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(54) **LAMINA FLEXIBLE DE LADRILLOS Y PROCEDIMIENTO DE CONSTRUCCION CON DICHA LAMINA DE CUBIERTAS ABOVEDADAS**

(57) The plate (1) comprises a support (2) having holes (2a), a plurality of bricks (3) forming a mesh, spacers (4), reinforcement and fixing means (5) affixed to the opposite borders (2b) of the support (2) and reinforced bars (6) in the spacers (4) connected to the support (2) and affixed by their ends (6a) to said elements (5). The plate (1) is suspended by said elements (5) allowing it to adopt an inverted catenary arch shape. The span and the rise are fixed by joining both elements (5) using rigid bars (10). The plate is then inverted (1) while maintaining the rigid bars (10). The plate is then placed in its final location and covered with concrete or mortar. Once the concrete or mortar has set, the bars (10) are removed thereby obtaining said arched roofing.

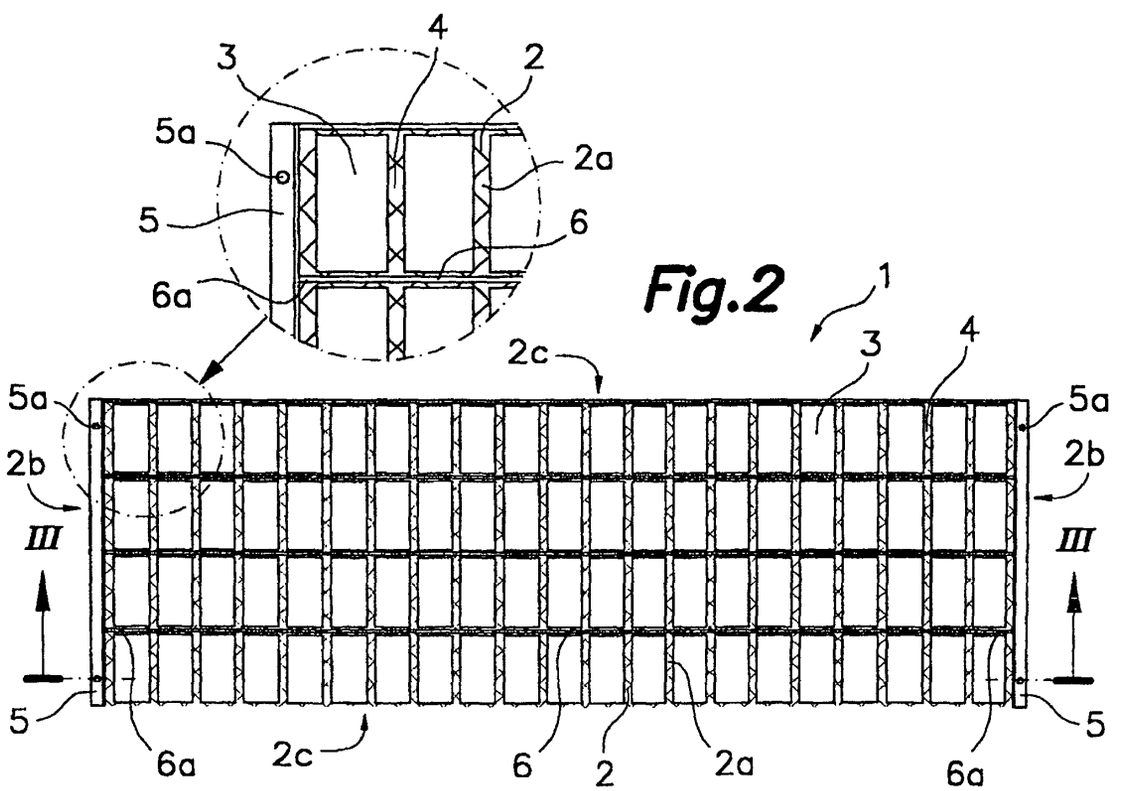

Fig.2

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Description

[0001] This invention relates to a brick flexible plate as apparent brick building element with permanent formwork, applicable to building pavements, walls and roofs, preferably having a sinuous development and more particularly to dome-shaped roofs of reinforced masonry with their intrados finished with apparent bricks.

[0002] This invention also relates to a method for building with the said plate of dome-shaped roof made of reinforced masonry with its intrados finished, that is to say for building dome-shaped roofs of the kind formed by a plurality of bricks arranged in a panel as a network leaving gaps between them for the bidirectional passage of stiffening reinforcements and with the said intrados finished with apparent bricks.

Background of the invention

[0003] Since very long ago masonry dome-shaped roofs are known. However, the said roofs demand significant thicknesses to achieve a sufficient bending strength for covering large spans or to support important solicitations such as overloads, wind or earthquakes, having been outweighed by reinforced concrete which allows thinner roofs. More recently, the use of steel reinforcement has been introduced between the joints of the said masonry with which a significant increase of their flexotensile and compressive strength is achieved which allows them to overweigh many limitations which relegated them to the functions of mere enclosure. In reinforced ceramic masonries, the ceramic parts act as concrete or mortar formwork as well as mechanically active elements, showing in addition an attractive finish of apparent brick which does not require any further treatment. This means taking best profit of the materials and saving workforce.

[0004] The major contribution to this technique was from the Uruguayan engineer Eladio Dieste, who in the forties started building laminar roofs made of ceramic masonry (brick panels or flooring blocks) arranged in a network defining a lengthwise and crosswise continuity of the joints in which the reinforced bars are housed as a network, thereafter filling the said joints with concrete or mortar with which, in addition the assembly is covered forming a thin compressing layer. With this technique the bricks are not mere weigh easing elements but their contribute to the roof strength, very thin roofs can be thus made using laminar geometries such as folded, having a catenary direction line or a double curve. Over one million square meters built in Uruguay, Argentina and Brazil back up the effectiveness of this method, with which up to 50 meter spans have been achieved.

[0005] More recently, the Spanish architect Carlos Clemente, participating jointly with Dieste, used that technique in several works at the Corredor del Henares, Madrid, Spain.

[0006] The main drawback the use of this technique shows is of economic nature because for building the said dome-shaped roofs it is essential to use arch falseworks and formworks which have a high cost of material and workforce in addition they are specific to each roof therefore they cannot be newly used for roofs having different characteristics.

[0007] In the state of the art prefabricated panels made of reinforced masonry are also known. However, they have difficulties for easily covering spans over 3.20 metres because of their flat geometry. In addition, they do not show a definitive internal finish therefore it is necessary to spend additional money for they intrados surface treatment.

[0008] Therefore, this invention has the object of overcoming those drawbacks providing a prebabricated element and abuilding process associated allowing an industrial manufacturing step in the work which prevents the use of falseworks and formworks when building dome-shaped roofs, providing at same time a definitive finish of their intrados and achieving with it a huge decrease of the costs and times for manufacturing and building the said roofs.

Short exposure of the invention

[0009] The first part of this object is achieved by providing a brick flexible plate which can be prefabricated which depending on the building element of apparent brick with permanent formwork is applicable for building pavements, walls and roofs having a sinuous development and namely for building dome-shaped roofs of reinforced masonry with their intrados finished with apparent bricks. The said brick flexible plate consists in a flexible laminar support, provided with a plurality of holes sufficient for concrete or mortar passing through on which a plurality of bricks are fastened arranged in a panel forming a network leaving between each other aligned gaps. The said laminar support has available stiffening and fastening elements , such as angular profiles fastened on first opposite end edges of the said laminar support. Along the said gaps aligned between the bricks are arranged in the direction perpendicular to the said stiffening and fastening elements a plurality of first reinforcing bars which are linked by means of separators at least to a series of points of the said laminar support and fastened by their ends to the said stiffening and fastening elements.

[0010] Above elements constitute the bottom of the brick flexible plate of this invention the said plate can be handle for example with a crane, being supported via the said stiffening and fastening elements to be bent either by its own weigh or by means of some device, immobilized and locked at a definitive place ending thereafter its building processes in the said definitive place.

[0011] If it is considered necessary for its final use, the brick flexible plate in addition comprises a plurality of second reinforcing bars arranged in the said gaps

aligned between bricks in the direction parallel to the said stiffening and fastening elements, crossing themselves with the first reinforcing bars between these later and the flexible plate and with their ends protruding from related second opposite end edges of the plate perpendicular to the said first opposite end edges. Typically, the said protruding ends are hook-like curved.

[0012] Depending on the use to which it is designed or of the variation of the building method selected which will be stated below, the brick flexible plate in addition comprises means for obturating the said aligned gaps between the bricks sufficient for retaining the concrete or mortar discharged or projected on the face corresponding to the laminar support thereof.

[0013] The second part of the object of this invention is achieved providing a process for building dome-shaped roofs with reinforced masonry with their intrados finished, of the kind formed by a plurality of bricks arranged on a panel forming network leaving gaps between each other for the bidirectional passage of stiffening frames and with the said finish of the intrados of apparent bricks.

[0014] The said process comprises first a series of steps from (a) to (c) which are directed to making a brick flexible plate as it was disclosed above, according to this invention. The order in which the said the said steps are carried out is makes no difference the plurality of bricks can be fastened first on the laminar support and thereafter the stiffening and fastening elements can be fastened as well as the reinforcing bars or vice versa. Thereafter following steps are carried out;

(d) hanging the said brick flexible plate by the said stiffening and fastening elements with the apparent panel face at the lower part leaving that it freely adopts, by its own weigh, a shape of a cross section in inverted arch having a catenary direction line, working at pure pulling;

(e) fastening a preselected span and deflection for the said inverted arch of catenary direction line linking to each other both stiffening and fastening elements of the first opposite end edges of the said brick flexible plate by means of stiffening bars having a predetermined length;

(f) inverting the position of the brick flexible plate keeping the said link by means of the said stiffening bars leaving it to freely adopt by its own weigh a dome-shaped configuration having an arcuate cross section with catenary direction line, of span and deflection same as those fixed by step (e) but operating under pure compression and placing the brick flexible plate thus arranged at its definitive place.

(g) coating the brick flexible plate by its higher part with concrete or mortar having care that the said concrete or mortar passes through the said plurality of holes of the laminar support and fills the said gaps aligned between bricks embedding the said first reinforcing bars and that in addition it forms a layer having a predetermined thickness above the said laminar support; and

(h) withdrawing, once the concrete is set, the said stiffening bars with which the said dome-shaped of reinforced masonry is formed, with an arcuate cross section having a catenary direction line and with its intrados finished, with apparent bricks, without any further treatment is required.

[0015] The result will be a laminar roof in which the said laminar support will remain built acting as a punch shearing resisting frame and contributing to lengthwise and crosswise bending strength of the said roof, as well to the bricks which would act as compression strength elements. The thickness of the layer of concrete or mortar and therefore the total thickness of the roof will be minimized because of its high strength which provides the arcuate bending having a catenary direction line.

[0016] For forming a longer dome-shaped surface, during the step (f) of the process of the invention, two or more of the said brick flexible plates are placed at their definitive place consecutively end-to-end. In addition, it has been provided a mechanical continuity along the whole dome-shaped surface by virtue of which once it is finished it acts as a large edge beam, that is to say, capable to be selfsupported, for example, only supported by its ends or with an overhanging portion. The said mechanical continuity is provided by a plurality of second reinforcing bars arranged in a direction parallel to that of the stiffening and fastening elements of the laminar supports of the brick flexible plates. The said second reinforcing bars can be, as it was explained before, built in each brick flexible plate prior to their placing at the definitive place or they can be added, for example, to each or to several of the brick flexible plates as they are placed, or they can be added to the whole of the brick flexible plates when they already are at their definitive place , end-to-end, or matching any of the said methods. It is obvious that when the said second reinforced bars do not extend along the whole dome-shaped surface, it is necessary to provide that they have protruding ends which overlap the second reinforcing bars of the adjacent brick flexible plates and the mechanical linking between them before proceeding to their embedment with the concrete or mortar.

[0017] The process according to the invention contemplates the obturation of the said gaps aligned between bricks prior to step (g), with the aim of retaining the concrete discharged on the laminar support of the brick flexible plate. In an example of embodiment of the invention, the said obturation is achieved by the ribs of the edges of the bricks adjacent to its apparent panel, the said ribs can remain very close to or contacting each other defining between them and the laminar support the said gaps aligned between bricks in which are located the first and if fit, also the second reinforcing bars. In another example of embodiment, the said obturation comprises the application at any moment between steps (c) and (g) of a flexible substantially impervious wall stretch, such as a plastic material plate, fastened detachable on the face of the apparent panel of the brick flexible plate or plates. In this case, step (h) will include

the operation of withdrawing the said flexible stretch of wall. Alternatively, the obturation of the said gaps between bricks would also be feasible by applying an elastic filler between step (e) and (g) the said filler remaining built in the intrados of the finished dome-shaped roof.

[0018] In the process of the invention, steps (a) to (c) are typically carried out in a step of industrial manufacturing for producing the said brick flexible plate, while steps (d) to (h) are carried out at the works. The application of the said flexible stretch of wall therefore can be carried out either during the prefabrication step or during the job at the works, in which case, the said application can be either carried out on each brick flexible plate before placing it at its definitive place or on the whole dome-shaped surface once in its place.

[0019] The production of the said brick flexible plate in an industrial mass prefabrication process allows as well the use of elements such as bricks and/or laminar supports specifically designed for that application as the use of elements currently available on the market. Although the said brick flexible plates can be produced in a large range of sizes, the more common sizes, bearing in mind the circumstances of carriage and handling, are ranging from about 6 to 12 metres in the direction perpendicular to the stiffening and fastening elements and about 1 to 2 metres in the direction parallel to them. With the larger sizes with a single dome it would be possible to cover for example about 10 m spans having unlimited lengths by consecutively juxtaposing elements joined end to end and with a few supporting posts or matching supporting posts and boarding joists.

[0020] For best understanding the invention a detailed description of some examples of preferred embodiment thereof are given below with reference to the drawing appended.

Short description of the drawings

[0021] Fig. 1 is a plan view of a laminar support for a brick flexible laminar plate according to this invention, on which stiffening and fastening elements and first reinforcing bars are fastened.

[0022] Fig. 2 is plan view including an enlarged detail of the laminar support of Fig. 1 on which a plurality of bricks has been fastened.

[0023] Fig. 3 is a view in cross section through the line III-III of Fig. 2 including an enlarged detail.

[0024] Fig. 4 is a part view of a brick flexible plate same as the one of Fig. 1 but incorporating a plurality of second reinforcing bars.

[0025] Fig. 5 is an enlarged detail of a cross sectional view through the line V-V of Fig. 4 showing in addition the placement of a flexible stretch of wall.

[0026] Fig. 6 is an enlarged detail of a cross sectional view of a variation of embodiment of a brick flexible plate according to the invention.

[0027] Fig. 7 to 11 are front views respectively illustrating steps (d) to (h) of the method for building dome-shaped roofs according to the invention starting from the use of a brick flexible plate same as the one of Fig. 4, Fig. 10 including an enlarged detail in cross section thereof.

[0028] Fig. 12 is an enlarged detail of a cross sectional view of a variation of embodiment of a brick flexible plate according to the invention.

[0029] Fig. 13 and 14 show schematic views in perspective of two variations in the arrangement of the second reinforcing bars on a dome-shaped surface formed by several brick flexible plates according to the invention, configured, located and end to end according the the method of the invention.

Detailed description of the examples of preferred embodiments

[0030] Referring first to Fig. 1 to 3, they show in general a brick flexible plate 1 comprising a flexible laminar support 2 provided with a plurality of bricks holes 2a for the passage of concrete or mortar on which a plurality of bricks 3 are fastened, arranged in a panel forming a network, leaving aligned gaps 4 between them. Stiffening and fastening elements 5 are fastened on first opposite end edges 2b of the said laminar support 2, while a plurality of first reinforced bars 6 are arranged along the said gaps 4 aligned between bricks, in the direction perpendicular to the said stiffening and fastening elements 5, the said first reinforcing bars 6 being linked at least to a series of points 2d of the said laminar support 2 and fastened by its ends 6a to the said stiffening and fastening elements 5.

[0031] The said stiffening and fastening elements 5 are, in an example of preferred embodiment, profiles of steel welded to the said first opposite end edges 2b of the said laminar support 2, the profiles of which typically comprise
elements which can be hooked by a crane, such as holes 5a or welded rings.

[0032] It has to be pointed out that the said link of the said first reinforcing bars 6 with points 2d of the laminar support 2 is carried out by means of separators 12, as shown in Fig. 5, 6 and 12, so that they remain arranged in the said gaps 4 aligned between bricks, at a distance from the laminar support 2 and without protruding from the apparent panel 3c of bricks 3.These separators 12 facilitates that in the event the said brick flexible plate is used for building a dome-shaped roof, as it will be explained below, the said reinforcing bars remain in a position as close as possible to the intrados, favouring to work pulling.

[0033] By juxtaposing several of the said brick flexible plates 1 joined end to end for example a longer dome-shaped surface 40 can be formed in which case it is necessary to establish a mechanical continuity between all the brick flexible plates 1 which compose it lengthwise the dome. For this, for example, each brick flexible plate 1 in addition includes a plurality of second reinforced

bars 7 arranged in the said gaps 4 aligned between bricks in the direction parallel to the said stiffening and fastening elements 5, crossing the first reinforcement bars 6 between them and the flexible plate and with its ends 7a protruding by corresponding second opposite end edges 2c of the plate perpendicular to the said first opposite end edges 2b. The said protruding ends 7a of the said second reinforcing bar 7 are hook-shaped curved and can be mechanically linked to the second reinforcing bars 7 of adjacent brick flexible plates 1.

[0034] The brick flexible plate 1 according to the invention in addition comprises, in some examples of preferred embodiment, obturating means of the said gaps 4 aligned between bricks. The purpose of the said obturating means is that they result sufficient for retaining a concrete or mortar discharged or projected on the face corresponding to the laminar support 2 of the brick flexible plate 1.

[0035] In one of the said examples of embodiment, the said obturating means are formed at least in part by ribs of edges 3b of the bricks 3 adjacent to their apparent panel 3c, the said ribs 3a can remain close to or contacting each other, delimiting between them and the laminar support 2 the said gaps 4 aligned between bricks where the first ones are housed and, if fit, also the second reinforcing bars 6, 7.

[0036] In another example of embodiment, the said obturating means are constituted by a flexible substantially impervious wall stretch 8, such as a plastic material plate, adhered detachable on the face of the apparent panel 1a of the brick flexible plate 1. The said wall stretch is withdrawn for providing the work final finish.

[0037] The bricks 3 forming the brick flexible plate 1 of this invention can be of different types such as uncored bricks, cored bricks or flooring block type and they are made of different materials such as ceramic and the like, cement, fibre cement or synthetic materials. Fastening the said bricks 3 on the laminar support 2 is carried out by means of a cement-glue 9 or a similar adhesive or by means of mechanical fastening such as socketing an elastic pincer type plug, the said pincers, in an example of particular embodiment are integral with the laminar support. When, for fastening the bricks the said cement glue 9 or similar adhesive is used, the further bending the laminar support is going to sustain has to be taken into account for which the adhesive is applied embracing only part of the brick width as it is illustrated in Fig. 5, preferably its central third part.

[0038] As for the said laminar support 2, it can also be carried out in different ways. In an example of preferred embodiment, the laminar support 2 is a panel which has a plurality of notches pierced in it oriented and thereafter pulled until the said notches remain open, material which is commercially available and which is currently called drawn panel. The said drawn panel will be typically arranged with the said notches oriented in the direction parallel to the said stiffening and fastening elements 5, in order to provide a higher flexibility in that direction perpendicular to it. The said drawn panel will be typically arranged with the said notches oriented in the direction parallel to the said stiffening and fastening elements 5 in order to provide a higher flexibility in that direction and a significant stuffiness to the perpendicular direction thereof. The said drawn panel, once embedded in concrete or mortar and once this later is set, will provide a great grip surface with the said concrete or mortar, while it will act as frame of the building element involved.

[0039] Other possible materials for that laminar support 2 are a rib mesh of the electrowelded type or a braided rib mesh.

[0040] On the other hand, the said first and second reinforcing bars 6, 7 are preferably corrugated steel bars of those currently used in the building industry.

[0041] As it was said above, an object of this invention consists in providing a process for building dome-shaped roofs using one or more brick flexible plates 1 as above disclosed. The said dome-shaped roofs are on the reinforced masonry kind with their intrados finished with apparent bricks.

[0042] The process according to this invention comprises first, steps (a) to (c) consisting in producing a brick flexible plate 1 as above disclosed therefore the description is not repeated here. Below and referring to Fig. 7 to 11, steps (d) and (h) are explained in which the building proper of the said dome-shaped roof is disclosed using the brick flexible plate 1 of steps (a) to (c) which in this example includes in addition a flexible wall stretch 8 acting for obturating the gaps aligned 4 between bricks.

[0043] Fig. 7 illustrates the step (d) consisting in hanging the said brick flexible plate 1 by the said stiffening and fastening elements 5, with the apparent panel face 1a at the lower part, leaving that it freely adopt , by its own weigh, a cross section configuration in inverted arch having a catenary direction line, working with pure pulling. This operation is typically carried out by means of a crane (not shown), for which holes 5a or welded rings are arranged on the said stiffening and fastening elements 5 which can be hooked by the said crane. In Fig. 7 to 9 the lift power exerted by the cables of the crane has been represented by means of arrows S and the weigh of the brick flexible plate 1 by means of the arrow P.

[0044] Fig. 8 illustrates following step (e) consisting in establishing a preestablished span L and deflection F for the said inverted arch having a catenary direction line linking to each other both stiffening and fastening elements 5 of the first edges 1b of opposite ends of the said brick flexible plate 1 by means of stiffening bars 10 having a predetermined length. In this position, the said stiffening bars 10 sustain compressive stresses represented by arrows C in this Fig. 8 while the brick flexible plate is submitted to pulling stresses, represented by means of arrows T, which confer it the said cross sectional configuration inverted arch having a catenary direction line.

[0045] Fig. 9 illustrates following step (f) consisting in inverting the brick flexible plate 1 position keeping the said link by means the said stiffening bars 10. In this position the stresses are inverted so that the said bars 10 are submitted to pulling stresses, represented by means of the arrows T while the brick flexible plate is submitted to pure compression stresses, represented by the arrows C, which confer them a dome-shaped configuration having a cross section in arch having a catenary direction line, a span L and deflection F same as those set at step (e) but operating under pure compression. The brick flexible plate 1 so arranged is placed on its definitive place, for example, supported on pillars 50.

[0046] Fig. 10 illustrates following step (g) consisting in coating the brick flexible plate 1 on its higher part with concrete or mortar caring that the said concrete or mortar passes through the said plurality of holes 2a (see enlarged detail) of the laminar support 2 and fills the said gaps 4 aligned between the bricks embedding the said first reinforcing bars 6 and forming in addition a layer 11 having a predetermined thickness over the said laminar support 2. At this step the presence of the flexible stretch of wall 8 is justified as a means for obturating the gaps 4 aligned between the bricks, retaining the concrete or mortar.

[0047] Last, Fig. 11 illustrates following step (h) consisting in withdrawing, once the concrete is set, the said stiffening bars 10 and, in this case, the flexible stretch of wall 8 with which the said dome-shaped roof of reinforced masonry remains formed having a cross section in arch of a catenary direction line and with its intrados finished, with apparent brick, without any further treatment is required.

[0048] The process according to this invention provided that, at step (f) two or more brick flexible plates 1 are placed at their definitive place, consecutively joined end to end, for forming a longer dome-shaped surface 40. In this case, it is necessary, as stated above, to establish a mechanical continuity between them which can be achieved in different ways.

[0049] In an example of embodiment, illustrated in Fig. 13, between steps (f) and (g) the step (g_1) is included consisting in arranging a plurality of second reinforced bars 17 in the said gaps 4 aligned between bricks in the direction parallel to the said stiffening and fastening elements 5, crossing themselves with the first reinforced bars 6 between these later and the flexible plate, each second reinforcing bar 17 extending along all the brick flexible plates 1 joined end to end, so that the said second reinforced bars 17 establish a mechanical continuity along the whole dome-shaped surface 40 therefore, once it is finished, it behaves as a large edge beam.

[0050] Fig. 14 illustrates another variation of the process in which between steps (f) and (g) the step (f_1) is included for: arranging, in addition, a plurality of second reinforcing bars 7 in the said gaps 4 aligned between bricks in the direction parallel to the said stiffening and fastening elements 5, crossing themselves with the first reinforcing bars 6 between these later and the flexible plate, each second reinforcing bar 7 extending along at least a brick flexible plate 1 and with its ends 7a protruding by corresponding second edges 2c of opposite ends perpendicular to the said first edges 2b of opposite ends; and (f_2) linking the said ends 7a of the second reinforced bars 7 protruding from a brick flexible plate 1 to related second reinforcing bars 7 of its brick flexible plate 1 adjacent joined end to end so that a mechanical continuity of the said second reinforcing bars 7 is established along the whole dome-shaped surface 40 by virtue of which once it is finished, ti behaves as a large edge beam.

[0051] Same illustration of Fig. 14 is valid for another variation of the process which is only different from the former in that the step (f1) is called here step (cl) and is carried out between the steps (c) and (d) instead of steps (f) and (g). That is to say, that the said plurality of second reinforcing bars 7 is directly included in the brick flexible plate 1, as it was exposed before with reference to Fig. 4, prior to the beginning of the dome-shaped roof building with it.

[0052] An obturation of the gaps 4 aligned between the bricks prior to step (g) also forms part of the process of the invention and it can be achieved, for example, by applying at any moment between steps (c) and (g) the said flexible stretch of wall 8 or by means of the said ribs (3a) of the edges (3b) of the bricks (3) above disclosed with reference to Fig. 6. Fig. 12 shows a detailed view in enlarged cross section of a portion of building element carried out by means of a brick flexible plate as that of Fig. 6. Referring to Fig. 12, the ribs 3a of the edges 3b of the bricks 3, adjacent to their apparent panel 3c, are very close to each other, defining between them and the laminar support 2 the said gaps 4 aligned between bricks. The concrete or mortar discharged on the extrados, that is to say, on the laminar support 2 penetrated through the holes 2a thereof filling the said gaps 4 aligned between bricks and embedding the first and second reinforced bars 6, 7, being retained by the said ribs 3a.

[0053] The process according to this invention is characterized in addition in that steps (a) to (c) can be carried out in an industrial prefabricated step for producing the said brick flexible plate 1, while the steps (d) to (h) are carried out in masonry.

[0054] It must be pointed out that above disclosed examples are provided only for illustration purpose, therefore in no case they must be interpreted as limitative, a man of the art being capable of introducing a number of variations without being beyond the scope of the invention, which is defined by the appended claims.

Claims

1. Brick flexible plate acting as building element of apparent brick with permanent formwork applicable to

building pavements, walls and roofs, having a sinuous development and more particularly to dome-shaped roofs of reinforced masonry with their intrados finished with apparent bricks, the said brick flexible plate (1) being **characterized in that** it comprises:

a flexible laminar support (2), provided with a plurality of holes (2a) for concrete or mortar passing through them on which a plurality of bricks (3) are fastened arranged in a panel forming a network leaving between each other aligned gaps (4);
stiffening and fastening elements (5), fastened on first opposite end edges (2b) of the said laminar support (2);
a plurality of first reinforcing bars (6) arranged along the said gaps (4) aligned between bricks, in the direction perpendicular to the said stiffening and fastening elements (5), the said first reinforcing bars (6) being linked at least to a series of points (2d) of the said laminar support (2) and fastened by its ends (6a) to the said stiffening and fastening elements (5).

2. Plate, according to claim 1 **characterized in that** the said link of the said first reinforcing bars (6) to the laminar support (2) is carried out by means of separators (7) so that they remain arranged in the said gaps 4 aligned between bricks, at a distance from the laminar support (2) and without protruding from the apparent panel (3c) of bricks (3).

3. Plate, according to claim 2, **characterized in that** it comprises in addition a plurality of second reinforced bars (7) arranged in the said gaps (4) aligned in the direction parallel to the said stiffening and fastening elements (5), crossing themselves with the first reinforcing bars (6) between these later and the flexible plate and with their ends (7a) protruding from related second opposite end edges (2c) of the plate perpendicular to the said first opposite end edges (2b).

4. Plate according to claim 3, **characterized in that** the said ends (7a) protruding from the said second reinforcing bars (7) are hook-like curved.

5. Plate, according to claim 1, **characterized in that** it comprises in addition means for obturating the said gaps (4) aligned between bricks, sufficient for retaining a concrete or mortar discharged or projected on the face corresponding to the laminar support (2) thereof.

6. Plate, according to claim 5, **characterized in that** the said obturating means are formed, at least in part , by ribs (3a) of the edges (3b) of the bricks (3) adjacent to its apparent panel (3c), the said ribs (3a) can remain very close to or contacting each other delimiting between them and the laminar support (2) the said gaps (4) aligned between bricks.

7. Plate, according to claim 5, **characterized in that** the said obturating means are constituted by a flexible substantially impervious wall stretch (8), such as a plastic material plate, adhered detachable on the face of the apparent panel (1a) of the brick flexible plate (1).

8. Plate, according to claim 1, **characterized in that** the said stiffening and fastening elements (5) are profiles of steel welded to the said first end edges (2b) opposite to the said laminar support (2).

9. Plate, according to claim 8, **characterized in that** the said profiles comprise elements which can be hooked by a crane, such as holes (5a) or welded rings.

10. Plate, according to claim 1, **characterized in that** fastening the said bricks (3) on the laminar support (2) is carried out by means of a cement-glue (9) or a similar adhesive.

11. Plate, according to claim 1, **characterized in that** the said bricks (3) are uncored bricks (3).

12. Plate, according to claim 1, **characterized in that** the said bricks (3) are cored bricks.

13. Plate according to claim 1, **characterized in that** the said bricks (3) are flooring block type bricks.

14. Plate, according to claim 1, **characterized in that** the said laminar support (2) is a panel which has a plurality of notches pierced in it oriented and thereafter pulled until the said notches remain open, as a drawn panel arranged with the said notches oriented in the direction parallel to the said stiffening and fastening elements (5).

15. Plate, according to claim 1, **characterized in that** the said laminar support (2) is a rib mesh of the electrowelded type.

16. Plate according to claim 1, **characterized in that** the said laminar support (2) is a rib mesh of the braided type.

17. Plate, according to claim 1, **characterized in that** the said laminar support (2) is a plate of plastic material provided with a plurality of openings, with a sufficiently low coefficient of elongation.

18. Plate according to claim 1, **characterized in that**

the said first and second reinforcing bars (6,7) are corrugated steel bars.

19. Dome-shaped roof built using at least a brick flexible plate (1) according to any of preceding claims.

20. Process for building dome-shaped roofs of reinforced masonry with its intrados finished of the kind formed by a plurality of bricks (3) arranged in a panel forming a network leaving gaps (4) between them for the bidirectional passage of stiffening reinforcements and with the said intrados finished with apparent bricks, the said process being **characterized in that** it comprises, nor necessarily in this order, the steps of:

(a) fastening the said plurality of bricks (3) arranged in a panel, forming a network, leaving between them gaps (4) aligned on a flexible laminar support (2) provided with a plurality of holes (2a) allowing the passage of concrete or mortar through them;
(b) stiffening first edges (2b) of opposite ends of the said laminar support (2) by fastening them to corresponding stiffening and fastening elements (5);
(c) arranging a plurality of first reinforced bars (6) along the said gaps (4) aligned between bricks, in the direction perpendicular to the said stiffening and fastening elements (5) linking the said first reinforcing arms (6) at least to a series of points (2d) of the said laminar support (2) and fastening their ends (6a) to the said stiffening and fastening elements (5),
so that a brick flexible plate (1) formed by the said laminar support (2), the said plurality of bricks (3) adhered to it is obtained, the said stiffening and fastening elements (5) fastened on first edges (2b) of opposite ends of the laminar support (2) and the said first reinforced bars (6) arranged along the said gaps (4) aligned between bricks, linked to the laminar support (2) and fastened by its ends (6a) to the stiffening and fastening elements (5); and
(d) hanging the said brick flexible plate (1) by the said stiffening and fastening elements (5) with the apparent panel face (1a) at the lower part leaving that it freely adopts, by its own weigh, a shape of a cross section in inverted arch having a catenary direction line, working at pure pulling;
(e) fastening a preselected span and deflection for the said inverted arch of catenary direction line linking to each other both stiffening and fastening elements (1b) of the first opposite end edges of the said brick flexible plate (1) by means of stiffening bars (10) having a predetermined length;
(f) inverting the position of the brick flexible plate (1) keeping the said link by means of the said stiffening bars (10) leaving it to freely adopt by its own weigh a dome-shaped configuration having an arcuate cross section with catenary direction line, of span and deflection same as those established at step (e) but operating under pure compression and placing the brick flexible plate (1) thus arranged at its definitive place.
(g) coating the brick flexible plate (1) by its higher part with concrete or mortar having care that the said concrete or mortar passes through the said plurality of holes (2a) of the laminar support (2) and fills the said gaps (4) aligned between bricks embedding the said first reinforcing bars (6) and that in addition it forms a layer (11) having a predetermined thickness above the said laminar support (2); and
(h) withdrawing, once the concrete is set, the said stiffening bars (10) with which the said dome-shaped of reinforced masonry is formed, with an arcuate cross section having a catenary direction line and with its intrados finished, with apparent bricks, without any further treatment is required.

21. Process according to claim 20, **characterized in that** step (f) comprises placing at its definitive place two or more of the said brick flexible plates (1) consecutively joined end to end for forming a longer dome-shaped surface (40).

22. Process, according to claim 21, **characterized in that** between steps (f) and (g) is included the step:

(g_1) arranging a plurality of second reinforced bars (17) in the said gaps (4) aligned between bricks in the direction parallel to the said stiffening and fastening elements (5), crossing themselves with the first reinforced bars (6) between these later and the flexible plate, each second reinforcing bar (17) extending along all the brick flexible plates (1) joined end to end,

so that the said second reinforced bars (17) establish a mechanical continuity along the whole dome-shaped surface (40) therefore, once it is finished, it behaves as a large edge beam.

23. Process, according to claim 21, **characterized in that** between the steps (f) and (g) are included the steps:

(f_1) arranging, in addition, a plurality of second reinforcing bars (7) in the said gaps (4) aligned between bricks in the direction parallel to the said stiffening and fastening elements (5),

crossing themselves with the first reinforcing bars (6) between these later and the flexible plate, each second reinforcing bar (7) extending along at least a brick flexible plate (1) and with its ends (7a) protruding by corresponding second edges (2c) of opposite ends perpendicular to the said first edges (2b) of opposite ends; and

(f_2) linking the said protruding ends (7a) of the second reinforced bars (7) of a brick flexible plate (1) to related second reinforcing bars (7) of its brick flexible plate (1) adjacent joined end to end,

so that a mechanical continuity of the said second reinforcing bars (7) is established along the whole dome-shaped surface (40) by virtue of which once it is finished, it behaves as a large edge beam.

24. Process, according to claim 21, **characterized in that** between steps (c) and (d) is included the step:

(c_1) arranging, in addition, a plurality of second reinforcing bars (7) in the said gaps (4) aligned between bricks in the direction parallel to the said stiffening and fastening elements (5), crossing themselves with the first reinforcing bars (6) between these later and the flexible plate, and with their ends (7a) protruding by corresponding second opposite end edges (2c) of the brick flexible plate (1) perpendicular to the said first opposite end edges (2b),

while between steps (f) and (g) is included the step of:

(f_2) linking the said protruding ends (7a) of the second reinforced bars (7) of each brick flexible plate (1) to related second reinforcing bars (7) of its brick flexible plate (1) adjacent joined end to end,

so that a mechanical continuity of the said second reinforcing bars (7) is established along the whole dome-shaped surface (40) by virtue of which once it is finished, it behaves as a large edge beam.

25. Process according to claim 20, **characterized in that** it includes an obturation of the said gaps (4) aligned between bricks prior to step (g).

26. Process according to claim 25, **characterized in that** the said obturation is achieved by ribs (3a) of edges (3b) of the bricks (3) adjacent to their apparent panel (3c) the said ribs can remain close to or contacting each other, defining between them and the laminar support (2) the said gaps (4) aligned between the bricks.

27. Process according to claim 25 **characterized in that** the said obturation comprises the application at any moment between the steps (c) and (g) of a flexible substantially impervious wall stretch (8), such as a plastic material plate, fastened detachable on the face of the apparent panel (1a) of the brick flexible plate or plates (1).

28. Process according to any of the claims 19 to 27, **characterized in that** steps (a) to (c) are carried out in a step of industrial prefabrication for producing the said brick flexible plate (1) while steps (h) to (c) are carried out at the works.

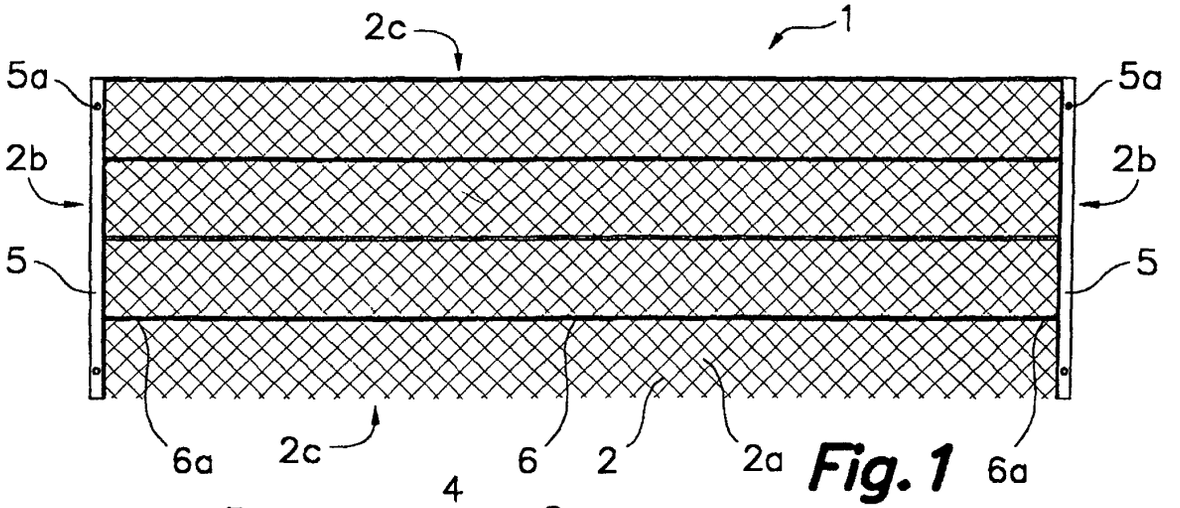


Fig. 1

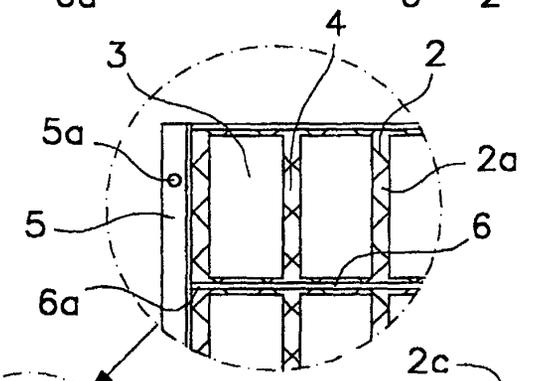
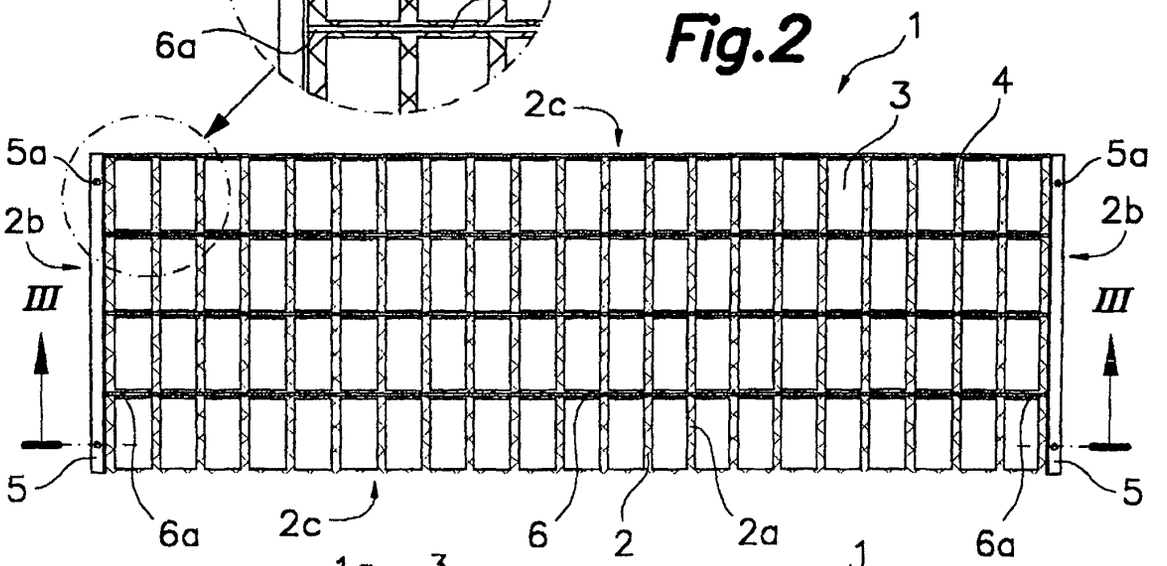


Fig.2



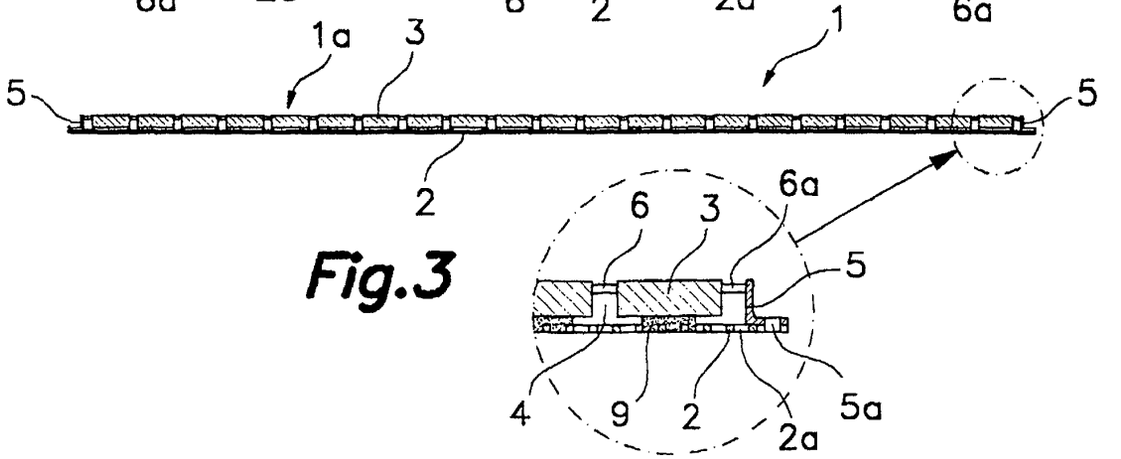


Fig.3

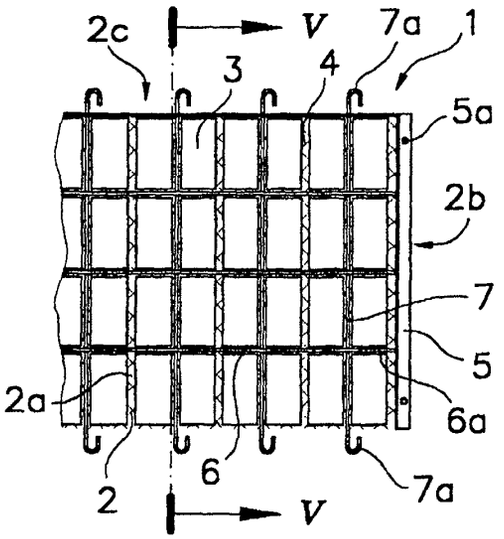


Fig.4

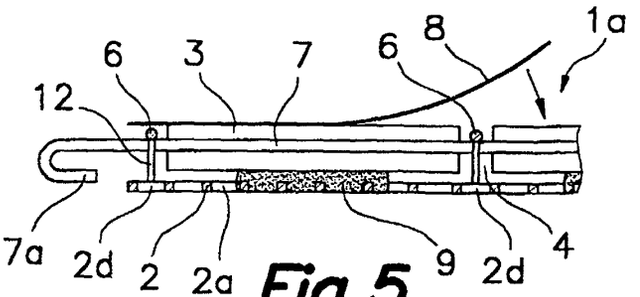


Fig.5

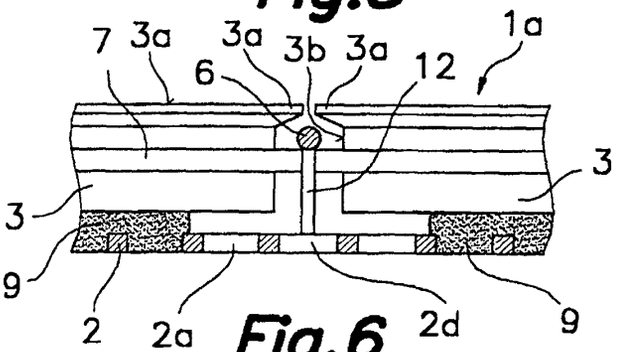


Fig.6

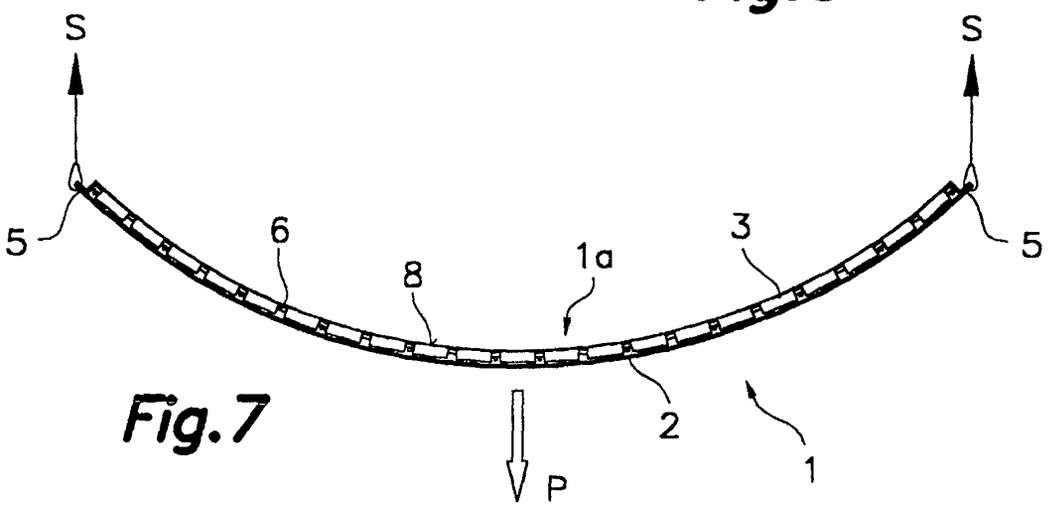


Fig.7

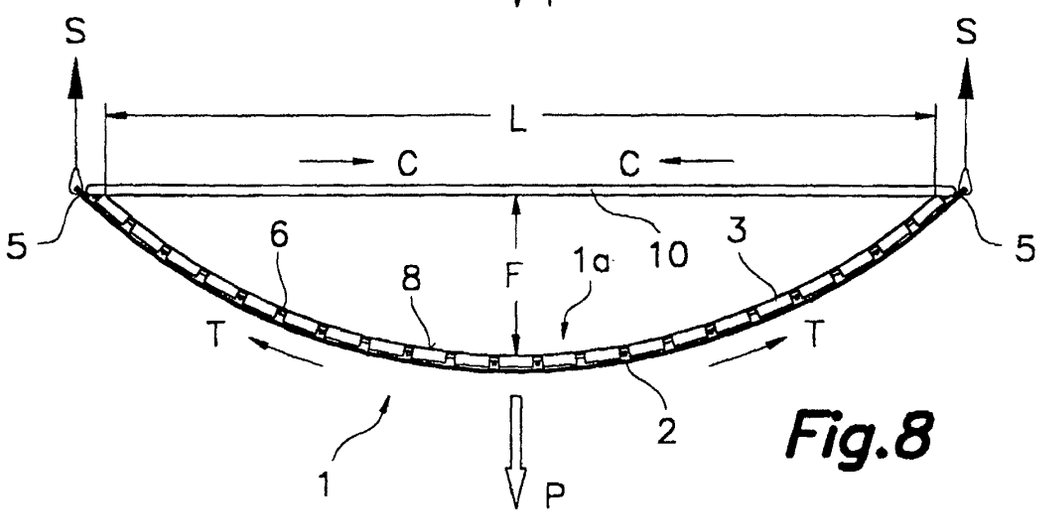
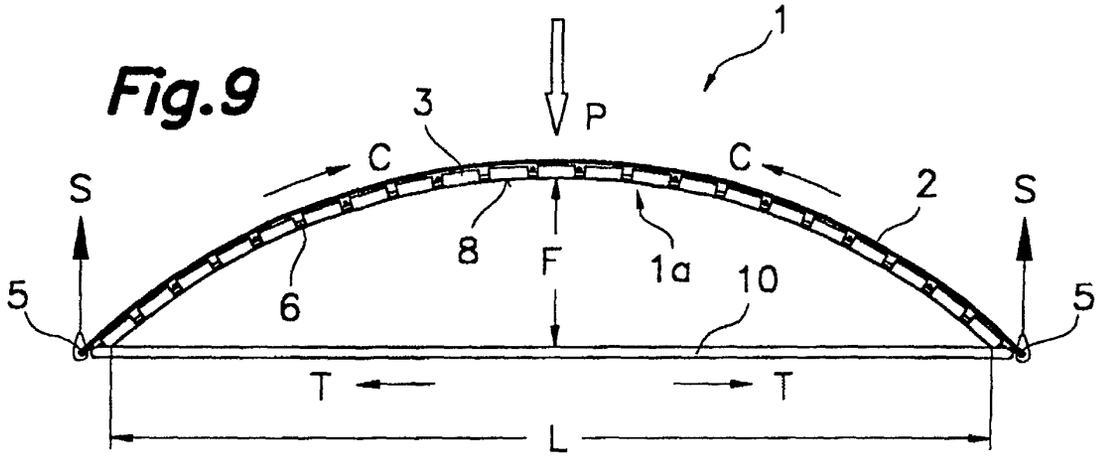


Fig.8

Fig.9



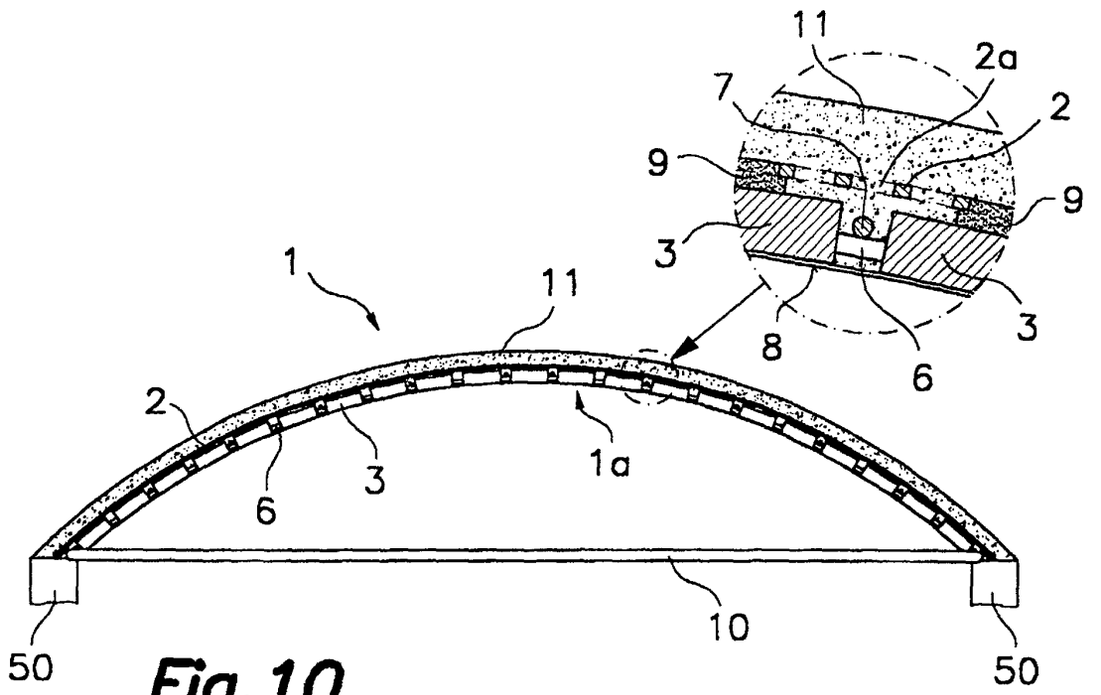


Fig.10

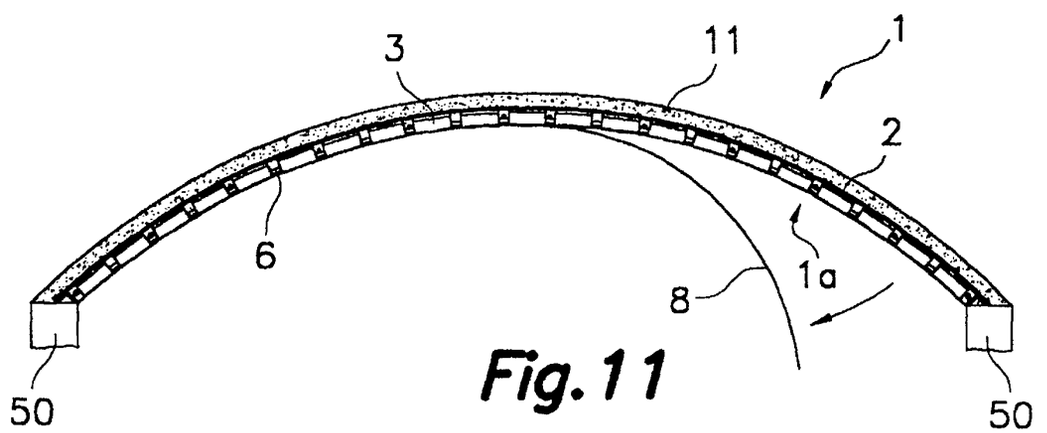


Fig.11

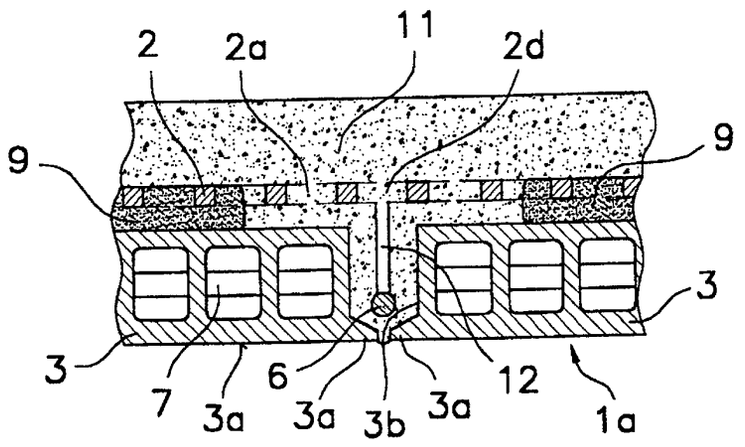


Fig.12

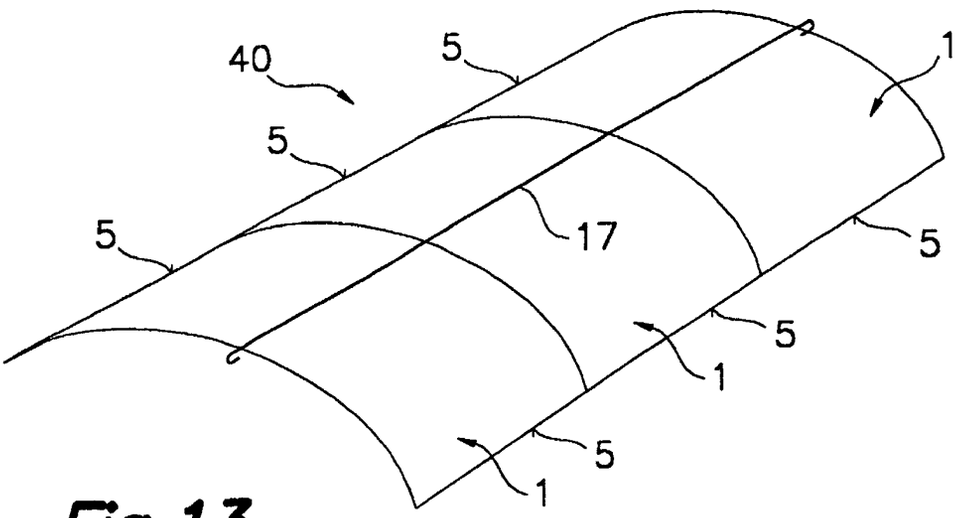


Fig.13

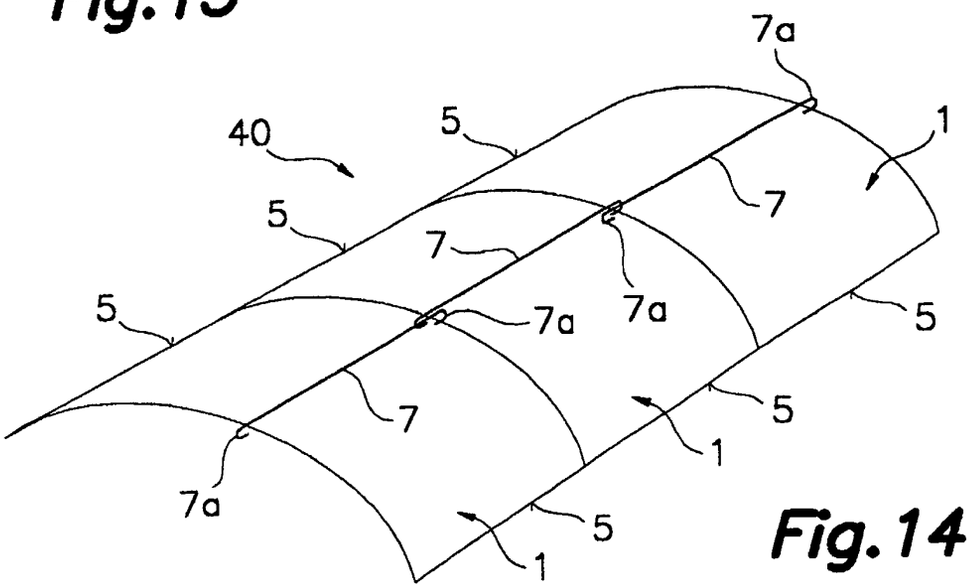


Fig.14

INTERNATIONAL SEARCH REPORT

Interi nal Application No
PCT/ES 99/00150

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 E04B1/32

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 E04B

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 practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 10 20 175 B (KOSFELD) 28 November 1957 (1957-11-28) column 1, line 34-49; figures 1-3	1,3,5,7, 10,18,20
A	US 4 279 680 A (WATSON) 21 July 1981 (1981-07-21) column 2, line 10-32; figures 1-3	20
A	GB 2 011 521 A (IBSTOCK BUILDING PRODUCTS) 11 July 1979 (1979-07-11)	

☐ *Further documents are listed in the continuation of box C.*

☒ *Patent family members are listed in annex.*

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 January 2000	27/01/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Kergueno, J

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter nal Application No
PCT/ES 99/00150

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 1020175 B		NONE	
US 4279680 A	21-07-1981	NONE	
GB 2011521 A	11-07-1979	NONE	

Form PCT/ISA/210 (patent family annex) (July 1992)