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(54) **Modular elements to be cast and fixed in seabeds or the like for the re-formation of aquatic life**

Fertigteilmodule zum Befestigen auf dem Meeresboden oder ähnlichem zur Wiederherstellung von Unterwasserleben

Éléments modulaires préfabriqués à fixer sur le fond marin ou similaire pour réinstaller la vie aquatique

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(56) References cited:
EP-B- 0 143 752 BE-A- 895 025
JP-A- 53 054 587 US-A- 5 173 006
US-A- 5 988 942

- "CHEMICAL ABSTRACTS + INDEXES,
AMERICAN CHEMICAL SOCIETY. COLUMBUS,
US" CHEMICAL ABSTRACTS + INDEXES,
AMERICAN CHEMICAL SOCIETY. COLUMBUS,
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Description

[0001] The present invention proposes to use particular modular elements to be cast and fixed in seabeds or the like in order to form artificial structures for the re-formation of aquatic life.

[0002] The present manufactured articles consist of essentially flat, octagonal elements made of reinforced concrete. These elements are assembled together to obtain structures that are arranged on seabeds or lakebeds in such a way to be statically stable. In this way, it is possible to create an ideal condition for the re-formation of an ecosystem, in particular an underwater ecosystem.

[0003] Unlike the known solutions, the modular elements according to the present invention offers the advantage of a great modularity of employment, there being provided the possibility of carrying out structures of different forms because the modular elements in question can be assembled according to the wished form.

[0004] As can be better understood from the following description, the modular element in question presents the main advantage of an easy transport of the components because unlike the components that were usually employed for the same purpose, the present modular elements can be piled up in containers, vans, trucks or ships. In this way, the loading and unloading of the pieces is greatly facilitated and simplified.

[0005] As is known, as concerns sea or lake ecosystems there exists the necessity of repopulating areas or beds that are underpopulated by the fish fauna, for instance owing to alterations in the local ecosystem caused by the man or by the water pollution, which provokes a thinning out of the aquatic vegetation and corals and the consequent dispersion of most of the aquatic species.

[0006] The aforesaid problem is mainly felt by the societies and clubs relating to underwater activities. These associations consider that the potential of the seabeds or lakebeds is impoverished by the thinning out of the fish fauna.

[0007] The prior art offers some solutions for the repopulation of seabeds or lakebeds. The prior art solutions propose to carry out artificial reefs and produce big masses or blocks in reinforced concrete. These masses or blocks show irregular shapes and are provided with openings and holes. They are transported and cast in the sea basin or lake basin. Then, these masses and blocks settle on the seabed or lakebed and create ideal habitats for the reproduction of the various underwater species.

[0008] In other cases, pieces of wreckage, car frames and tyres can be used, especially when it is necessary to create artificial underwater diving points. However, these things involve pollution, environmental upheavals and alterations in the ecosystem.

[0009] As concerns such artificial masses or blocks, it is to be said that their employment is very difficult and not practical at all because their manoeuvrability is very difficult and awkward owing to the weight and excessive

encumbrance of these manufactured articles.

[0010] The patent US-A-5173006 reveals an artificial reef structure shaped as a truncated pyramid, assembled on site, comprised of identical panels forming openings at the top and bottom of the artificial reef.

[0011] These panels are made of fibreglass and they are provided with bracings and brackets in order to connect the panels each other.

[0012] The aim of the present invention is to eliminate or at least to drastically reduce the aforesaid problems by producing a series of elements to be cast and fixed in seabeds, lakebeds or the like in order to form artificial structures for the re-formation of underwater life, the peculiarity of which is the modularity because these modular elements can be arranged and assembled in situ in different ways according to the need.

[0013] A first immediate advantage that can be reached with the present solution is the easiness of storage and transport of the manufactured article since the modular elements in question are equal and can be piled up.

[0014] In addition, the modular elements can be arranged according to various levels so as to build small or middle or great stable, artificial structures in sea or lake areas with little natural indentations and underpopulated as concerns fauna.

[0015] In other words, the present invention offers the possibility of improving the biological complexity of the system so as to obtain a productive substratum that does not pollute like wreckage, car frames or tyres. The modular elements according to the present invention can develop in a short time structures that are biologically different and stable.

[0016] In addition, the present invention offers the advantage that only a few skin-divers, for instance two, are necessary to perform all the loading and unloading operations to and from the boat. The energy to be spent is very scarce if compared with the remarkable results achieved.

[0017] The structure can be assembled above ground and then, it is laid on the seabed. Otherwise, the elements can be put on the seabed or lakebed and then, they are assembled with very short operations that consist in putting them near each other and fixing each other by means of screws and bolts.

[0018] All the aforesaid particular advantages and functions are reached according to the present invention through modular elements to be cast and fixed in seabeds or the like so as to obtain artificial units for the re-formation of underwater life, characterized by the fact that the modular element is made of reinforced concrete or the like, has an essentially polygonal shape, in particular it is shaped as a perforated octagon, the body of this element being flat and having a certain thickness, the modular element showing shaped openings in its central part, and by the fact that on the edge of the modular element there are provided connecting means for coupling and fixing the modular elements each other by means of screws or

the like in order to obtain either simple pyramidal modular structures or more complex modular structures on the seabeds or lakebeds.

[0019] Further particular advantages and functions of the present invention will be better understood from the following description of a preferred embodiment of the invention which is given as a non-exclusive example thereof on the hand of the accompanying drawing wherein:

Fig. 1 shows a schematic front view of one of the modular elements according to the invention as a whole;

Fig. 2 shows a schematic lateral thereof;

Fig. 3 shows a perspective, schematic view of a detail of a pair of modular elements which are connected each other and form a pyramidal structure;

Fig. 4 shows a perspective, schematic view of a possible assemblage of the modular elements forming a simple pyramidal module.

[0020] With reference to the accompanying drawing, number 1 denotes one of the modular elements as a whole according to the present invention. These elements are cast and fixed in seabeds, lakebeds or the like in order to obtain artificial structures for the re-formation of underwater life.

[0021] The peculiarity of such elements 1 is the modular nature thereof since they can be arranged and assembled in situ according to different structures depending on the need.

[0022] To this end, the modular element 1 is shaped as a perforated octagon, the body of this element being flat and having a certain thickness. The modular element shows shaped openings 2 and one of the sides of the octagon shows bevels 3 for facilitating the coupling of the modular elements.

[0023] Each of the perforated octagon elements must be coupled with other similar elements showing the same features. To this end, stirrups 4 are provided in the median points of their sides turned outwards. These stirrups are made of steel or another suitable metal. There are also provided holes for the insertion of screws 5.

[0024] The modular elements are assembled together and are arranged according to an angle of 90 degrees. Thus, it is possible to obtain a base modular structure having an essentially pyramidal three-side shape which is very stable and can be laid on the bottom of a basin. This structure can be utilized alone or associated with other elements so that any wished modular composition can be realized.

[0025] As said, the aforesaid structure is very stable and the tangential thrusts are always transferred mechanically to the seabed. In other words, any current coming on the modular structure, periodically or continuously, pushes the structure itself so that it anchors more and more to the bottom.

[0026] Moreover, the structure is carried out in such a

way as to permit the creation of local washing currents on the outer surface for preventing a sanding up of the modular structure as well as the creation of inner washing currents on the inner surface for favouring an increase of the nutritional substances and the development of sedentary forms of life.

[0027] The angulation of the faces and the particular arrangement of the openings gives rise to microcurrents having a frequency in the range of 2-10 Mhz. especially in the highest modular structures. Such microcurrents are amplified by a more complex structure and are perceived by the various forms of the underwater life such as fish, shellfish, crustaceans, molluscs, etc. which are attracted by the modular structures so that the area can be repopulated in a short time.

[0028] The base material for making the modular element in question is concrete.

[0029] In this case it is more convenient to use concrete made of natural elements such as washed sand and broken gravel and it is better to avoid an utilization of composite materials including cement that has not been integrated with additives, nor is it fluidified. The composition of the concrete does not include synthetic disarming agents for the forming operations. Furthermore, the surfaces of the modular element are then washed with salt water in order to lower the pH of the surface. In this way, it is possible to obtain an artificial "stone" which is very suitable for being colonized by the forms of life.

[0030] Concerning the anchorages, the mechanical small parts for coupling the modular elements are made of stainless steel, which is absolutely unalterable in water or salt water. The utilization of special metals such as chromium, vanadium, tungsten and titanium is avoided because they are reactive metals which modify both the acidity of the surrounding area and the electrolysis paths of the structure and are a biochemical hindrance to the proliferation of the underwater flora and fauna.

[0031] The modules are assembled three at a time and create a structure which is simple and quick to be built. In addition, it is possible to simply put a second level or a third level of modular elements on the first level of elements. The so-obtained pyramids are extraordinary artificial citadels for the repopulation or development of the underwater habitat.

[0032] The assembling operation of the modules is very simple and rapid. Two skin-divers can perform all the loading operations on a boat and the laying underwater. The modules can be assembled above ground and then, they are laid underwater. However, it is also possible to lay the single elements on the seabed and assemble them after.

[0033] Anyhow, the single operations take few time and consist in putting the modular elements near each other and screwing in screws 5 and their respective bolts on the stirrups.

[0034] As previously said, the present modular structure permits to build small, middle and big stable artificial structures in sea and lake areas where there are few

natural indentations or areas that are underpopulated by the fauna. Thus, the utilization of these structures improves the biological complexity of the system.

[0035] Moreover, new ecosystems may be created in unusual areas or where it is more convenient or necessary to do so, for instance in diving centers, research institutes and bodies in control of the repopulation of the seabed.

[0036] A skilled artisan can find further possible constructive forms and coupling systems for the modular elements and obtain solutions included in the scope of protection of the invention as defined in the following claims.

Claims

1. Modular elements to be cast and fixed in seabed or the like for obtaining artificial structures for the reformation of aquatic life, wherein each modular element (1) is a concrete piece, has an essentially polygonal shape suited to connect other elements (1), the body of this elements (1) being flat, the modular element showing openings (2) in its central part and on the edge of the modular element (1) there are provided connecting means (4) for coupling and fixing the modular elements (1) to each other by means of screws, in order to obtain either simple essentially pyramidal modular structures or more complex modular structures, said polygonal shape of the modular element (1) is an octagonal shape, in order to obtain said simple pyramidal structures for the reformation of aquatic life by assembling three elements at a time, said simple pyramidal structures for the reformation of aquatic life, obtained by assembling three elements at a time, being suited to obtain more complex modular structures by adding a second or third level of modular elements.
2. Modular elements to be cast and fixed in seabed or the like, as claimed in claim 1, **characterized by** the fact that at least one of the sides of the polygonal shaped modular element (1) is provided with bevels (3), said bevel (3) being designed to facilitate the coupling of the modular elements (1) each other.
3. Modular elements to be cast and fixed in seabed or the like as claimed in claim 1, **characterized by** the fact that means (4) for coupling and fixing the modular elements (1) each other, in order to obtain either simple pyramidal modular structures or more complex modular structures, comprise stirrups (4), made of steel or other proper material, means being provided designed to connect each other said stirrup.
4. Modular elements to be cast and fixed in seabed or the like, as claimed in claim 3, **characterized by** the fact that said means, designed to connect each other said stirrup, comprise screw or the like which are

inserted in holes obtained in said stirrups (4).

5. Modular elements to be cast and fixed in seabed or the like, as claimed in the foregoing claim, **characterized by** the fact that each modular element (1) is made of concrete comprising natural elements such as washed sand and broken gravel on avoiding an utilization of composite material, including cement that has not been integrated whit additives or fluidified, the composition of the concrete doesn't include synthetic disarming agents for the forming operations, the surface of modular element (1) being then washes with salt water in order to lower the pH of the surface.

Patentansprüche

1. Fertigteilmodule zum Giessen und Befestigen auf dem Meeresboden oder ähnlichem zum Erhalten von künstlichen Strukturen zur Wiederherstellung von Unterwasserleben, bei welchen jedes Fertigteilmodul (1) ein Betonstück ist und eine im wesentlichen vieleckige Form hat, geeignet zum Anschliessen von anderen Modulen (1), wobei der Körper dieser Module (1) flach ist, das Fertigteilmodul in dem mittleren Teil Öffnungen (2) aufweist und an der Kante des Fertigteilmoduls (1) Verbindungsmittel (4) zum Anbringen und Befestigen der Fertigteilmodule (1) eins an dem anderen vorgesehen sind, und zwar mit Hilfe von Schrauben, um entweder einfache wesentliche pyramidenförmige Modularstrukturen oder mehr komplexe Modularstrukturen zu erhalten, wobei die genannte vieleckige Form des Fertigteilmoduls (1) eine achteckige Form ist, um die genannten einfachen pyramidenförmigen Strukturen zur Wiederherstellung von Unterwasserleben zu erhalten, und zwar durch die Montage von gleichzeitig drei Elementen, und wobei die genannten einfachen pyramidenförmigen Strukturen zur Wiederherstellung von Unterwasserleben, erhalten durch die Montage von gleichzeitig drei Elementen, geeignet ist zum Erhalten von mehr komplexen Modularstrukturen durch das Hinzufügen einer zweiten oder einer dritten Lage von Fertigteilmodulen.
2. Fertigteilmodule zum Giessen und Befestigen auf dem Meeresboden oder ähnlichem nach Patentanspruch 1, **dadurch gekennzeichnet, dass** wenigstens eine der Seiten des vieleckig geformten Fertigteilmoduls (1) mit Abschrägungen (3) versehen ist, wobei die genannten Abschrägungen (3) dazu bestimmt sind, das Verbinden der Fertigteilmodule (1) miteinander zu erleichtern.
3. Fertigteilmodule zum Giessen und Befestigen auf dem Meeresboden oder ähnlichem nach Patentanspruch 1, **dadurch gekennzeichnet, dass** die Mittel

(4) zum Verbinden und Befestigen der Fertigteilmodule (1) miteinander, um entweder einfache pyramidenförmige Modularstrukturen zu erhalten oder mehr komplexe Modularstrukturen, Bügel (4) enthalten, hergestellt aus Stahl oder einem anderen geeigneten Material, wobei die Mittel dazu vorgesehen sind, dass jeder genannte Bügel einer mit dem anderen verbunden wird.

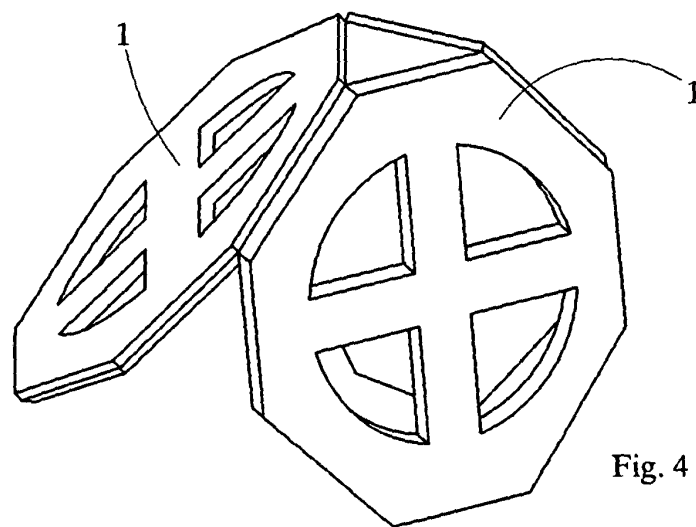
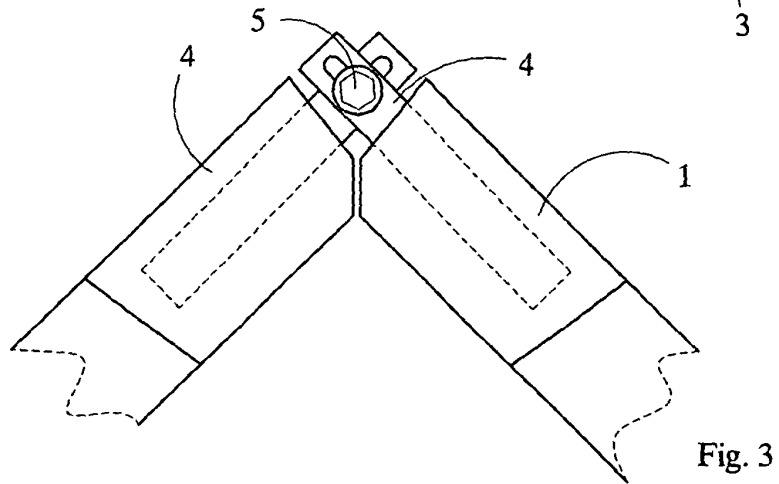
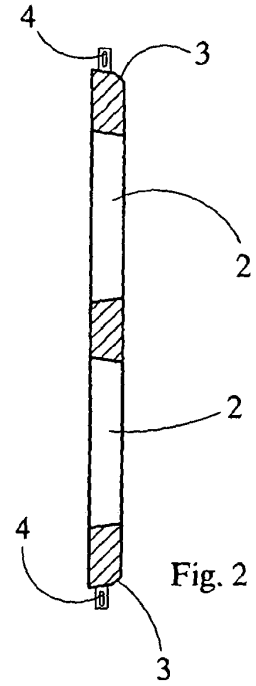
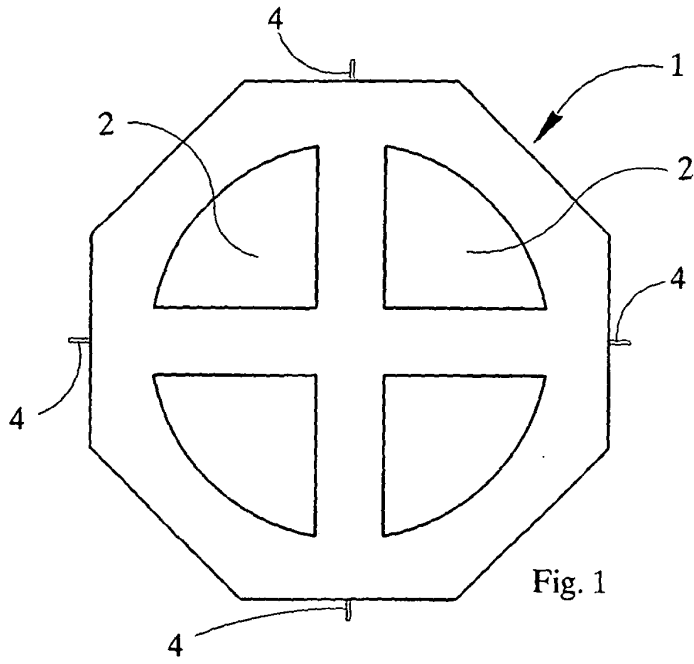
4. Fertigteilmodule zum Giessen und Befestigen auf dem Meeresboden oder ähnlichem nach Patentanspruch 3, **dadurch gekennzeichnet, dass** die genannten Mittel, die dazu bestimmt sind, einen jeden genannten Bügel mit einem anderen zu verbinden, Schrauben oder ähnliches enthalten, welche in Bohrungen eingesetzt werden, die in den genannten Bügeln (4) erhalten sind. 10
5. Fertigteilmodule zum Giessen und Befestigen auf dem Meeresboden oder ähnlichem nach dem vorstehenden Patentanspruch, **dadurch gekennzeichnet, dass** jedes Fertigteilmodul (1) aus Beton hergestellt ist, enthaltend natürliche Elemente wie gereinigten Sand und Kiessplitt zum Vermeiden der Verwendung von zusammengesetztem Material, einschliesslich Zement, der nicht mit Zusätzen angereichert oder verflüssigt wurde, und der Beton enthält keine synthetischen Entformungsmittel für die Formarbeiten, wobei die Oberfläche des Fertigteilmoduls (1) dann mit Salzwasser gewaschen ist, um den pH-Wert der Oberfläche zu senken. 20 25 30

Revendications

1. Des éléments modulaires préfabriqués à fixer sur le fond marin ou similaire afin d'obtenir des structures artificielles pour réinstaller la vie aquatique, **caractérisés en ce que** chaque élément modulaire (1) est un élément en béton, a une forme essentiellement polygonale faite pour être accouplée avec d'autres éléments (1), le corps de ces éléments (1) étant plat, chaque élément modulaire présentant des ouvertures (2) dans sa partie centrale et le bord respectif de chaque élément modulaire (1) étant doté de moyens d'accouplement (4) pour accoupler et fixer les éléments modulaires (1) les uns aux autres à l'aide de vis et obtenir ainsi des structures modulaires simples essentiellement pyramidales ou des structures modulaires plus complexes, ladite forme polygonale de l'élément modulaire (1) est une forme octogonale de manière à obtenir lesdites structures pyramidales simples pour la reformation de la vie aquatique en assemblant trois éléments à la fois, lesdites structures pyramidales simples pour la reformation de la vie aquatique, obtenues par l'assemblage de trois éléments à la fois, permettant d'obtenir des structures modulaires plus complexes en ajou-

tant un deuxième ou un troisième niveau d'éléments modulaires.

2. Les éléments modulaires préfabriqués à fixer sur le fond marin ou similaire selon la revendication 1, **caractérisés en ce qu'**au moins un des côtés de l'élément modulaire (1) en forme de polygone comporte des biseaux (3), ledit biseau (3) étant destiné à faciliter l'accouplement des éléments modulaires (1) les uns avec les autres. 5
3. Les éléments modulaires préfabriqués à fixer sur le fond marin ou similaire selon la revendication 1, **caractérisés en ce que** les moyens (4) d'accouplement et de fixation des éléments modulaires (1) les uns aux autres, afin d'obtenir soit des structures modulaires pyramidales simples ou des structures modulaires plus complexes, comprennent des étriers (4) réalisés en acier ou autre matériau approprié, des moyens étant prévus pour l'accouplement avec chaque autre étrier. 15
4. Les éléments modulaires préfabriqués à fixer sur le fond marin ou similaire selon la revendication 3, **caractérisés en ce que** lesdits moyens d'accouplement desdits étriers entre eux comprennent une vis ou similaire qui est introduite dans des trous réalisés dans les étriers (4) eux-mêmes. 25
5. Les éléments modulaires préfabriqués à fixer sur le fond marin ou similaire selon la revendication précédente, **caractérisés en ce que** chaque élément modulaire (1) est réalisé en béton comprenant des éléments naturels tels que du sable lavé et du gravier concassé en évitant l'utilisation de matériau composite, incluant du ciment qui n'a pas été intégré avec des additifs ou fluidifié, la composition du béton ne comprend pas d'agents synthétiques de désarmement pour les opérations de formage, la surface de l'élément modulaire (1) étant ensuite lavée à l'eau salée afin de réduire le pH de ladite surface. 30 35 40 45 50 55



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5173006 A [0010]