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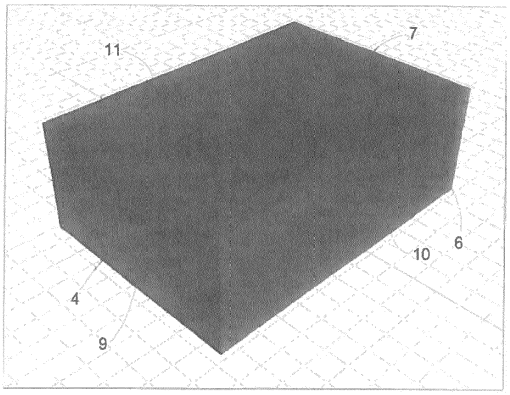
(54) INTERNAL STRUCTURE OF A DEFORMATION BLOCK, DEFORMATION BLOCK AND DEFORMATION SYSTEM

(57) The invention relates to the internal structure of a deformation block especially for exits, bridges, overpasses, driveways and similar structures that are constructed in roadside ditches that serve for draining roads. The invention also relates to a deformation block from which bridges, overpasses, driveways and similar structures for all kinds of roads are built and a deformation system which consists of single deformation blocks.

The subject matter of the internal structure of the deformation block consists in the fact that it consists of at least two rows of cells, wherein the cell axes in the direction of the impact force in the individual rows of cells are mutually offset.

The deformation block for this purpose consists of at least two rows of cells, wherein the cell axes are in different cell rows are mutually offset, and it is provided with a through hole for water drainage.

The deformation system consists of at least two deformation blocks that are arranged in a base shaped piece, a rear edge or a baffle of which are partially deformable so that the internal structure of these deformation blocks is crushed against them.



OBR.11.

FIG. 11

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Description

Technical Field

[0001] The invention relates to an internal structure of a deformation block especially for exits, bridges, overpasses, driveways and similar structures that are constructed in roadside ditches that serve for draining roads. The invention also relates to a deformation block from which bridges, overpasses, driveways and similar structures for all kinds of roads are built and a deformation system which consists of single deformation blocks.

Description of the Prior Art

[0002] Currently, there are separate exits, bridges, overpasses and similar constructions on roads designed as perfectly rigid barriers. In the course of a vehicle crash into a separate exit, no deformation zone of the exit is activated, and direct warping of crush zones of a vehicle takes place. Faces of separate exits are designed as vertical or inclined and are linked by a tube. The faces of separate exits are not systematically protected against a vehicle impact. Up to the present, no comparable technologies are used that could dampen the impact of a vehicle and were "friendly" to the crew of the vehicle, thus allowing a programmable deformation from the acting impact loads, and at the same time to ensure an adequate strength in the vertical direction during passage of vehicles over a separate exit. It causes severe consequences for vehicle crews that for various reasons ditch the car and crash into the structure.

[0003] Contribution in solving this problem can be inserting a certain number of rigid non-deformable ribs into a base shaped piece of the exit, said ribs move aside upon impact and thereby compensate to some extent the consequences of such impact into thus formed structure. But this is a very complex technical solution, technologically difficult to perform and in many cases it is difficult to ensure its reliable long-time operation in difficult conditions.

[0004] Another solution to this technical problem is to avoid a self-collision of a vehicle with a solid construction of the exit, bridge or overpass using crash barriers of different structures and shapes that detour vehicles in front of the exit face. Practice shows that even such costly solutions are not effective enough.

Summary of the Invention

[0005] These drawbacks of the prior art are greatly reduced by means of an internal structure of a deformation block which is an essential structural element especially for transport exits, bridges, overpasses, driveways and similar structures, the principle of which consists in that the internal structure of the block is formed by at least two rows of cells, wherein the cell axes in direction of the shock forces in the individual rows of cells are mutually offset.

[0006] It is preferred that the cells are formed of a brittle concrete, wherein the cross-sectional area of the cell walls is smaller than the inner cell area. In the horizontal cross-section, the individual cells have a square, rectangular or regular hexagonal to octagonal shape, wherein the cross section of cells in adjacent rows can be different. Some walls of the cell cross section may exhibit a convex shape.

[0007] The deformation block for this purpose consists of at least two rows of cells, wherein the cell axes in different cell rows are mutually offset, and it is provided with a through hole for water drainage. The through hole in the deformation block may extend to the bottom of one of the walls of the deformation block.

[0008] Individual deformation blocks are assembled in a deformation system which consists of at least two deformation blocks that are arranged in the base shaped piece, the rear face or baffle of which are partially deformable, so that the internal structure of these deformation blocks is crushed against them.

[0009] The deformation blocks in the deformation system may have different shapes, different sizes or different internal structure.

[0010] The present invention solves the rigidity of all structures in the horizontal plane, namely of exits, bridges, overpasses and driveways while maintaining the rigidity in the vertical direction as well as the water flow so that the impact of a vehicle to this construction causes a gradual reduction of the vehicle speed. When using the internal structure according to the invention, the stiffness of the deformation block in the vertical plane is sufficient for axle loads of passing vehicles. The water passage through the deformation blocks is retained, because the openings in the deformation block are arranged at the very bottom of the deformation block or alternatively in the space above its bottom edge.

[0011] On impact, the internal structure of the deformation block is collapsed in a controlled manner and thereby a gradual deceleration of the vehicle takes place. The internal structure of the deformation block according to the invention effectively dissipates the kinetic energy of the vehicle simply by removing its speed; it means that the kinetic energy of the vehicle is not initially drawn to the deformation of the vehicle crush zones. At the same time, the deformation block has a sufficient stiffness in the vertical direction and is able to transmit loads from the axle loads.

[0012] Given that the internal structure of the deformation block can be made from conventional materials, such as cement, silica flour, fine-grained sand, silica flue dust, plasticizers and water, a low price of deformation blocks is guaranteed. In the case of the use of high performance cement composites, these products are due to their dense microstructure and low porosity nearly impermeable and thus their lifespan is comparable to the life of roads.

[0013] Frost-resistant materials provide resistance of

the deformation block against frost.

[0014] Upon impact, a brittle fracture occurs in the internal structure of the deformation block, thus causing optimal dissipation of the kinetic energy. The geometry of the honeycomb design of the deforming block internal structure may be exactly specified according to the requirements and traffic conditions on particular roads.

[0015] Irreversible changes in the kinetic energy during the vehicle collision take place in the deformation block in three modes. In the first mode, the collapse of individual cells of the internal structure of the deformation block takes place in the flexural tension. The cells in the deformation block have the same resistance and the level of the withdrawn energy is constant in this mode.

[0016] In the second additional mode, the dissipation of kinetic energy causes pushing the destroyed material from already collapsed cells of the inner structure of the deformation block in front of the vehicle itself. While passing through the deformation block, the collapsed material accumulates in front of the vehicle and the resistance against the penetrating vehicle is growing. Withdrawal of the kinetic energy is in this mode is linearly dependent on the depth of penetration of the vehicle into the deformation block.

[0017] In the third mode, the dissipation of kinetic energy of the vehicle causes compressing the collapsing material in the deformation the system against the rear edge of the base shaped piece. The collapsed material from the whole deformation system is pushed to the rear edge of the base shaped piece and further removal of kinetic energy takes place, which in this case is linearly related to the residual kinetic energy of the vehicle. During this mode, the crush zones of the vehicle are initialized.

Brief Description of Drawings

[0018] The invention will be further explained on the basis of the accompanying drawings, wherein Fig. 1 shows the internal structure of the deformation block, wherein the individual cells in a horizontal cross-section have the shape of a rectangle, Fig. 2 shows the internal structure of the deformation block, wherein the individual cells in a horizontal cross-section have the shape of a rhombus, Fig. 3 shows the internal structure of the deformation block, wherein the individual cells in a horizontal cross-section have the shape of an irregular hexahedron, Fig. 4 shows the internal structure of the deformation block, wherein the individual cells in a horizontal cross-section have the shape of another irregular hexahedron, Fig. 5 shows the internal structure of the deformation block, wherein the individual cells in a horizontal cross-section have the shape of an octahedron, Fig. 6 shows the internal structure, wherein the individual cells in a horizontal cross-sectional have in adjacent rows of the shape of a different rectangle, Fig. 7 shows an actual embodiment of the deformation block with cavities in the shape of a rectangle, Fig. 8 shows an actual embodiment of the deformation block with cavities in the shape of a hexahedron, Fig. 9 shows an actual embodiment of the deformation block with cavities in the shape of a rectangle with a through hole, Fig. 10 shows an actual embodiment of the deformation block with cavities in the shape of a hexahedron with a through hole, Fig. 11 shows an actual implementation of the deformation system with a deformation block with a through hole, which is arranged in the base shaped piece with a rear edge, thus forming a half of the structure under the exit, Fig. 12 shows an actual embodiment of the structure under the whole exit, consisting of two deformation systems, Fig. 13 shows a schematic embodiment of the internal structure of the deformation block with arrows that indicate the expected impact of a vehicle with the cells in the shape of a rectangle and square, Fig. 14 shows a schematic embodiment of the internal structure of the deformation block with arrows that indicate the expected impact of a vehicle with the cells in the shape of various hexahedrons, Fig. 15 shows a schematic embodiment of the internal structure of the deformation block with arrows that indicate the expected impact of a vehicle with the cells that have two convex walls, and Fig. 16 shows a schematic embodiment of the cells and a process of their brittle fracture, which is the dominant mode of deformation during the dissipation of the kinetic energy of the vehicle.

Example of Embodiments of the Invention

[0019] The invention relates to the internal structure of a deformation block especially for exits, bridges, overpasses, driveways and similar structures that are constructed in roadside ditches that serve for draining roads. The invention also relates to a deformation block from which bridges, overpasses, driveways and similar structures for all kinds of roads are built and a deformation system which consists of single deformation blocks. On impact of a vehicle into the deformation block, collapses of individual cells occur that gradually draw the kinetic energy of the vehicle to their brittle fracture through reducing its speed only. The rigidity of individual honeycombs and the corresponding deformation stiffness of the whole deformation block are set so that always primarily deformation of the block occurs and not a massive deformation of the vehicle.

[0020] The internal structure of the deformation unit comprises at least two rows 1,2 of cells 3, wherein the axes of the cells 3 in the direction of action of impact forces in the individual rows 1.2 of the cells 3 are offset. The cells 3 are formed of a brittle concrete, wherein the cross sectional area of walls of the cells 3 is smaller than the inner area of the cell 3. The internal structure of the deformation block can also be manufactured from an antifreezing ceramic material or from other materials, the physical properties of which meet the requirements.

[0021] Individual cells 3 have in a horizontal cross-section the shape of a square, rectangle, or a regular or irregular hexagon to octagon, but in term of the essential

requirements under principles of the invention also other shapes of the cells are appropriate. For example, at least one wall of the cross-section of the cell 3 may have a convex shape.

[0022] It is always necessary to observe that the axes of the cells 3 of the deformation block that are parallel to the direction of a vehicle impact, are in the case of square and rectangular cells in the individual rows alternated, thereby ensuring the discontinuity of their walls. This system will lead to a deformation of individual cells of the deformation block in flexural tension.

[0023] The deformation block consists of at least two rows 1,2 of cells 3, wherein the axes of the cells 3 in the adjacent rows 1.2 of cells 3 are offset. In its bottom portion, the deformation block is provided with a through hole 4 for water drainage. It may extend up to the bottom surface 5 of the deformation block or be located above it. The deformation block may be formed of several parts which may have different internal structure, and thus the collapsing of the individual parts of the deformation block can be affected in a controlled manner and thereby gradually decelerate the vehicle.

[0024] The deformation block is made of a quasi-brittle material. On impact of a vehicle into the deformation block, collapsing individual cells occurs, and they gradually draw the kinetic energy of the vehicle to their brittle fracture, by reducing its speed only. The rigidity of individual rows of the cells 3 and the corresponding deformation stiffness of the whole deformation block are set so that always primarily deformation of the block occurs and not a massive deformation of the vehicle.

[0025] According to another embodiment, the deformation block can be designed so that its upper side is closed, which prevents the penetration of foreign objects into a honeycomb structure, which could result in a reduction in the efficiency of the deformation block.

[0026] Thanks to the used material which is high-grade cement composite, it is possible to guarantee a sufficient resistance to freezing and thawing cycles and against chemical de-icing substances, and thus to ensure the life-time comparable to the life-time of land communications.

[0027] The material of the deformation block is frost-proof, wherein the frost resistance is determined after the performance of 50 cycles of freezing and thawing. After performing these cycles, the strength in the three-point flexural tension and compressive strength of the samples are tested.

[0028] The deformation system of the road exit comprising at least one deformation block which is arranged in the base shaped piece 6, the rear edge 7 or the baffle 8 of which are partially deformable. Particularly against the rear face 7 or the baffle 8 of the deformation block the brittle internal structure is crushed as a consequence of an impact, as shown in Fig. 16. The base shaped piece 6 consists of a bottom 9, right and left lateral walls 10,11 and a rear edge 7.

[0029] The deformation system may be composed of several deformation blocks, which may have different shapes or dimensions.

Industrial Applicability

[0030] The internal structure of the deformation block, the quasi-brittle deformation and the deformation system with the controlled design of the internal structure according to the present invention will find application in the field of land communication where there is a need to reduce the risk of injury during traffic accidents.

[0031] The quasi-brittle deformation controlled block design of the internal structure can be applied in the construction of separate exits, as it allows a controlled deformation in the horizontal direction and provides sufficient rigidity in the vertical direction. The deformation block is also programmed so that during a traffic accident a deformation of the sole quasi-brittle block occurs and only afterwards collapsing the crush zones of the vehicle takes place.

List of reference numerals

[0032]

1- first row
2- second row
3 - cell
4 - through hole
5 - bottom surface
6 - base shaped piece
7 - rear edge
8 - baffle
9 - bottom
10 - right side wall
11 - left side wall

Claims

1. An internal structure of a deformation block, especially for transport exits, **characterized in that** it comprises at least two rows (1,2) of cells (3), wherein the axes of the cells (3) in the direction of the impact force in the individual rows / 1.2) cells (3) are offset.

2. The internal structure of a deformation block, especially for transport exits, according to claim 1, **characterized in that** the cells (3) are formed of a brittle concrete, wherein the cross sectional area of the cell (3) walls is smaller than the inner area of the cell (3).

3. The internal structure of a deformation block, especially for transport exits, according to claim 1, **characterized in that** the individual cells (3) have in a horizontal cross-sectional the shape of a square, a rectangular or a regular hexagon to octagon.

4. The internal structure of a deformation block, especially for transport exits, according to claim 1, **characterized in that** the cross-section of cells (3) in adjacent rows (1,2) is different.

5. The internal structure of a deformation block, especially for transport exits, according to claim 1, 2 and 4, **characterized in that** at least one wall of the cross-section of the cell (3) has a convex shape.

6. A deformation block, in particular for transport exits, **characterized in that** it comprises at least two rows (1,2) of cells (3), wherein the axes of the cells (3) in the individual rows (1,2) of the cells (3) are offset, and it is provided with a through hole (4).

7. The deformation block, in particular for transport exits, according to claim 6, **characterized in that** it is formed from several parts having a different internal structure.

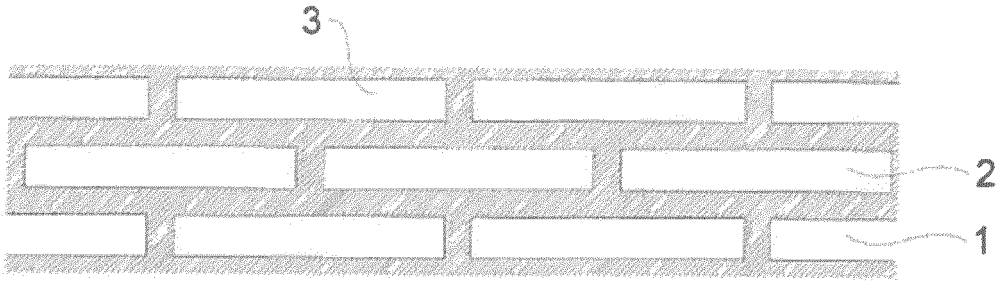
8. The deformation block, in particular for transport exits, according to claim 6, **characterized in that** the through hole (4) extends up to the bottom surface (5) of the deformation block.

9. A deformation system, especially for transport exits, **characterized in that** it comprises at least one deformable block which is arranged in a base shaped piece (6), a rear edge (7) or a baffle (8) of which are partially deformable.

10. The deformation system, especially for transport exits, according to claim 9, **characterized in that** said deformable blocks are of different shapes or sizes.

11. The deformation system, especially for transport exits, according to claim 9, **characterized in that** the base shaped piece (6) comprises a bottom (9), right and left side walls (10,11) and a rear edge (7).

FIG. 1
FIG. 2
FIG. 3



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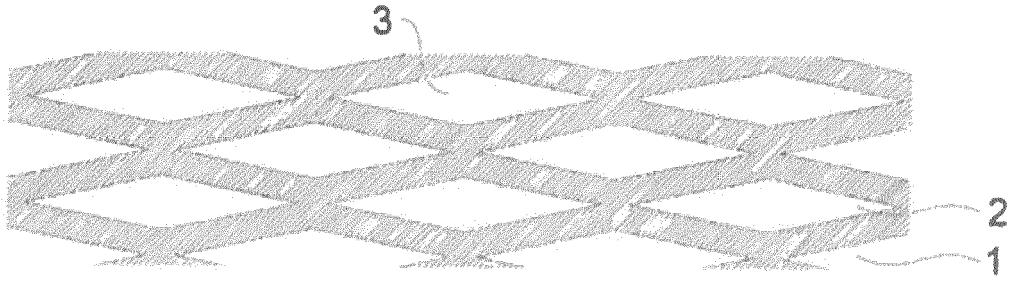

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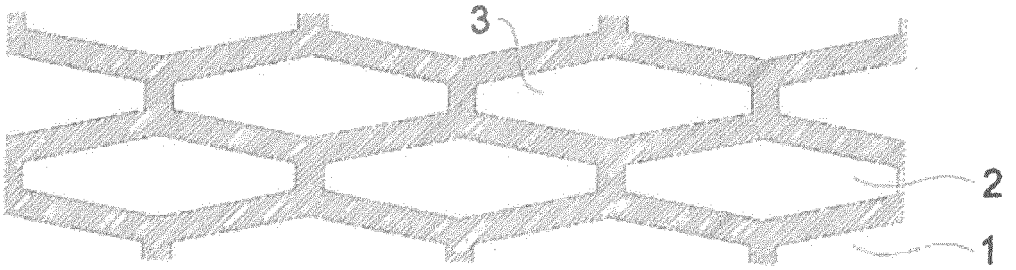
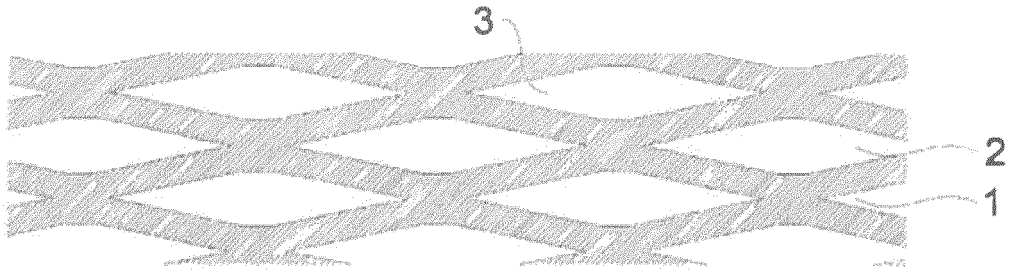


OBR.3.

FIG. 4
FIG. 5
FIG. 6



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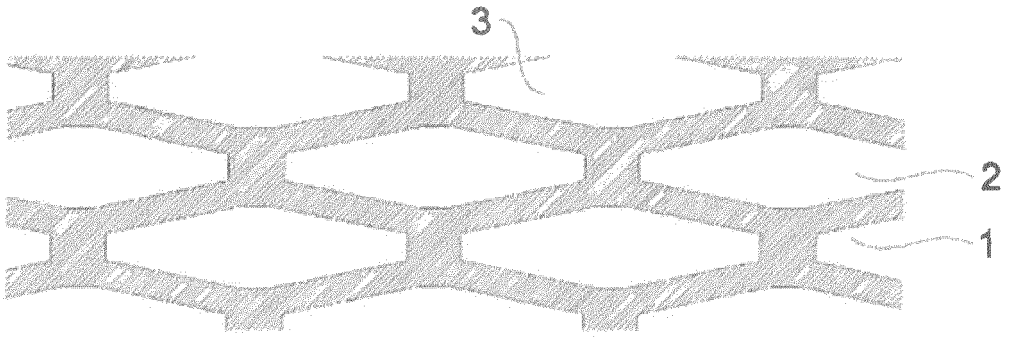

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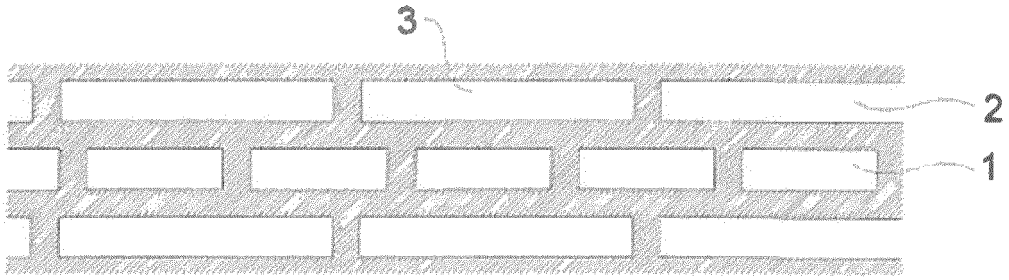

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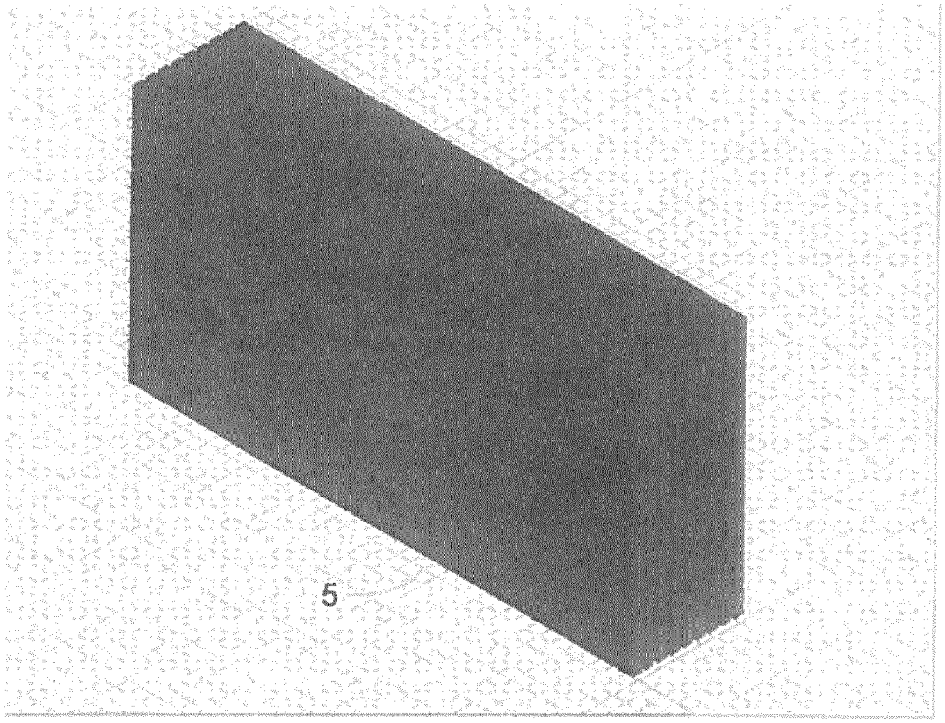
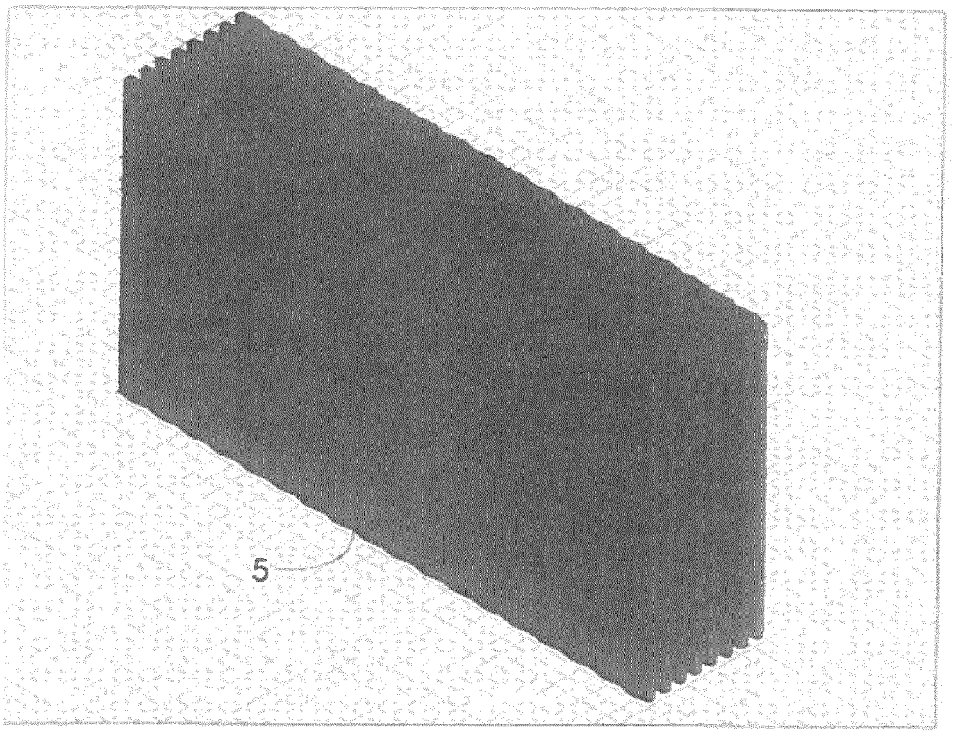


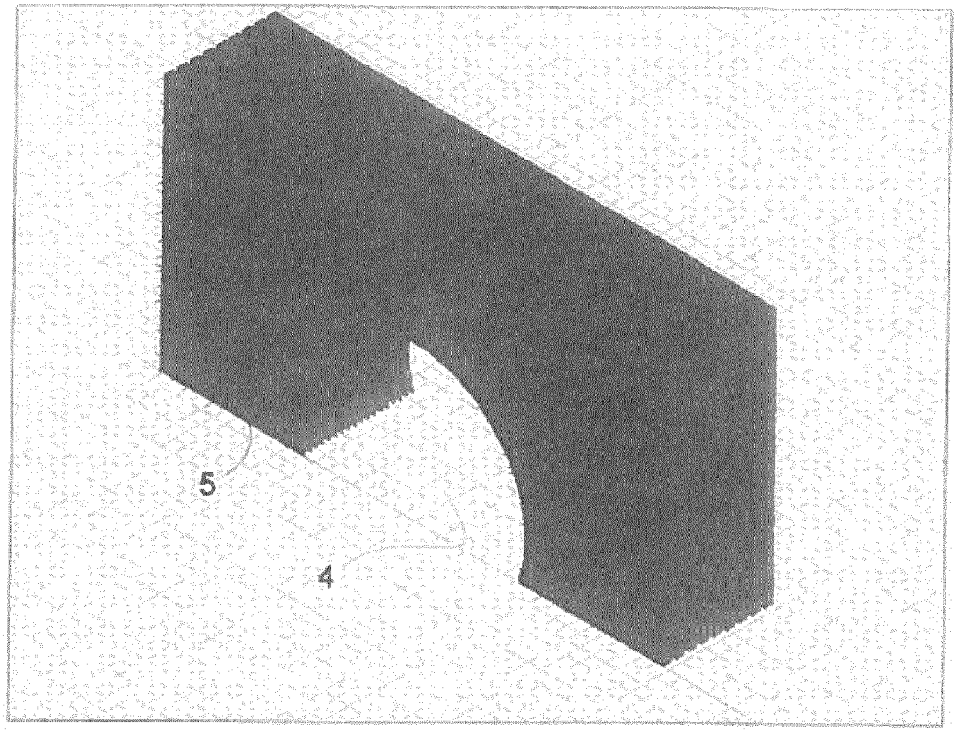
OBR.7

FIG. 7



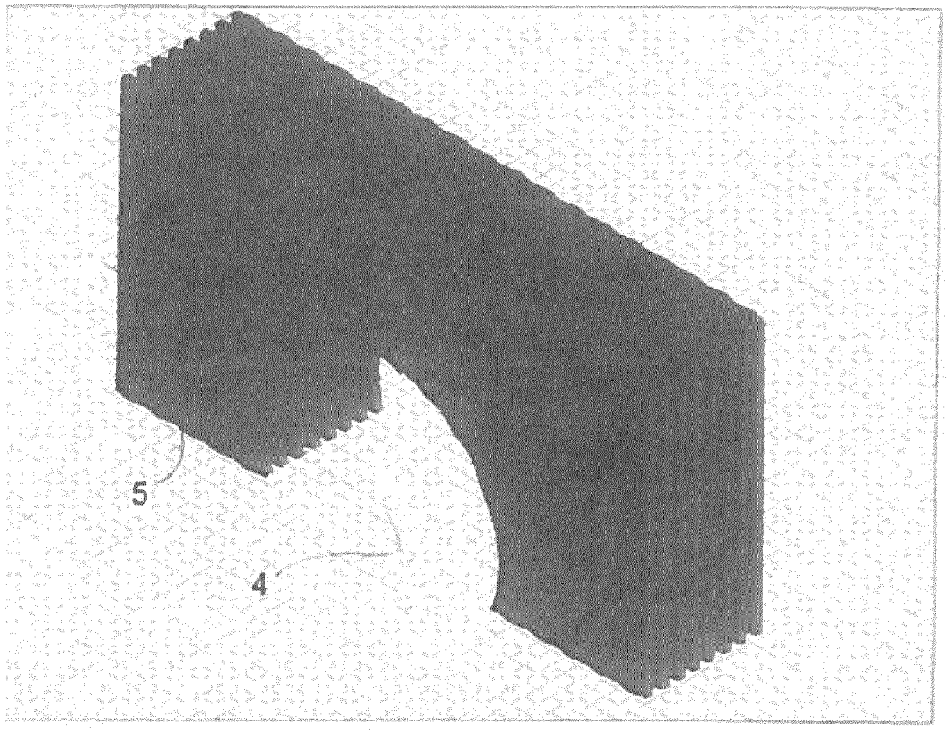
OBR 8

FIG. 8



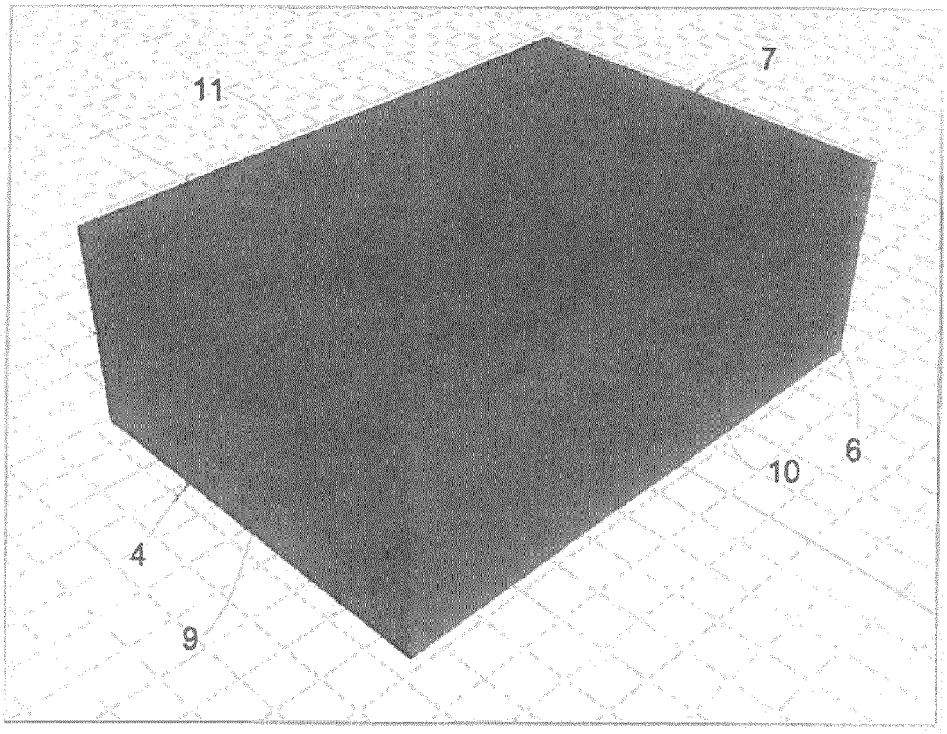
OBR 9.

FIG. 9



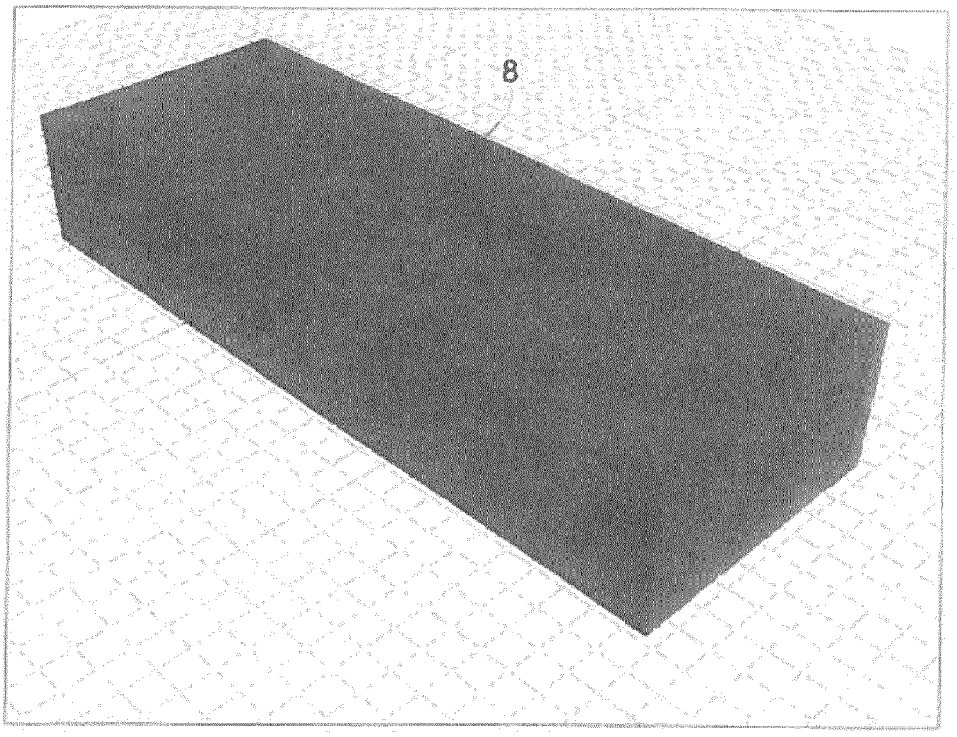
OBR.10.

FIG. 10



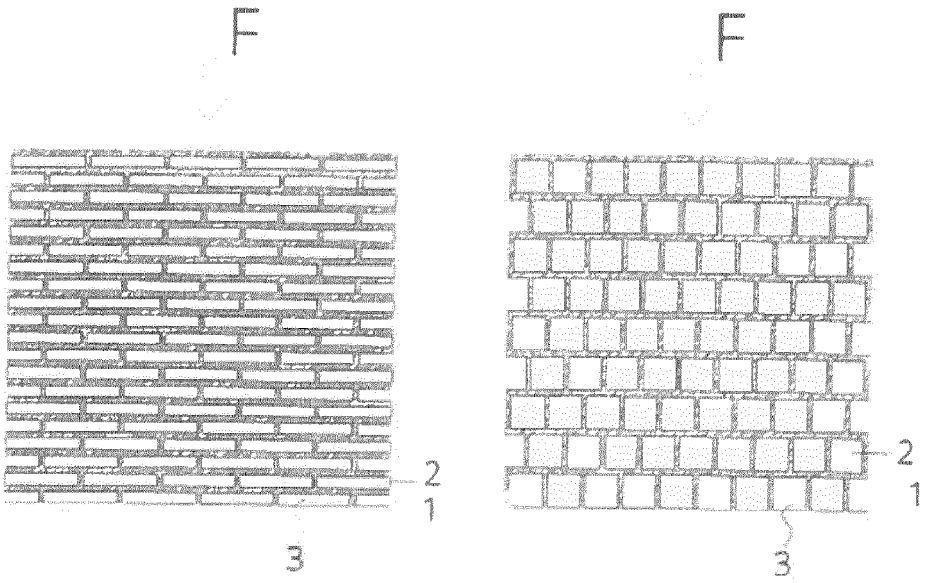
OBR.11.

FIG. 11

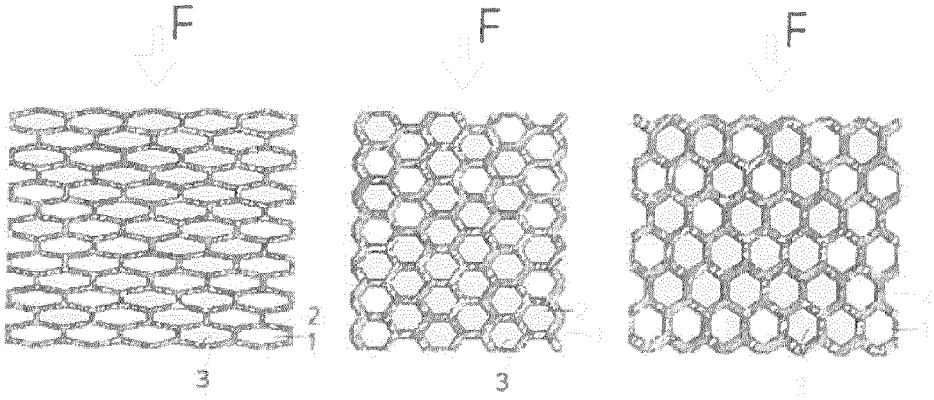


OBR.12.

FIG. 12

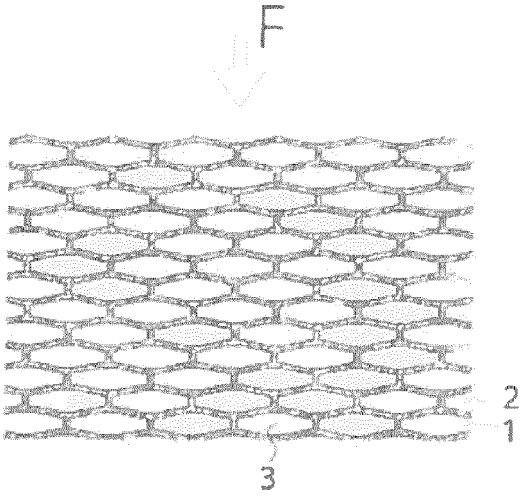


OBR.13.



OBR.14.

FIG. 13
FIG. 14



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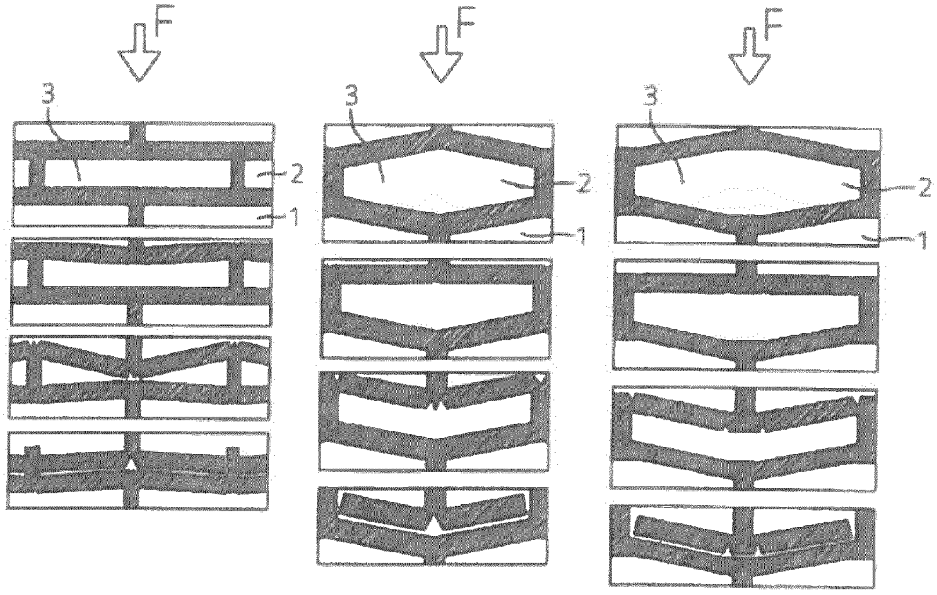

OBR.16.

FIG. 15
FIG. 16

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EUROPEAN SEARCH REPORT

Application Number
EP 15 46 6010

DOCUMENTS CONSIDERED TO BE RELEVANT

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TECHNICAL FIELDS SEARCHED (IPC)
E01F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 October 2016	Flores Hokkanen, P

CATEGORY OF CITED DOCUMENTS

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