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

(57) The present manufactured articles consist of essentially flat octagonal elements made of reinforced concrete. These elements are assembled together to obtain structures which 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 a re-formation of an ecosystem, in particular an underwater

ecosystem.

The subject element (1) has a polygonal shape, in particular it is shaped as a perforated octagon. The body of this element is flat and has a certain thickness. The element shows shaped openings (2) and one of the side of the octagon shows bevels (3) that facilitate the coupling of the modular elements.

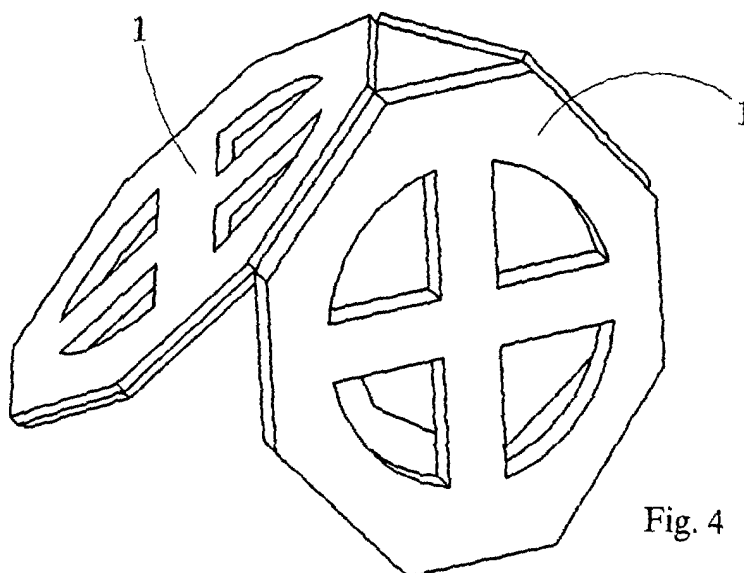


Fig. 4

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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 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.

[0011] 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.

[0012] 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.

[0013] 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.

[0014] 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.

[0015] 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.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] To this end, the modular element 1 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 shows shaped openings 2 and one of the sides of the octagon shows bevels 3 for facilitating the coupling of the modular elements.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] 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 in-

crease of the nutritional substances and the development of sedentary forms of life.

[0025] 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.

[0026] The base material for making the modular element in question is concrete. 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.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] 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.

[0031] 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.

[0032] 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.

[0033] A skilled artisan can find further possible constructive forms and coupling systems for the modular elements and obtain solutions that are to be considered as included in the scope of protection of the invention as defined in the following claims.

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Claims

1. Modular elements to be cast and fixed in seabeds or the like for obtaining artificial structures for the re-formation of aquatic life, **characterized by** the fact that each modular element (1) is a concrete piece or the like, has an essentially polygonal shape and preferably it is shaped as an octagon, the body of this element being flat and having a certain thickness, the modular element showing openings (2) 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 (5) or the like in order to obtain either simple pyramidal modular structures or more complex modular structures on the seabeds or lakebeds. 15 20 25
2. Modular elements to be cast and fixed in seabeds or the like as claimed in claim 1, **characterized by** the fact that each modular element (1) has a polygonal shape, in particular it is shaped as a perforated octagon, it is flat, has a certain thickness and is provided with shaped openings, one of the octagon faces being provided with bevels (3) for facilitating the coupling of the modular elements each other. 30 35
3. Modular elements to be cast and fixed in seabeds or the like as claimed in the foregoing claims, **characterized by** the fact that each of the perforated octagon elements (1) can be coupled with other similar elements having the same features, and to this end the median points of its sides turned outwards are provided with stirrups (4) made of steel or other proper metal, the stirrups being provided with holes for the insertion of screws (5) or the like. 40 45
4. Modular elements to be cast and fixed in seabeds or the like as claimed in the foregoing claims, **characterized by** the fact that each modular element is made of concrete consisting preferably of natural elements such as washed sand and broken gravel on avoiding an utilization of composite materials including cement that has not been integrated with additives or fluidified, the composition of the concrete does not include synthetic disarming agents for the forming operations, the surfaces of the mod- 50 55

ular element being then washed with salt water in order to lower the pH of the surface.

