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(71) Applicant: **Guer Ingeniera, S.L.**
38359 Santa Cruz de Tenerife (ES)

(72) Inventors:
- **SANTANA RIOS, Luis V.**
Urb. Poeta Manuel Verdugo 24
E-38359 Santa Cruz de Tenerife (ES)
- **BERENGUER PEREZ, J.M.,**
Urb. Poeta Man. Verdugo 24
E-38359 Santa Cruz de Tenerife (ES)

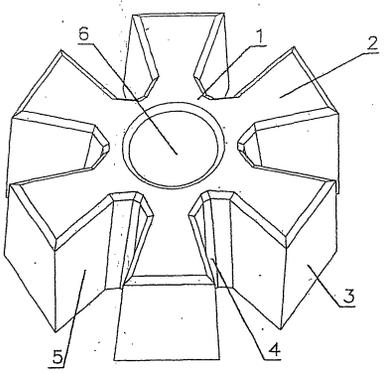
(74) Representative: **Hernán-Carrillo Portolés, Santiago**
Henson & Co
Fortuny 7
28010 Madrid (ES)

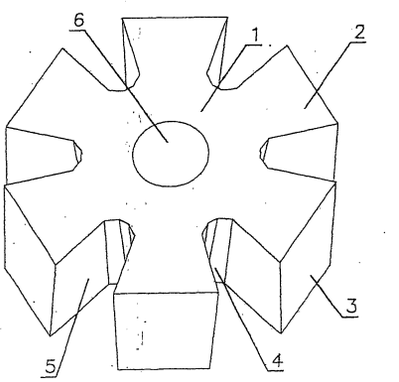
(54) IMPROVED ARTIFICIAL BLOCK WHICH IS DESIGNED TO BE POSITIONED IN AN ORDERED MANNER SUCH AS TO FORM A LAYER FOR THE PROTECTION OF DIKES, SEASHORES AND RIVER BANKS

(57) It corresponds to a circular shaped block of variable size that maintains the ratios between the sides 1,25 (height) / 1,443 (side) for sea environment and of 0,90 (height) and 1,443 (side) for use in banks not exposed to the action of wave surges, and that may be broken down into two zones. The interior zone, formed by a central perforated cylinder (1) from which six wings (2) project in the shape of prismatoids. The exterior construction of the block has the shape of a hexagonal prism.

Said block permits the connection between parts by simple contact that meant by the juxtaposition of the exterior faces (3) with a set constructive order.

FIGURE 1a





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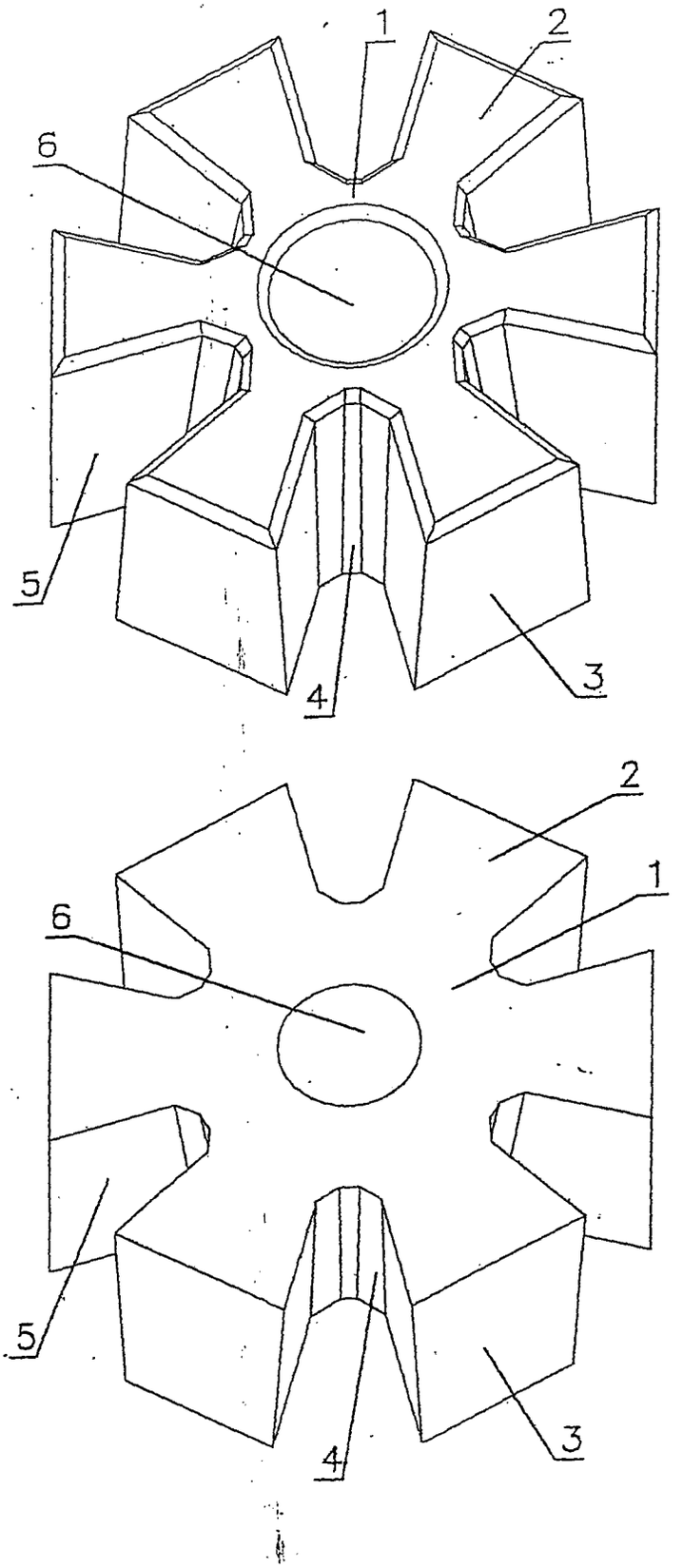


FIGURE 1b

Description

OBJECT OF THE INVENTION

[0001] The present invention refers to an improved artificial block for the protection of dykes and river banks or sea shores in a side slope, the special configuration and studied design of which, makes them capable of being placed in an orderly manner in one single layer that permits the notable reduction of the waves, exposed on the dykes during the various processes, due both to its structural stability and to the favourable hydraulic behaviour of the dyke.

BACKGROUND OF THE INVENTION

[0002] The use of reinforced concrete artificial parts or in mass, for the protection of maritime constructions has spread to world level due to multiple reasons. On one hand, strong restrictions on the use of quarries for the obtention of natural sea walls are being studied. On the other hand, the need of performing construction works in areas gradually requiring profounder depths, demands the increase of the unitary weight of the parts, reaching values that do not make possible the use of natural sea walls.

[0003] The services of concrete blocks are known in greater accuracy due to the large number of experimental studies performed during the last years concerning their hydraulic and structural behaviour. This has implied the development of a varied number of parts with diverse shapes for use as constitutive parts of the protection mantle of sea dykes.

[0004] In Spain, the artificial part that has been used most frequently for the protection of dykes has been the cubic or parallelepiped block, obtaining units of up to 150 t in weight in the case of the dykes of Punta Lucero in the Port of Bilbao. However, the use of this extraordinarily robust part, involves a high cost of concrete per areal unit of the protected dyke.

[0005] As from the publication of the empirical stress formulas of Spanish Engineers Castro (1934) and Iribarren (1939, 1965), there has been an awareness of the degree in which other factors intervene in the overall stability of the mantle. Some of them, such as the shape of the block, still appear masked within general coefficients. This is the case among the most known, of coefficients N and f of the Iribarren-Nogales formula or coefficient K_o of the Hudson formula (1958, 1961). The shape of the block has great influence on the degree of coupling in the assembly of each individual unit when multiplying the number of contact points and increasing the interlocking forces between said unit and adjacent ones. As from 1960, the development of blocks with diverse shapes (tetra pods, tribars, akmon, stabit, etc) has started which, in exchange for a complicated structural shape, full of recesses and projections, achieve a unitary weight reduction with the subsequent savings in material and machinery. The progress in the audacity of shapes continues until the commencement of the 70's. The birth of the dolo - dolosse in its acceptance of origin - apparently marks the "non plus ultra". For waves which up to now required the use of a solid rectangular block of 50 Tn in weight, it is now enough with a dolosse of hardly 12 Tn. Additionally, with these parts, the mantle is much more porous and their necessary number is reduced, improving as well, the hydraulic qualities as regards reflection and over-flow of the waves.

[0006] The following step in the art, for the purpose of optimizing the use of materials, is the proposal of protection mantles constituted by one single layer of blocks. The Accropode and Core-Loc blocks, both protected under the corresponding patent, are example of parts for the formation of mantles with units placed in disorderly manner. Solutions with blocks placed in orderly manner are also proposed, such as COB, SHED, Seabee, Armorloc, Pressrock, Ortherblock or X-Block, though for dykes in areas of average wave energy.

[0007] The strong degree of coupling between this type of parts favours the reduction of the volume to be used per areal unit of the dykes to be protected and additionally implies an important cost savings in the construction.

DESCRIPTION OF THE INVENTION

[0008] As regards its structure, the part recommended as object of the invention is configurated within a hexagonal based prism that maintains the ratio between sides 1,250 (height) / 1,443 (side) for the sea environment part and of 0.900 (height) / 1,443 (side) for the one to be used on banks not exposed to the action of waves. The size of the part may vary, keeping always these ratios, in order to adapt its behaviour to the requirements required in each case, by the characteristics of the wave or current.

[0009] In order to describe its shape, the part can be broken up into two zones; the bottom zone, which is the central cylinder; the exterior zone, that presents 6 identically dimensioned radii.

[0010] The central cylinder constitutes the core of the part. A perforation exists at its centre, that is likewise cylindrical and that totally crosses through the part.

[0011] Each one of the radii that project from the centre cylinder has a generally prismatoid shape with one of its larger faces joined to the generatrix of the cylinder. The six prismatoids, equal to each other, are arranged forming between them 60 degree angles in such a manner, that transversal cross sections are formed, inscribed in regular hexagons. Grooves remain opened between the prismatoids that form the radii of the part, that permit the dissipation of sub-pressures that may be generated by the hydraulic flow of the waves under the base of the part, by the bottom granular filter layer.

[0012] The placement of the parts is carried out in one single layer and in set manner. The connection between parts is achieved by simple contact meant by the juxta-

position of the external faces of the wings. The placement base shall be constituted by a layer of natural sea walls of appropriate weight in each case according to the dimensions of the part, and appropriately regularized.

[0013] As has been indicated, the assembly of placed parts forms a side slope with numerous gaps, due to the exceptional design of each unit.

[0014] It can be affirmed in a summarized manner, that a dyke exposed to the action of waves is applied for, because of the actions caused during the following processes;

a) Impact of the mass of water that accompanies an affecting wave.
b) Drag forces generated by the flow of the mass of water that runs along the side slope in ascending and descending direction.
c) Extraction forces generated by the pressure gradients between the interior and exterior zones of the dyke.

[0015] The structural stability of a protection mantle of a dyke or bank constructed with a layer of blocks that is the object of the invention is mainly based on two effects:

- Attenuation of the extraction forces because of the high permeability and porosity of the protection layer that is presented by said blocks; resistance to the movement of individual parts, both on the slope plane and on the perpendicular plane, due to the coactions that are imposed by adjacent blocks.

[0016] Another characteristical feature of the dykes formed with the blocks of the invention lies on the low reflection index of the waves. The attenuation of the energy of the waves reflected on the dyke or banks is produced by means of the following processes:

a) Phased difference of the reflected waves; produced due to the time taken by the mass of water of the wave during the ascending and descending process along the slope.
b) Strong percolation of the mass of water between the gaps that form the juxtaposition of the parts and that divert the return currents towards the bottom layer.
c) Generation of turbulences during the ascending process of the water due to the rough edges of the parts.

[0017] This kind of hydraulic behaviour likewise generate a favourable behaviour of the dykes versus the over-flowing of the waves since the progressive dissipation of energy during the ascending phase of the wave along the side slope collaborates in decreasing the height of the run-up on the same.

[0018] In the case of river banks or coastal slopes not exposed to the direct action of waves, the block of the invention maintains its protective properties of the slope versus the drag forces that generate the currents parallel to the shore. The moderate loss of energy by turbulence caused by the porosity of the mantle collaborates in slightly reducing of the current flow rate.

[0019] To all these properties of functional character, said block adds the important quality of reducing the volume of the concrete material necessary for constructing the protection mantle of the dyke.

[0020] The aesthetic type of benefits involved by its application shall also be considered, due to the appearance of quality conferred by the ordered placement of the parts and the regularity of the profile.

[0021] With these functional characteristics, the part that is the object of the invention may be applicable to the following purposes:

1) Formation of sloped banks in harbour docks that are affected by waves of diverse origin and in which it is advisable to keep a limited level of agitation.
2) Formation of exterior facings of harbour dykes in slopes or other maritime construction works that due to the reflection of waves may cause problems during the manoeuvring of ships navigating in surrounding areas.
3) Formation of facings in maritime or lake construction works that may cause erosion problems along the coasts or adjacent shores, due to the reflection of waves that affect them.
4) Construction or surfacing of river banks in which it is advisable to reduce the energy of waves reflected on them or the longitudinal current rate of the course.
5) Formation of banks or seaside promenades situated in rear areas of beaches in which it is advisable to reduce the risk of erosion by the reflection of waves during storms or in which aesthetic quality requirements are planned.

[0022] From the constructive point of view, the blocks of the invention may be used for the formation of low reflection edges under very diverse structural shapes. It is advisable to ensure their foundations on a bottom layer of natural sea walls with regularized surface and with a concrete foot block that prevents displacement of the blocks of the invention. The layer of blocks shall be totally confined to prevent their seatings and side movements. The placement of the blocks of the invention shall start with a row of half parts. The number of horizontal rows may vary from one, demanded by the necessary services, and the variations in the currents or of the courses of the water levels. For the formation of rectangular sections, it shall be possible to construct half parts that are the object of the invention, or else in the joint formation of facings with the concrete "in situ".

[0023] The material employed in the construction of the part shall be concrete, of the type and quality specified by the Standards that are applicable in each case. In

Spain, the use of HA-35/P/20/IIIc+Qb+E is recommended, as per Spanish EHE, as well as that of polypropylene fibre, improving with this, the crack, impact, flexo tensile and abrasion strengths. In order to facilitate the elevation of the part, 2 pass-through PVC tubes (Ø 83 mm), are arranged on two of their wings, for the passage of cables or slings. The manufacturing of the part is carried out individually by moulding by means of formwork. The geometry of the part is especially designed to permit the regular and homogeneous concreting of all the areas of the part and the easy deforming.

[0024] The part that is the object of the invention is designed to be placed on mantles with one single layer and in an orderly manner, in such a way, that the parts keep a specific orientation as regards adjacent parts.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

Figures 1a and 1b are general views of the complete block, both from its top and bottom part.

Figures 2a and 2b are general views of % blocks both from their top and bottom part, which are used on the upper and lower part of the rows.

Figure 3 is a view of the block for its geometric definition, both from a top, a bottom and an elevational plan view.

Figure 3a is a cross section on a cutting line A-A of Figure 3

Figure 3b is a cross section on a cutting line B-B of Figure 3

Figure 4 is a view of the placement of the blocks and the connection between them.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0026] With reference to the numbering adopted in the figures, it can be observed how the artificial block proposed by the invention, includes the following characteristical parts in its configuration, that respond to the numerical references as follows:

1.- Central core
2.- Six prismatic arms
3.- Exterior faces for support with the other blocks
4.- Prismatic notches
5.- Interior faces
6.- Hollow frustum of cone

[0027] According to this configuration and constitution, the artificial block recommended by the invention can be used for multiple applications that have been previously described, presenting, as advantageous characteristic, as regards other conventional products, improved performances according to the following point:

- Placement plan design of hexagonal type that increases the number of adjacent parts (6) with which each individual part is coupled.
- High volume of open areas that favour the elimination of sub-pressures reduces the run-up of water on the slope and increases the loss of energy of the wave reflected by turbulence and percolation.
- Major plan occupation of each part that causes reduction of the volume of the concrete.
- Simplicity in the manufacturing process of the part (formworking, concreting, demoulding and curing).
- High surface/volume ratio that favours the elimination of the heat from the hardening with the subsequent reduction of internal stresses of the part.

[0028] From the results of the tests on the physical model obtained in the experimentation canal of the INHA specialized hydraulic laboratory, it can be deduced that its stability versus the action of waves is considerably superior to that of other blocks. As example, in order to resist wave surges of waves with significant height of Hs = 8,10 m, the necessary weights of the blocks, expressed in tons, would be as indicated in the enclosed table:

Block	Required weight (t)
Of the invention	3,15
Dolosse (2 layers)	21,17
Core-loc	21,17
Press Rock	23,62
Accropode	28,23
Stabit	28,23
Tribar	33,87
Hexapod (2 layers)	35,66
Tetrapod (2 layers)	42,34
Antifer (2 layers)	42,41
Cube (2 layers)	45,17

[0029] Since these are the strict tests results, the authors of the invention consider advisable to introduce a safety factor of 2, so as to evade the risks derived from the imperfections of the implementation of the process increasing 200% the necessary weights, or what is equivalent, reducing 66,6% the stability coefficient (K_D of the Hudson formulation) directly obtained from the tests on the model. With this, the weight of the part for resistance of the previous surge of waves shall become 9,45 t.

[0030] In any case, the strong reduction of the necessary weight for obtaining an appropriate strength behav-

iour in comparative terms with other types of artificial blocks, means the use of the blocks of the invention, joined to the high areal unit protected with each block of the invention, implies an important saving of concrete in the construction of the dyke and the possibility of using implementation means of reduced capacity and cost.

[0031] An orientativa index of this advantage of said blocks over the rest of the parts resides in the factor that expresses the necessary volume of concrete to protect an areal unit of the dyke mantle.

[0032] The following Table includes the factor for each one of the parts depending on the height of the significant wave of the wave surge of the project, Hs. With this it can be verified that even with the safety factor introduced, the reduction of the volume of concrete implies the use of the block of the invention.

[0033] Table. Required concrete volume for the protection of the dyke (m^3/m^2) depending on the wave of the project

Block	Concrete volume
Of the invention	0,090 Hs
Core-loc	0,148 Hs
Accropode	0,182 Hs
Tetrapod (2 layers)	0,350 Hs
Cube (2 layers)	0,370 Hs

[0034] Additionally, the block of the invention presents an advantage derived from the reduction of the size and weight of the natural sea-walls that shall constitute the layer on which it seats and in consequence, a greater simplicity of construction since its profiling con be performed with less powerful and costly means of construction.

[0035] From these results it can be deduced that due to its qualities derived from the design of its shape and degree of coupling, the block of the invention presents important improved strengths over other parts developed in the context of the present state of the art and supposes an option that consists in reducing the construction cost of the dykes and river banks.

[0036] The hydraulic behaviour of the mantles formed with the block of the invention, versus the run-up and overflowing of the waves and versus the reflection of their energy, has been verified in the corresponding tests, demonstrating very favourable performances.

[0037] The artificial block is provided with two zones, interior zone (1) and exterior zone that presents six radii (2) of identical dimensions.

[0038] The central core is perforated and forms a hollow frustum of cone construction (6).

[0039] Each one of radii (2) that project from the central cylinder has a prismatoid shape with one of its larger sides joined to the generatrix of the cylinder. The six prismatoids (2) are equal to each other and are arranged forming between them 60° angles, in such a manner, that they form transversal cross sections inscribed in regular hexagons.

[0040] The face of the prismatoid that serves as support to other connecting blocks is (3) and the interior faces (5) and notch (4) are the ones that permit the dissipation of sub-pressures that the hydraulic flow of the waves may generate under the base of the parts, by the bottom granular filter layer.

[0041] The placement of the parts is carried out with one single layer and in a set manner, inter-connecting the part by simple contact meant by the juxtaposition of the exterior faces (3) of wings (2), as can be observed in Figure 4, and with the constructive order indicated from 1 to 20.

[0042] The placement base shall be constituted by a natural sea-wall layer of appropriate weight in each case, to the dimensions of the duly regularized part.

[0043] It must be pointed out, that both in the top and bottom part, and alternately, half blocks are used to configurate the framework of the connection as is indicated in Figure 4.

[0044] The total assembly of parts is arranged according to a slope with numerous gaps due to the exceptional design of each unit.

Claims

1. **Improved artificial block, configurated for orderly one-layered placement for the protection of dykes, river banks and seashores,** which having been designed to reduce the effect of the mass of water that accompanies an affecting wave, and of the dragging force generated by the flow of the mass of water that runs along the side slope in ascending and descending direction and to the extraction forces generated by the pressure gradients between the internal and external zones of the dykes in the facings of the lake, river and sea constructions, is essentially **characterized in that** it is configurated inside a circular shaped block of variable size that maintains the ratio between sides 1,25 (height) / 1,443 (side) for sea environment and of 0.90 (height) and 1,443 (side) for use on banks not exposed to the action of wave surges and that can be broken down into two zones. The interior zone, formed by a central perforated cylinder (1) from which six wings (2) project with prismatoid shape. The exterior construction of the block has the shape of a hexagonal prism.

2. **Improved artificial block, configurated for orderly one-layered placement for the protection of dykes, river banks and seashores,** which, according to Claim 1 is essentially **characterized in that** the central cylinder is perforated and has a frustum of cone (6) construction and each one of the radii (2)

that project from the central cylinder has a prismatoid shape with one of its larger faces joined to the cylinder generatrix. The six prismatoids (2) are equal to each other and are arranged forming between them 60˚ angles in such a manner that transversal cross sections are formed, inscribed in regular hexagons.

3. **Improved artificial block, configurated for orderly one-layered placement for the protection of dykes, river banks and seashores,** which, according to Claims 1 and 2 is **characterized in that** the side of the external prismatoid perimeter that serves as support to other connecting blocks is (3) and the internal faces (5) of the notch (4) are the ones that allow the dissipation of sub-pressures that the hydraulic flow of the waves may generate under the base of the parts, by the lower granular filter layer.

4. **Improved artificial block, configurated for orderly one-layered placement for the protection of dykes, river banks and seashores,** which according to the previous Claims is **characterized in that** the placement for the parts is performed in one single layer and in set manner, inter-connecting the parts by simple contact meant by the juxtaposition of the external faces (3) of the wings (2), as can be observed in Figure 4, and with the constructive order indicated from 1 to 20.

5. **Improved artificial block, configurated for orderly one-layered placement for the protection of dykes, river banks and seashores,** which according to the previous Claims, is **characterized in that** the placement base is made up of a natural sea-wall single layer of appropriate weight in each case, to the dimensions of the duly regularized part.
It must be pointed out that both the top and bottom part, and alternately, half blocks are used to configurate the framework of the connection as is indicated in Figure 4.
The assembly of parts placed form a side slope with numerous gaps due to the exceptional design of each unit.

6. **Improved artificial block, configurated for orderly one-layered placement for the protection of dykes, river banks and seashores,** which according to the previous Claims, is **characterized in that** there exists great structural stability in the constructed dyke, producing attenuation of the extraction forces due to the high permeability and porosity of the protection layer presented by the blocks, and movement strength of the individual parts, both on the side slope plane and in the perpendicular plane, due to the co-actions imposed by adjacent blocks

7. **Improved artificial block, configurated for orderly one-layered placement for the protection of dykes, river banks and seashores,** which according to the previous Claims is **characterized in that** the hydraulic behaviour resides in the low reflection index of the waves, caused because;
the phased difference of the reflected waves is produced due to the time taken by the mass of water of the wave during the ascending and descending process along the side slope; strong percolation of the mass of water between the gaps that form the juxtaposition of the parts and that divert the return current towards the bottom layer, generation of turbulences in the ascending process of the water due to the rough edges of the parts.

8. **Improved artificial block, configurated for orderly one-layered placement for the protection of dykes, river banks and seashores,** which according to the previous Claims is **characterized in that** a favourable behaviour of the dyke exists versus the overflow of the waves, since the progressive energy dissipation in the ascending phase of the wave along the side slope collaborates in decreasing the height of the run-up on the same.

9. **Improved artificial block, configurated for orderly one-layered placement for the protection of dykes, river banks and seashores,** which according to Claims 1 and 2, is **characterized in that** it is constructed in reinforced concrete material, even with another type of appropriate material for exceptional uses or cases of application. The manufacturing of the block is carried out individually by moulding by means of formwork, having also designed the block taking into account, on the one hand, that it may permit the regular and homogenous concreting of all the areas of the part and facilitates the deforming; on the other hand, the aesthetic type of consideration, due to the regularity of the profile, and also to reduce the volume of the concrete material necessary for constructing the protection mantle of the dyke, since the real volume of the part is 58,3% of the apparent in the general structure.

Amended claims under Art. 19.1 PCT

1. Bloque artificial perfeccionado configurado para su colocación ordenada en una capa, para la protección de diques y riberas maritimas y fluviales, que habiendo sido disenado para reducir los efectos del impacto de la masa de agua que acompana a la ola incidente, a las fuerzas de arrastre generadas por los flujos de la masa de agua que recorren el talud en sentido ascendente y descendente y a las fuerzas de extracción generadas por los gradientes de presión entre las zonas interiores y exteriores del dique, en los parámetros de las obras

marítimas lagunares y fluviales, esencialmente se caracteriza, porque está configurado de tal forma que la envolvente exterior del bloque tiene la forma de un prisma hexagonal, donde la zona interior está forma da por un cilindro central-1- perforado, del que parten seis alas (2) con forma de prismatoides, de tamano variable, que mantiene las relaciones entre los lados 1,25 (altura) / 1,443 (lado) para el ámbito marítimo y de 0,90 (altura) y 1,443 (lado), donde el lado está considerado desde el centro de revolución a la cara exterior del prismatoide y la altura es el canto del prismatoide.

2. Bloque artificial perfeccionado configurado para su colocación ordenada en una capa, para la protección de diques y riberas maritimas y fluviales, donde el cilindro central perforado, se caracteriza porque forma un entorno de tronco de cono (6) en su parte central y cada uno de los radios (2) que salen del cilindro central, tiene una forma de prismatoide con una de sus caras mayores unidas a la generatriz del cilindro. Los seis prismatoides (2) son iguales entre si y se disponen formando entre ellos ángulos de 60˚ de modo que se conforman secciones transversales inscritas en hexágonos regulares.

3. Bloque artificial perfeccionado configurado para su colocación ordenada en una capa, para la protección de diques y riberas maritimas y fluviales, que de acuerdo con las reivindicaciones 1 y 2, se caracteriza porque la cara del perímetro exterior del prismatoide que sirve de apoyo a otros bloques en conexión es la (3) y las caras interiores (5) y la entalladura (4) son las que permiten disipar las subpresiones que pueden generar bajo la base de las piezas, el flujo hidráulico de las olas por la capa de filtro granular inferior

4. Bloque artificial perfeccionado configurado para su colocación ordenada en una capa, para la protección de diques y riberas maritimas y fluviales, que de acuerdo con las reivindicaciones anteriores, se caracteriza porque la conexión entre piezas se realiza por simple contacto que supone la yuxtaposición de las caras exteriores (3) de las alas (2).

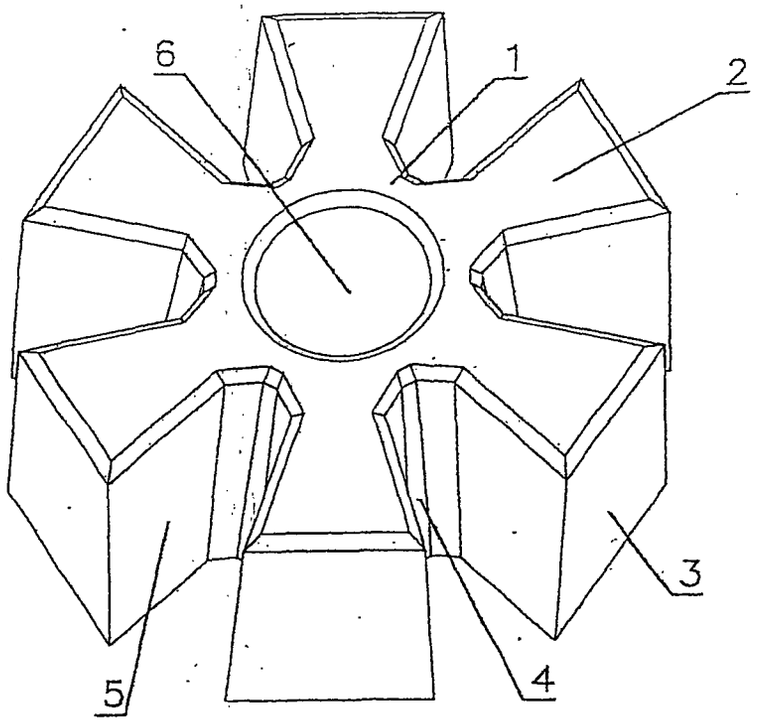
5. Bloque artificial perfeccionado configurado para su colocación ordenada en una capa, para la protección de diques y riberas maritimas y fluviales, que de acuerdo con las reivindicaciones anteriores, se caracteriza porque la base de colocación estará constituida por una capa de escolleras naturales de peso adecuado, en cada caso, a las dimensiones de la pieza debidamente regularizada. Es de destacar que tanto la parte superior como inferior y de forma alternada se utilizan medios bloques para configurar el entramado.
El conjunto de piezas colocadas conforma un talud con numerosos huecos debido al singular diseño de cada unidad.

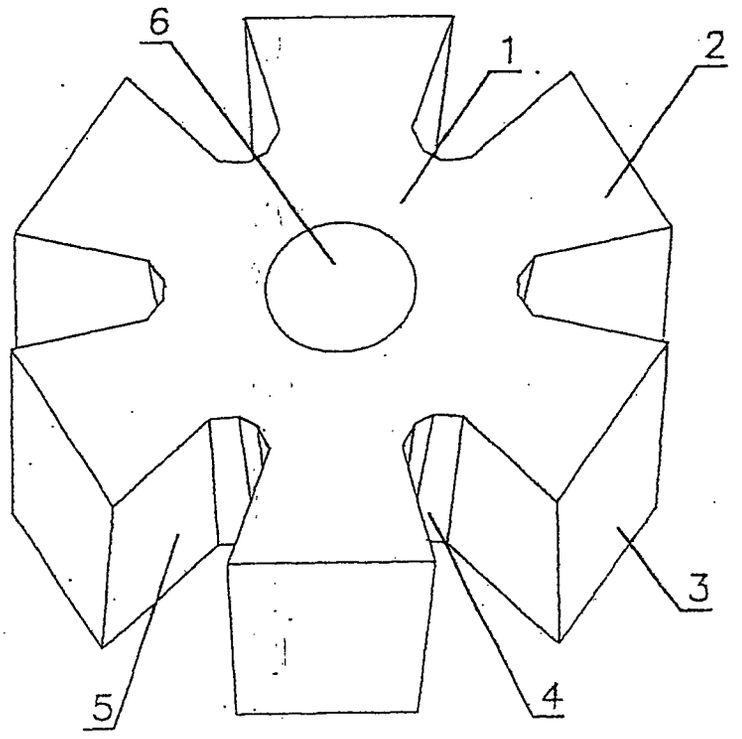
6. Bloque artificial perfeccionado configurado para su colocación ordenada en una capa, para la protección de diques y riberas maritimas y fluviales, que de acuerdo con las reivindicaciones 1 y 2, se caracteriza porque el material empleado en la construcción de la pieza será de hormigón y la fabricación se realiza individualmente por moldeo, mediante encofrado, y desencofrado con facilidad, donde el volumen real de la pieza es del 58,3% del aparente en el conjunto de la estructura.

REIVINDICACIONES MODIFICADAS

[recibidas por la Oficina Internacional el 14 de Diciembre de 2004 (14.12.04);
reivindicaciones originales 1 a 9 reemplazadas por las reivindicaciones modificadas 1 a 7;]

FIGURE 1a





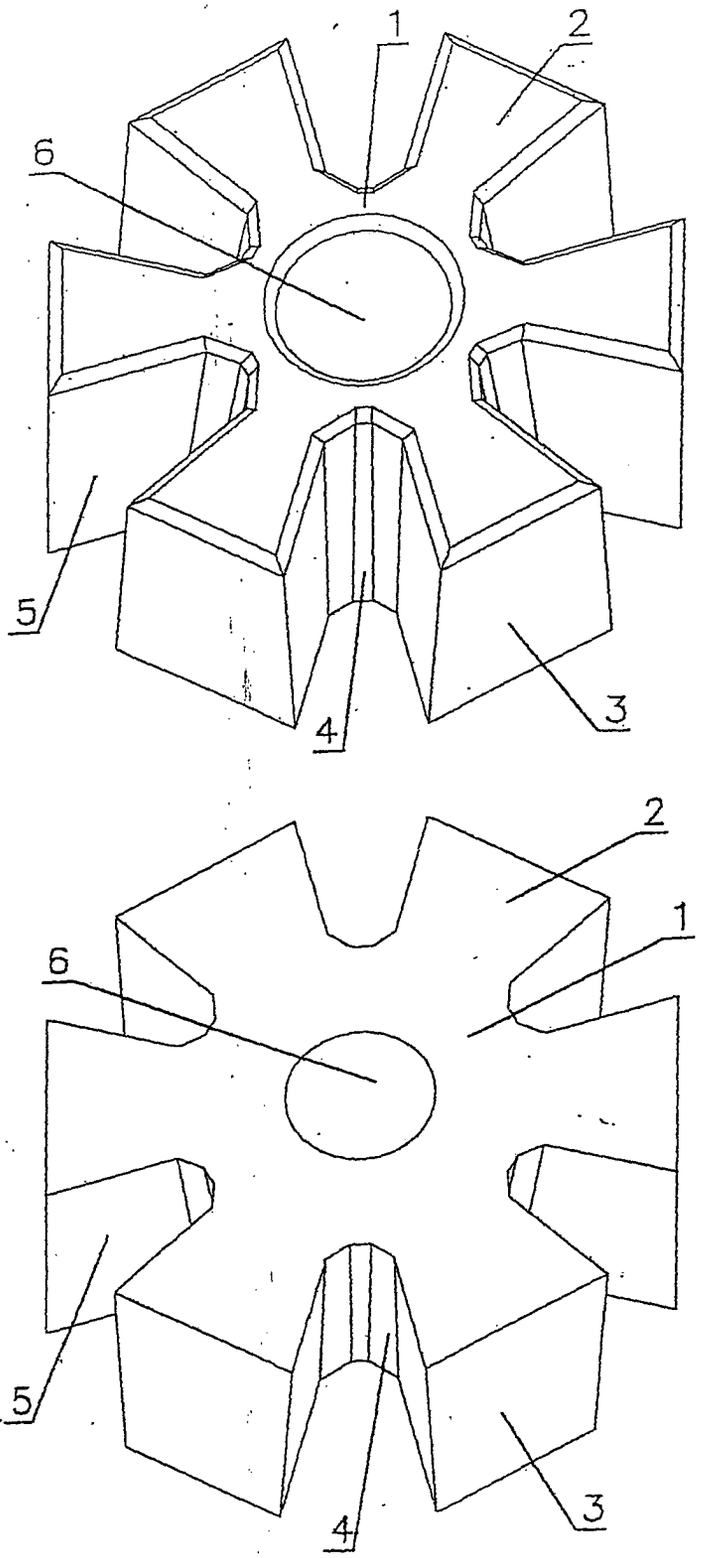


FIGURE 1b

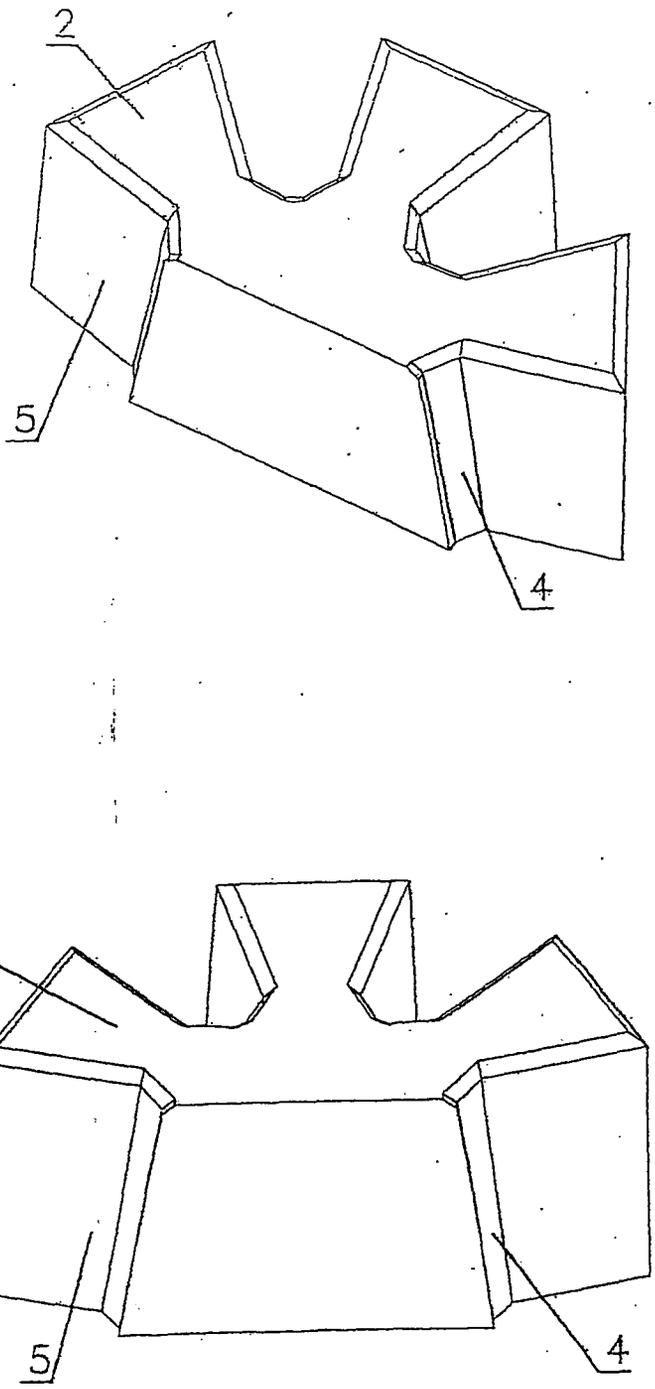


FIGURE 2a

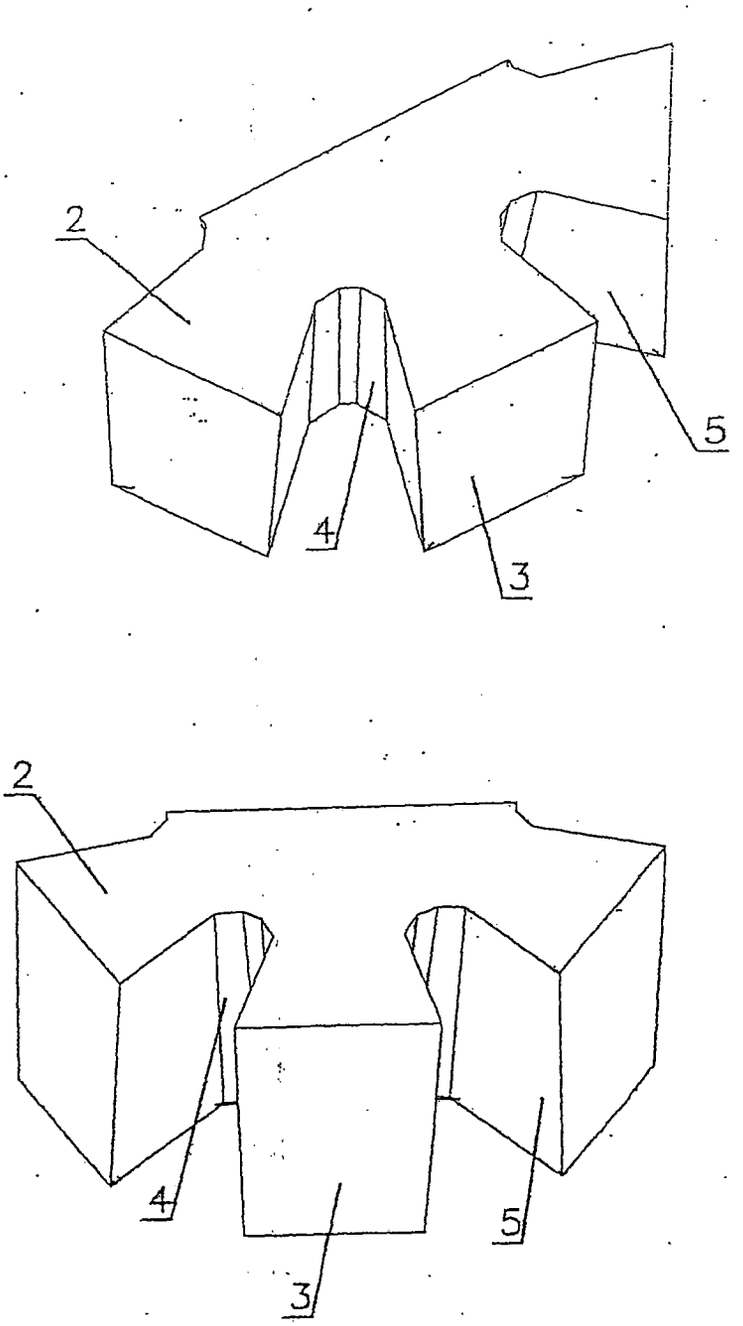


FIGURE 2b

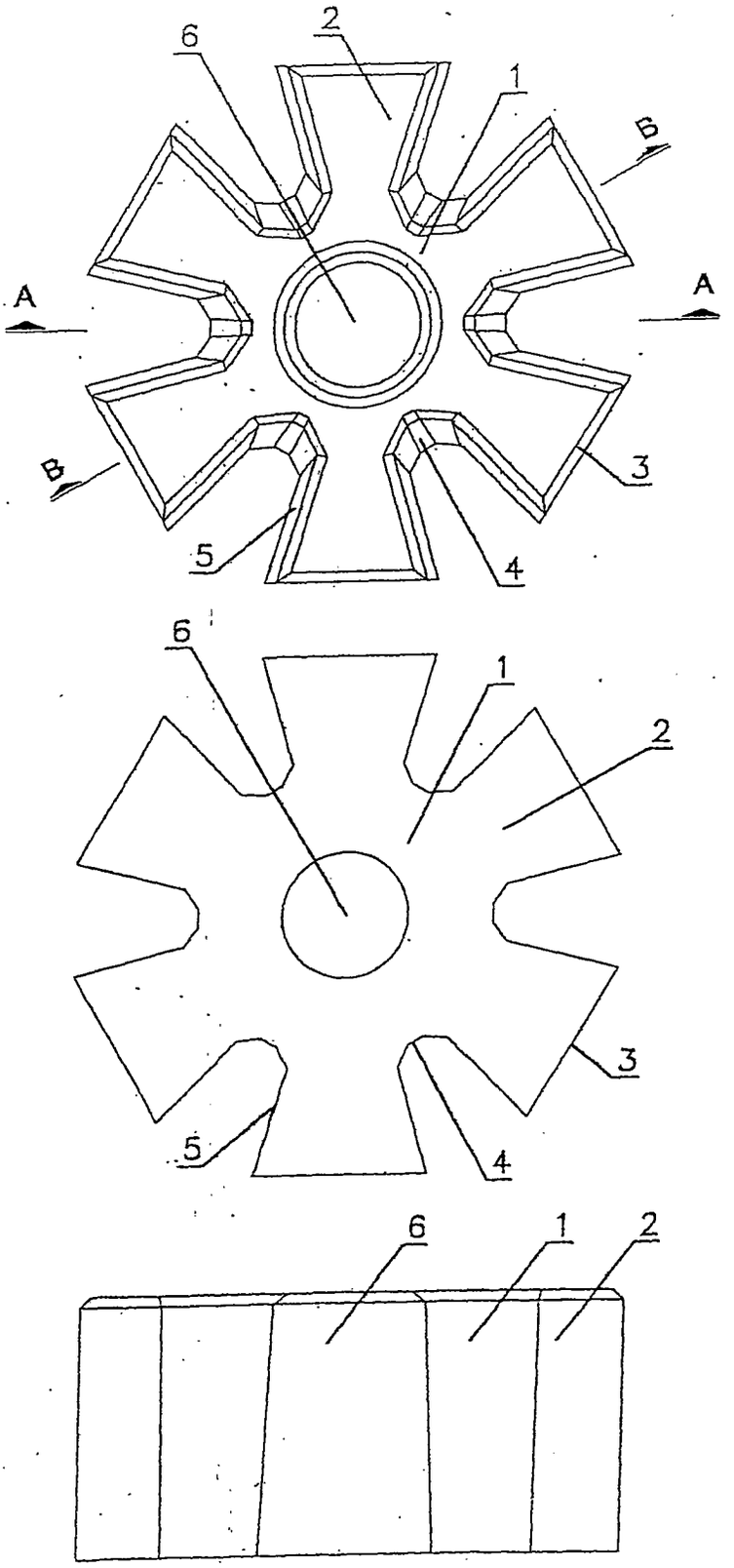
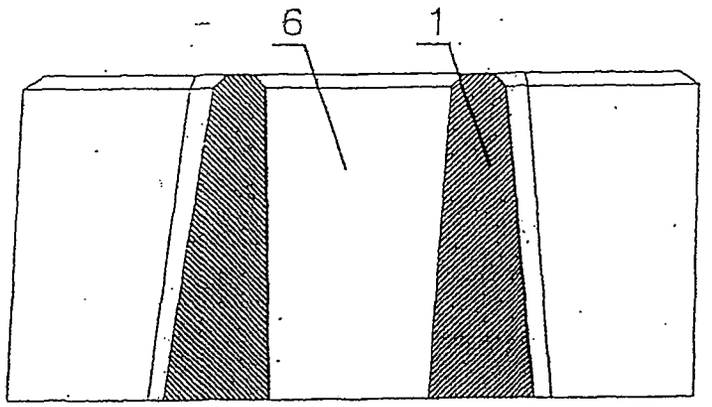
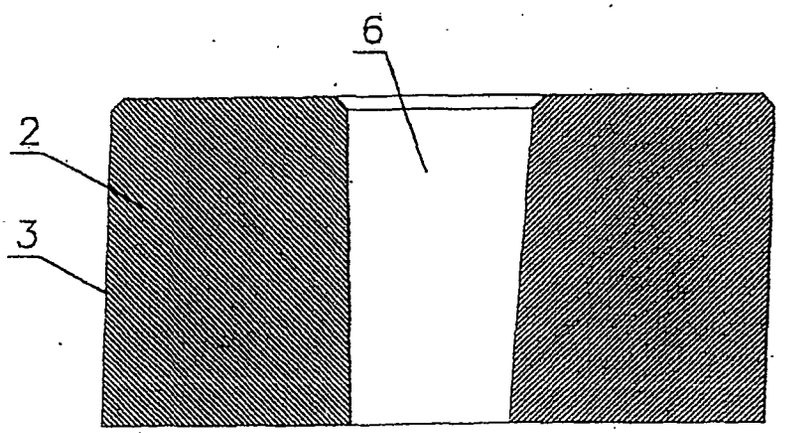


FIGURE 3



SECCIÓN A–A

FIGURE 3a



SECTION B-B

FIGURE 3b

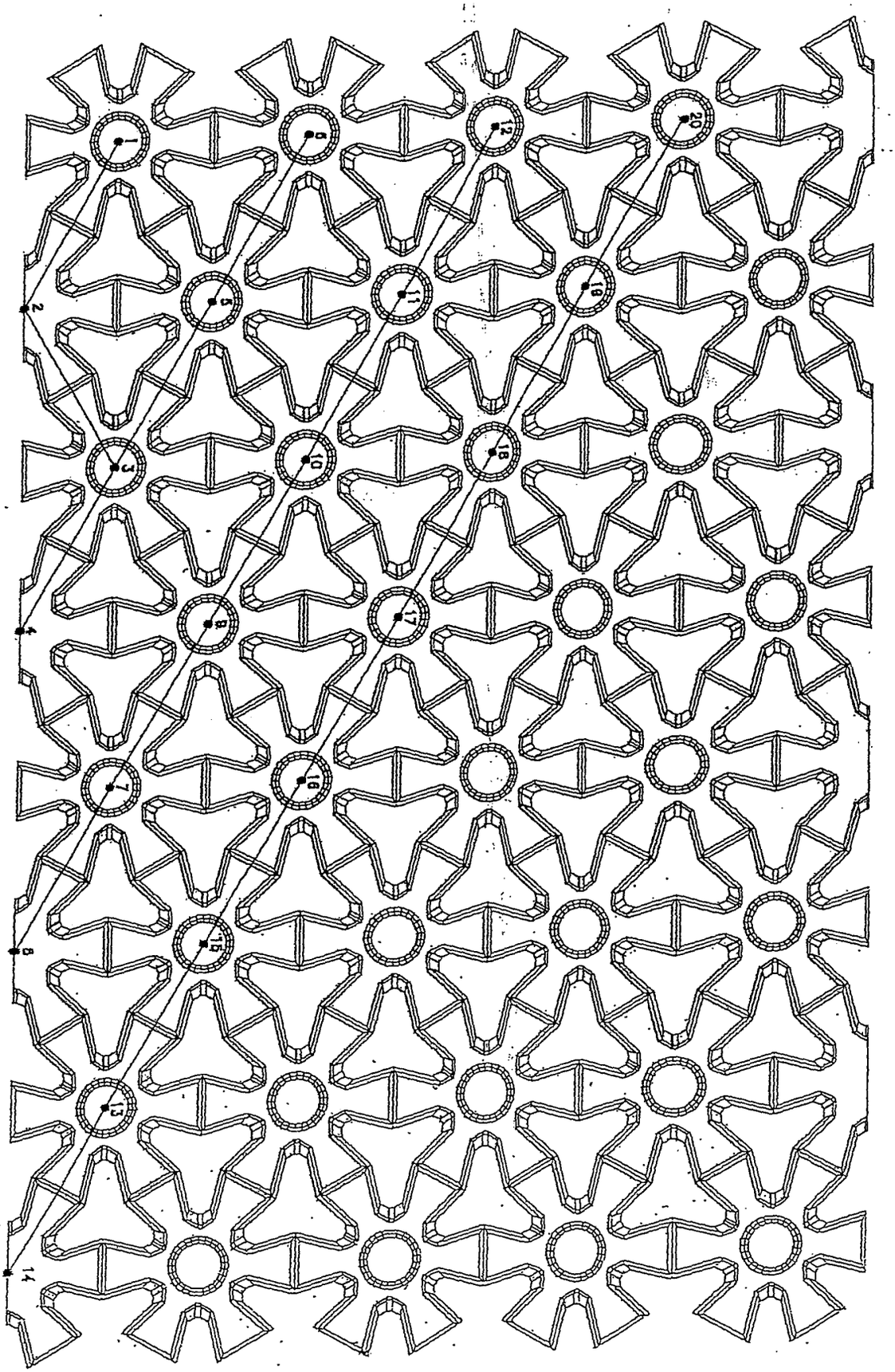


FIGURE 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ ES 2004/000113

A. CLASSIFICATION OF SUBJECT MATTER

IPC [7] E02B3/14
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC [7] E02B3/+; EC: E02B3/+

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CIBEPAT,EPODOC, WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4172680 A (BROWN)30.10.1979, resumen;columna 3 líneas 47-66;figuras.	1-5,9
A	US 6508042 A (KWEON y otros) 21.01.2003; resumen; figuras	1-3
A	US 3096621 A (P.F.DANEL)09.07.1963; Todo el documento	1,2
A	US 5988942 A (ATKINSON) 23.11.1999;columna 3;líneas 19-51; figuras 1,2,4,7,8,17,30.	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 Mayo 2004 (20.05.2004)	02 JUN 2004 02. 06. 2004
Name and mailing address of the ISA/ S.P.T.O.	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

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Information on patent family members

International Application No
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