, or there are no strong height variations in water level or turbulences along the path to cross, and no floating objects or debris are dragged, it is possible to use oblique rafts as device to assemble. If water flow is highl turbulent, or there are strong height variations in water level and / or floating dragged objetcs and debris, the only possible devices that can work in these conditions are rotating capsules.

[0154] An oblique raft is a raft assembled with identical oblique floats (129) (or less preferably with oblique floats (138)), both of which have twin pointed ends. Because there are no distinction between prow and stern on any of them , being both extremes ending in tip end, both can serve as forward part of the watercraft. For building half of an oblique raft, said identical oblique floats (129) (or les preferable, oblique floats (138)) are coupled, belonging each one to a floating structural module, to four identical crossbars (1) along their oblique transverse grooves (132), (133) and (134), leaving gaps between each two of them as they can not (and must not) be placed together in mutual contact., and being preferable to use only two side floating elements for giving the less weight possible for easy handling and lifting by hand, despite it is possible to build oblique rafts with more floating elements. The other half of the same oblique raft is assembled exactly in the same way, but with the difference of using oblique floats (129) or oblique floats (138) whose oblique transverse grooves (132), (133) and (134) have the same angle but in the opposite specular direction. By this way, two halves of this oblique raft in assembly are mirror-symmetric and one can be coupled with full coincidence over the other, giving a oblique raft which is reversible as it has twin swappable top and bottom floating layers. By turning out the oblique raft, swapping top and bottom, the watercraft is the same but the angle between crossbars (1) and oblique floats (129) is mirrored. All crossbars (1) are provided with terminal pieces for passing cables (15), and a series of parallel cables can be passed through said crossbars (1). If the guide cable is sufficiently tense, the crossbars (1) are always maintained, more or less, approximately in perpendicular direction to the water flow direction, but oblique floats (129) will be in an angle relative thereto. Said angle, obviously, can be selected by choice of these oblique floats (129) for adapt to conditions as water flow speed. Submerged floating elements on bottom floating layer act as passive propulsion devices by diverting the water flow partially to a side, in a way that the more load transported over the oblique raft, the more oblique surface from oblique floats (129) are sunk and the more transverse pushing force is obtained (depending also as commented of the selected oblique floats (129) because the angle). So if the guide cables are enough oiled, said transverse component pushes the oblique raft on the desired direction with no motors used and no physical effort spent. If a water hit sinks all oblique raft, the top floating layer increases buoyancy inmediately, making the oblique raft to raise from water. Once the oblique raft reaches the opposite shore, and cargo or passengers have been extracted, to reverse its displacement direction it is necessary only to flip top and bottom layers, turning the oblique raft 180 degrees, so mirroring relative angle of floating elements. While doing this, the guide cables must be loosen, untied and also swapped, interchanging forward cables with backward cables and to the contrary with no need of extracting them from the crossbars (1), and tying and tightening them other time, so the trip in the other direction is performed in the same way. To facilitate these tasks in overturning steps, passengers or cargo are accommodated in a strong container, like a basket or a stretcher, which is coupled and joined to the crossbars (1) in middle of both oblique floats (129) from the top floating layer, so it is detached and reattached when the overturn has been made. This oblique raft is rigid and strong, suitable for strong water stream and relatively hard water stream conditions, with the only limitation of swapping top and bottom layers and front and rear guide cables for switching direction of displacement. As this switching step is to be made by human strength, the size and weight must be manageable, imposing a limit of the load and number of people to transfer on each trip, but two or more of these devices can be placed, working in parallel for taking less time if necessary.

[0155] As oblique rafts do not need human force or electric or mechanical motors or traction devices, this same principle is good for assembly a new bigger model of oblique raft for transference of higher capacity of cargo or people between two opposite shores using the water stream force, as ferries that cross rivers displacing along a transference cable, but with the need that the angle of their floating elements should be mirrored and even adjusted with no need of lifting the craft, so if this were possible, the oblique raft could stay in water at the shore in load and unload processes, and accelerate and braking by adjusting in navigation the angle of their floating elements in relation to the flow. Said assembly, which can be seen in **Figure 50,** will be only suitable for non-rescue operations in laminar strong water flow conditions, but has no oil or electric consumption. It is detachable with parts and elements already described and which can be identified by their respective numbers, with exception of the crossbars (181), which can be exactly identical to crossbars (1), or having the drilled screw holes practiced only in preset positions, different from the same ones present in crossbars (1) and especially modified for this assembly, as well as longitudinal straight bars (182), whose task is to link in a same line firmly all vertical shafts from crossbars with central vertical shaft (147), so both crossbars (181) and longitudinal straight bars (182) form a rhomboidal flexible grate whose sides are rigid but whose angles can be varied thanks to a hand crank and locked into fix positions thanks to oblique braces (183).

[0156] Turning to emergency situations, since water flows copying landforms or submerged objects above, the flow can be irregular in height and / or turbulent, giving waves, turbulence, vortices, and in the case of presence of cavities in the landform, hydrostatic tides. So in these cases, especially such harder ones, it may happen that the water drag force is excessive for any watercraft or pontoon bridge, as well as even for such oblique rafts. Cargo and passengers are unprotected against overturned or have the risk of falling overboard when the watercraft is shaking if they are not secured thereto, or the same watercraft could finish overturned and their passengers dragged and drowned. Such shaking movements in watercrafts can go breaking the transference cables because the continuous shaking out. Worst, the transference cable is close to the water and dragged objects as trees or debris could hook with them and break or release their extremes. However, if it were possible to place the transference cable in a raised position from water, such possibility of collision or hooking with dragged objects and debris will be reduced. Rotational capsules are suitable for facing hard situations as these described.

[0157] For assembling a rotational capsule, four (at least) identical regular convex polygonal frames (32) (that is, equilateral and equiangular convex polygonal frames (32)) are coaxially arranged in parallel vertical planes coupled on the transverse grooves (4), (6) and (77) of a certain number of identical closed symmetric floats (72), (73) and (85), in a way that all segments of all sides of the identical regular convex polygonal frames (32) are fully occupied by said floats (72), (73) or (85), so them are arranged around said regular convex polygonal frames (32) in a peripheral prismatic arrangement, radially symmetric in relation to the center. Smaller arrangements are those in which they are used as many floats (72), (73) or (85) as sides have the regular convex polygonal frames (32) used, so that each side is occupied by a single float (72), (73) or (85) of the same width in segments as its length. Bigger arrangements are those in which the same arrangement of floats (72), (73) or (85) that completes exactly all the segments in length of a side of the regular convex polygonal frames (32), is repeated symmetrically radially on all other sides. Once assembled both types of elements in a regular polygonal prismatic structure, there is a central hollow coaxially aligned inside the same, also in shape of regular polygonal prism with the same number of sides. The crew can access inside this hollow to couple other elements. Coupled pairs of twin U-shaped longitudinal bars (3) or rectangular frames (99) can be docked and screwed simultaneously to the regular convex polygonal frames (32) and to the floats (72), (73) or (85) used until completing all segments in length of each side of the regular convex polygonal frames (32) (in easier words, using a single one of these elements or several ones but always completing the length of each side), giving a sandwiched structure on each side of the regular polygonal prismatic structure. If instead of these elements, coupled pairs of twin U-shaped longitudinal bars (3) or rectangular frames (99) are used, they can be mutually linked by their longitudinal hinges (110), either if they are placed on corners as if they are placed on faces of the inner prismatic hollow, so the regular polygonal prismatic structure is even stronger and tougher. Rectangular platforms (101) are also coupled. Since in all floating structural modules the U-shaped longitudinal bars (3) or similar counterparts and the crossbars (1) are placed in different parallel horizontal planes, in this arrangement the U-shaped longitudinal bars (3) and regular convex polygonal frames (32) are placed in two different coaxial aligned prisms, one contained inside the other. By this geometrical feature, the vertices of all regular convex polygonal frames (32) protrudes from the floating elements, so they can be joined by longitudinal bars (112), hosted in a longitudinal row of holes for each vertex. We should notice that in this structure these longitudinal bars (112) are placed outside from the arrangement of floating elements, while in all previous reel cage middle pieces they are placed inside the arrangement of floating elements.

[0158] With the aid of thick pins, screws or bolts, or also preferably using the own longitudinal bars (122), two twin star-shaped adjustable racks (116) of the same number of spokes than sides in the regular convex polygonal frames (32) used, are docked over the two outer ones on the assembled prismatic structure, being connected each spoke to each vertex and all star-shaped adjustable racks (116) and regular convex polygonal frames (32) coaxially aligned. With this arrangement the two outer star-shaped adjustable racks (116) give two aligned holes which are coincident to the symmetry axis of the prismatic structure, so suitable for placing a thick cylindrical hollow shaft for making the capsule to spin around. Inside said thick cylindrical hollow shaft the transference cable orset of parallel transference cables pass, suitably lubricated tensioned and for this function. In turn, the faces of the inner prismatic hollow are filled with any cushioned or inflatable elements for protecting the passengers when all the capsule is spinning passing through the water stream, who are housed within the prismatic structure in rotation, being attached hanging from central thick cylindrical hollow shaft from safety harnesses and other security equipment, as helmets. Said thick cylindrical hollow shaft may be also cushioned. Passengers may pick up his legs toward the abdomen if necessary, depending on the space available and the diameter of the structure built, so they do not hit the rotating periphery. This rugged floating rotary cage which has peripheric spinning outer hull, lacks a preferred vertical orientation, so it can not overturn in any way independently of the value of the water stream force and torque applied to the prismatic structure, so the stronger the water flow is, the higher angular acceleration suffers the rotational capsule and it spins faster, and to the contrary., so the rotating capsule floats while it rotates freely around its central rotation axis. As passengers and cargo hang from the thick cylindrical hollow shaft and all weights are equitatively distributed as all prismatic structures sides are identical, the center of gravity is placed on the rotation axis, usually centered on it. Passengers, firmly attached to the thick cylindrical hollow shaft, are surrounded by padded protections and can not be released except by breaking or voluntary opening of harnesses, but in that case they still remain inside the cage, rolling over the cushioned parts. As the rotation axis and the transverse cable are above the floats (72), (73) or (85) in contact with water, the torque exerted is very large, but rather than producing uncontrolled pitching or shaking as in the case of a normal watercraft, this is translated into a rotary motion for making the rotating capsules spin, so the capsule is stabilized as it rolls over the water stream, dragged objects or debris. With hull in rotation, as a result of the principle of conservation of angular momentum, a stabilization of the spatial orientation of its rotation axis tends to reduce pitching and tilting movements in the transference compared to conventional watercrafts, and reducing in turn pulls on the cable. Furthermore, there is a dynamic increase in buoyancy in rotating capsules, since the rotation makes the rotating capsule to climb over incident water flow through its rotation inertia. For adjusting the moment of inertia of the structure a series of identical weights can be placed at equal radial distances from the center on the spokes from star-shaped adjustable racks (116).

[0159] Since the rotating capsule has to move transversely to the water stream using the transverse component from their own pushing force, both in a direction as to the contrary, it can resort to the transverse cable placement in slightly oblique arrangement with respect to the water stream, as in **Figure 51.** With this solution, to reverse the direction of movement it is necessary to reverse the arrangement of the cable ends, which must necessarily be longer than the width of the water stream to cross, what means time and efforts required for rolling the capsule across the soil on the shore to its new starting position on each trip, but only in case the shores are free of obstacles. Therefore, an oblique radial paddle (184) is placed on the rotating capsule to each one of all spokes from both star-shaped adjustable racks (116), so arranged in a radial symmetrical distribution. Each oblique radial paddle (184) is a metal bar with square cross section which can be inserted snugly inside, displaced along and fixed at a certain radial distance from center along each one of said spokes with bolts (as telescopic legs). To such bar a metal plate is welded for shaping the paddle at an angle of 45 ° in relation the faces of said square bar. These oblique radial paddle (184) protrudes from the floats (72), (73) or (85), all of them with the same orientation of 45° or -45° in all spokes, so they cooperate. When water flow hits each oblique radial paddle (184), the longitudinal component makes the rotating capsule to spin, and the transverse component makes the rotating capsule to slide along the transference cable on the desired direction, which depends on the coupling orientation of them. Once the rotating capsule has reached the shore and passengers have got out, simply all oblique radial paddle (184) are rotated 90° for inverting the direction. As the floats (72), (73) and (85) are symmetrical with respect to a vertical transverse symmetry plane that passes through its own center, both two ends are equal and indifferent, therefore the rotating capsule present the same behavior in a sense of displacement as on the other. In other case such behavior in both directions can be different. We should notice that, with exception of said oblique radial paddles (184), no additional elements have been added still, so all the structure described for now for building rotating capsules is made with elements, parts and pieces already seen. An additional element to add to rotating capsules are a kind of triangular prism-shaped floats (185) .Each one of them fits exactly in the triangular hollow between two adjacent floats (72), (73) or (85), so their bases are regular triangles (equilateral and equiangular) only in case of a rotating capsule having six sides, while in all the rest of cases their bases are an isosceles triangle, whose angles depend on the number of sides of the rotating capsule where it is to be coupled. By their coupling, said triangular prism-shaped floats (185) increase the buoyancy of the rotating capsule by filling with floating bodies the gaps between the main floats (72), (73) or (85). Each triangular prism-shaped float (185) has a complete longitudinal hole which crosses completely it, located in a position near the vertex which is inserted between the two adjacent floats (71), (72) or (85), in a way that each longitudinal bar (122) can impale each triangular prism-shaped float (185) through such longitudinal hole, holding it in position without being released. Said triangular prism-shaped float (185) may be replaced by a pneumatic inflatable version (196) for increasing buoyancy and saving space in vehicles.

[0160] Another important elements to couple to each rotating capsule are twin radially-symmetric sliding covers (187), being each one constituted by one piece or more. Said pieces cover both sides of the tubular prismatic hollow of the rotating capsule, avoiding it could be filled with water, and impede that the passengers may be hit and injured with floating objects that can entry into said tubular prismatic hollow, pushed by the stream. Each one of said twin radially-symmetric sliding covers (187) are polygon-shaped pieces, or several identical pieces that when joined in a radially-symmetric arrangement they shape a polygon, being such polygon regular and of the same number of sides than the twin regular bases of the prismatic structure of the rotating capsule. So that the single piece or the radial arrangement of several identical ones of them, disposed in a plane which is parallel to the regular convex polygonal frames (32), is / are then introduced from one side inside the prismatic central hollow of the rotating capsule along its main longitudinal central symmetry axis, exactly matching with the inner flat faces of said prismatic central hollow, actually corresponding to the top surfaces of the floats (71), (72), (73) or (85) used in the assembly and the radially inner faces of the regular convex polygonal frames (32) coupled on the transverse grooves (4), (6) and (77), fitting snugly between and over them without clearances. Each one of said twin radially-symmetric sliding covers (187), or the radial arrangement of several identical ones of them, has / have longitudinal slots which are also arranged in a radially-symmetric disposition, in a way that they can fit without play on the longitudinal guides or flanges (11) or (78) of each one of the floats (71), (72), (73) or (85) assembled in the rotating capsules, and slide along them until stop touching the star-shaped adjustable rack (116), to which it / they can be screwed or bolted from inside the prismatic tubular hollow by passengers, as well as from outside to the floats (71), (72), (73) or (85), arranged radially, by means of the sets of floats-sliding covers fixing screw (12).

[0161] We should notice that said rotating capsules are also tsunami emergency capsules. Only differences are that they do not use transference cables and oblique radial paddles (184).

[0162] At least on paper it is possible to build not only tsunami emergency capsules and rotating capsules, but also floating walkways of rotary-peripheral hull, although because the increased complexity of the structure and its lower strength they may be hardly realizable except in exceptional cases of preassembly and / or previous placement in anticipation of a possible extraordinarily rapid evacuation of large numbers of people in case of danger, as for example, danger of sudden thaw of a rushing river or a high risk of liquefaction of a sloping ground or permafrost. A floating walkway of rotary-peripheral hull is a walkway placed connecting two shores, which is arranged crossing a water body, water stream, frozen water stream or sloping terrain with high risk of liquefaction, characterized by being wrapped by one or several prismatic rotary structures, made with floating structural modules, in a way that each one of said prismatic rotary structures spin around a floating walkway section, in the same way that rotary capsules do, but in a longitudinal fix position over such floating walkway. Then, they try to offer protection to people crossing the walkway in a situation of evacuation emergency in a similar way that the rotary capsules offer to the passengers inside. The prismatic rotary structures rolls over water, dragged objects, debris, ice blocks, or any solid object, while the people cross inside such structure in rotation for making a fast evacuation in seconds or minutes if necessary. Said prismatic rotary structures are the same ones used for rotary capsules, but with lack of oblique radial paddles (184), twin radially-symmetric sliding covers (187) and star-shaped adjustable racks (116).

[0163] As can be seen in **Figure 51b,** such horizontal walkway is located inside of a large three dimensional prismatic frame (188) which is positioned within and along each and every one of the inner prismatic tubular hollows that each and every prismatic rotatory floating peripheral arrangements placed one after another to complete the entire length between the two anchoring points at the edges or shores. To permit relative rotation of each one of the prismatic rotatory floating peripheral arrangements around its corresponding three dimensional prismatic frame (188) containing the gateway or gateway horizontal section, all rectangular platform sections (101) on each and every floating structural modules have been replaced by curved rectangular platform sections (189), all of them with the same outer perimeter, dimensions, sets of holes and anchoring positions than usual rectangular platform sections (101) have for compatible coupling on the coupled pairs of U-shaped longitudinal bars (3), coupled pairs of hinged U-shaped longitudinal bars (111), rectangular frames (99) and hinged rectangular frames (112), but with the feature that its top surface is not flat as in the former one, but curved in the longitudinal direction, so that each one constitutes an angular sector of a hollow cylindrical tube of the same angle value that the result of dividing a complete circle by the number of sides that the regular convex polygonal frames (32) used in the same assembly. With these curved rectangular platform sections (189) coupled inside, each prismatic rotatory floating peripheral arrangement has not an inner middle longitudinal coaxial polygonal hollow, but a cylindrical one, so it can spin making contact rolling on several inner rolling elements (190), as wheels or rollers, which are located at some selected points around the three dimensional prismatic frame (188) for a ood rolling action, and having parallel rotation axes to the same from the prismatic rotatory floating peripheral arrangement where they are placed inside.

[0164] These inner rolling elements (190) are arranged rigidly thereto, so that their rotational axes are all parallel to the symmetry and rotation axis of each one of the prismatic rotatory floating peripheral arrangements and therefore about their respective inner longitudinal cylindrical hollow, and further grouped into several coaxial groups which are angularly spaced along a plane transverse to this symmetry and rotation axis on different points to ensure centered, stable coaxial rolling contact between these inner rolling elements (190) and the inner surface of cylindrical inner longitudinal hollow constituted by all curved rectangular platform sections (189) of each prismatic rotatory floating peripheral arrangement.

[0165] In order to conserve as much as possible the horizontality of the central gateway step, three dimensional prismatic frame (188) is weighted at its bottom by easily removable weight or weights, or has weighted adjustable bars to be placed at variable distances to produce an adjustable torque over the three dimensional prismatic frame (188) that counteracts the torque applied on the same piece due to the rotation of the prismatic rotatory floating peripheral arrangement. The gangway sides are protected from inner rolling elements (190) and the prismatic rotatory floating peripheral arrangement in rotation around, while one or more upper longitudinal bars allow to walkers or evacuees to wear a safety harness or belt to be hooked to the same for safety while they cross from side to side.

[0166] To finally conclude, this set of pieces is extremely broad and extensive, but all use the same standardized compatible mutual anchoring locking system. This allows to determine the manufacture and production volume of each one of the various elements and pieces individually, depending on its application, necessity, demand and frequency of use. With this invention, flood fighter brigades may have a modular detachable tool with which to respond fastly and adapt proportionally to the seriousness, extension, intensity and many other variables to take into account in flooding situations, as they can assemble multiple structures to choose among, depending on the situation, and reusing the same modules and pieces in almost all possible structures, only changing a part of the elements for

Claims

1. Set of parts and pieces in kit form for union and assembly of modular watercrafts and floating structures having different number of floats, whose pieces to assemble among, by its repetition a certain number of times and its subsequent mutual sideward coupling to give different sizes and hull arrangements, consist of:

   - a plurality of identical floats (2), wherein each float (2) has:

     - at least two transverse grooves (4) in the central section of each float (2) which are practiced horizontally in perpendicular direction in relation to the float (2) and crossing completely it, all of them of the same cross-section in a way that allow the coupling, snugly relatively sliding and further fixing of a single crossbar (1) inside each one of them by screwing them together through a set of crossbars-floats fixing screws or bolts (7),
     - as well as two further transverse grooves (5) which are practiced outside from and flanking all the set of transverse grooves (4) of the same float (2) horizontally in perpendicular direction in relation to the float (2) and crossing completely it, so that in parallel to the transverse grooves (4), being all these further transverse grooves (5) of the same cross-section for allowing snugly coupling and further fixing over the same ones of one or almost always two U-shaped longitudinal bars (3) that couple to the floats (2) through their respective two twin shorter linear sections once the latter ones are introduced inside said further transverse grooves (5) and screwed together through a set of floats-U-shaped longitudinal bars fixing screws (9),
     - as well at least a single transverse groove (6), which are practiced outside from all the set of transverse grooves (4) and outside all the set of further transverse grooves (5) of the same float (2) horizontally in perpendicular direction in relation to the float (2) and crossing completely it, so that in parallel to the sets of transverse grooves (4) and the further transverse grooves (5), all of the same cross-section than each one of the transverse grooves (4), which allows the coupling, snugly relatively sliding and further fixing of a single crossbar (1) inside one of them by screwing them together through a set of crossbars-floats fixing screws or bolts (7),
     - as well as above the top flat horizontal surface of the prow end of each float (2) and only interrupted by the single transverse groove (6), one or more parallel longitudinal strong guideways or flanges (12)

that are arranged symmetrically in relation to the vertical longitudinal symmetry plane that passes through the center of the float (2) ,

- at least a pair of identical crossbars (1), to be placed in the middle section of each float (2) in final coupling position,
- a detachable front sliding cover (11) swappable by a detachable front sliding plate (35) for each float (2),
- a set of crossbars-floats fixing screws or bolts (7) for each float (2) and for each crossbar (1), for joining crossbars (1) and floats (2) among them,
- a set of crossbars-U-shaped longitudinal bars fixing screws, threaded rods or bolts (8) for each float (2) and for each crossbar (1), for joining crossbars (1) and U-shaped longitudinal bars (3) among them,
- a set of floats-U-shaped longitudinal bars fixing screws (9), for each float (2) for joining floats (2) and U-shaped longitudinal bars (3) among them,
- a set of floats-sliding covers fixing screws (13) for each float (2), for joining floats (2) and front sliding covers (11) or front sliding plates (35) among them

in a way that this set of parts and pieces allows the construction of said modular watercrafts and floating structures by consecutive repetition sideward and subsequent coupling, along at least a pair of said two twin crossbars (1) of a certain number of these pieces excepting the crossbars (1), being said crossbars (1) of the same constant cross-section square or rectangular, being each U-shaped longitudinal bar (3) made of metal tube of square or rectangular cross-section which is bent twice in right angles symmetrically at both sides in relation to the center of the piece and to the original tube section, thus giving to the piece a symmetrical U-shape embodiment composed of a central longer straight section which in final coupling position is arranged in parallel to the floats (2) and two twin shorter straight sections that remain arranged perpendicularly to the central longer section and to the floats (2) in final coupling position, in a way that over each float (2) each detachable front sliding cover (11) or each detachable front sliding plate (35) are placed on the top of its prow end by inserting each coupling over the longitudinal guideways or flanges (12) by means of a corresponding set of longitudinal bottom grooves or slots which fit perfectly on the previous ones and prevent the extraction of these sliding pieces (10) and (35) upwards, up to a transverse ending stopper, fixing it to the float (2) with a set of screws floats-sliding covers fixing screws (13) in a way that each joined pair of U-shaped longitudinal bars (3) form a rectangular metal frame above of each one of which it is possible to attach at will by screwing an optional modular rectangular platform section (10) for constituting a top walking platform, being **characterised in that** upon this set of pieces two solid or hollow tubular small crossbars (14) are added for each pair of U-shaped longitudinal bars (3) to join them mutually in a way that the half of each solid or hollow tubular small crossbar (14) is introduced inside an end or extreme or each one of the two twin transverse arms of square or rectangular section of each U-shaped longitudinal bar (3) with their respective outer and inner cross-sections matching for snugly fitting without gaps or clearances, being each one pierced with a series of complete vertical holes threaded for being joined to the floats (2) with the so joined pair of U-shaped longitudinal bars (3) by the sets of floats-U-shaped longitudinal bars fixing screws (9), so that allowing to each floats-U-shaped longitudinal bars fixing screw (9) to cross consecutively and to fix firmly together the end of a U-shaped longitudinal bar (3), a half of a solid or hollow tubular small crossbar (14) and the float (2), working each solid or hollow tubular small crossbar (14) as a linking piece that maintains each coupled pair of U-shaped longitudinal bars (3) joined together as a single independent rectangular frame that remains joined without the need of being coupled to a float (2), being detachable as a single whole from the floats (2), and when placed inside each coupled pair of two twin U-shaped longitudinal bars (3), reinforcing them avoiding or hindering the collapse or breaking of the so joined U-shaped longitudinal bars (3) and the watercraft of floating structure, allowing specially reinforced expandable frames for enlargeable modular watercrafts and floating structures unreachable or not constructible with the lack of said solid or hollow tubular small crossbar (14).

Patentansprüche

1. Satz von Stücken und Teilen in Bausatzform für die Verbindung und den Zusammenbau von modularen Wasserfahrzeugen und modularen schwimmenden Strukturen mit unterschiedlicher Anzahl von Schwimmkörpern, deren Teile durch eine bestimmte Anzahl von Wiederholungen und anschließende gegenseitige seitliche Kopplung zusammengefügt werden, um unterschiedliche Größen und Rümpfe zu ergeben Anordnungen, die besteht aus:

- eine Vielzahl identischer Schwimmkörper (2), wobei jeder Schwimmkörper (2) aufweist:
  - ◦ mindestens zwei Quernuten (4) im Mittelteil jedes Schwimmkörper (2), die horizontal in senkrechter Richtung zum Schwimmkör-

per (2) verlaufen und ihn vollständig durchqueren, wobei sie haben alle den gleichen Querschnitt, so dass sie die Verbindung, das bequeme relative Gleiten und die weitere Befestigung eines einzelnen Querbalkens (1) in jedem von ihnen ermöglichen, indem sie durch einen Satz Befestigungsschrauben oder Bolzen für Schwimmkörpern und Querbalken (7) zusammengeschraubt werden,

◦ sowie zwei weitere Quernuten (5), die außerhalb aller Quernuten (4) desselben Schwimmkörpers (2) angebracht sind und diese horizontal in senkrechter Richtung zum Schwimmkörper (2) flankieren und diesen vollständig durchqueren, so dass parallel zu den Quernuten (4), alle diese weiteren Quernuten (5) den gleichen Querschnitt haben, um eine passgenaue Kopplung und weitere Befestigung über denselben von einem oder fast immer zwei u-förmigen Längsbalken (3) zu ermöglichen, in beiden Fällen sind diese an die Schwimmkörper (2) gekoppelt durch ihre jeweiligen zwei kürzeren linearen Zwillingsabschnitte, sobald die letzteren in die weiteren Quernuten (5) eingeführt und durch einen Satz Befestigungsschrauben für Schwimmkörpern und u-förmigen Längsbalken (9) zusammengeschraubt werden,

◦ sowie mindestens eine einzige Quernut (6), die außerhalb der Sätz der Quernuten (4) ausgebildet sind, und außerhalb der Satz weiterer Quernuten (5) desselben Schwimmkörpers (2), und zwar so, dass sie horizontal in senkrechter Richtung zum Schwimmkörper (2) verlaufen und diesen vollständig durchqueren, so dass sie parallel zu den Sätzen von Quernuten (4) und den weiteren Quernuten (5) verlaufen, alle haben den gleichen Querschnitt wie jede der Quernuten (4), alle haben den gleichen Querschnitt wie jede der Quernuten (4), was die Kopplung, das passgenaue Verschieben und die weitere Befestigung einer einzelnen Quersbalken (1) in einer von ihnen durch Zusammenschrauben durch einen Satz Befestigungsschrauben oder Bolzen für Schwimmkörperen und Quersbalken (7),

◦ sowie über der flachen horizontalen Fläche des Bugendes jedem Schwimmkörper (2) und nur unterbrochen durch die einzelnen Quernut (6), eine oder mehrere parallele, längs verlaufende, starke Führungsbahnen oder Flanschen (12), die symmetrisch dazu angeordnet sind die vertikale Längssymmetrieebene, die durch die Mitte des Schwimmkörpers (2) geht,

- mindestens ein Paar identischer Querbalken (1), um in der endgültigen Kupplungsposition im Mittelteil jedes Schwimmkörpers (2) platziert zu werden,
- eine abnehmbare vordere Schiebedeckeln (11), die durch eine abnehmbare vordere Schiebeplatte (35) für jeden Schwimmkörper (2) austauschbar ist,
- ein Satz Befestigungsschrauben oder Bolzen für Schwimmkörpern und Querbalken (7) für jeden Schwimmkörper (2) und für jeden Querbalken (1), zum Verbinden von Querbalken (1) und Schwimmkörpern (2) miteinander,
- ein Satz Befestigungsschrauben, Gewindestangen oder Bolzen für Schwimmkörpern und Quersbalken (8) für jeden Schwimmkörper (2) und für jede Quersbalken (1), zum Verbinden von Quersbalken (1) und u-förmigen Längsbalken (3) miteinander,
- ein Satz Befestigungsschrauben für Schwimmkörpern und u-förmigen Längsbalken (9) für jeden Schwimmkörper (2), zum Verbinden von Schwimmkörpern (2) und u-förmigen Längsbalken (3) miteinander,
- ein Satz Befestigungsschrauben für Schwimmkörpern und Schiebedeckeln (13) für jeden Schwimmkörper (2) zum Verbinden von Schwimmkörpern (2) und vorderen Schiebedeckeln (11) bzw. vorderen Schiebeplatten (35) miteinander.

auf eine Art und Weise, dass dieser Satz von Teilen und Stücken den Bau der modularen Wasserfahrzeuge und modularen schwimmenden Strukturen durch aufeinanderfolgende seitliche Wiederholung und anschließendes Koppeln entlang mindestens eines Paares der zwei Zwilling Querbalken (1) einer bestimmten Anzahl dieser Teile mit Ausnahme der ermöglicht Querbalken (1), wobei die Querbalken (1) den gleichen konstanten Querschnitt haben, quadratisch oder rechteckig, wobei jeder u-förmige Längsbalken (3) aus einem Metallrohr mit quadratischem oder rechteckigem Querschnitt besteht, das an beiden Seiten symmetrisch zweimal im rechten Winkel gebogen ist Bezug zur Werkstückmitte und zum ursprünglichen Rohr mit quadratischem oder rechteckigem Querschnitt, sodass dadurch erhält das Teil eine symmetrische u-förmige Ausführungsform, bestehend aus einem zentralen längeren geraden Abschnitt, der in der endgültigen Kopplungsposition parallel zu den Schwimmkörpern (2) angeordnet ist, und zwei kürzere gerade Zwillingsabschnitte, die in der endgültigen Kopplungsposition senkrecht zum mittleren längeren Abschnitt und zu den Schwimmkörpern (2) angeordnet bleiben, in der Weise, dass über jedem Schwimmkörper (2) jede abnehmbare vordere Schiebedeckeln (11) oder jede abnehmbare vordere Schiebeplatte (35) auf der Oberseite ihres Bugendes platziert wird, indem jede Kupplung über die Führungsbahnen oder Flanschen (12) gesteckt wird mittels Satzes von Längsnuten oder -schlitzen am Boden, die perfekt auf die vorherigen passen und das Herausziehen dieser Schiebetücke (10) und (35) nach oben verhindern, bis hin zu einem quer verlaufenden Endanschlag und befestigung am Schwimmkörper (2) mit einem Satz Befestigungsschrauben für Schwimmkörperen und Schiebedeckeln (13), so dass jedes verbundene Paar u-förmiger Längsbalken (3) einen rechteckigen Metallrahmen bildet, über jedem einzelnen von ihnen es ist möglich, durch Verschraubung einen optionalen modularen rechteckigen Plattformabschnitt (10) zur Bildung einer oberen Laufplattform nach Belieben anzubringen, **dadurch gekennzeichnet, dass** zu diesem Satz von Teilen zwei massive oder hohle rohrförmige kleine Querstangen (14) für jedes Paar u-förmiger Längsbalken (3) hinzugefügt werden, sie so miteinander zu verbinden, sodass die Hälfte jedes massiven oder hohlen rohrförmigen kleinen Querstangen (14) wird in ein Ende oder Extrem oder jeder der beiden Zwillingsquerarme mit quadratischem oder rechteckigem Querschnitt jedes u-förmigen Längsbalken (3), wobei ihre jeweiligen Außen- und Innenquerschnitte so aufeinander abgestimmt sind, sodass sie passgenau ohne Lücken oder Zwischenräume passen, wobei jedes einzelne mit einer Reihe vollständiger vertikaler Löcher mit Gewinde versehen ist, zur Verbindung mit den Schwimmkörper (2) mit dem so verbundenen Paar u-förmiger Längsbalken (3) durch die von Sätze Befestigungsschrauben für Schwimmkörperen und u-förmigen Längsbalken (9), so dass es möglich ist, so dass sich jede Befestigungsschraube für Schwimmkörpern und u-förmigen Längsbalken (9) es ermöglicht, das Ende einem u-förmigen Längsbalken (3), eine Hälfte einer massiven oder hohlen rohrförmigen kleinen Querstange (14) und den Schwimmkörper (2) nacheinander zu kreuzen und fest aneinander zu befestigen, jede massive oder hohle rohrförmige kleine Querstange (14) wird als Verbindungsstück verwendet, das jedes gekoppelte Paar u-förmiger Längsbalken (3) als einen einzigen unabhängigen rechteckigen Rahmen zusammenhält, der verbunden bleibt, ohne dass er an einen Schwimmkörper (2) gekoppelt werden muss, als Ganzes von den Schwimmkörpern (2) abnehmbar und in jedes gekoppelte Paar von zwei u-förmigen Längsbalken (3) eingesetzt, sodass deren Verstärkung wird das Zusammenbrechen oder Brechen der so verbundenen u-förmigen Längsbalken (3) sowie die Wasserfahrzeuge und die schwimmender Struktur, wodurch speziell verstärkte erweiterbare Rahmen für vergrößerbare modulare Wasserfahrzeuge und modulare schwimmende Strukturen ermöglicht werden, die möglicherweise unerreichbar oder nicht konstruierbar sind, wenn die massive oder hohle rohrförmige kleine Querstange (14) fehlt.

Revendications

1. Ensemble de pièces et de morceaux en kit pour l’union et l’assemblage d’embarcations et de structures flottantes modulaires comportant un nombre différent de flotteurs, dont les pièces doivent être assemblées entre elles par leur répétition un certain nombre de fois et leur couplage latéral mutuel ultérieur pour donner différentes tailles et arrangements du coque, lequel consiste en:

- une pluralité de flotteurs (2) identiques, dans lesquels chaque flotteur (2) comporte:
    - ◦ au moins deux rainures transversales (4) dans la section centrale de chaque flotteur (2) qui sont pratiquées horizontalement dans la direction perpendiculaire par rapport au flotteur (2) et le traversent complètement, toutes de même coupe transversale, ce qui permet l’accouplement, parfaitement coulissement relatif et fixation d’une seule barre traversale (1) à l’intérieur de l’une d’elles en les vissant ensemble au travers d’un jeu de vis ou boulons de fixation barres traversales-flotteurs (7),
    - ◦ ainsi que deux rainures transversales supplémentaires (5) qui sont pratiquées à l’extérieur et encadrant tout l’ensemble des rainures transversales (4) du même flotteur (2) horizontalement dans une direction perpendiculaire par rapport au flotteur (2) et le traversant complètement, de telle sorte que parallèlement aux rainures transversales (4), toutes ces autres rainures transversales supplémentaires (5) de même coupe transversale pour permettre un accouplement serré et une fixation ultérieure sur celles-ci d’une ou presque toujours de deux barres longitudinales en forme de U (3) qui couplent aux flotteurs (2) à travers de leurs deux sections linéaires jumelles plus courtes respectives une fois que ces dernières sont introduites à l’intérieur desdites rainures transversales supplémentaires (5) et vissées ensemble au moyen d’un jeu de vis de fixation flotteurs-barres longitudinales en U (9),
    - ◦ ainsi qu’au moins une seule rainure transversale (6), qui sont pratiquées à l’extérieur de tout l’ensemble de rainures transversales (4) et à l’extérieur de tout l’ensemble de rainures transversales supplémentaires (5)

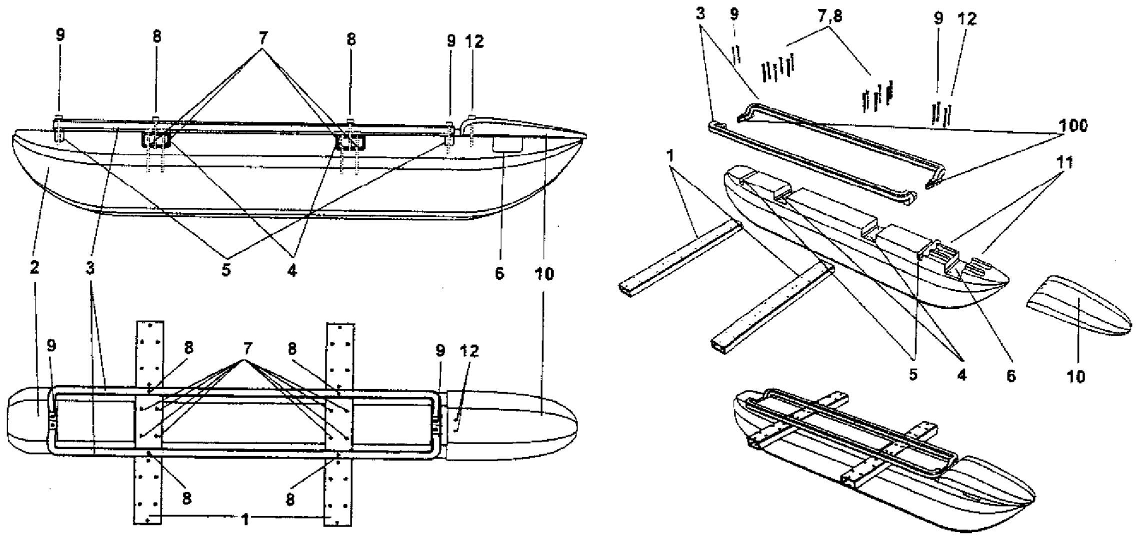
d’un même flotteur (2) horizontalement en direction perpendiculaire par rapport au flotteur (2) et le traversant complètement, de sorte que parallèlement aux ensembles de rainures transversales (4) et aux autres rainures transversales supplémentaires (5), toutes de même coupe transversale que chacune des rainures transversales (4), ce qui permet l’accouplement serré, un parfaitement coulissement relatif et la fixation d’une seule barre traversale (1) à l’intérieur de l’une d’elles en les vissant ensemble au travers d’un jeu de vis ou boulons de fixation barres traversales-flotteurs (7),

◦ ainsi qu’au-dessus de la surface horizontale plane supérieure de le bout de la proue de chaque flotteur (2) et seulement interrompue par l’unique rainure transversale (6), un ou plusieurs guides ou languettes longitudinales parallèles (12) résistants qui sont disposés symétriquement par rapport à le plan de symétrie longitudinal vertical passant par le centre du flotteur (2),

• au moins une paire de barres traversales identiques (1), à placer dans la section médiane de chaque flotteur (2) en position finale d’accouplement,
• un couvercle coulissant avant amovible (11) échangeable par une plaque coulissante avant amovible (35) pour chaque flotteur (2),
• un jeu de vis ou boulons de fixation barres traversales-flotteurs (7) pour chaque flotteur (2) et pour chaque barre transversale (1), pour joindre les barres traversales (1) et les flotteurs (2) entre eux,
• un jeu de vis, tiges filetées ou boulons de fixation barres transversales-barres longitudinales en U (8) pour chaque flotteur (2) et pour chaque barre transversale (1), pour joindre les barres transversales (1) et les barres longitudinales en U (3) entre eux,
• un jeu de vis de fixation flotteurs-barres longitudinales en U (9), pour chaque flotteur (2) pour joindre les flotteurs (2) et les barres longitudinales en U (3) entre eux,
• un jeu de vis de fixation flotteurs-couvercles coulissants (13) pour chaque flotteur (2), pour assembler les flotteurs (2) et les couvercles coulissants avant (11) ou les plaques coulissantes avant (35) entre eux,

de telle sorte que cet ensemble de pièces et de morceaux permet la construction desdites embarcations et structures flottantes modulaires par répétition consécutive latéralement et couplage ultérieur, le long d’au moins une paire desdites deux jumelles barres transversales (1), d’un certain nombre de ces pièces à l’exception de les barres transversales (1), lesdites barres transversales (1) ayant la même coupe transversale constante carrée ou rectangulaire, étant chacune barre longitudinale en U (3) constituée d’un tube métallique de coupe transversale carrée ou rectangulaire qui est plié deux fois à angle droit symétriquement aux deux côtés par rapport au centre de la pièce et à la piece de tube d’origine, donnant ainsi à la pièce une forme de réalisation symétrique en forme de U composée d’une section centrale droite plus longue qui en position d’accouplement finale est disposée parallèlement aux flotteurs (2) et deux sections droites jumelles plus courtes qui restent disposées perpendiculairement à l’anterieure section centrale plus longue et aux flotteurs (2) en position d’accouplement final, de manière à ce que, au-dessus de chaque flotteur (2), chaque couvercle coulissant avant amovible (11) ou chaque plaque coulissante avant amovible (35) sont placés sur le haut de son bout avant en insérant chaque accouplement sur les guides ou languettes longitudinales parallèles (12) au moyen d’un ensemble correspondant de rainures ou fentes longitudinales inférieures qui s’adaptent parfaitement aux précédentes et empêchent l’extraction de ces pièces coulissantes (10) et (35) vers le haut, jusqu’à une butée transversale finale, la fixant au flotteur (2) avec un jeu de vis de fixation flotteurs-couvercles coulissants (13) de manière à ce que chaque paire de barres longitudinales en U (3) assemblées forme un châssis métallique rectangulaire au-dessus de chacune d’elles il est possible de fixer à volonté en vissant une section de plateforme modulaire rectangulaire (10) en option pour constituer une plateforme de marche supérieure, étant **caractérisé en ce que** sur cet ensemble de pièces, deux petites barres transversales pleines ou creuses tubulaires (14) sont ajoutées pour chaque paire de barres longitudinales en U (3) pour les joindre mutuellement d’une manière que la moitié de chaque petite barre transversale pleine ou creuse tubulaire (14) soit introduite à l’intérieur d’une extrémité ou extrême de chacun des deux bras transversaux jumeaux de coupe transversale carrée ou rectangulaire de chaque barre longitudinale en U (3) avec leurs sections transversales extérieures et intérieures correspondantes s’ajustant parfaitement sans espaces ni jeux, chacun étant percé d’une série de trous verticaux complets filetés pour être joinées aux flotteurs (2) avec la paire ainsi jointe de barres longitudinales en forme de U (3) par les ensembles de vis de fixation flotteurs-barres longitudinales en U (9), de sorte que permettant à chaque vis de fixation flotteurs-barres longitudinales en U (9) de transpercer consécutivement et de fixer solidement entre elles l’extrémité d’une barre longitudinale en U (3), une moitié d’une petite barre transversale pleine ou creuse tubulaire (14) et le flotteur (2), faisant fonctionner chaque petite barre transversale pleine ou creuse tubulaire (14) comme une pièce de liaison qui maintient chaque paire couplée de barres longitudinales en U (3) réunies ensemble comme un seul châssis rectangulaire indépendant qui reste joint sans qu'il soit nécessaire de étant couplé à un flotteur (2), étant détachable des flotteurs (2) dans leur ensemble, et lorsqu'ils sont placés à l'intérieur de chaque paire couplée de deux barres longitudinales en U (3) jumelles, les renforcer en évitant ou en empêchant l'effondrement ou la rupture des barres longitudinales en U (3) ainsi jointes et les embarcations ou structures flottantes, permettant des cadres agrandissables spécialement renforcés pour des embarcations modulaires extensibles et des structures flottantes qui sont inaccessibles ou non constructibles en l'absence de ladite petite barre transversale pleine ou creuse tubulaire (14).

Figura 1



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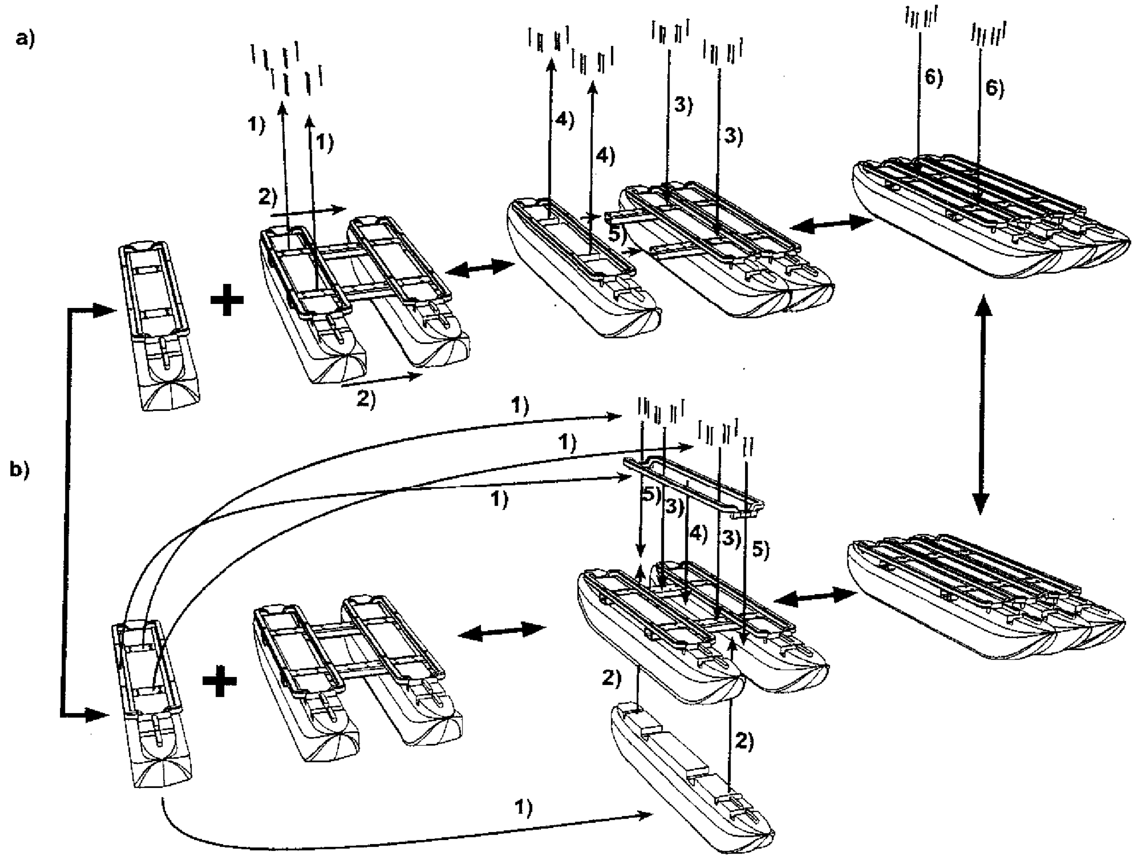

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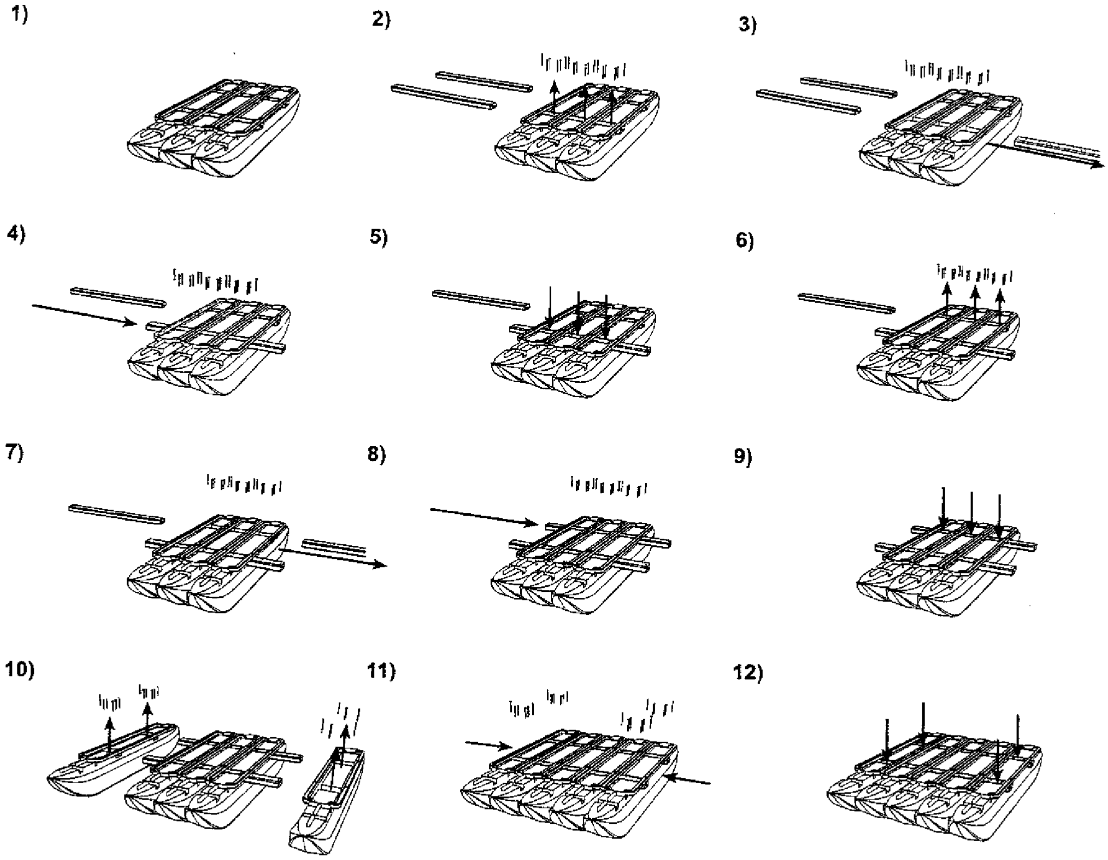

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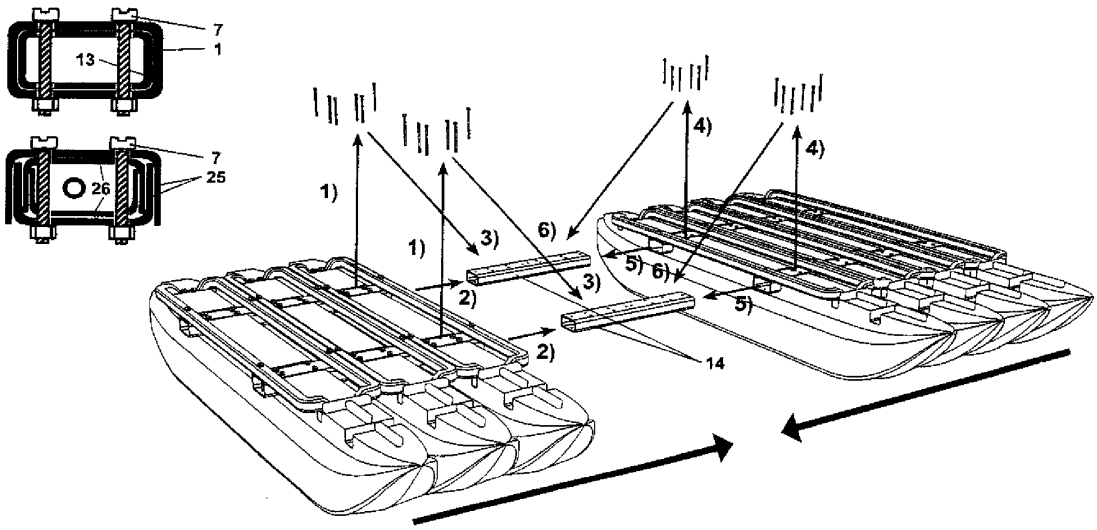

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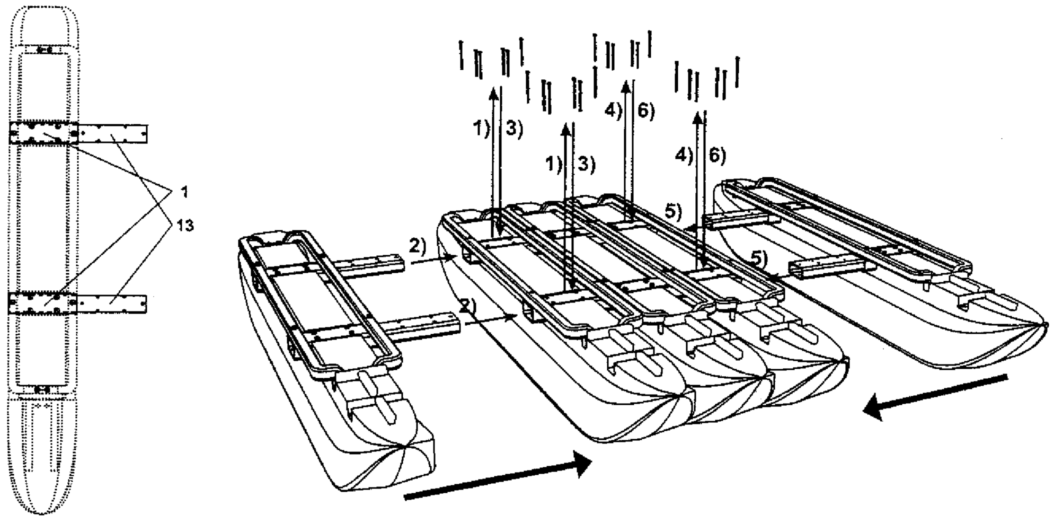

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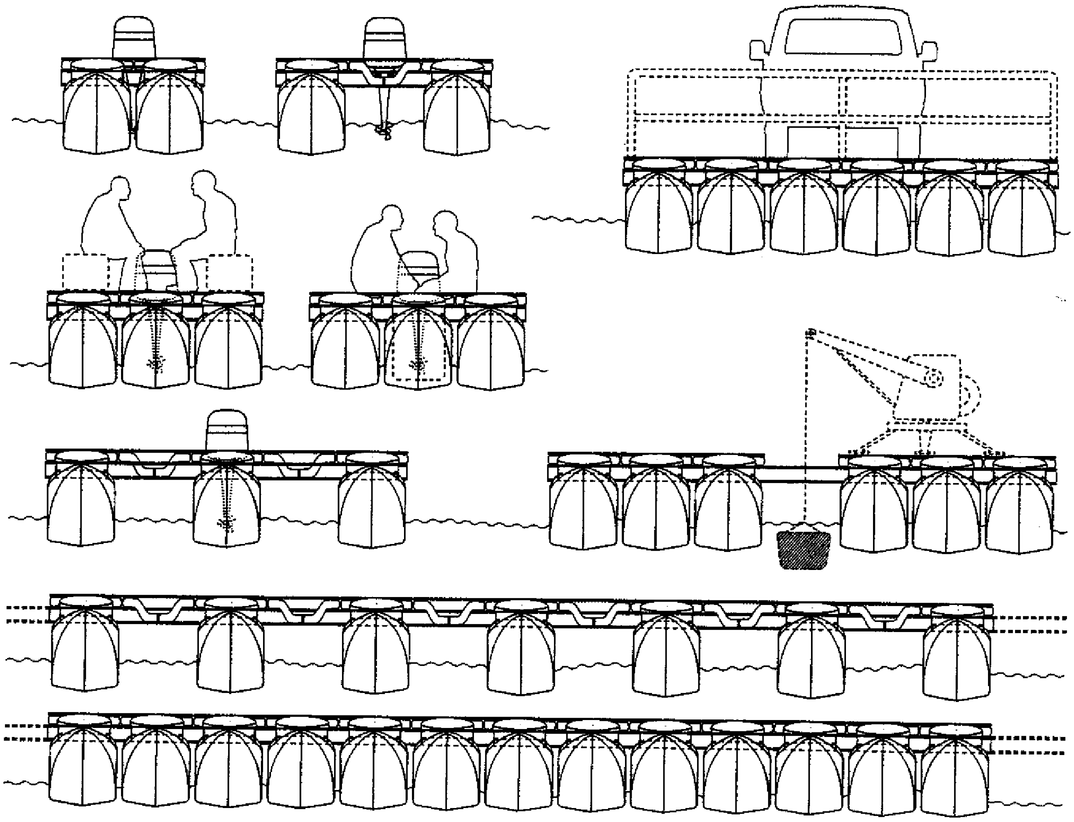

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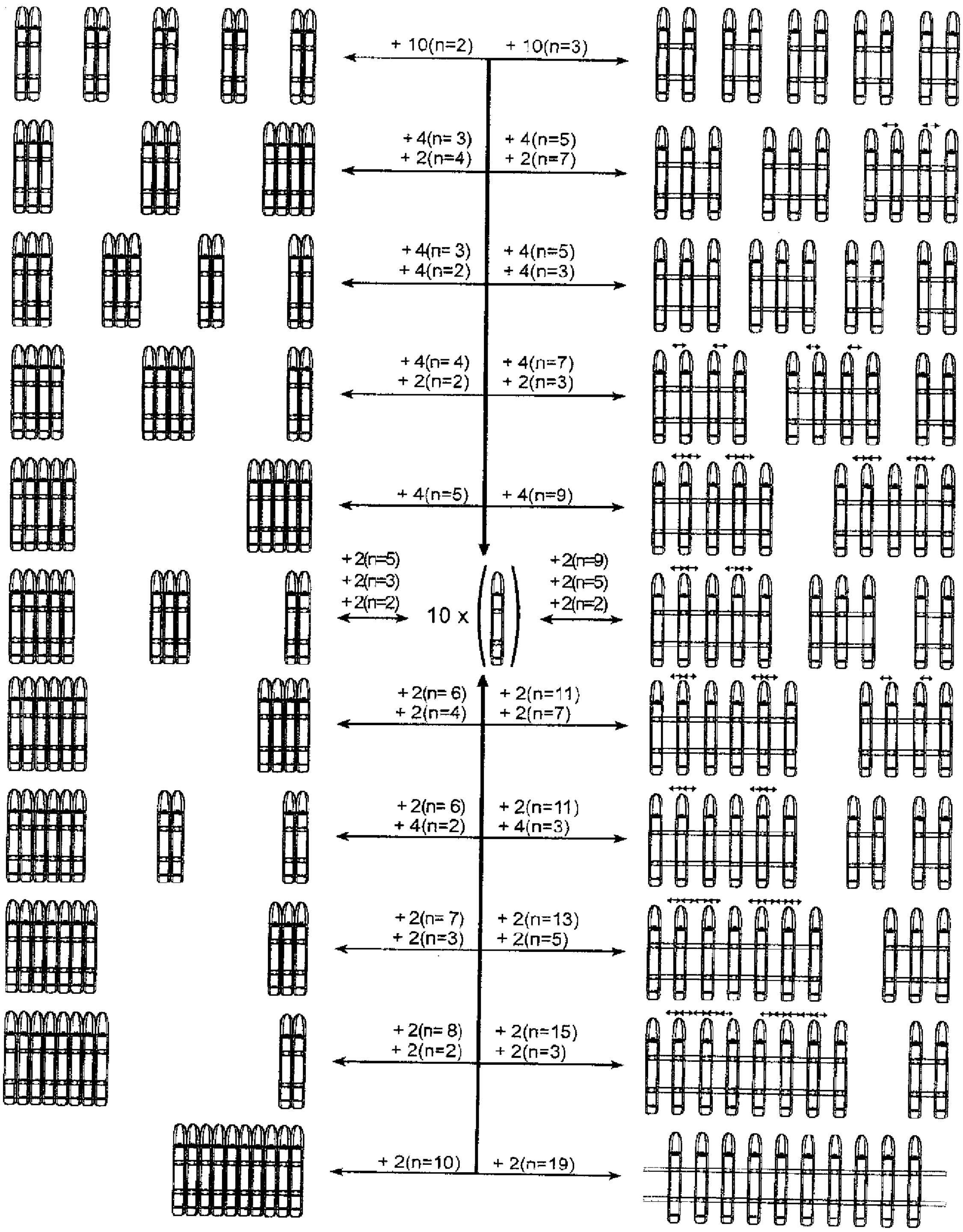

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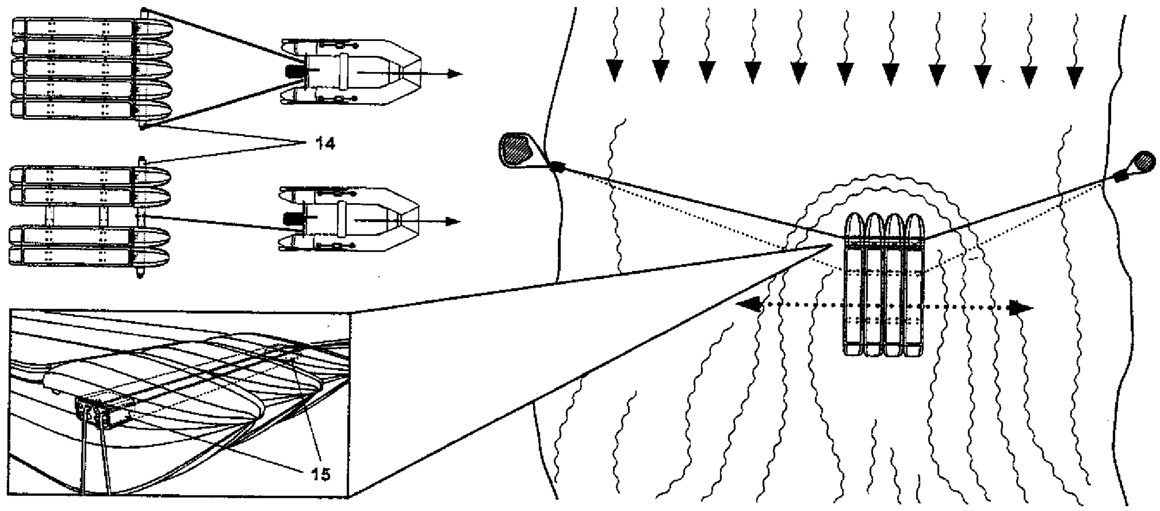
Figura 8



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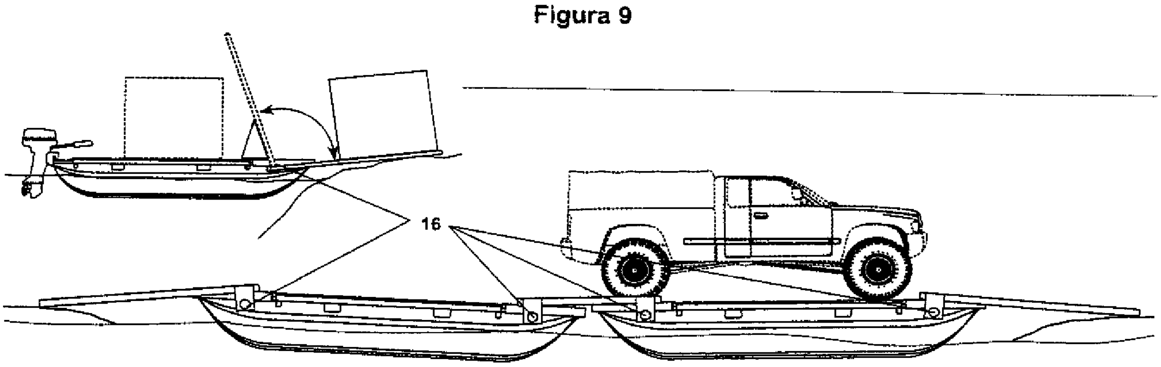

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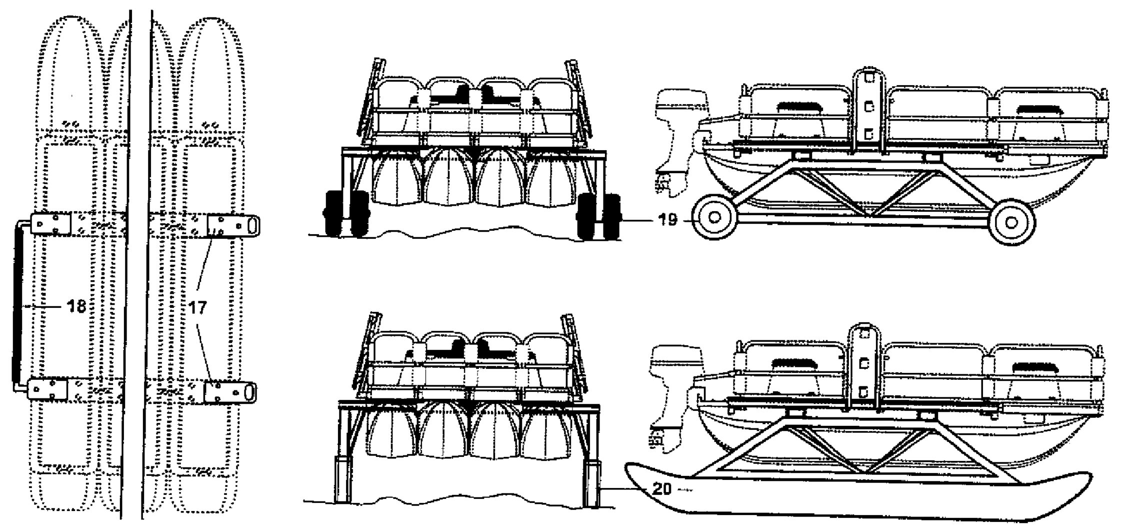

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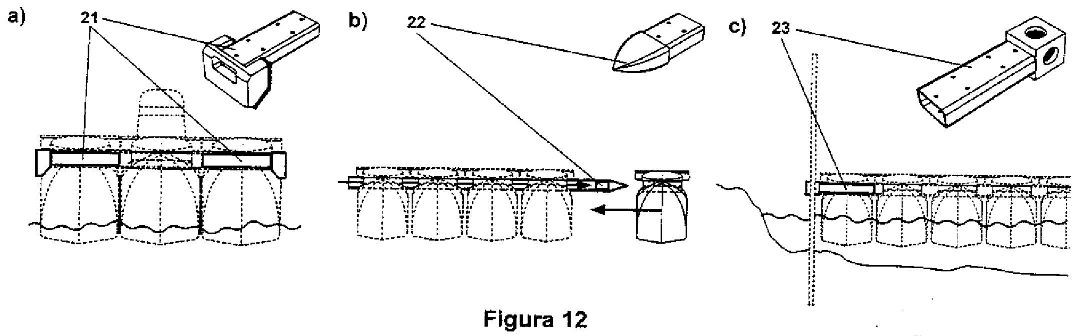

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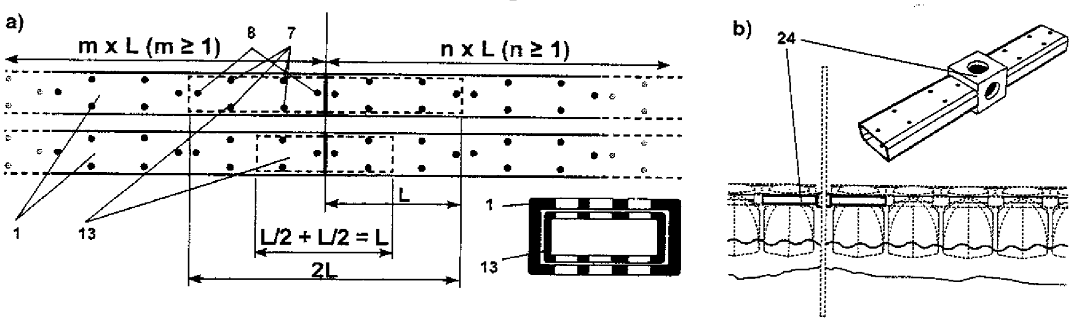

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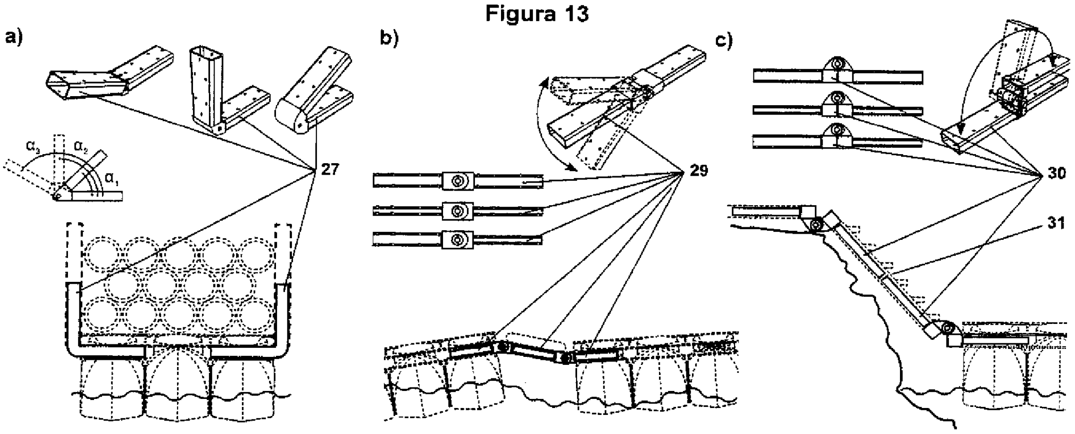

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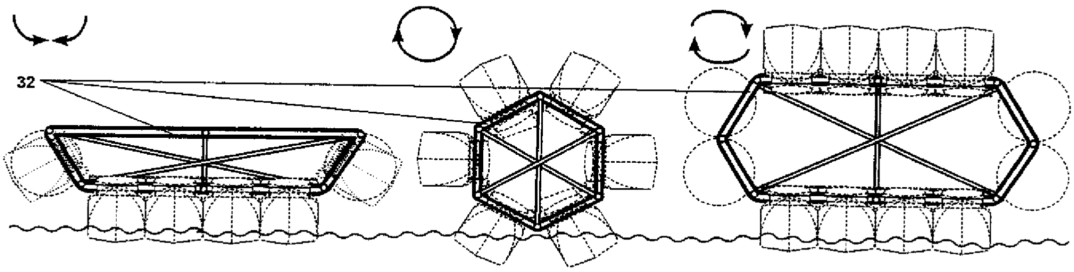

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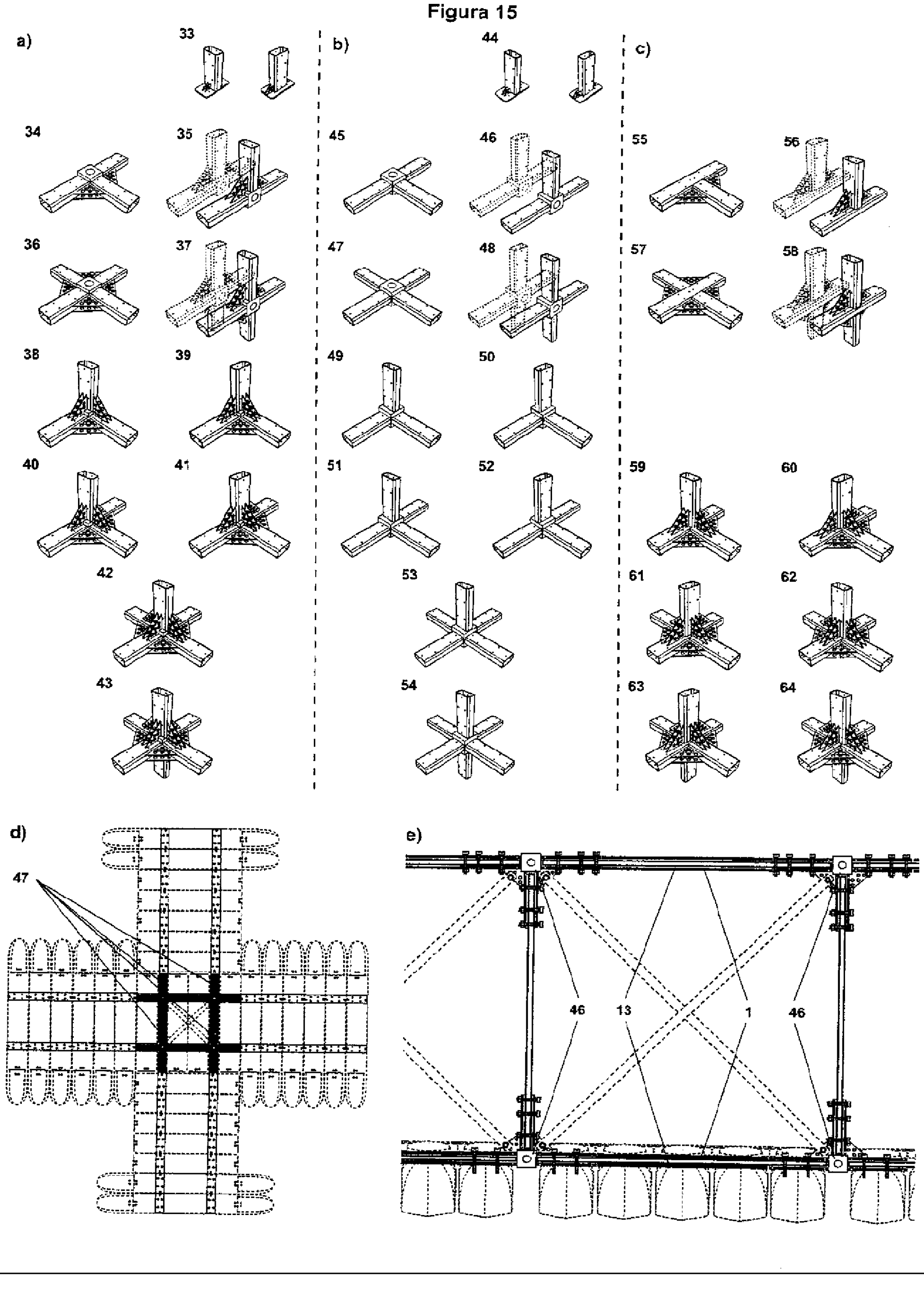
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Figura 16

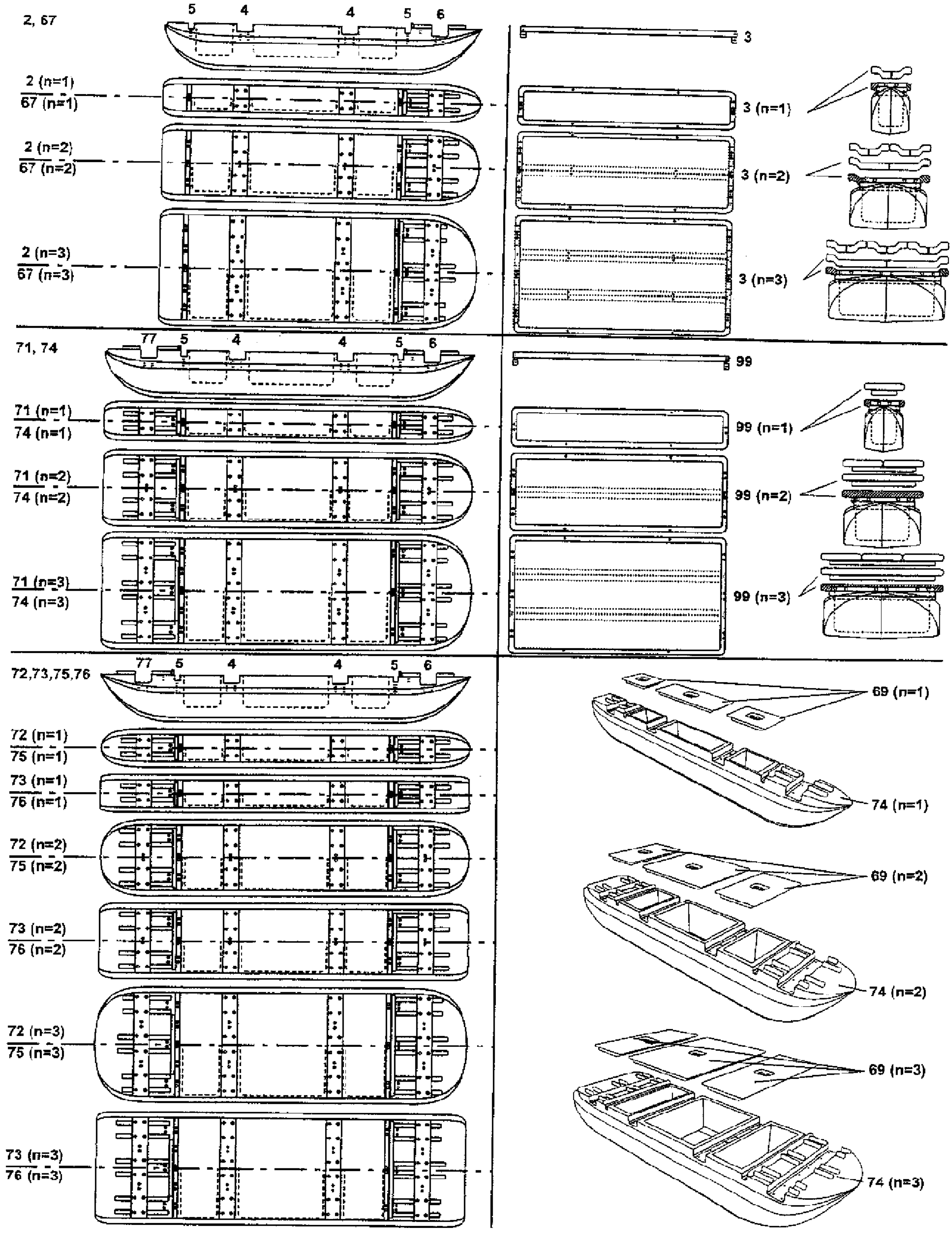
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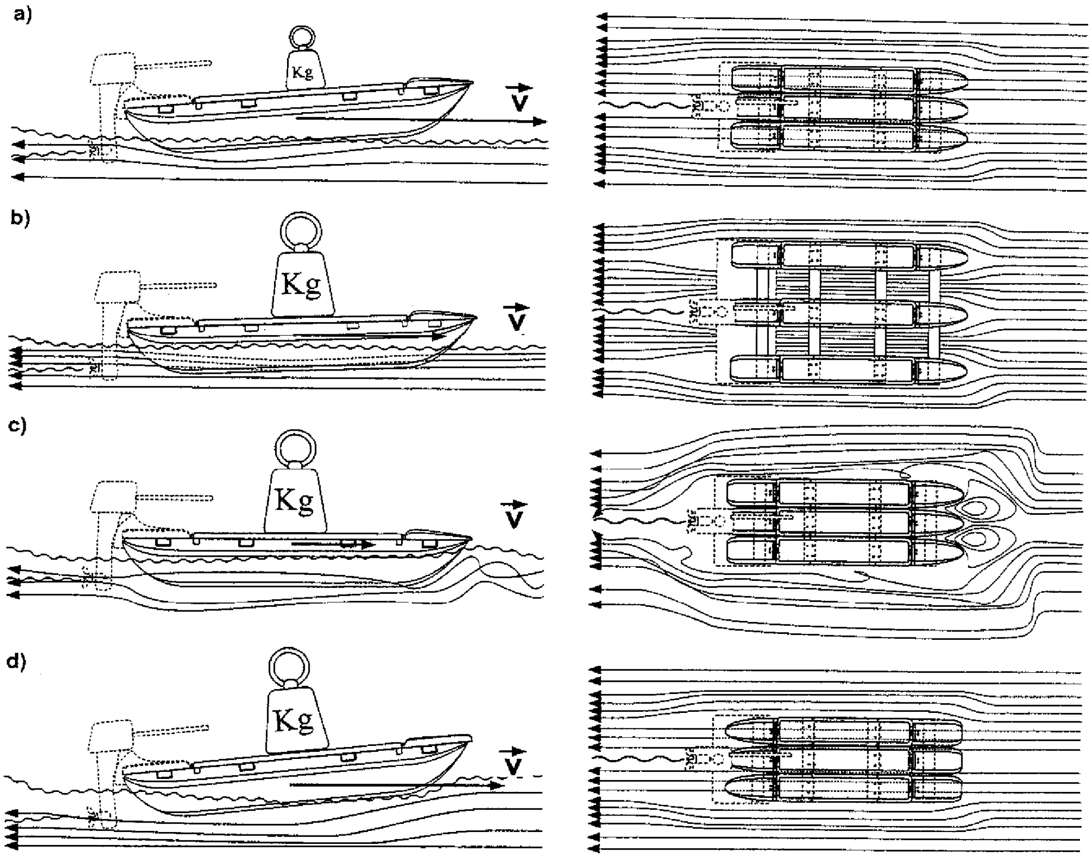
Figura 17



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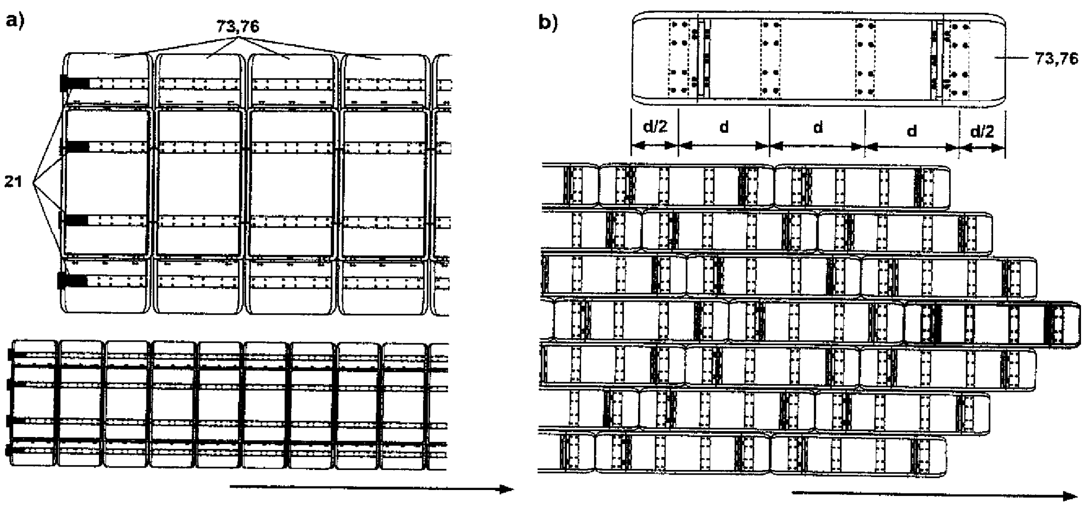

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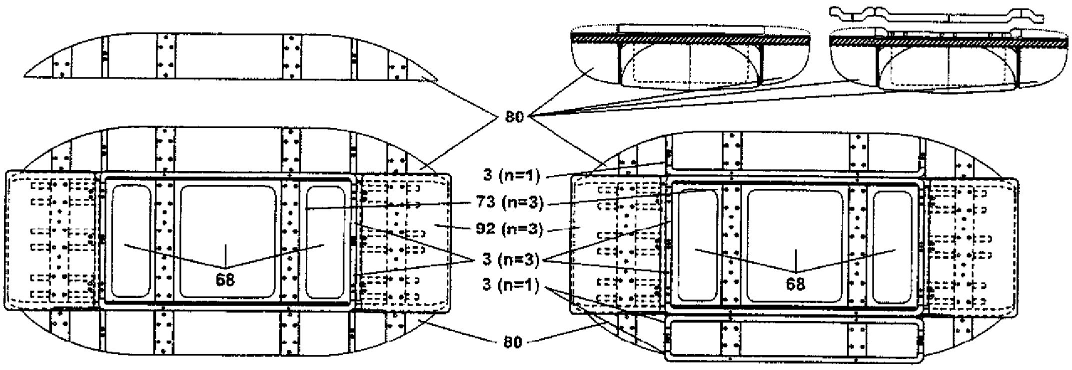

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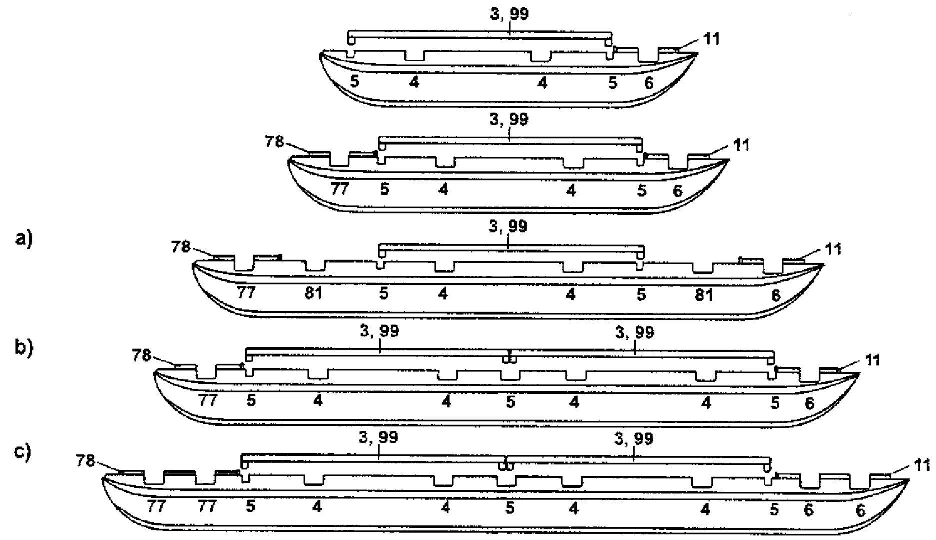

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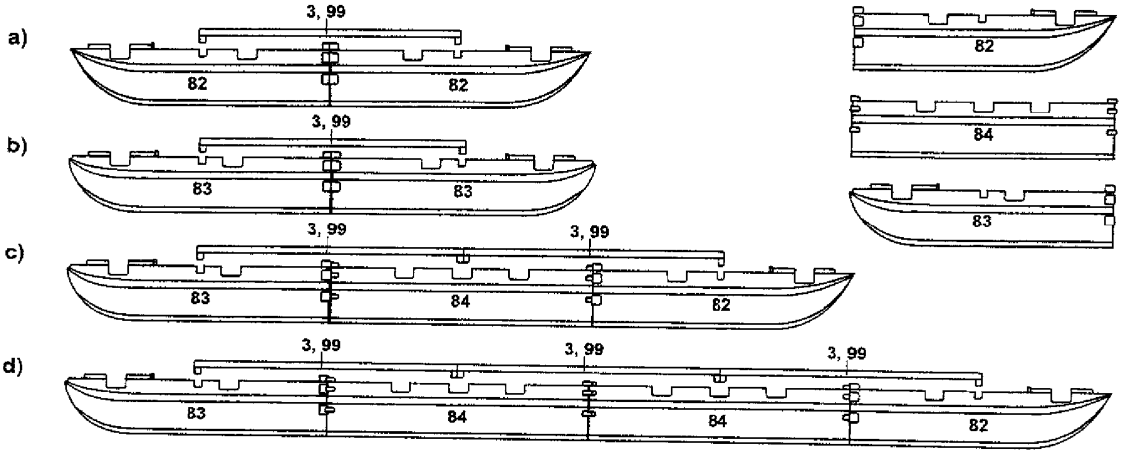
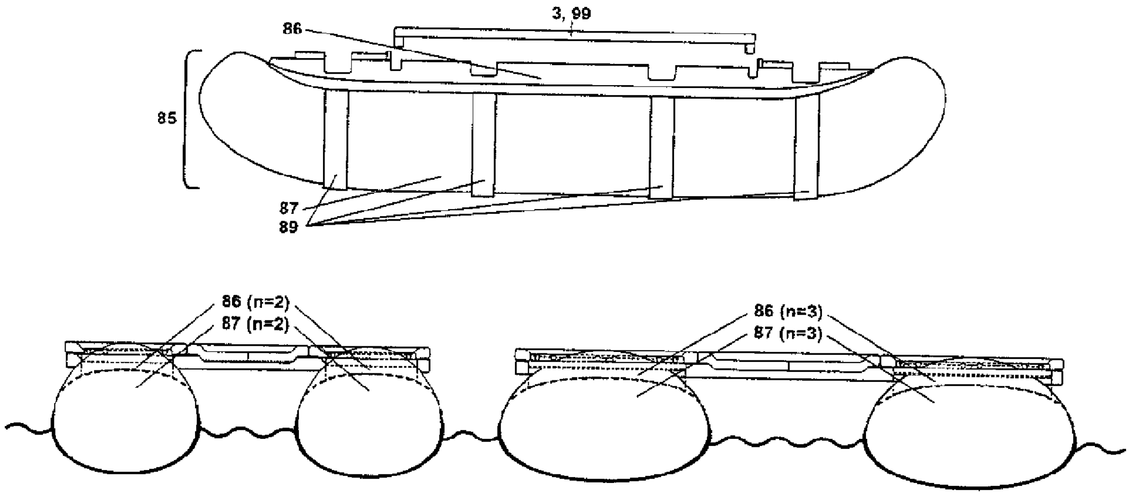


Figura 22



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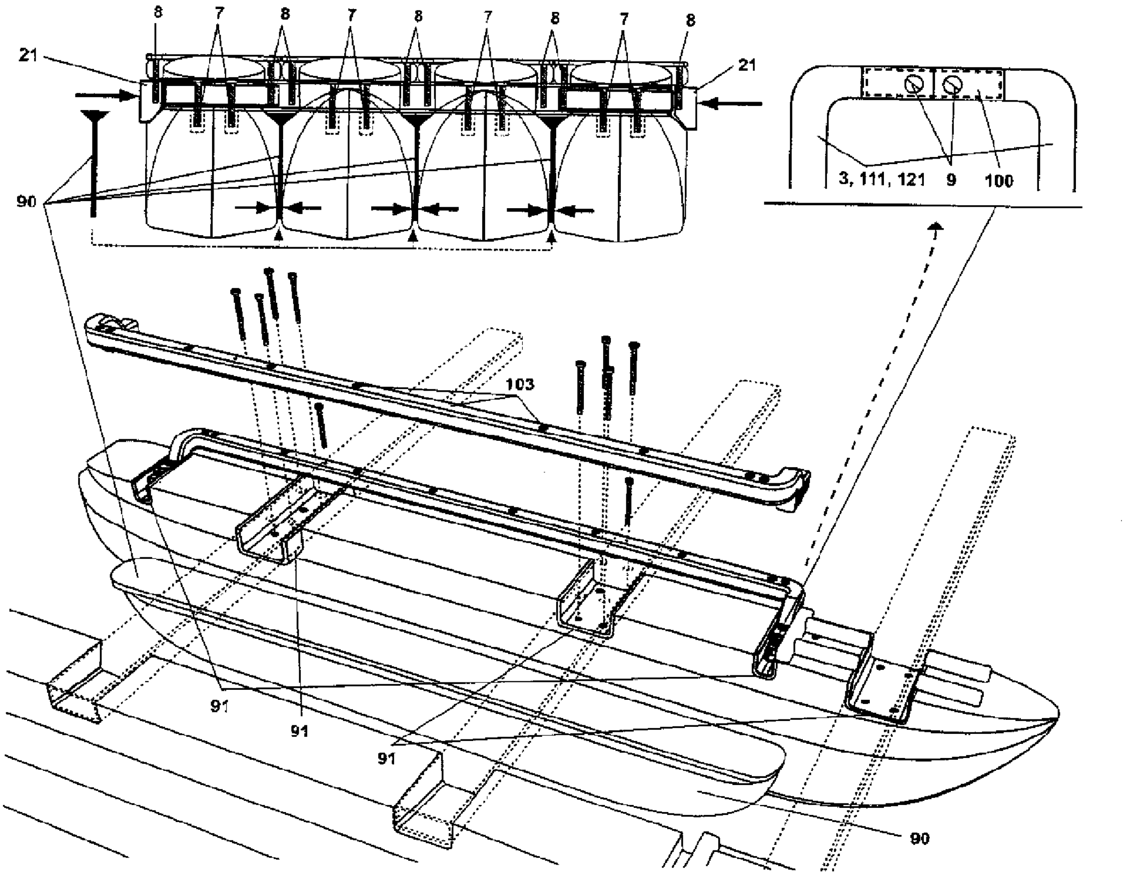

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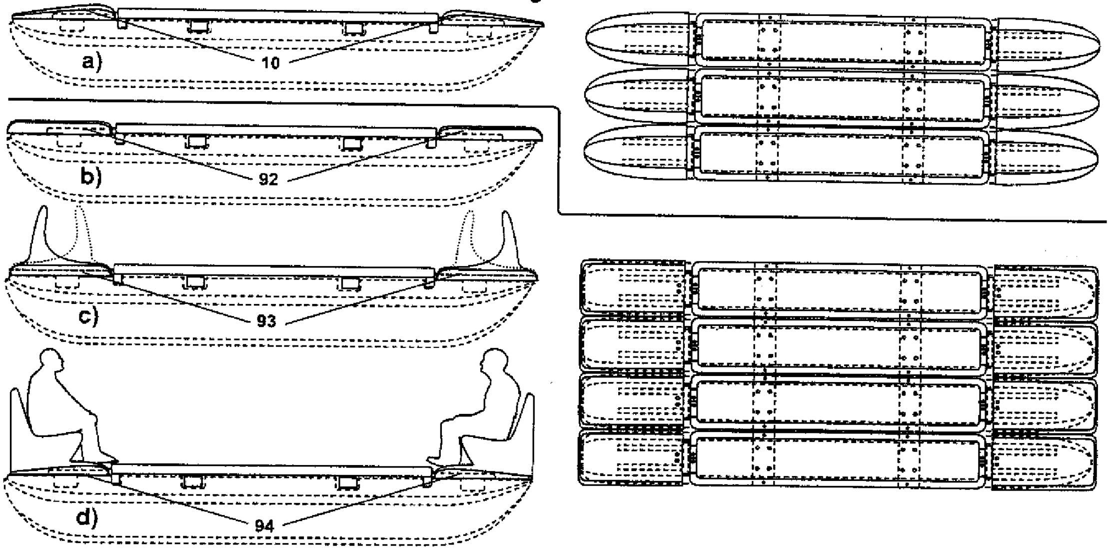

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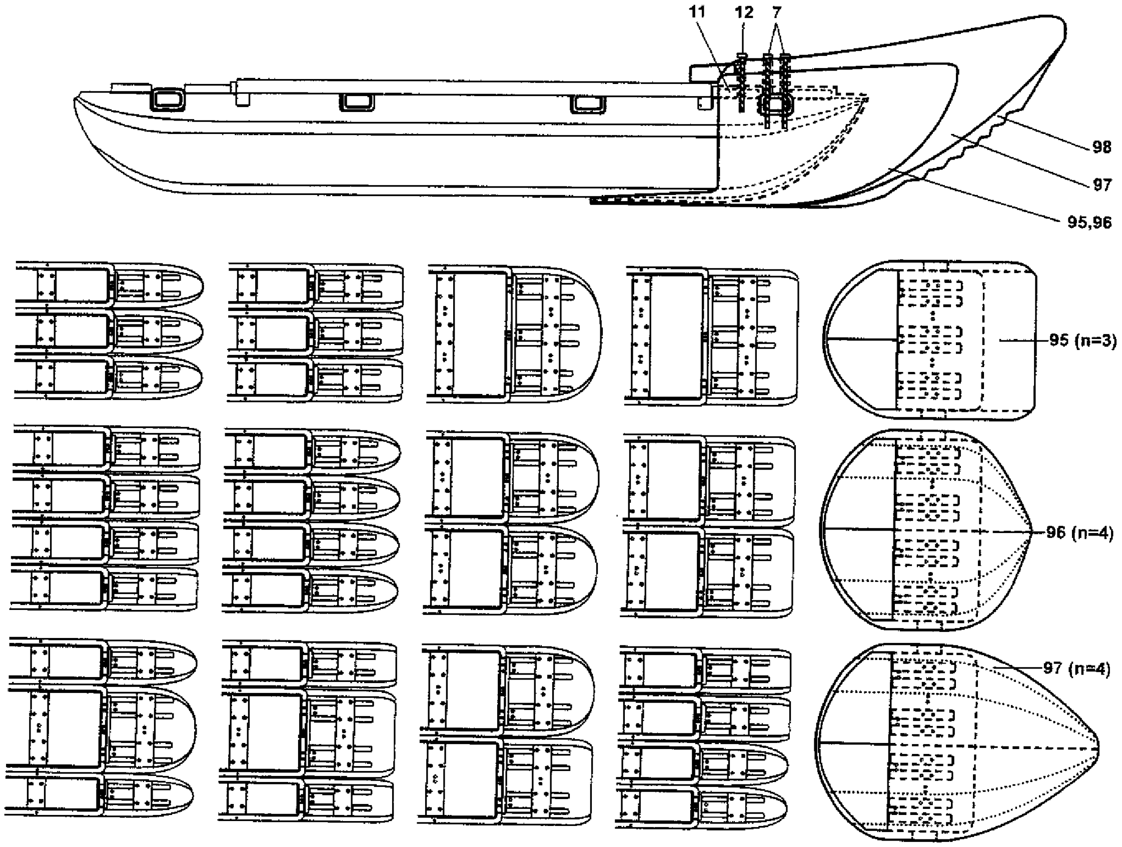

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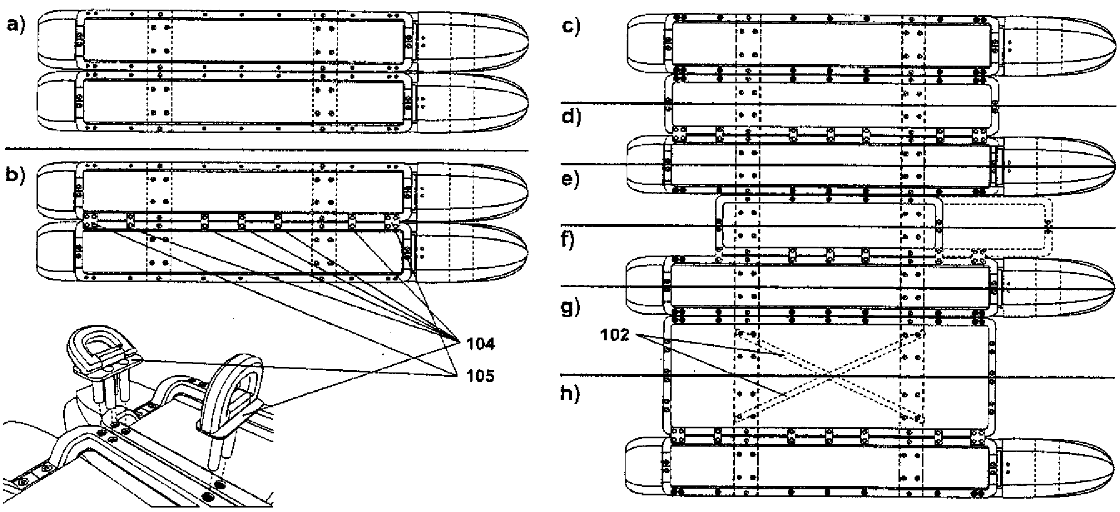

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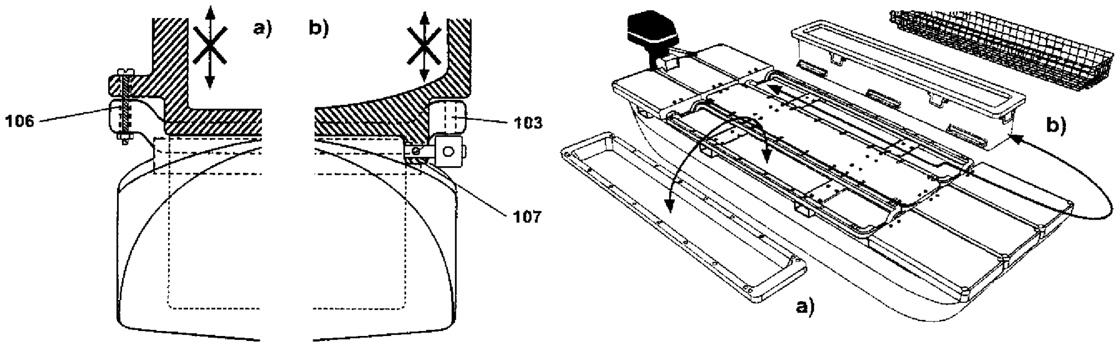

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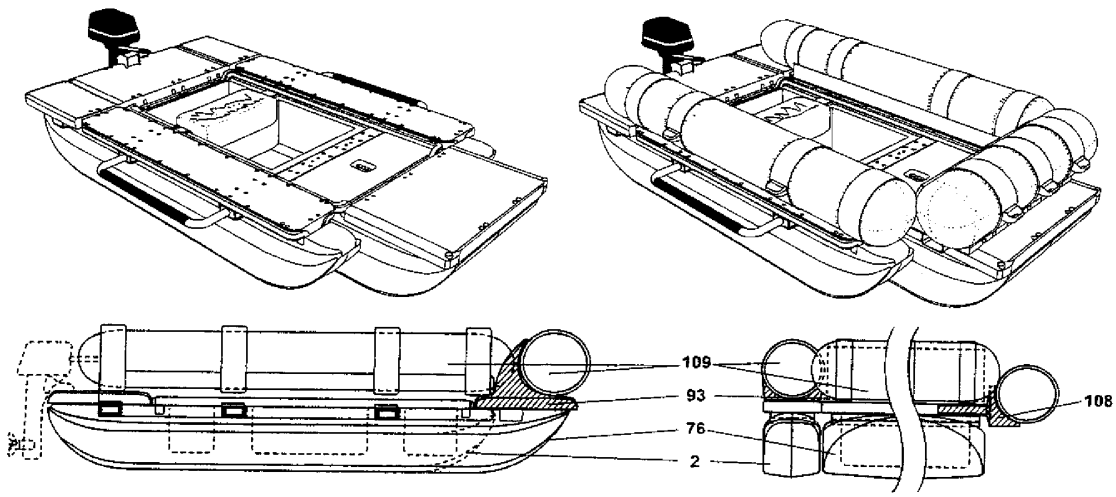

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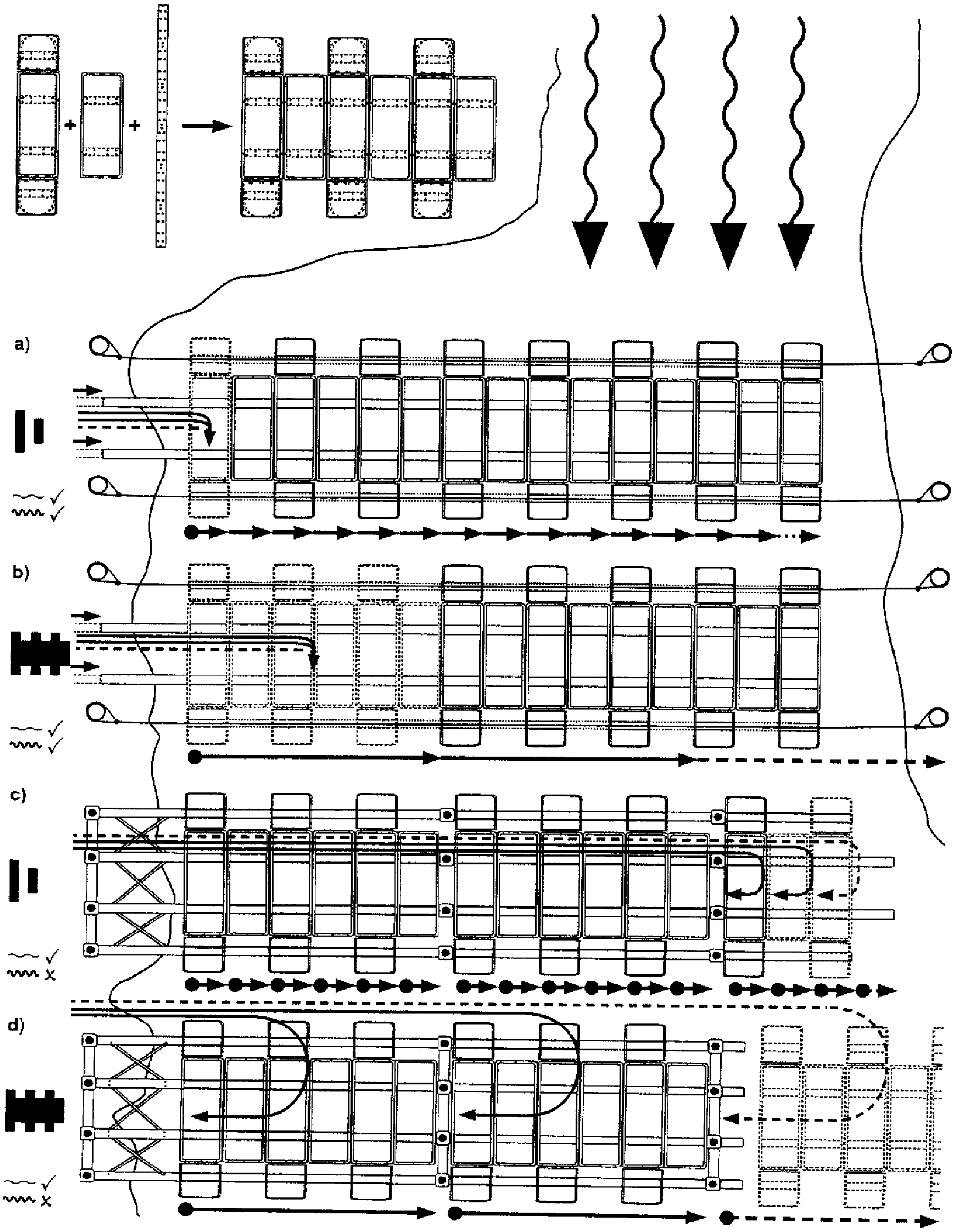
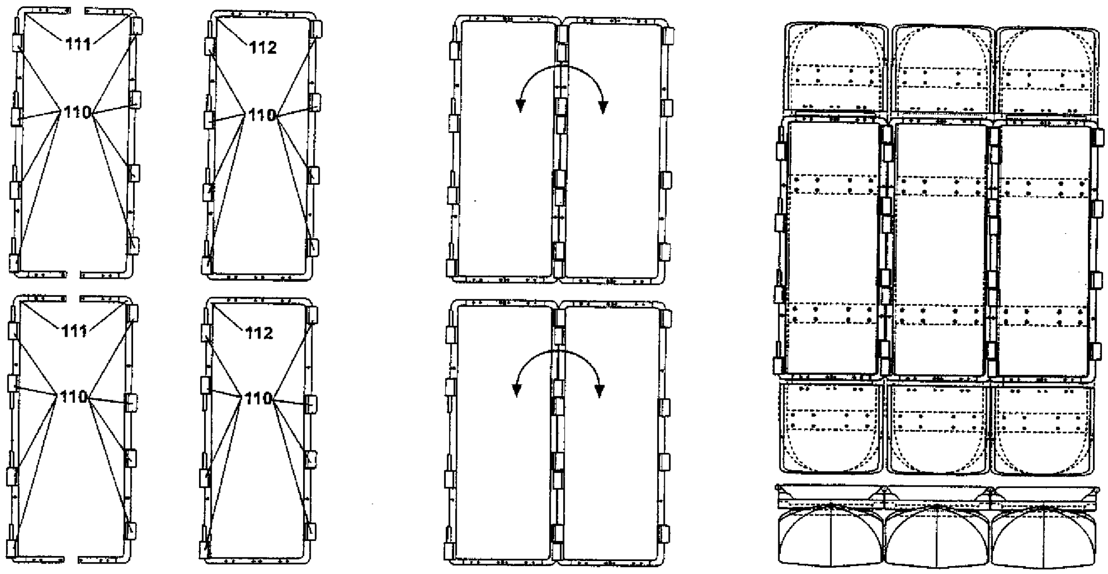


Figura 30



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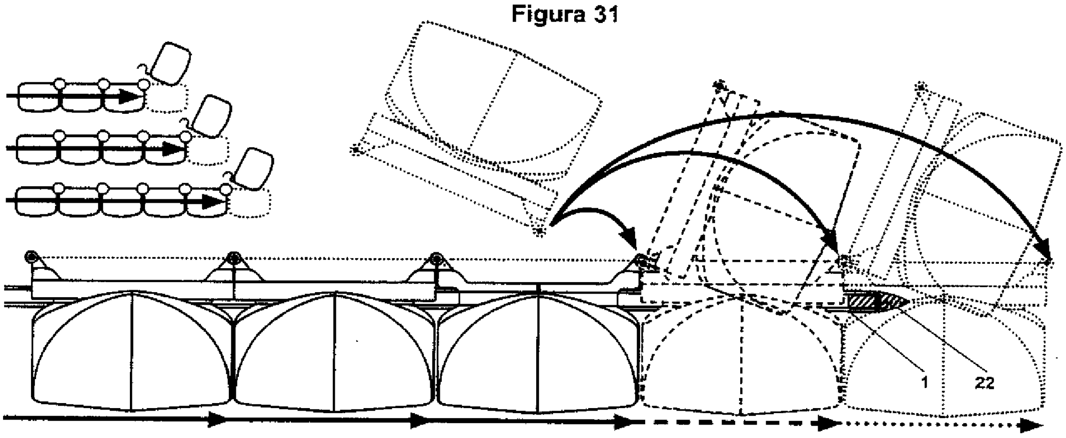
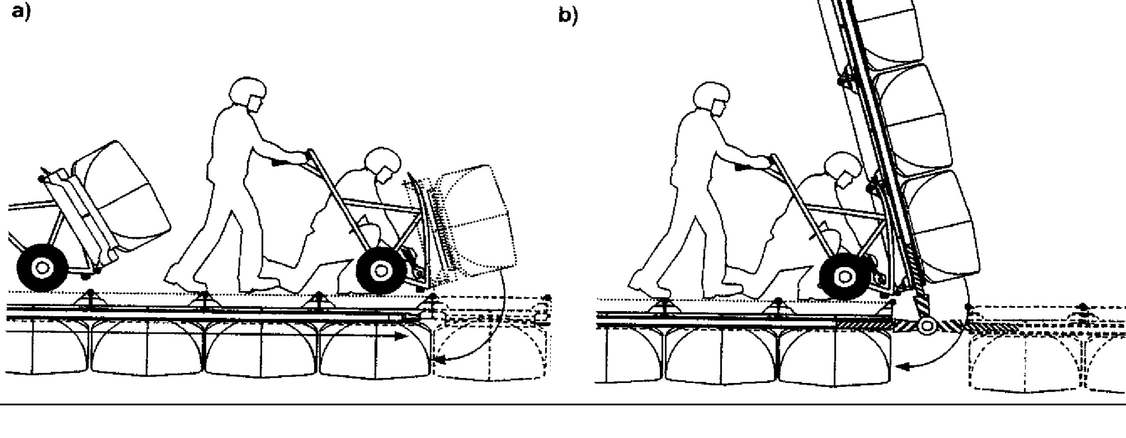


Figura 32

a)

b)



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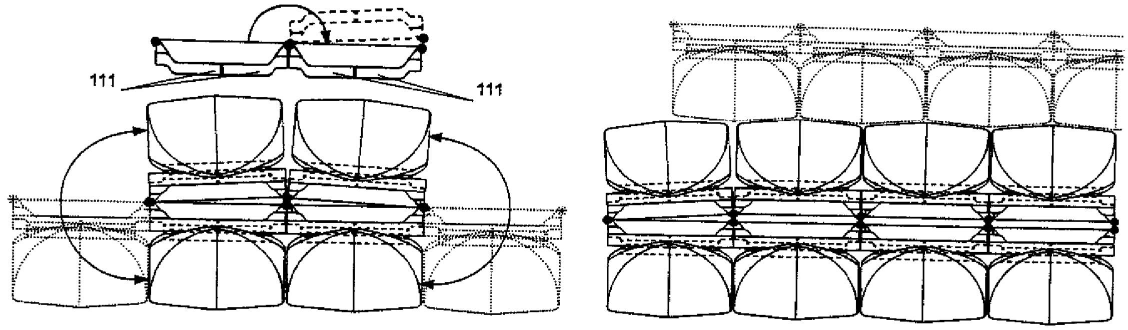

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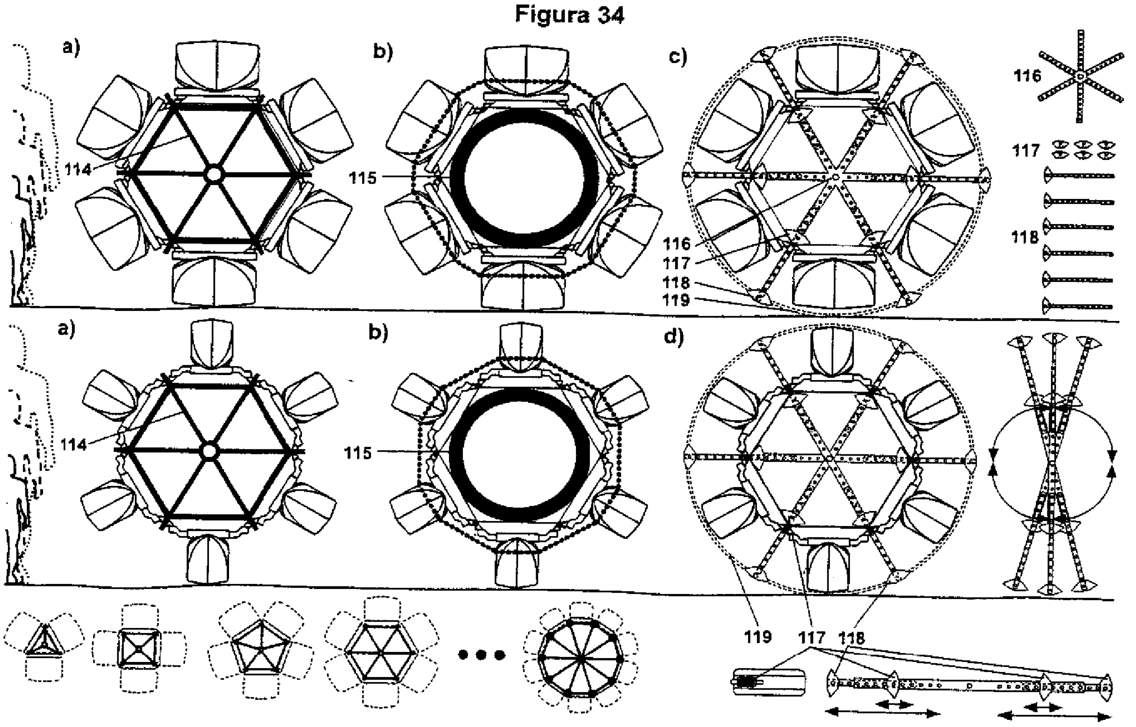

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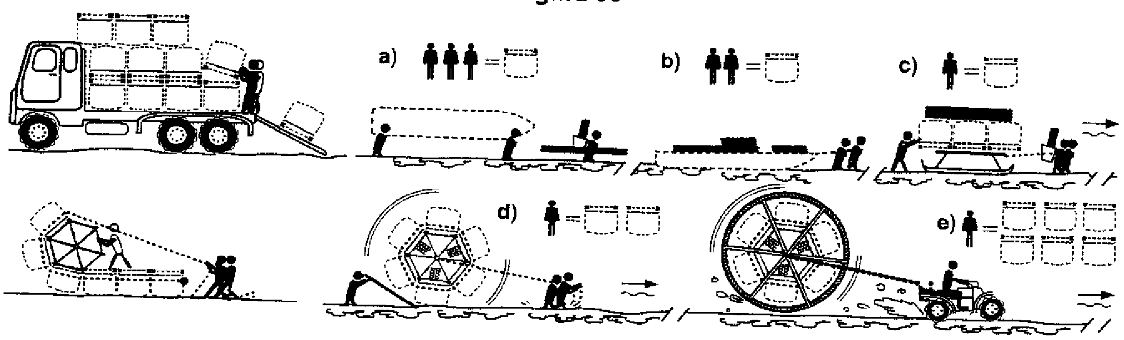

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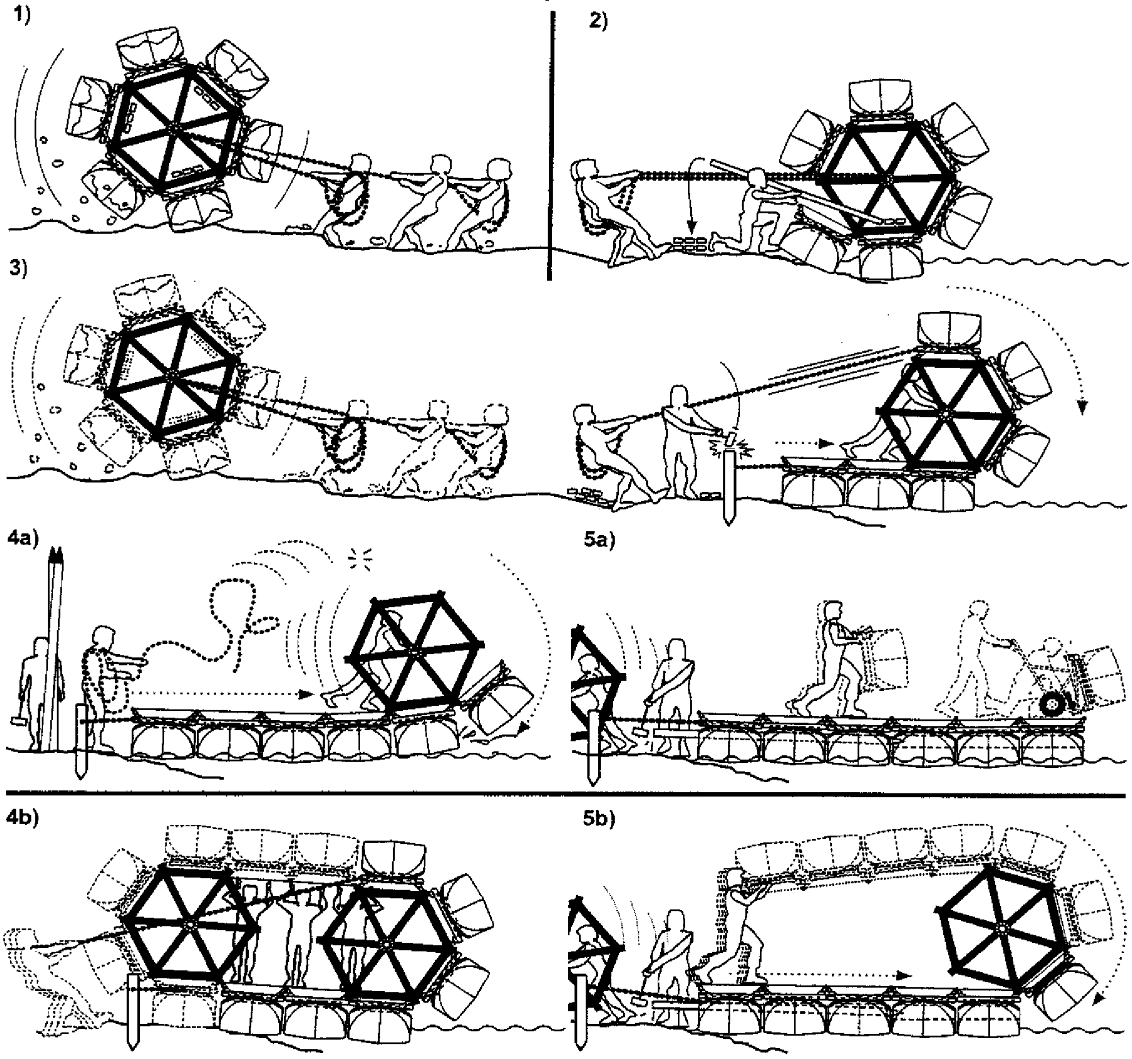

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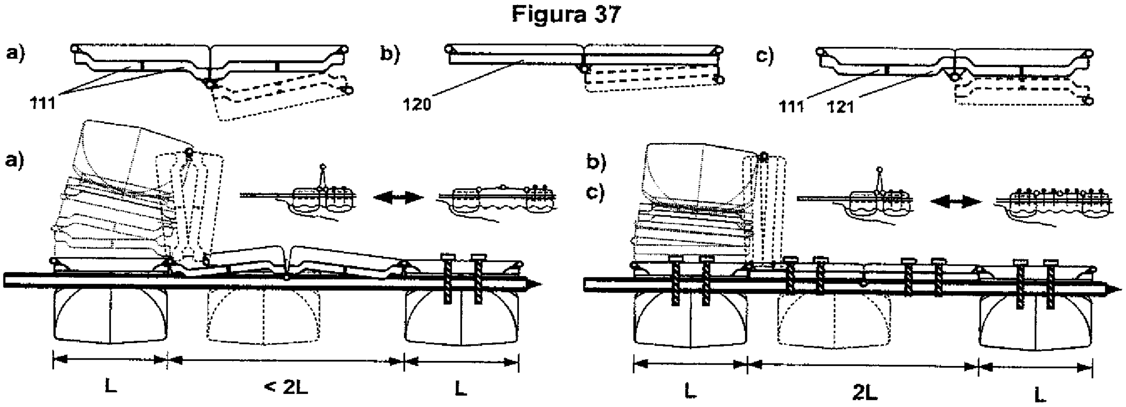

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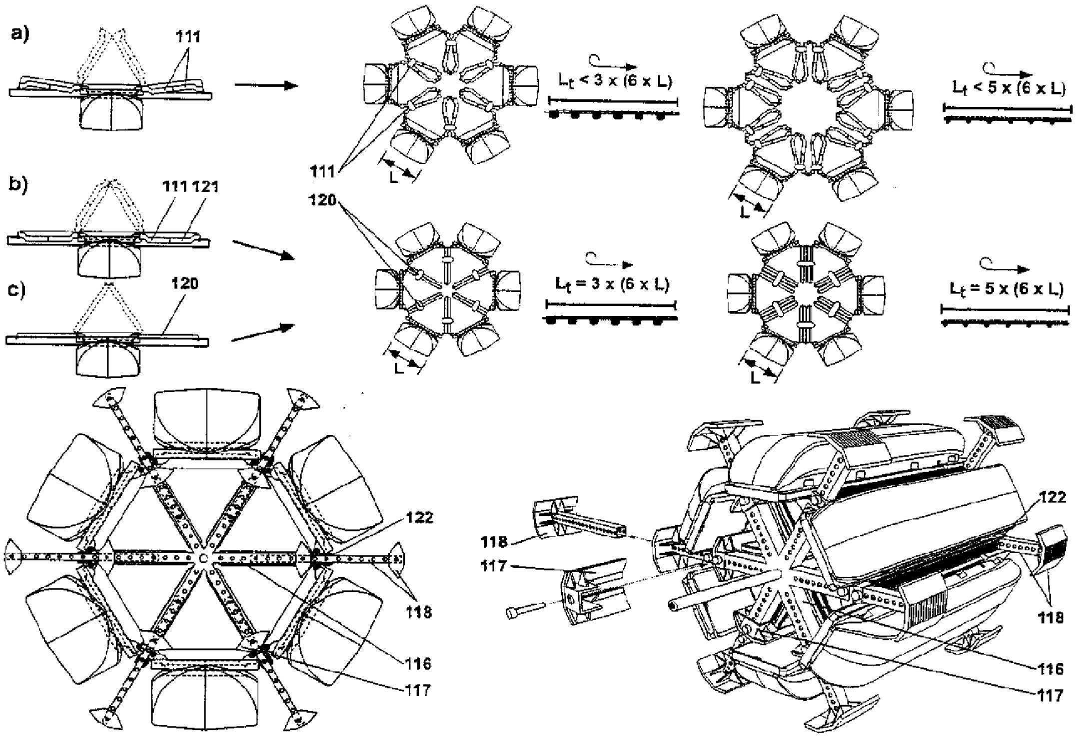

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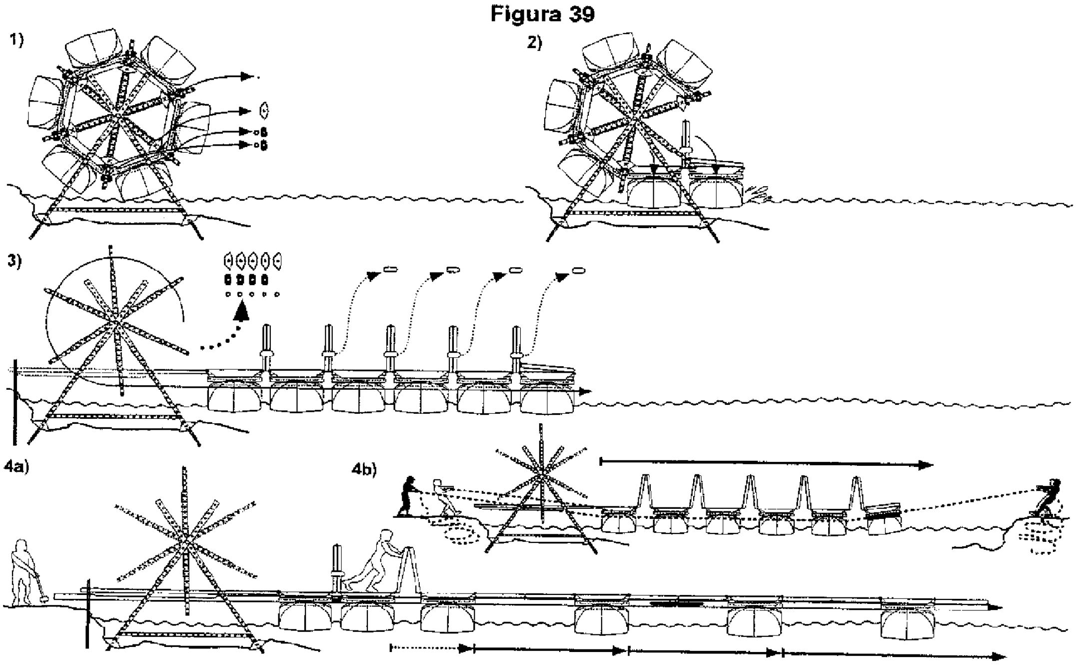

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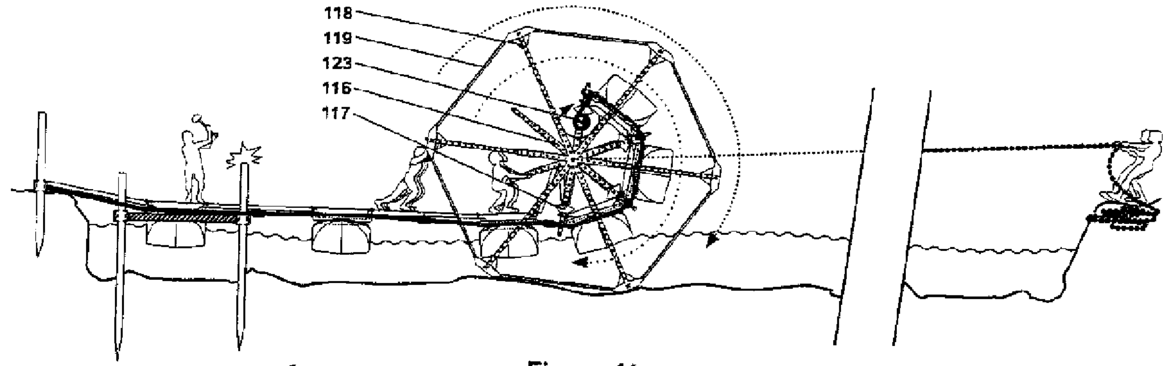

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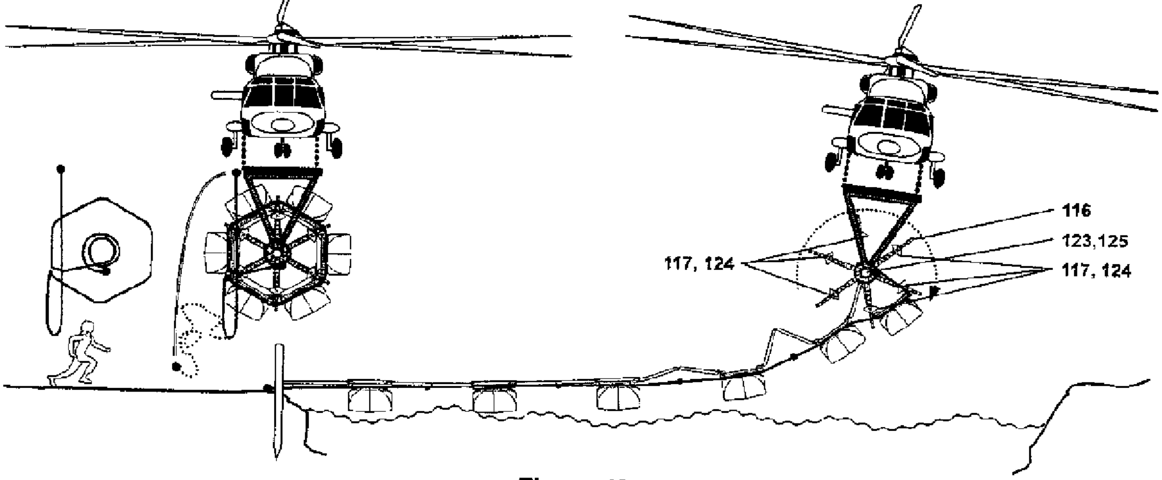

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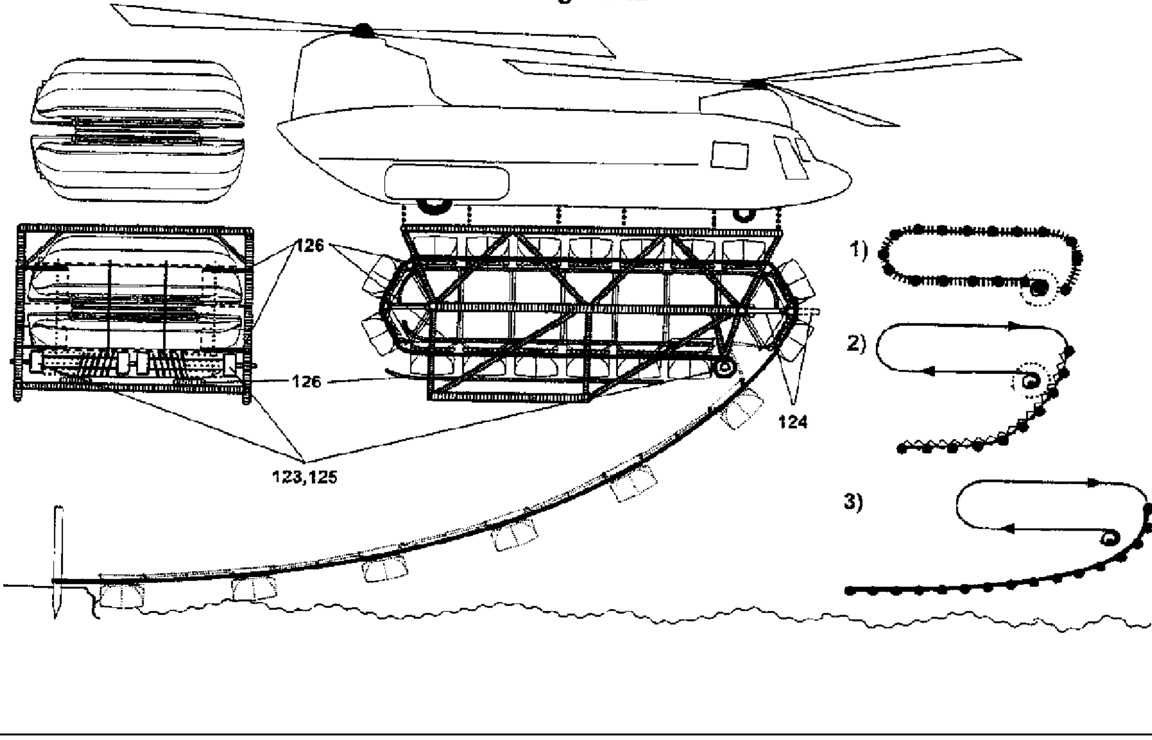

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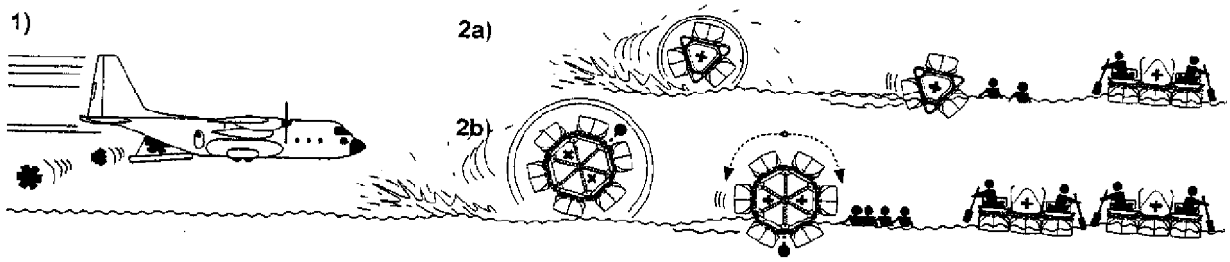

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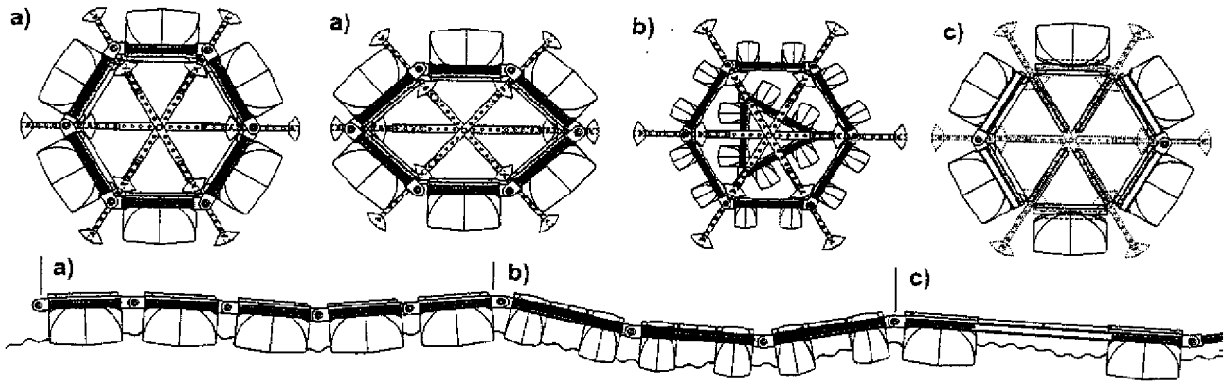

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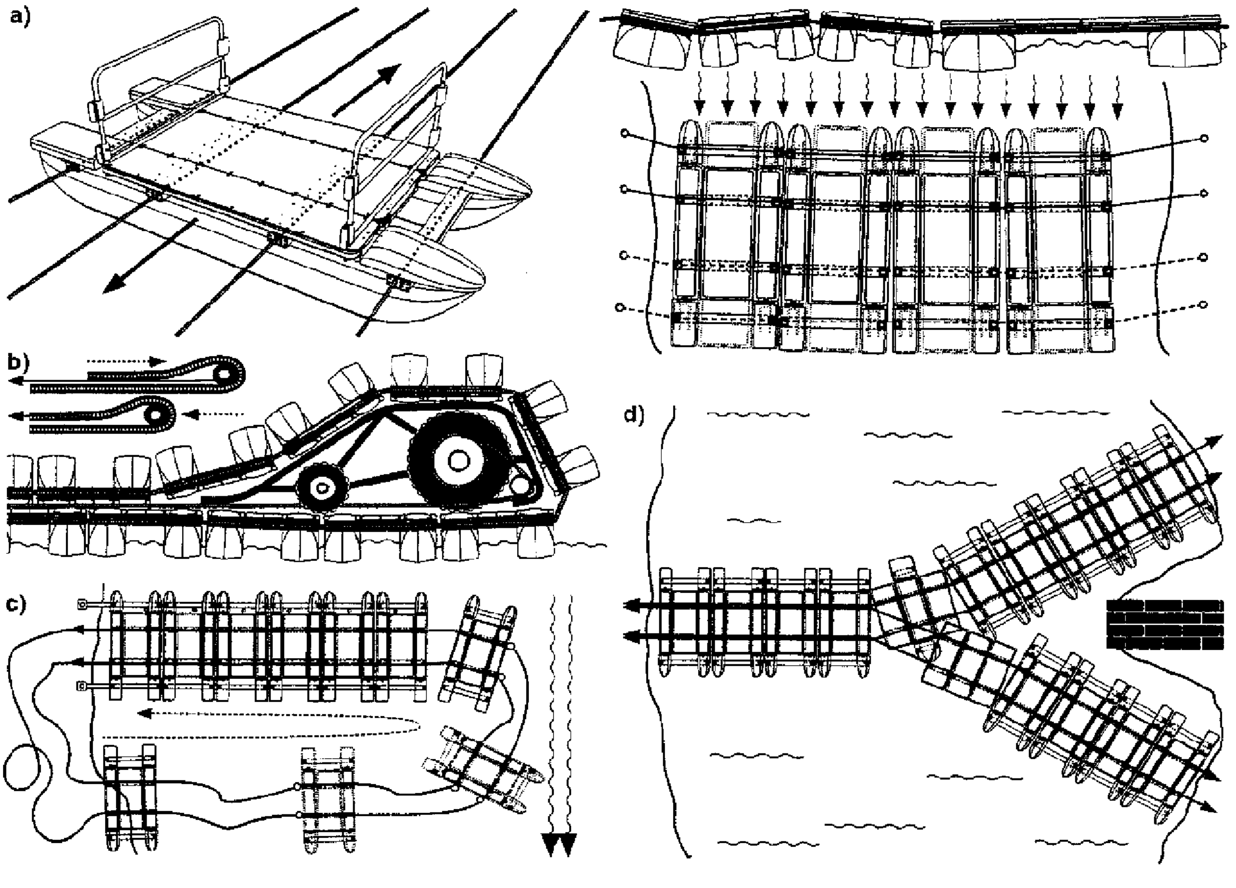

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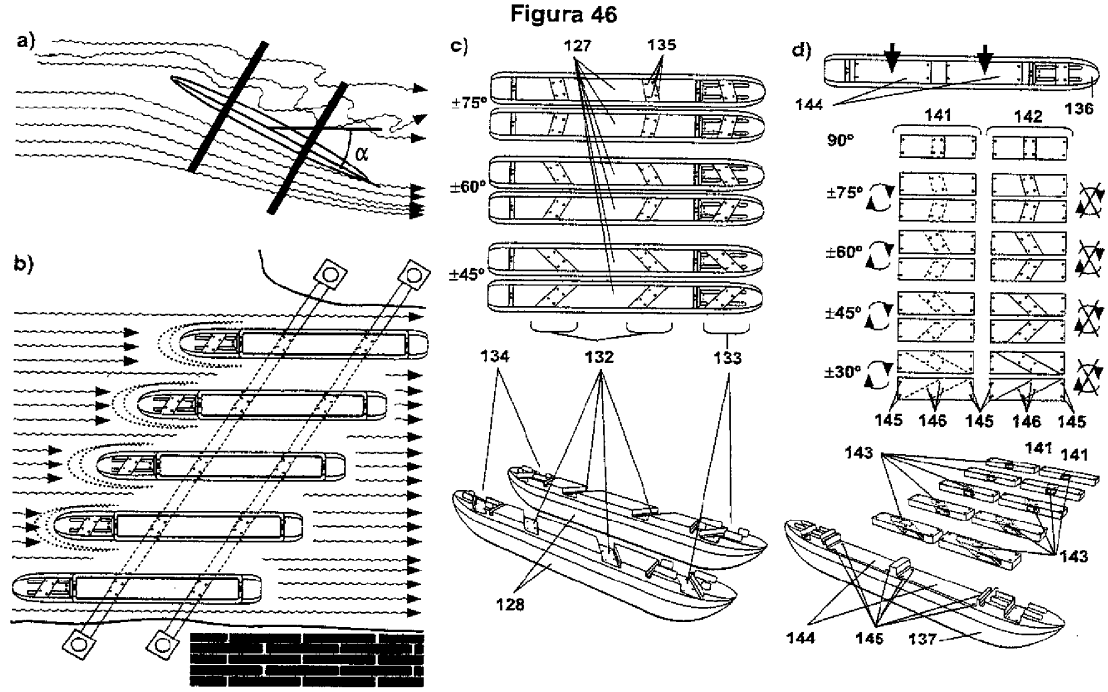

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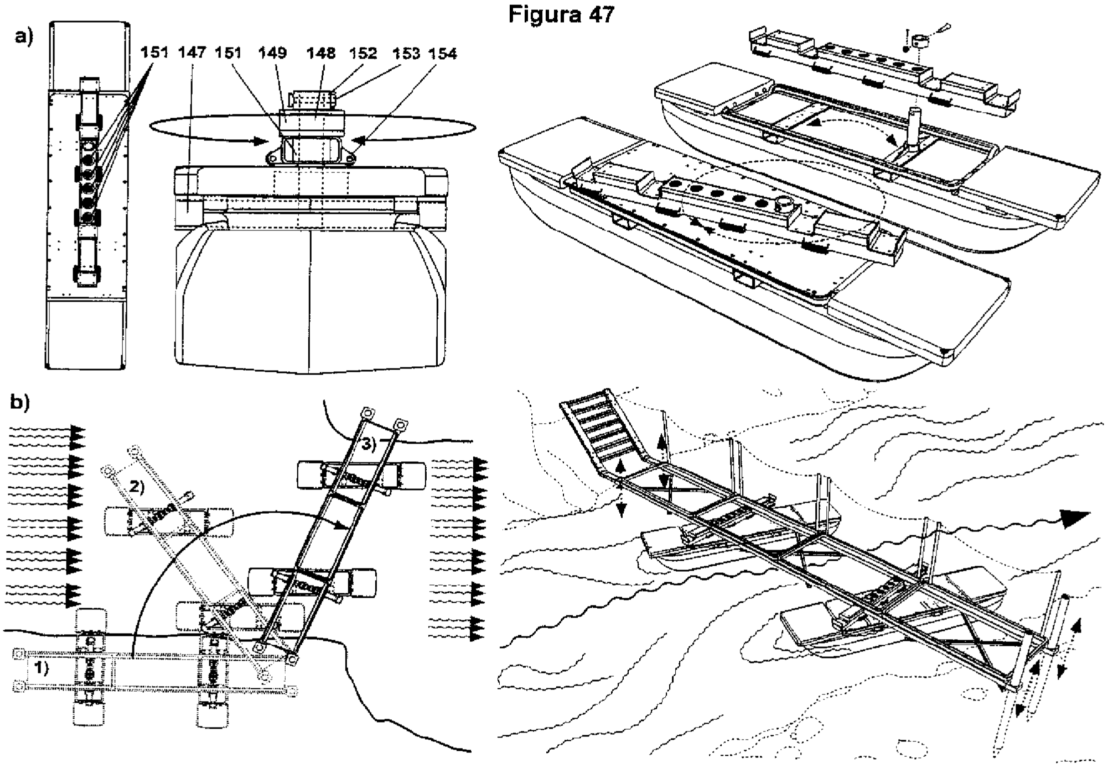

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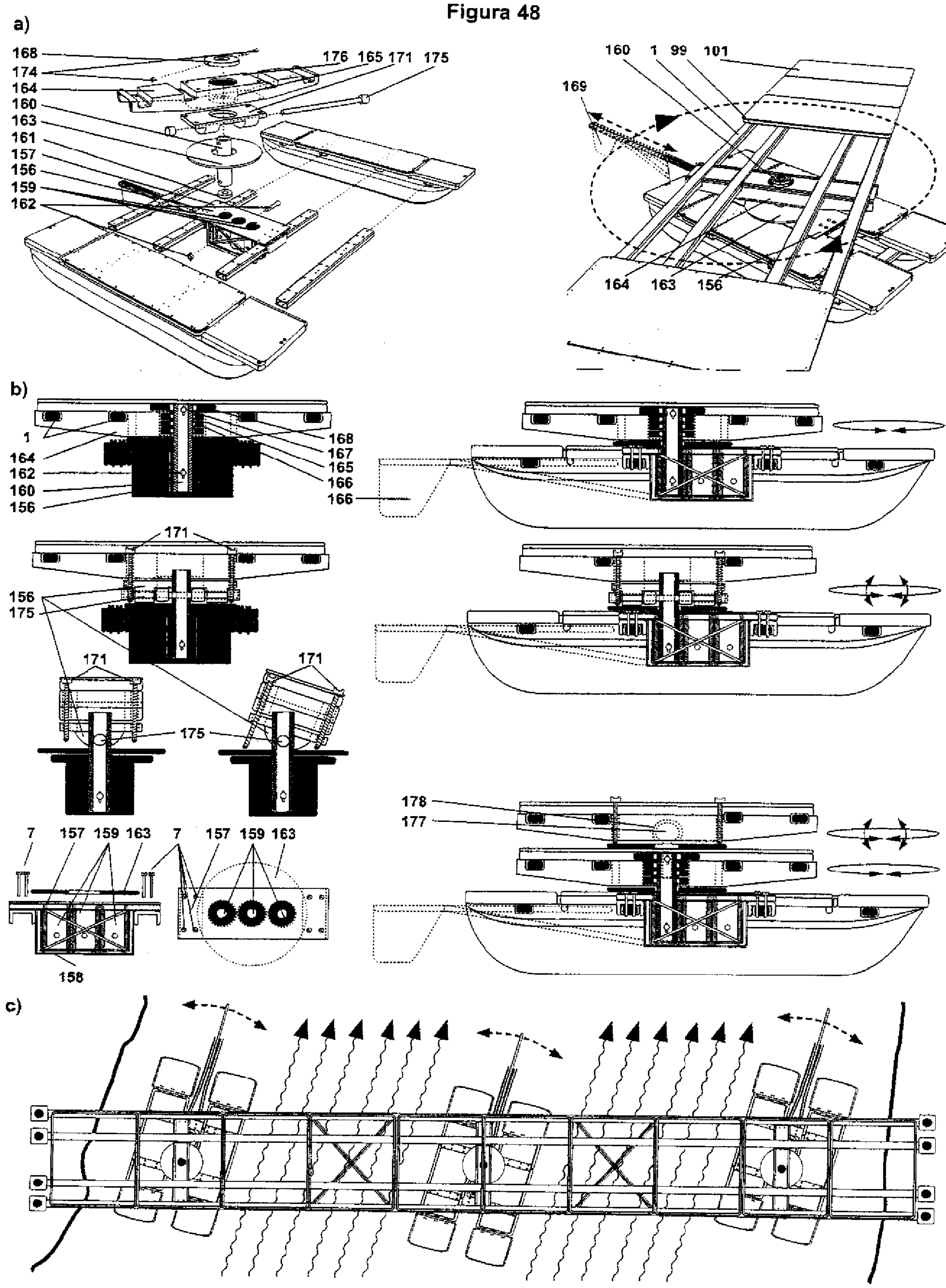
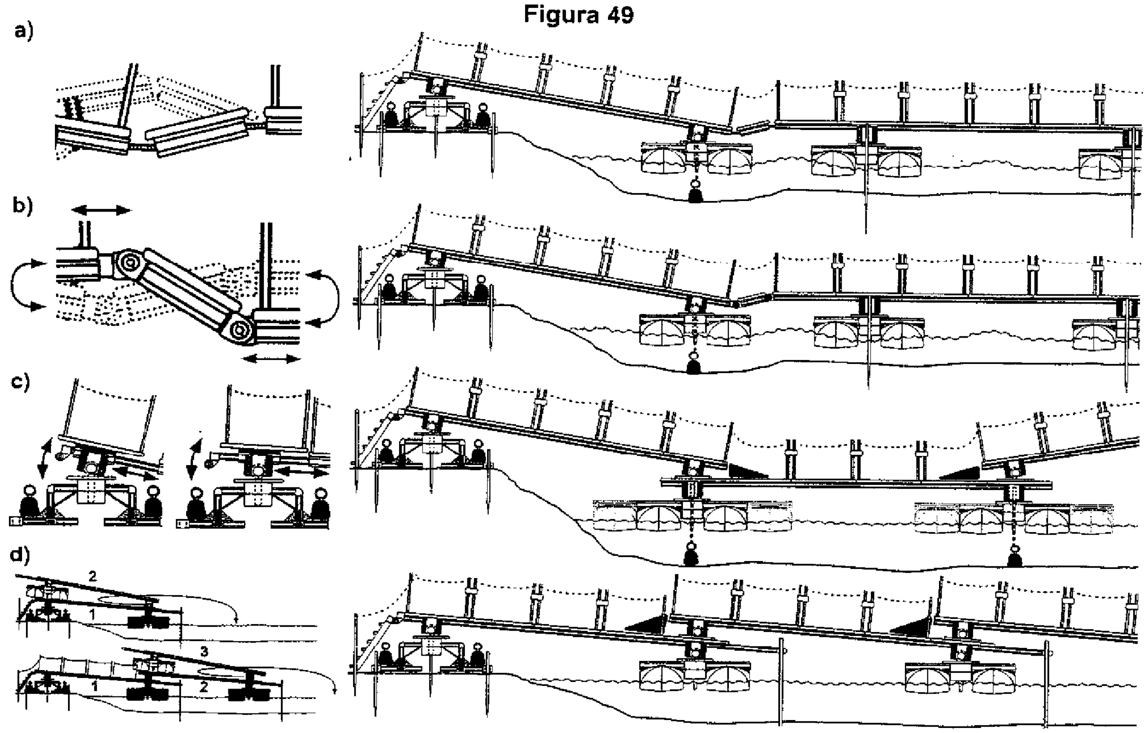

a)
168
174
164
160
163
161
157
156
159
162
176 165 171 175
160 1 99 101
169
164 163 156
b)
1
164
162
160
156
168
167
165
166
166
171
156
175
171
175
171
7 157 159 163
7 157 159 163
158
178
177
c)

Figura 49



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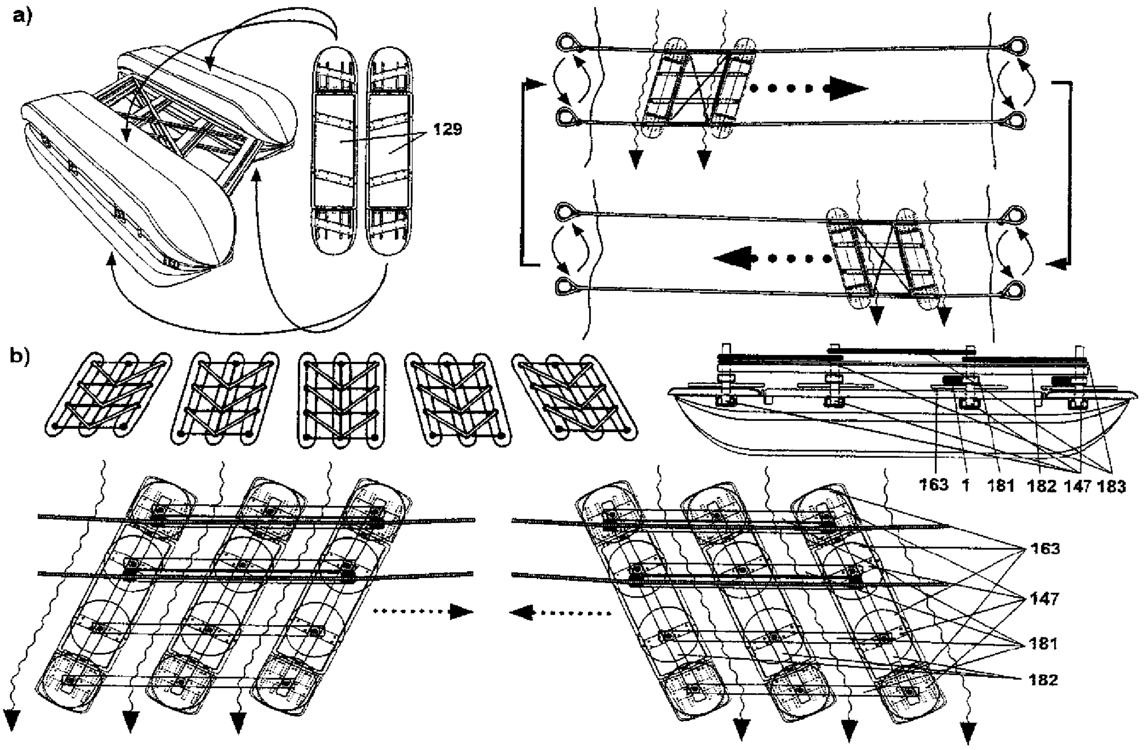

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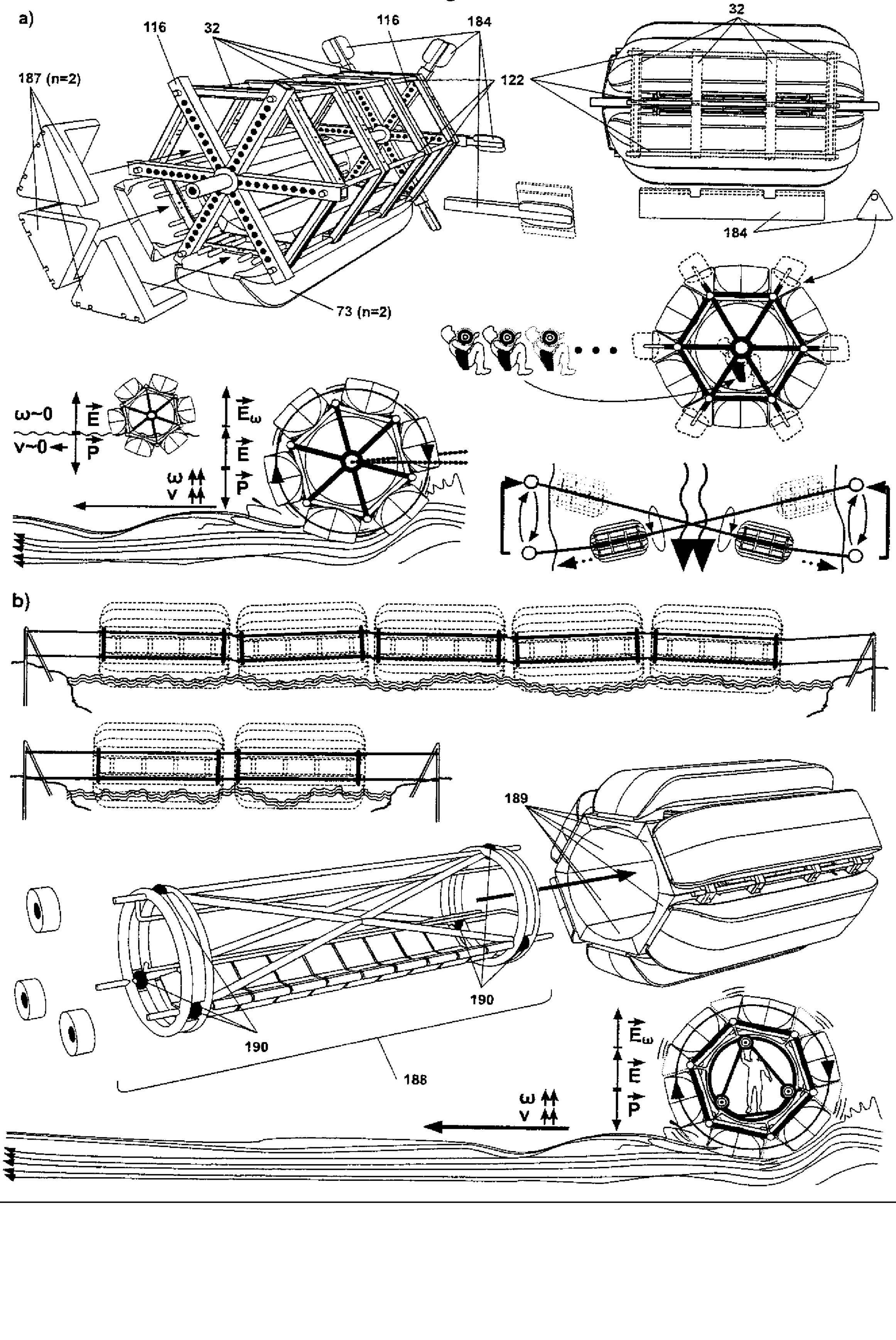
a)
116
32
116
184
187 (n=2)
122
73 (n=2)
32
184
ω~0
v~0
E
P
Eω
ω
v
b)
189
190
190
188
Eω
E
P
ω
v

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- ES 1064408 U **[0002]**
- EP 20070822879 A **[0002]**