

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) A CONCRETE COMPONENT OR BLOCK FOR A SUBAQUEOUS PROTECTIVE COVERING STRUCTURE

(71) We, TATSUO AKAMATSU, a Japanese citizen, of No. 972, Kushimoto, Kushimoto-Cho, Nishi Muro-Gun, Wakayama-Prefecture, Japan and MATSUI REAL ESTATE CO. LTD., a Japanese company, of No. 1-1, Muro-machi 2-chome, Nigonbasehi, Chuoku, Tokyo, Japan, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an improved concrete component or block and an improved covering structure comprising a plurality of such components for the purpose of protection of breakwaters, harbour or river walls and other marine or riverine constructions against the action of water or waves.

There have been proposed and practically used various types of concrete components or blocks and protective covering structures for the purpose of protection of breakwaters, harbour or river walls and other marine or riverine structures and beaches against the erosive action due to the kinetic energy of water or waves.

One requirement of such concrete components or blocks is that they should be interlocked with each other so as to provide a protective covering structure having a great number of voids into which water or waves can penetrate and hence a large surface area over which the wave energy can be dissipated. A second requirement called for in such components is that when located in position they can be effectively prevented from moving under the forces of the waves. Otherwise, the protective structure comprising such components may be destroyed by the force of the waves which may be sometimes fairly great. The components are preferably so designed that they can maintain their predetermined equilibrium in all positions which they may assume when located in position. In addition, the components are required to have the ability to interlock with each other and maintain the interlock relation so that the components

when used in a protective covering structure assure the stability of such a covering structure when located in position.

An object of the present invention is to provide an improved protective covering structure comprising a plurality of concrete components or blocks inter-connected with each other so as to define a plurality of interstices or voids into which water or waves can penetrate and over which the kinetic energy of the water or waves can be effectively dissipated.

Another object of the present invention is to provide an improved concrete component or block which is useful in the building of a protective covering structure for breakwaters, harbour or river walls and other marine or riverine constructions and is stable against the action of water or waves and can be economically manufactured.

According to one aspect of the present invention, there is provided a concrete component or block for building a protective covering structure for marine or riverine constructions subjected to the action of water or waves, said component comprising a moulded concrete mass having three integrally connected elongate pillar members of similar cross-section and of similar length disposed in such an angular relation to each other that each pillar member extends transversely of the other pillar members with the longitudinal axis of each pillar member extending in a direction equi-angular to the longitudinal axes of the other pillar members and disposed nearer to one end than to the other end of each of the other pillar members and the opposite ends of each pillar member each projects an equal distance from the pillar member adjacent the respective end whereby said component may remain in equilibrium in whatever position the same comes to rest when placed in position.

According to another aspect of the present invention, there is provided a protective covering structure for marine or riverine constructions subjected to the action of water or waves, said covering structure comprising a plurality of identical concrete components or blocks

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interlocked with each other so as to provide a plurality of interstices into which water or waves can penetrate and over which the kinetic energy of said water or waves can be dissipated, each of said concrete components comprising a moulded concrete mass having three integrally connected elongate pillar members of similar cross-section and of similar length disposed in such an angular relation to each other that each pillar member extends transversely of the other pillar members with the longitudinal axis of each pillar member extending in a direction equiangular to the longitudinal axes of the other pillar members and disposed nearer to one end than to the other end of each of the other pillar members and the opposite ends of each pillar member each projects an equal distance from the pillar member adjacent the respective end whereby said components may remain in equilibrium in whatever position they come to rest when placed in position.

The above and other objects and attendant advantages of the present invention will be more readily apparent to those skilled in the art from the following description when read in conjunction with the accompanying drawings.

The accompanying drawings illustrate several embodiments of the present invention in which:—

Figure 1 is a perspective view of one of the components of a protective covering structure for breakwaters, marine or, river walls and other marine or riverine constructions in accordance with the present invention;

Figure 2 is a plan view of said component of Figure 1. (The dimensions given on the left hand side of Figure 2 are distances measured along the longitudinal axis of pillar 2);

Figure 3 is a perspective view of a covering for breakwaters, marine or river walls and other marine or riverine constructions, which covering comprises a plurality of components identical with that shown in Figures 1 and 2 showing one way of arrangement of such components by which the components are interlocked to form such a protective covering structure;

Figure 4 is a perspective view of a modified protective covering structure which comprises a plurality of components identical with that shown in Figures 1 and 2 showing another way of arrangement of such components by which the components are interlocked to form such a protective covering structure;

Figure 5 is a perspective view of a further modified protective covering structure which comprises a plurality of components identical with that shown in Figures 1 and 2 showing a third way of arrangement of such components to form a protective covering structure; and

Figure 6 is a front elevational view of a modified form of component in accordance with the present invention.

Referring to the various figures of the accompanying drawings and particularly to Figures 1 and 2, one form of break-water covering structure component according to the present invention and generally indicated at 1, has been conventionally formed by pouring concrete or mortar materials into a suitable mould having the cavity corresponding to the configuration of the component to be formed. The component 1 comprises three substantially identical integrally connected elongate pillar members 2, 3 and 4 each having a square cross-section. The three pillar members 2, 3 and 4 have substantially the same dimensions in which the ratio of the length to the width is about 4 to 1 and the pillar members are integrally interconnected to one another in such an angular relation that the longitudinal axis of each pillar member extends in a direction perpendicular to the longitudinal axis of the other two pillar members. In addition the three pillar members are disposed in such a predetermined angular relation that the longitudinal axis of each pillar member is disposed so that the normal from each axis to each other axis divides each axis in the ratio 1.5 to 2.5. Furthermore, the opposite ends of each pillar member project beyond the width of the other members by a distance corresponding to substantially one quarter of the length of each member. In addition, the respective pillar members 2, 3 and 4 have flat end faces which join similarly flat side faces substantially at right angles. In the covering component comprising the three identical pillar members having the dimensional relation, design and disposition as mentioned above, when the component is laid on a plane 14 for example of a harbour, as shown in Figure 1 one longitudinal ridge 9 of the pillar member 4, one lower end edge or ridge 13 of the pillar member 3 are positioned in the same plane 14 in which the lowest adjacent side faces of the pillar member 4 form a dihedral angle having the ridge 9 as the apex, the lowest adjacent end face and side face of the pillar member 2 form a dihedral angle having the end edge 12 as the apex and the lowest adjacent end face and side face of the pillar member 3 forming a dihedral angle having the end edge 13 as the apex. Since the three pillar members 2, 3 and 4 have substantially the same length to width ratio and dimensions and are disposed in the same angular relation to each other as described hereinabove, the component 1 can remain in equilibrium in whatever position the same comes to rest in the plane 14. When the component 1 is laid in the plane 14 with one longitudinal ridge of either one of the three pillar members parallel to or in a substantially flush contact, the centre of gravity of the component is positioned at a point corresponding to substantially one third in the height of the component as measured from the base or the

one longitudinal ridge whereby the component may provide a stable protective covering structure for a marine construction in which a plurality of such components 1 can be located in a stabilized condition in a breakwater, jetty slope and the like.

When the above-mentioned marine or riverine construction protecting covering structure is a breakwater, jetty, revetted slope, sea or river bank and the like for protecting the facilities against the kinetic energy of water or waves, a length of wire rope (not shown) is placed around the component 1 in any desired position thereof and a conventional crane (not shown) which carries the component 1 to a desired position in a breakwater or the like construction which is to be protected. When a desired number of such components 1 have been carried to the desired position by the crane workers arrange or interlock the components 1 into a covering structure in any suitable manner. One manner by which the components 1 are interlocked with each other to provide a covering structure is illustrated in Figure 3.

Referring to Figure 3, a plurality of the components 1 each having the design and arrangement of the three pillar members 2, 3 and 4 as mentioned above are interlocked with each other in a horizontal assembly line with the lowest longitudinal ridge 9 of each of the pillar members 4 of the component 1 laid in a substantially flush contact with the surface plane 15 of a breakwater for example, providing interstices 18 between adjacent components 1.

The protective covering structure of Figure 3 is shown as comprising a plurality of components 1 as shown in Figures 1 and 2 interlocked with each other in a horizontal direction, but in a straight line as seen from above. However, it should be understood that these components 1 can be interlocked with each other so as to form a covering structure of a number of other configurations depending upon the profile of a marine or riverine construction to be protected by such a covering structure. In any formation of the covering structure the components 1 can be interlocked with each other in such a mutual relation that they may provide a great number of interstices 18 into which water or waves can penetrate and over which the kinetic energy of the water or waves can be dissipated while allowing the components to maintain their interlocking relation.

Furthermore, in practice, the horizontally disposed pillar members 4 and the lower ends of the angularly disposed pillar members 2 and 3 are partially embedded into the ground beneath the surface plane 15 of the breakwater and accordingly, the covering structure comprising the thus disposed components 1 can effectively resist the kinetic energy of waves as a unitary mass and thus provide a

stable covering for such a marine construction.

Figure 4 illustrates a second manner for building of a protective covering structure for a sea wall or river bank comprising the above-mentioned components 1 in accordance with the present invention. The covering structure shown in Figure 4 is adapted to be suitably employed on a sloped or rather uneven surface of a breakwater or the like construction. As seen from this figure, the components 1 in this covering structure are arranged or interlocked in conformity with the configuration of the sloped surface of the breakwater. In the covering structure of Figure 4, the successive components 1 are arranged in a side-by-side relation to one another with rather wider interstices 18' between the adjacent pillar members 2. In this embodiment, some of the laterally disposed pillar members 4 are not in contact with the surface 16 initially while the other laterally disposed members 4 are in contact with the surface at varying angles. When the components 1 are arranged in the manner as described in connection with and illustrated in Figure 4, they will provide a stable and reliable break-water surface covering structure in which the portions of the components which contact the sections of the surface 16 of the sea wall or river bank and especially the pillar members 4 are more or less embedded into the ground of the surface sections and the structure can effectively protect the sea wall or river bank against any washing-away and/or erosive action by the water.

As in the arrangement of the covering structure shown in Figure 3, the components 1 arranged and interlocked as shown in Figure 4 can be stabilized in position when located in the sloped or stepped surface of a sea wall or river bank because even if surface sections of the sea wall or river bank are broken or eroded by waves, the portions of the components 1 especially the pillar members 4, will be more or less forced into the ground under the sea wall or river bank thereby compensating for such breakage or erosion.

Figure 5 illustrates a somewhat different or third manner by which components 1' of the type shown in Figures 1 and 2 are interlocked with each other to provide another sea wall or river bank surface covering structure. Different from the foregoing embodiments of Figures 3 and 4, the embodiment of Figure 5 is characterized by that one corner of the lower end of each of the three pillar members of each component 1' lies in the same plane or contacts the surface 17 of the sea wall or river bank in the same manner with respect to the sea wall surface. In other words, the three pillar members 2', 3' and 4' of each component 1' are disposed in the same angular relation with respect to the sea wall surface 17.

As seen in Figure 5, the components 1'

are interlocked with each other to form a substantially horizontal covering structure having relatively large interstices 19 between the adjacent components 1 which interstices the waves can penetrate and over which the kinetic forces of the waves can be dissipated whereby the covering can effectively protect the sea wall from the action of water. Furthermore, in the embodiment of Figure 5, except for the components 1' at the opposite extreme ends of the structure the components 1' are so interlocked with each other that the thus interlocked components can provide a reliable covering unit which is stable when placed in a desired position.

In the foregoing various embodiments description has been made on the instances in which the components 1 or 1' are interlocked with each other to provide a covering structure in a single layer. However, it should be understood that each of the above-mentioned three types of covering structure may be employed in any desired multi-layer formation. In such a multi-layer embodiment, the components 1 or 1' in adjacent upper and lower layers are interlocked with each other thereby to provide a reliable and stable multi-layer covering structure.

Although each of the components 1' employed in the covering structure of Figures 3 to 5 inclusive comprises three pillar members 2', 3', and 4' each having a substantially square cross-section and the length to width of 4 to 1, the present invention is in no way limited to the use of such a particular design, but each of the components may comprise three integral pillar members having circular, polygonal or any other cross-section provided that the pillar members in each component have the same length to width or diameter ratio as the pillar members shown in Figures 1 to 5 inclusive. Similarly, each component comprises three integrally interconnected pillar members of any desired cross-section configuration having the outer peripheries provided with projections of mortar at suitable points thereon so as to increase the surface area over which water is dissipated. In addition, although the pillar members shown in Figures 1 to 5 inclusive are shown as having end faces which are flat and perpendicular to the side faces, the pillar member ends may take any other shape such as a pointed, frusto-conical or domed shape. All the above-mentioned modifications are also within the scope of the present invention.

Figure 6 shows a modified form of component by the present invention and as seen in this figure, the component 1'' comprises three integrally formed pillar members 2'', 3'' and 4'' of hexagonal cross-section which have the same length to width or diameter ratio and a plurality of such components 1'' can be interconnected in the same manner as shown in Figures 3 and 4 to form a protective cover-

ing structure for marine or riverine construction.

WHAT WE CLAIM IS:—

1. A concrete component or block for building a protective covering structure for marine or riverine constructions subjected to the action of water or waves, said component comprising a moulded concrete mass having three integrally connected elongate pillar members of similar cross-section and of similar length disposed in such an angular relation to each other that each pillar member extends transversely of the other pillar members with the longitudinal axis of each pillar member extending in a direction equiangular to the longitudinal axes of the other pillar members and disposed nearer to one end than to the other end of each of the other pillar members and the opposite ends of each pillar member each projects an equal distance from the pillar members adjacent the respective end whereby said component may remain in equilibrium in whatever position the same comes to rest when placed in position.
2. A concrete component or block as set forth in Claim 1, in which each of said three pillar members of the component is of square cross-section and has substantially a length to width or diameter ratio of 4 to 1 and said longitudinal axes of the pillar members extend in mutually perpendicular directions and the normal from each axis to each other axis divides that other axis in the ratio of 1.5 to 2.5 whereby said component may remain in equilibrium in whatever position the same comes to rest when placed in position with one longitudinal ridge of one pillar member and one end ridge of each of the other pillar members lying in substantially the same plane.
3. A concrete component or block as set forth in Claim 2, in which said pillar members have end faces which are substantially perpendicular to the side faces thereof.
4. A concrete component or block as set forth in Claim 1 in which said pillar members each have a square cross-section.
5. A concrete component or block as set forth in Claim 1 in which said pillar members each have a circular cross-section.
6. A concrete component or block as set forth in Claim 1 in which said pillar members each have a polygonal cross-section.
7. A protective covering structure of marine or riverine constructions subjected to the action of water or waves, said covering structure comprising a plurality of identical concrete components or blocks as claimed in any one of the preceding claims, interlocked with one another so as to provide a plurality of interstices into which water or waves can penetrate and over which the kinetic energy of said water or waves can be dissipated.
8. A concrete component or block substantially as herein described with reference

to and as illustrated in Figures 1 and 2 or 6 of the accompanying drawings.

- 5 9. A protective covering structure substantially as herein described with reference to and as illustrated in Figures 3, 4 or 5 of the accompanying drawings.

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The following corrections were allowed under Section 76 on 4 February 1972:-

Page 1, line 6, for 'Nigonbasehi,' read 'Nihonbashi,'

THE PATENT OFFICE
2 March 1972

R 8091/20

ERRATUM

SPECIFICATION NO. 1,250,623

Page 1, line 4, for Matsui read Mitsui

THE PATENT OFFICE
24 March 1972

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