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(54) LIQUID DRAINAGE SYSTEM FOR FLAT SURFACES

(57) The object of the invention is a liquid drainage system for flat surfaces, especially roofs, terraces, baths, car parks, designed to drain water or other liquids from the area of the surface, a system comprising at least one rectangular plate (**1**), the lower surface (**4**) of which is substantially flat and the upper surface (**5**) is non-flat, **characterised in that** at points (**A1, A2, A3, ..., An; B1, B2, B3, ..., Bn; C1, C2, C3, ..., Cn**) of the upper surface (**5**) at least at a part of the upper surface (**5**) the inclination of the upper surface (**5**) is smoothly variable.

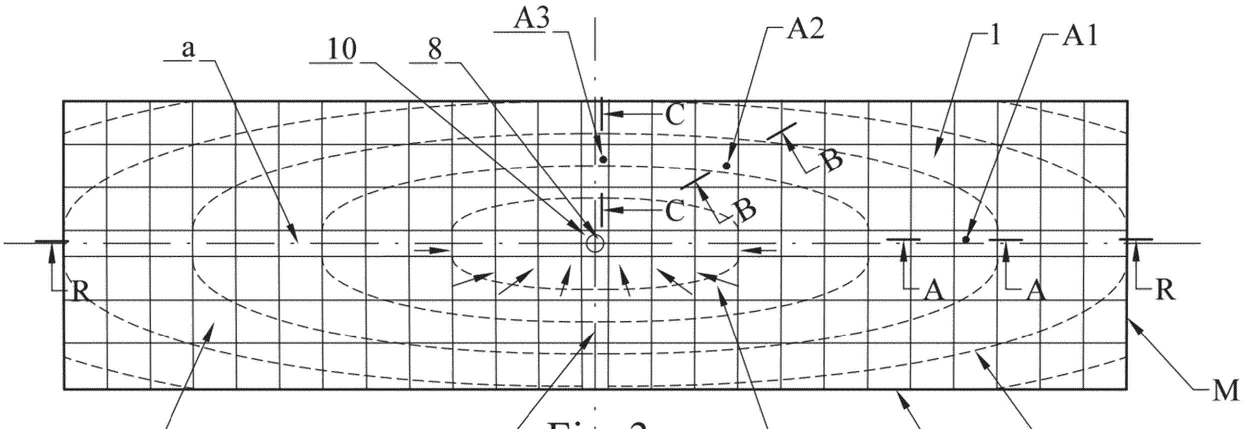


Fig. 3

EP 4 571 011 A1

Description

[0001] The object of the invention is a liquid drainage system for flat surfaces, which can be used to cover a substantially flat, confined surface that is exposed to water, in particular rainwater, other liquids, for example working liquids, where drainage is required.

[0002] The drainage of water or other liquids from an essentially flat surface is an issue that must be considered in the design of houses, garages, outbuildings, car parks, terraces, car washes, baths, etc. In all these cases, a slope must be maintained on the covered surfaces to allow water or other liquid to drain into the drainage channel. Preferably, a minimum slope should be maintained to ensure effective drainage.

[0003] The roofs of houses, garages, workshops and other commercial buildings can be shaped as essentially flat and essentially horizontal, whereby it is usually necessary to ensure that the roofing is sloped to direct rainwater or water from melted snow into drains from where the water flows into the sewer system. The basic requirement is that water ponding does not form. It is usually assumed that the path of falling water or other liquids to the drain should be as short as possible. Geometrically, this condition is fulfilled by surfaces that are sections of a cone with a circular base. With a circular cone, both the shortest path and the same slope conditions are met, but with elongated shaped surfaces, the distance between the drain and the furthest edge point can create problems in roofing design. For example, in the case of an elongated rectangular shaped roof with a drain in the centre, there may be a situation where the maximum heights of the pitch elements at the corners of the roofs exceed the assumed height of the attic surrounding the roof. In addition, the panels used for the roof covering can vary greatly in thickness.

[0004] Solutions are known for elongated roofs in which the flat surfaces at the distant ends are joined to form corner baskets, and further into the centre of the roof the water flows along the joining of the two flat surfaces forming a central gutter. The flowing water is concentrated first in the corner baskets and then in the central gutter. The joints of the roofing materials are also concentrated in these elements, which significantly increases the risk of leaks.

[0005] In the state of the art, roofing systems are known that include slabs that are flat on both sides, whereby the lower and upper surfaces are not parallel and the necessary angle is maintained between the lower and upper surfaces to generate runoff. This may be a system involving prefabricated slabs with a prefabricated pitch, with the slabs laid side by side on a flat surface.

[0006] Patent EP 2852717 discloses a system for covering surfaces in which the covering basin is formed as an inverted cone with a circular base. The surface of the basin has a circular slope, and the radial slope is directed towards the drain and is sloped by exactly the same amount towards the drain point from each point on the top surface of the plate.

[0007] The problem facing roofing manufacturers is to design a liquid drainage system that avoids large differences in roofing edge heights at bathhouse sidewalls, at car park edge slabs, for roofing at attics while maintaining efficient drainage of liquids or water, particularly rainwater. There is a demand for efficient drainage of liquids at the lowest possible cost for the roof covering.

[0008] According to the invention, a system has been developed for drainage liquids, in which the upper surfaces of the plates have an incline that is continuously variable.

[0009] The essence of the invention is a drainage system for flat surfaces, especially roofs, terraces, baths, car parks, designed for drainage of water or other liquids from the area of the surface, a drainage system comprising at least one rectangular plate, the lower surface of which is substantially flat and the upper surface is non-flat. The system is characterised in that at the points on the upper surface at least a part of the upper surface the inclination of the upper surface is smoothly variable.

[0010] The system is characterised by the fact that the upper surface is shaped as a slice of the lateral surface of an elliptical cone, and the points on the upper surface have a slope that varies smoothly from the smallest slope for the longer axis of the cone base to the largest slope for the shorter axis of the cone base.

[0011] The system is characterised by the elliptical cone being a straight cone.

[0012] The system is characterised in that the elliptical cone is an inclined cone. Advantageously, the system also comprises at least one plate whose upper surface is shaped as a slice of a cylinder or the plate is in the form of a wedge.

[0013] Advantageously, the system also includes at least one plate whose top surface is flat.

[0014] The system is characterised by the fact that the top surface of the plate is shaped as a slice of the side surface of a pyramid, the base of which is a rectangle with rounded corners, and the points on the top surface have a slope varying from the smallest slope at the shorter side of the pyramid base to the largest slope on the longer side of the pyramid base.

[0015] The system is characterised by the fact that at least one panel is square.

[0016] Advantageously, the system further comprises a flat plate adapted for or in which a drain hole is made.

[0017] Advantageously, the system comprises at least two plates adapted for making a drain hole or in which a drain hole is made at the junction of these plates.

[0018] The system is characterised by the fact that at least one plate has a mark made on its upper surface to indicate the direction of drainage of water or other liquid.

[0019] The system is characterised by the fact that the sign is in the form of an arrow or arrowhead.

[0020] The system is characterised by the fact that the sign takes the form of a line or strip of variable width.

[0021] The system is characterised by the fact that the sign is located at the side of the board with the smallest thickness.

[0022] By using the drainage system according to the invention, less variation in the height of the roofing connection at the edges of the roofing, in the case of roofing at the parapet, can be achieved. The invention makes it possible to design a run-off surface for surfaces of any polygonal shape with as few drains as possible. The use of straight and inclined elliptical cones allows any location of the drains, whereby the drains can be located both at the sides of the roofing and at the corners of the roofing. The roof covering according to the invention is not material-intensive, the execution of the drain at the side of the roof or in the corner does not entail the need for thick plates. Furthermore, when the roofing system according to the invention is used, there is no concentration of water, which reduces the risk of roofing leaks. The invention is applicable to any substantially flat surface from which water or other liquid has to be drained.

[0023] The proposed solution will also avoid situations (common in current slope shaping solutions) where there is a concentration of run-off water at the joints of waterproofing materials forming a waterproofing barrier (roofing felt, PVC foil and others, EPDM type materials and others). All of these solutions are based on roll materials bonded at the interfaces. Practice shows that leaks (apart from mechanical damage) form at the point where the individual pieces of material are joined. The concentration of joints and water in one place significantly increases the risk of leakage. By avoiding this type of situation, the proposed solution will increase the durability of the waterproofing.

[0024] The invention is described in more detail in the performance examples shown in the drawing, in which

Fig. 1 shows the roof covering from the state of the art for a rectangular roof with one centrally located drain,

Fig. 2 shows a cross-section through the roof covering of Fig. 1,

Fig. 3 shows the roof covering in the first example of a drainage system with a centrally located drain,

Fig. 3a shows the roof covering in the second example of a drainage system with a centrally located drain,

Figs. 4a, 4b, 4c show cross-sections of the roofing panels from Fig. 3,

Fig. 5 shows a cross-section through the roof covering of Fig. 3,

Fig. 5a shows a cross-section through the roof covering from Fig. 3a,

Fig. 6 shows the roof covering in the third example in the implementation of a drainage system with a centrally located drain,

Fig. 7 shows the roof covering in the fourth example of execution with the drain at the long side of the rectangular roof,

Fig. 8 shows the roof covering in the fifth example of execution with two drains at the shorter sides of the rectangular roof,

Fig. 9 shows the roof covering in the sixth example of execution, where the roof covering trough is in the form of an inclined elliptical cone,

Fig. 10 shows the roof covering in the seventh example covering a trough in the form of a sloping elliptical cone,

Fig. 11 shows the roof covering in the eighth example of execution, in which the roof covering basin is in the form of a pyramid with rounded edges,

Figs. 12a, 12b, 12c show cross-sections through the roofing panels of Fig. 11,

Fig. 13 shows the roof covering in the ninth example of execution, in which the roof covering basin is in the form of a sloping pyramid, and

Fig. 14 shows a perspective view of a single plate of the liquid drainage system.

[0025] **Fig. 1** shows a roof covering **100** of rectangular shape, known from the state of the art, in which plates **101** are used which, when laid on the roof, form a basin **102** in the shape of a cone with a circular base. To make the shape of the basin visible, the levels **103** shown by dashed lines are indicated, the levels **103** being circular in shape. The single panel **101** of the roof covering has a bottom surface **104** substantially flat and an upper surface **105** which is formed as a slice of the side surface of a cone with a circular base. The slope of the upper surface **105** of the plate **101,** generally the surface over which rainwater flows, is the same for all plates **101** and is indicated in the cross-section shown in **Fig. 2** as the **y**-angle. In **Fig. 2,** the **T-T** cross-section shows the attic **106** (the wall topping the building) and the side edge **107** of the roofing (the edge of the roofing at the attic), the side edge **107** being parabola-shaped. The height difference between the lowest point **H1** and the highest point **H2** of the side edge **107** of the roof covering **100** is denoted as **d.**

[0026] The liquid drainage system according to the invention makes it possible to develop a covering for roofs, terraces, baths, car parks and any other essentially flat surface. **Fig. 3** shows a roof covering in the first example of implementation on a rectangular roof, in which square plates **1** are used, which together form a basin **2** shaped as the side surface of an elliptical cone, i.e. one whose base is an ellipse. The aforementioned cone is directed with its apex downwards **(Fig. 5),** and the shape of the basin **2** having a central depression is made visible by means of the horizontals **3** shown by dotted lines. The base ellipse has a longer axis a essentially parallel to the longer side **K** of the roof and a shorter axis **b** parallel to the shorter side **M** (the entire axes of the base of the cone are not shown). The cone is a straight cone, i.e. the axis of the cone (at the intersection of axes **a** and **b)** is perpendicular to the base of the cone. The single slab **1** of the roofing has a bottom surface **4** substantially flat and an upper surface **5,** which is formed as a slice of the side surface of an elliptical cone. The slope of the upper surface **5** of the slab **1** is smoothly variable and is shown in the cross-sections shown in **Figs. 4a, 4b, 4c,** the cross-sections being indicated in **Fig. 3** and being positioned so as to show the slope of the upper surface **5** towards the drain, i.e. they are determined by planes passing through the drain or the area at the drain. In the drawing, for the purpose of explaining the invention, greater gradients are shown than are actually used. On cross-section **A-A** shown in **Fig. 4a,** the slope of the roof surface and, at the same time, the slope of the upper surface **5** of plate **1** of the roofing system at point **A1** within the longer axis **a** of the base of the cone and, therefore, of the axis a **of the** basin **2** is indicated by angle α**1** with respect to the horizontal plane, similarly, on cross-section **B-B** at point **A2 (Fig. 4b)** the slope of the upper surface **5** of plate **1** in the area between the longer axis **a** and the shorter axis **b** is indicated by angle **a2,** and on cross-section **C-C** at point **A3 (Fig. 4c)** marks with angle α**3** the inclination of the upper surface **5** of slab **1** within the shorter **b** axis, which is also the b axis of basin **2.** For the cross-sections shown, the inclination relationship can be described as $\alpha 3 > \alpha 2 > \alpha 1$, i.e. the inclination along the longer a axis is the smallest and along the shorter **b** axis the largest, while additional cross-sections through slabs **1** can be determined by showing the inclination for subsequent points up to **An.** The inclination of the upper surface **5** of the plate **1** is smoothly variable around the drain **8,** the plate **1** can be made generally rectangular, the proportions of the lengths of the sides of the plates being individually selected for the covering in each case. The drain **8** is centrally located in the basin **2** on a flat plate **10** (Fig. **3).** In the system according to the invention, a flat plate **10** can be used in which the drain **8** will only be made during the installation of the roofing. Arrows **11** are shown on several of the plates to indicate the direction of drainage of water or other liquid from the basin **2,** and which facilitate the laying of the plates on a roof or other flat surface, the arrows **11** may be replaced by any other indicators/characters i.e. elements indicating the direction of drainage. The actual gradients are small, making it easy to make a mistake, the arrows or other free marks applied to the top surface of the slab serve to verify the correct alignment of the slabs, both during and after laying. A roofer seeing the boards marked with drainage direction marks will easily spot a misplaced board. **Fig. 5** shows a cross-section through the roofing from **Fig. 3,** the cross-section shows attic **6** at the longer side **K** of the roof in cross-section **R-R.** At the parapet **6,** the side edge **7** of the roof covering is visible, with the height difference of the lowest point **G1** and the highest point **G2** of the side edge **7** indicated as **d1.**

[0027] **Fig. 3a** shows a roof covering made analogous to the roof covering of **Fig. 3,** whereby the drain **8** is centrally located at the junction of four adjacent plates **1.** The drain **8** can be located at the junction of two adjacent plates **1,** generally at the junction of at least two plates **1.** The plates **1** can have undercuts made, which together form the drain **8** or undercuts can be made in the plates **1** during assembly. **Fig. 5a** shows a cross-section through the roof covering of **Fig. 3a.**

[0028] In the second example of implementation shown in **Fig. 6,** the roofing basin **2** is formed as the side surface of an elliptical cone, the surface of the roofing basin **2** being divided into four parts **2A, 2B, 2C, 2D** which are sections of an elliptical cone separated by flat surfaces **9** which reach the drain **8.** The plates of the flat top surface **9** may be in the form of a wedge. The surface 9 may be in the form of a slice of a cylindrical surface. The top surface **5** of the roofing plate **1** comprises at least a section of the side surface of an elliptical cone, the slope of the top surface **5** being smoothly variable for points around the drain **8.** The top surface **5** of the roofing plate **1** may comprise a section of both a conical and a flat surface. Rainwater flows down the conical surface or down the flat (possibly cylindrical) surface.

[0029] In the third manufacturing example shown in **Fig. 7,** the basin **2** is formed analogously to the previous manufacturing example, with the drain **8** located at the longer side **K** of the roof. The surface of the basin **2** comprises two parts **2A, 2B** being sections of an elliptical cone separated by a flat surface **9,**

[0030] In the fourth example of execution shown in **Fig. 8,** the roof covering is shaped to form two basins **2, 2'** one behind the other along the longer side **K** of the roof. The roof covering in this example of execution consists of two symmetrical parts which comprise sections of elliptical cones, the shape of the plates **1** being analogous to the previous examples of execution and the plane of symmetry **S** running in the middle of the roof transverse to the longer side **K.** The roof covering is provided with two drains **8, 8'** centrally located with respect to the shorter sides **M.**

[0031] **Fig. 9** shows the roof covering in the fifth example of execution, in which the panels **1** form a basin **2** in the shape of an elliptical cone inclined in such a way that the apex of the cone and the drain are situated in the corner of the roof. The shape of the basin is similarly visualised by means of spirit levels shown with dashed lines. The slope of the roof is smoothly variable, considering the points **B1, B2, B3** the smallest gradient is at **BI**, the greater gradient is at **B2** and the greatest gradient is at

B3.

[0032] **Fig. 10** shows a polygonal roofing with a shape that is a combination of two rectangles. The plates **1** of the roof covering are formed so as to form two basins **2, 2'** having the shape of sloping elliptical pyramids. By using this shape of the basin, we have only two drains **8, 8',** which are situated on one side of the roof and therefore on one side of the building. Any other positioning of the drains is possible, e.g. in corners or in a corner and at the side of the roof.

[0033] **Fig. 11** shows a roof covering of rectangular shape, the plates **1** of the covering together form a basin **2** of pyramidal shape with rounded side edges and the base of this pyramidal shape is a rectangle with rounded corners. The parts of the basin that are the rounded edges of the pyramid are conical surfaces. The aforementioned pyramid is oriented with its apex downwards, centred on the roof surface, and the shape of the basin **2** is made visible by means of the horizontals **3** shown by dashed lines. The pyramid in question is a straight pyramid, where the longer side of the pyramid base is parallel to the longer side **K** and the shorter side of the pyramid base is situated parallel to the shorter side **M,** the drain **8** is centrally situated in the flat plate **10.** In **Fig. 11,** cross-sections situated to show the slope of the surface of the basin and the example plates towards the drain are marked. The figure shows, for clarity, higher gradients than are used in reality. On cross-section **D-D** in **Fig. 12b** the slope of the surface of the covering, i.e. the slope of the upper surface **5** of slab **1** at the shorter side of the roof at point **C1** is marked with angle **01** with respect to the horizontal plane, on cross-section **E-E** in **Fig. 12b** shows the slope of the upper surface **5** of slab **1** at point **C2** within the rounded edge of basin **2,** and on cross-section **F-F** in **Fig. 12c** at point **C3** at the longer side of the roof, the slope is shown at angle **03**. The above cross-sections were determined by planes passing through the drain or the area near the drain. For the cross-sections shown, the slope relationship can be described as β**3**> β**2**> β**1**, with additional cross-sections through slabs **1** showing the slope for other points **Bn.** The slope of the top surface **5** of plate **1** is infinitely variable, plate **1** of the drainage system can be made square or rectangular.

[0034] **Fig. 13** shows a roof covering in which the panels **1** form a basin **2** in the shape of a sloping pyramid such that the apex of the pyramid and the drain **8** are situated at the shorter side **M** of the roof. The shape of the basin is similarly shown using spirit levels. The slope of the roof is smoothly variable.

[0035] **Fig. 14** shows a plate **1** of the system according to the invention, on the upper surface **5** of which a mark in the form of an arrow **11** is applied, the shown slope of the surface **5** being greater than in reality. The walls **12** and **13** of the plate **1** shown in **Fig. 14** are visible, the walls **14** and **15** are invisible. The opposing walls are positioned parallel to each other, wall **12** is parallel to wall **15,** wall **13** is parallel to wall **14.** In the example plate **1,** mark **11** is positioned at the corner of plate **1** formed by walls **12** and **13,** Mark **11** is positioned at the edge where the thickness of plate **1** is smallest. Mark **11** may be in the form of a line or a strip of variable width, for example it may be in the form of a triangle resembling an arrowhead. The mark **11** may be located at any point on the surface **5,** for example centrally. The mark **11** defines the orientation of the slab **1** with respect to the drain **8** of the roofing, the marks **11** on the finished roofing slabs are oriented towards the drain **8.** The mark **11** simultaneously defines the orientation of the slab **1** in the roofing and shows the direction of the liquid flowing down the roofing. In the roofing fabrication examples discussed above, large arrows **11** with a length close to the overall dimensions of slab **1** are shown for the legibility of the drawing; in practice, smaller marks may be used.

[0036] The application of the drainage system, generally of liquids in the above implementation examples is referred to the roof covering, nevertheless the drainage system according to the invention can be applied to the shaping of the surface of a car park, bath house, terrace etc.

Claims

1. The drainage system for flat surfaces, especially roofs, terraces, baths, car parks, designed for drainage of water or other liquids from the area of the surface, wherein a system comprising at least one rectangular plate **(1),** the lower surface **(4)** of which is substantially flat and the upper surface **(5)** is non-flat, **characterised in that** at the points **(A1, A2, A3,** ..., **An; B1, B2, B3,** ..., **Bn; C1, C2, C3,** ..., **Cn)** on the upper surface **(5)** at least on a part of the upper surface (5) the inclination of the upper surface **(5)** is smoothly variable.

2. The system according to claim 1, **characterized in that** the upper surface **(5)** is shaped as a slice of the lateral surface of an elliptical cone, and the points **(A1, A2, A3, ..., An; B1, B2, B3, ..., Bn; C1, C2, C3, ..., Cn)** on the upper surface **(5)** have an inclination smoothly varying from the smallest inclination for the longer axis **(a)** of the cone base to the largest inclination for the shorter axis (b) of the cone base.

3. The system according to claim 2, **characterised in that** the elliptical cone is a straight cone.

4. The system according to claim 2, **characterised in that** the elliptical cone is an inclined cone.

5. The system according to any one of claims 2 to 4, **characterised in that** the system also comprises at least one plate **(9),** the upper surface **(5)** of which is shaped as a cylinder section or the plate is wedge-shaped.

6. The system according to any one of claims 2 to 4, **characterised in that** it also comprises at least one plate, the upper surface **(5)** of which is flat.

7. The system according to claim 1, **characterised in that** the upper surface **(5)** of the plate **(1)** is shaped as a slice of the side surface of a pyramid, the base of which is a rectangle with rounded corners, and the points on the upper surface **(5)** have a slope varying from the smallest slope at the shorter side of the pyramid base to the largest slope at the longer side of the pyramid base.

8. The system according to any one of claims 1 to 7, **characterised in that** at least one plate **(1)** is square.

9. The system according to any one of claims 1 to 8, **characterised in that** system further comprises a flat plate (10) adapted for or in which a drain hole **(8)** is provided.

10. The system according to any one of claims 1 to 8, **characterised in that** system comprises at least two plates (1) adapted to provide a drain hole **(8)** or in which a drain hole **(8)** is provided at an interface between said plates.

11. The system according to any one of claims 1 to 10, **characterised in that** at least one plate **(1)** has a mark **(11)** made on the upper surface (5) to indicate the direction of drainage of water or other liquid.

12. The system according to claim 11, **characterised in that** the mark **(11)** is in the form of an arrow or arrowhead.

13. The system according to claim 11, **characterised in that** the mark **(11)** is in the form of a line or strip of variable width.

14. The system according to claim 11 or 13, **characterised in that** the mark **(11)** is located at the side of the plate **(1)** with the smallest thickness.

PRIOR ART

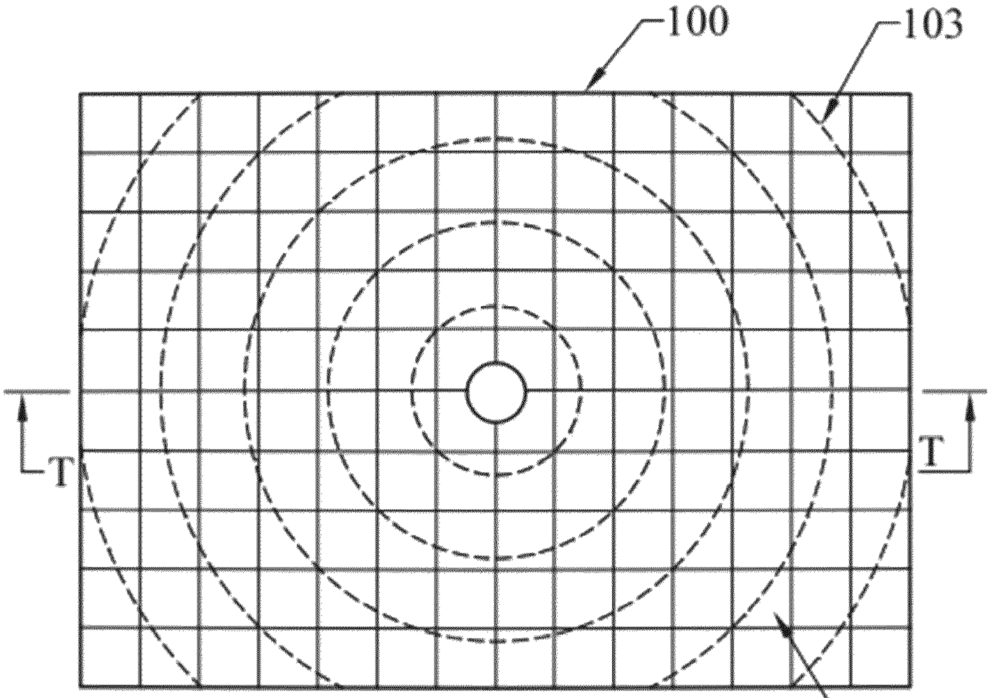


Fig. 1

T - T

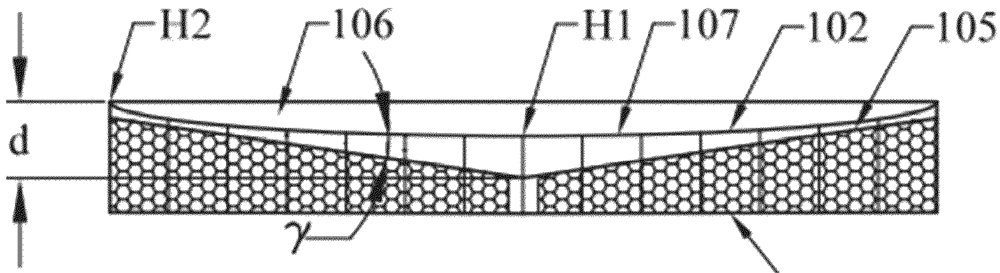


Fig. 2

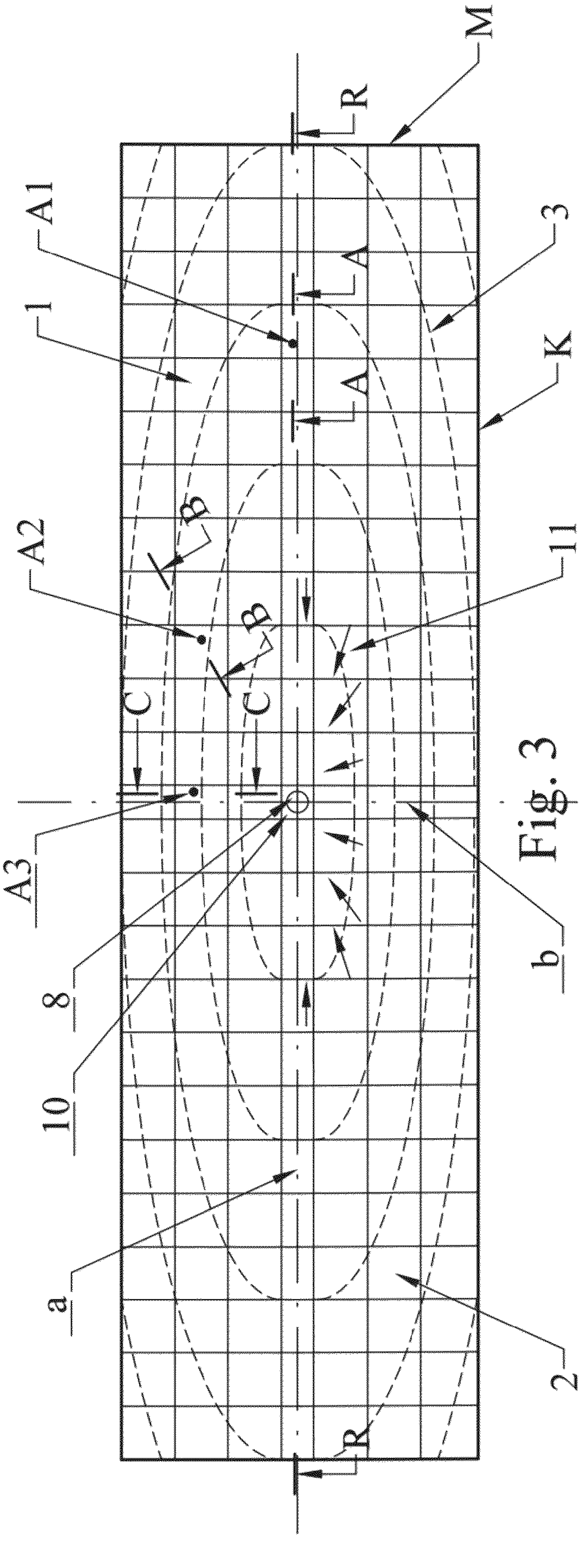
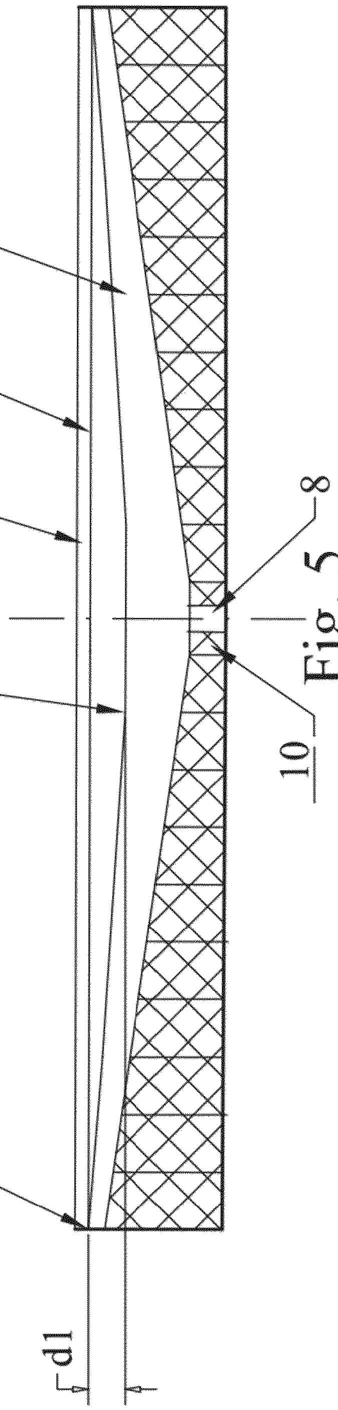


Fig. 3



R - R

Fig. 5

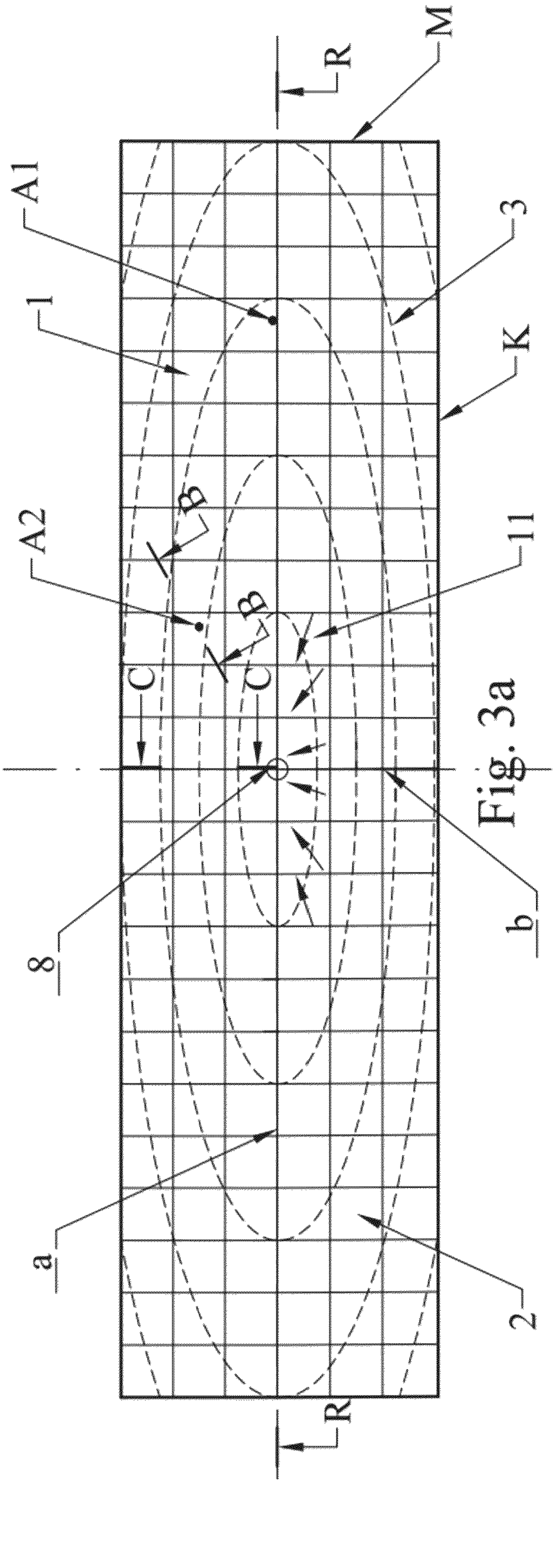


Fig. 3a

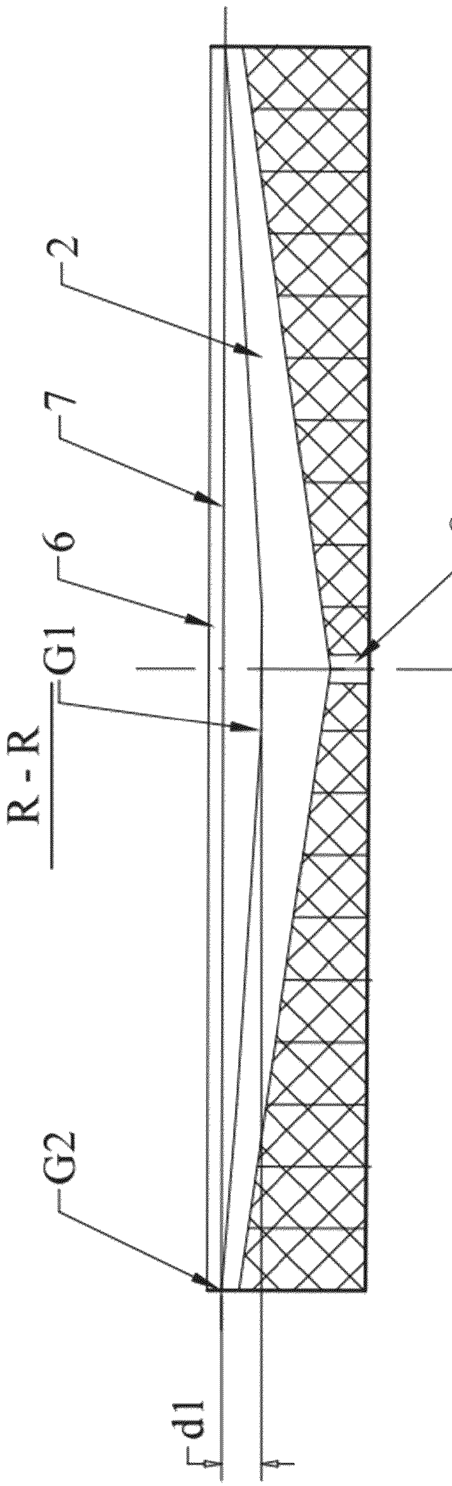


Fig. 5a

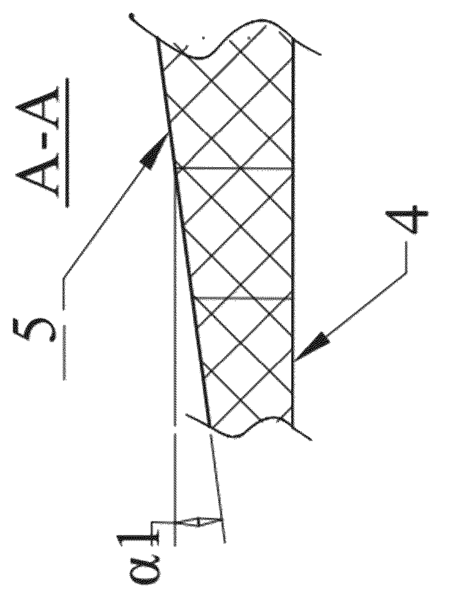


Fig. 4a

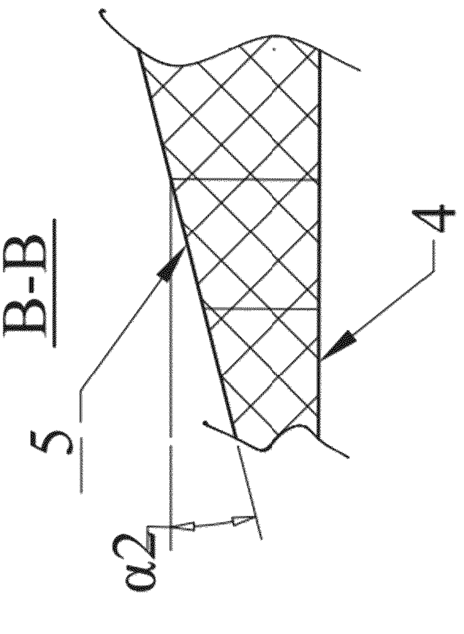


Fig. 4b

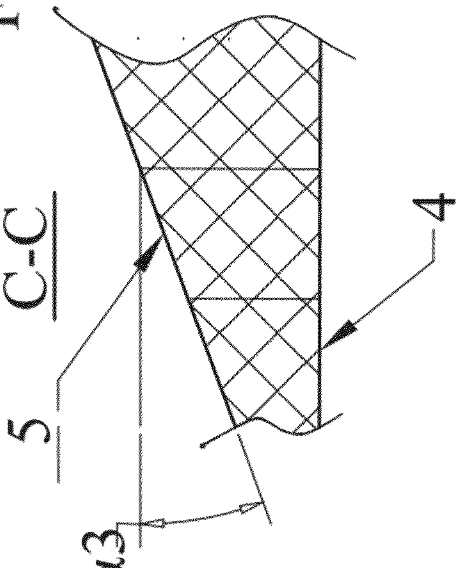


Fig. 4c

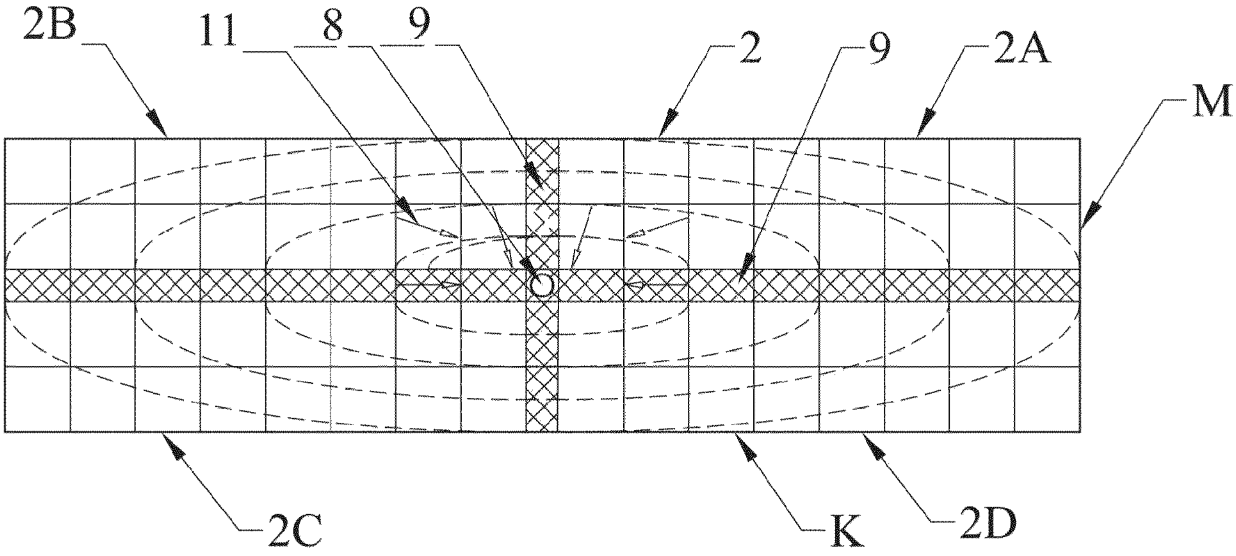


Fig. 6

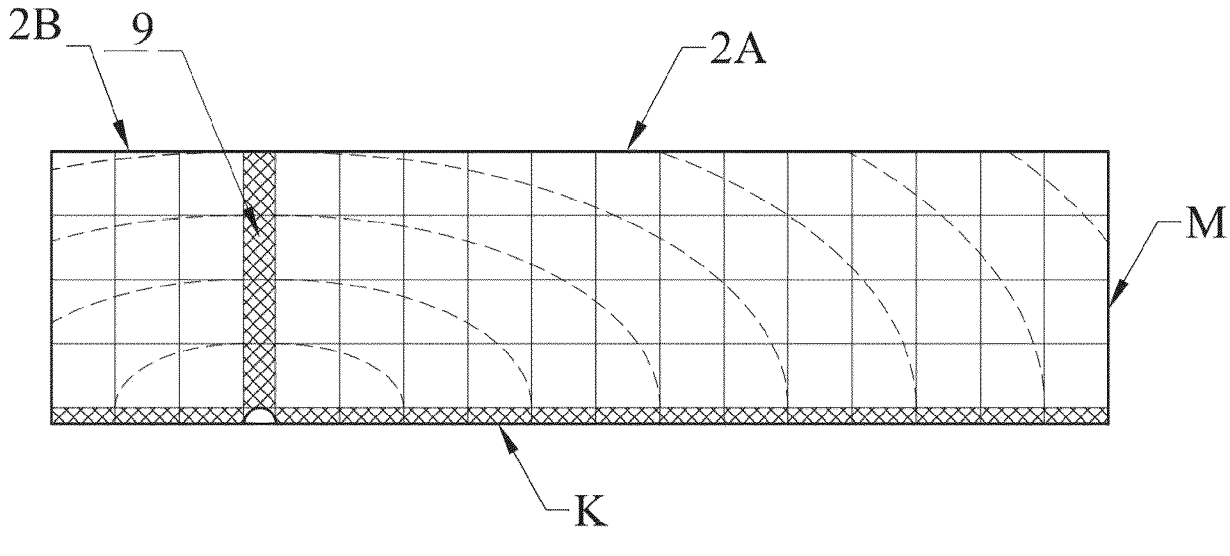


Fig. 7

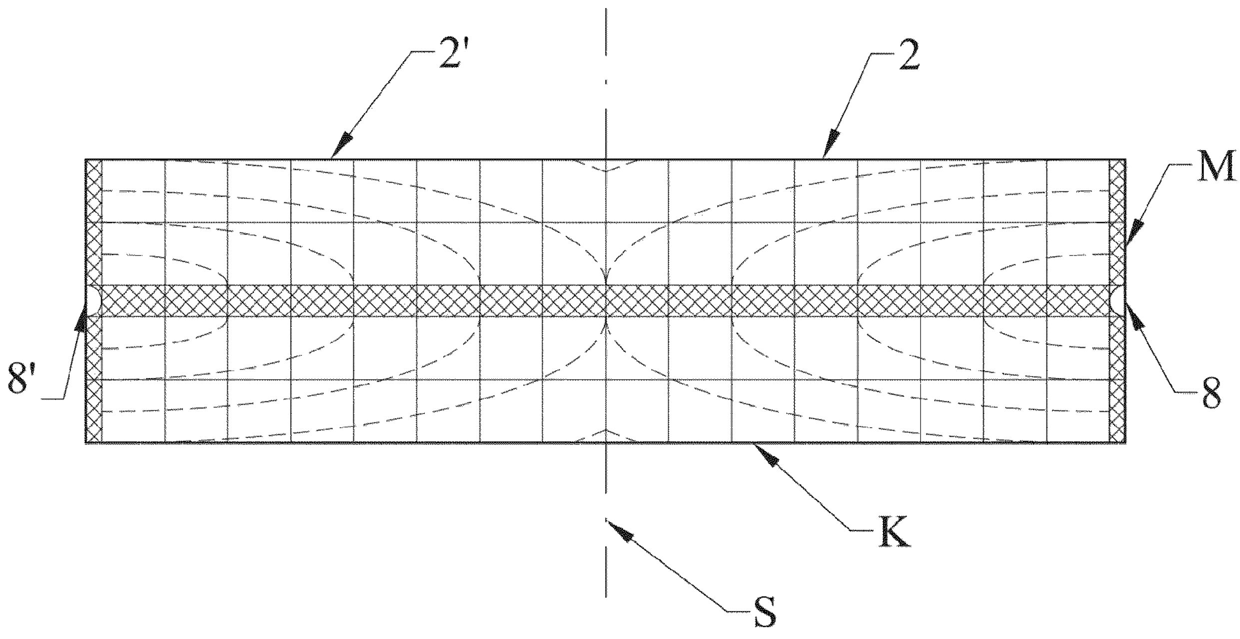


Fig. 8

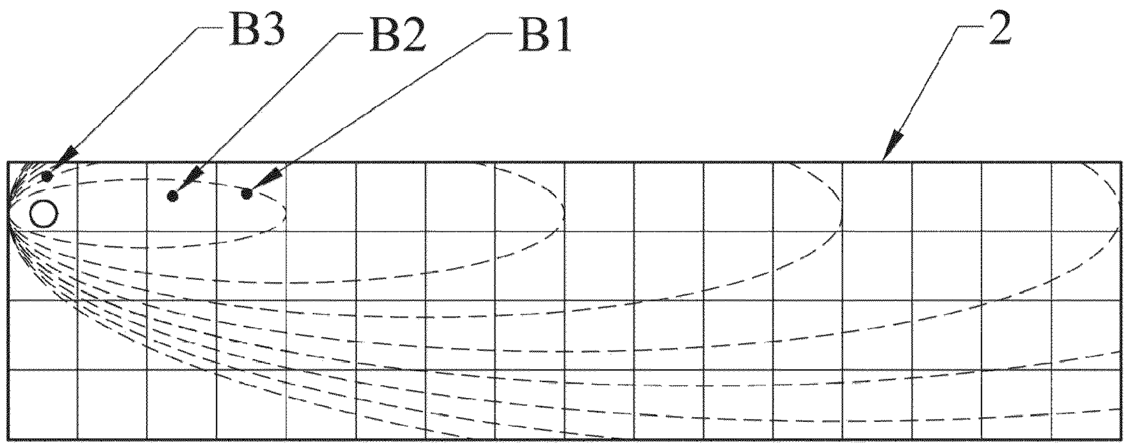


Fig. 9

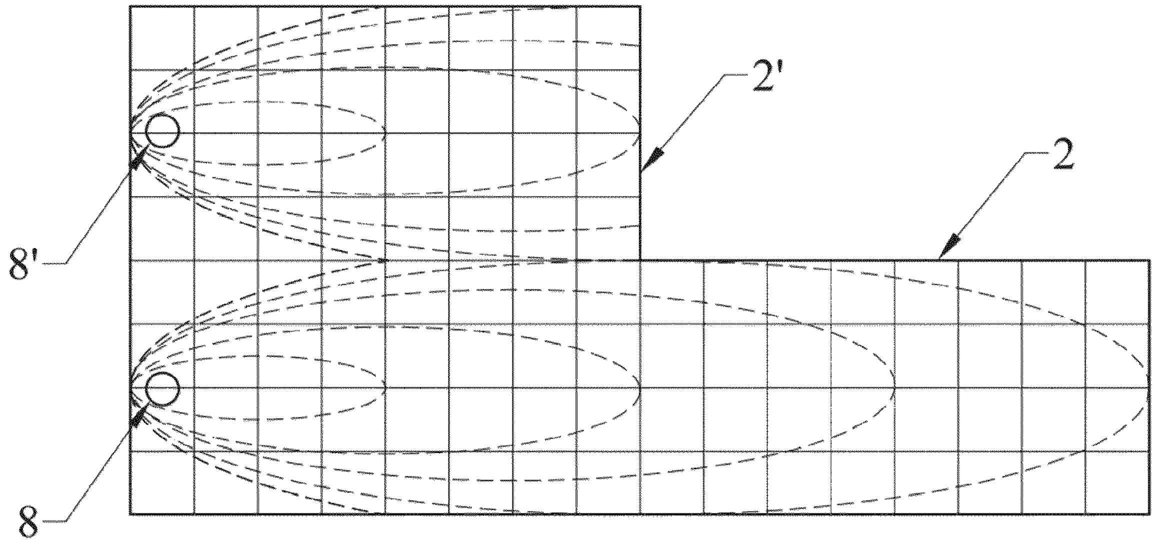


Fig. 10

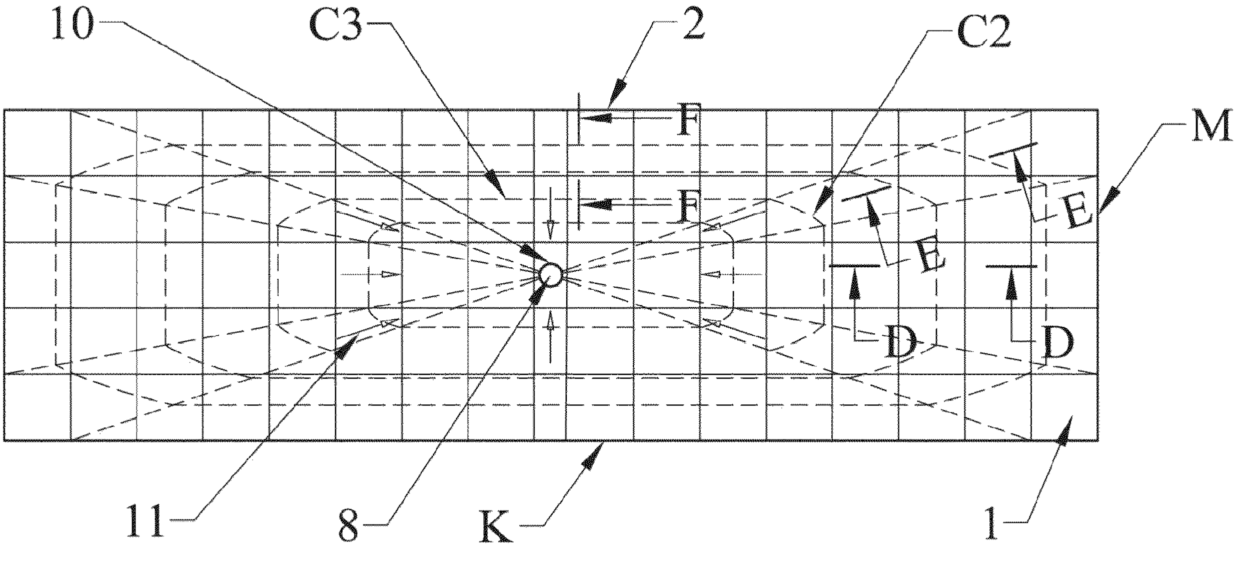


Fig. 11

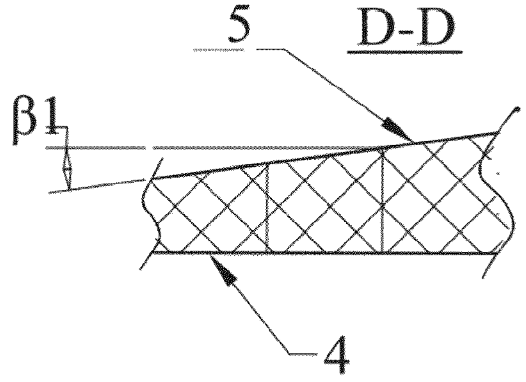


Fig. 12a

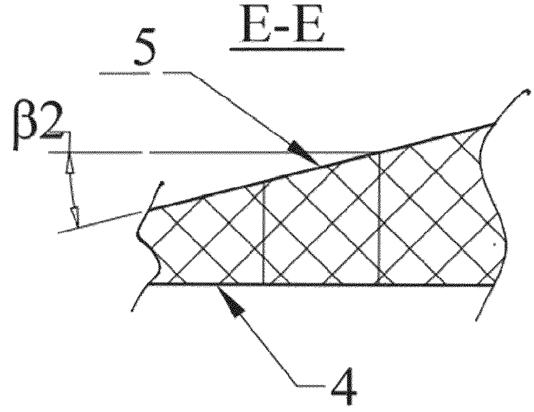


Fig. 12b

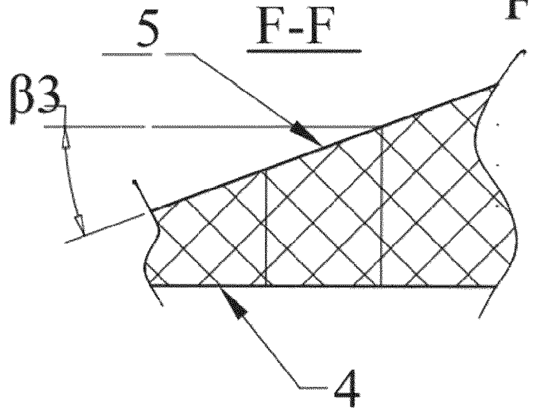


Fig. 12c

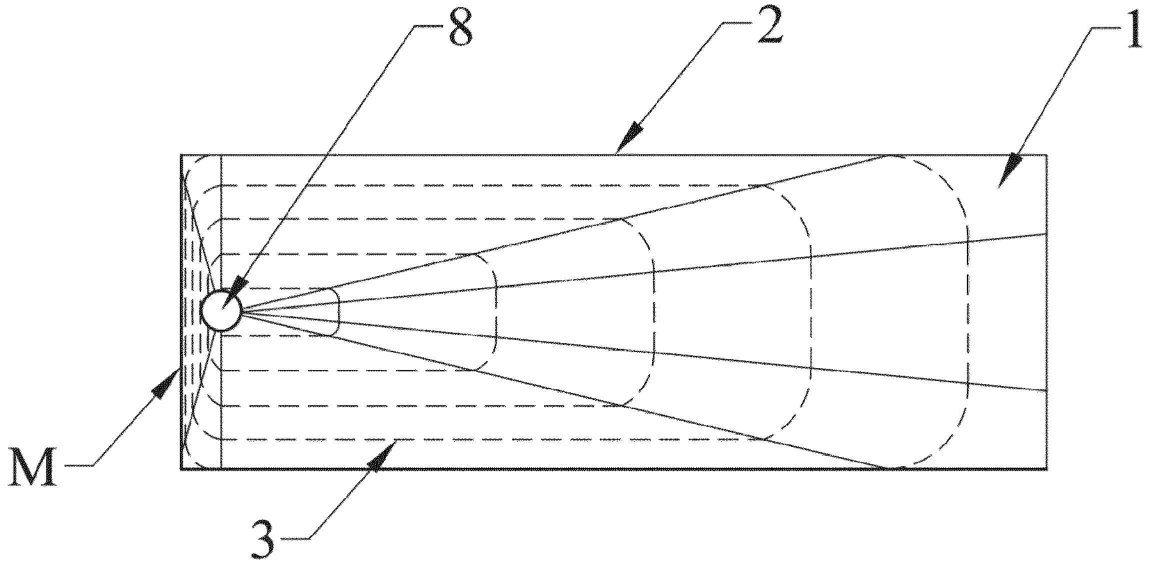


Fig. 13

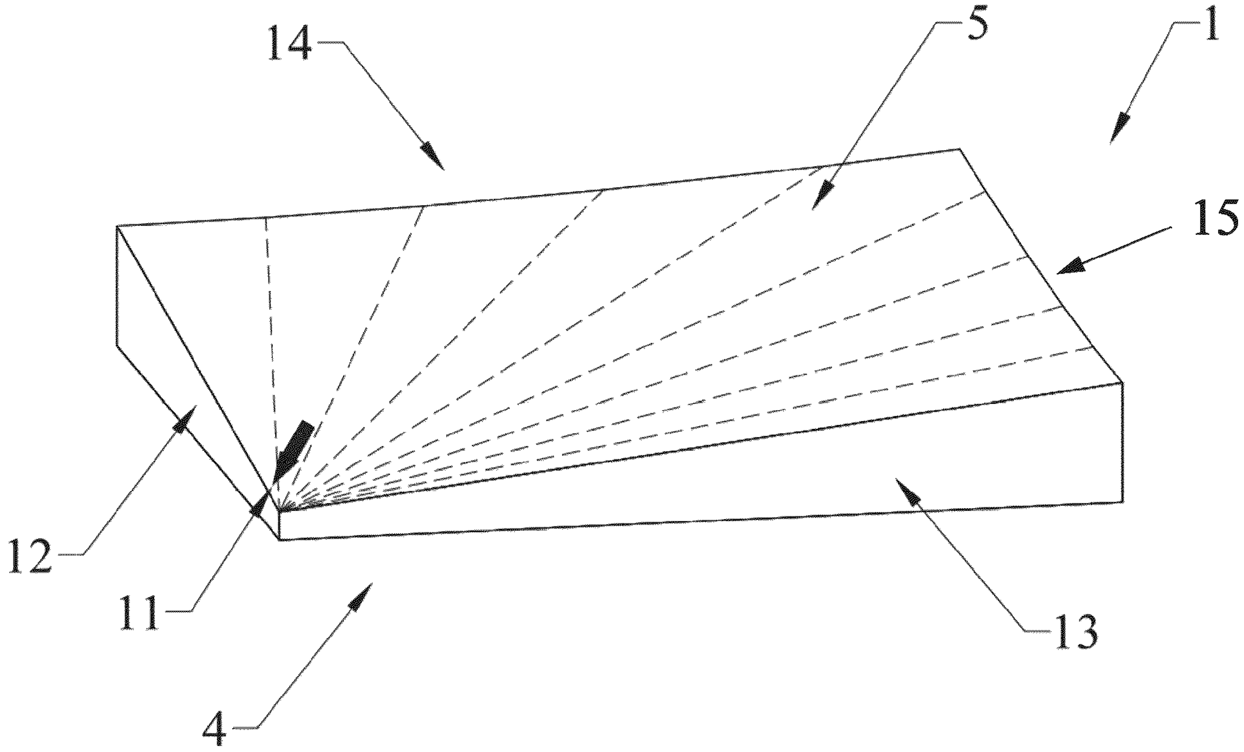


Fig. 14

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EUROPEAN SEARCH REPORT

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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	20 February 2025	Demeester, Jan

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