(19) Europäisches Patentamt
European Patent Office
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(11) **EP 2 322 733 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.05.2011 Bulletin 2011/20

(51) Int Cl.:
E04B 5/48 *(2006.01)* ***E04B 5/36*** *(2006.01)*
E04F 15/024 *(2006.01)*

(21) Application number: **10190908.3**

(22) Date of filing: **11.11.2010**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **12.11.2009 IT PD20090335**

(71) Applicant: **Da Dalt, M. Federica**
31015 Conegliano (TV) (IT)

(72) Inventor: **Da Dalt, M. Federica**
31015 Conegliano (TV) (IT)

(74) Representative: **Locas, Davide et al**
Cantaluppi & Partners
Piazzetta Cappellato Pedrocchi, 18
35122 Padova (IT)

(54) Modular building element for forming cavities, for example in ventilated under-floor spaces, floors and ceilings

(57) A modular building element (1) permits the formation of cavities, for example, under-floor spaces and ventilated floors and ceilings, in regular surfaces of any dimensions, and comprises a covering surface (10) and a plurality of supports (11) allowing the surface (10) to rest on a support surface (100) so as to define at least three openings (12) in first (2) and second (3) connecting portions and a space beneath said modular building element (1), the first connecting portion (2) of the element (1) being superimposable on a second connecting portion (3) of a further modular element (1) so as to define a continuous surface suitable for forming a continuous cavity, and is **characterized in that** said first and second connecting portions (2, 3) are superimposable on one another in a plurality of operative positions, each of which can achieve the connection of two modular elements (1) with different interaxial spacings (i, i', i") between adjoining elements (1) along one axis as well as along the intersecting axis.

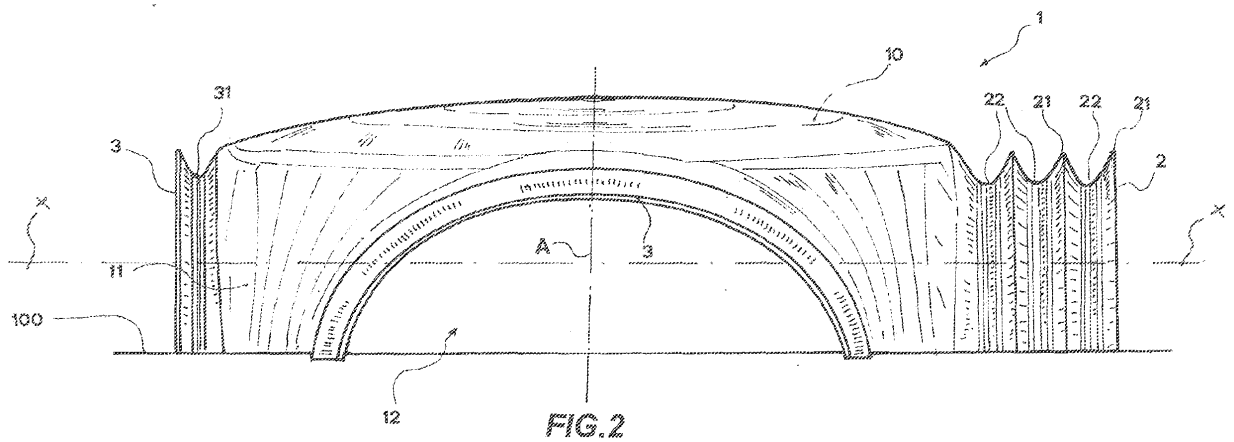

FIG.2

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Description

[0001] The present invention relates to a modular building element for forming cavities, for example, ventilated under-floor spaces and floors and ceilings.

[0002] In both civil and industrial construction fields, it is known to use ventilated cavities beneath floors or in ceilings for the elimination of any moisture or gases that may be present in the ground or for the arrangement of technological installations and networks.

[0003] A first solution for forming such structures is described in GB 1 129 892 A, US 1 805 483 A and US 1 924 035 A. The cavities are formed by arranging side by side a series of elongate arched elements which together form a linear cavity. The elements are joined together at their ends and have a series of coupling positions which enable the overall length of the cavity to be adjusted. This solution does not permit the formation of cavities which extend along two different axes.

[0004] An alternative solution to these structures is represented by the use of modular forms such as those described, for example, in Italian patent No. 1253374.

[0005] These forms typically comprise a cover with a square or rectangular base which can rest on a support surface, normally a floor or a weak mix of concrete, by means of at least four supports connected by a corresponding number of arches. Laying takes place by the fitting together of the arches of two adjoining elements with partial superimposition thereof, so as to form a solid and continuous surface and to permit the rapid construction of a platform which can be walked on and on top of which concrete is poured.

[0006] A space is thus defined beneath the concrete, permitting adequate ventilation and, more generally, protection from moisture, or the insertion of installations of various types.

[0007] Although this constructional solution, which thus provides for laying by means of an interlocking system, is particularly quick and easy, it requires the use of a series of elements of identical dimensions to be placed side by side with superimposition along the edges.

[0008] It can therefore readily be understood that it is not possible to cover regular surfaces of any size but only surfaces which have dimensions linked to a multiple of the unchanging interaxial spacing of the basic modular element.

[0009] In practice, therefore, the forms are cut at the edges of the surface to be covered so as to achieve complete coverage.

[0010] However, this solution has been found rather impractical since, in some cases, the cut forms must be adequately supported, thus leading to a longer laying time, wastage and greater costs.

[0011] An alternative solution is provided by patent application WO 2001 088298 which provides for the use of an accessory element that enables two adjacent forms to be connected by positioning them a greater distance apart than is permitted by fitting them together, or by filling the remaining space at the edge if the forms are laid continuously.

[0012] In practice, this accessory is constructed as an arched duct which can be fitted in the arches that are present in the forms. However, it can readily be understood that this solution has been found not to be very practical or economic in use since it requires the use of further elements, in addition to the forms, for the formation of the cavities. Moreover, the accessories described in the above-mentioned patent application have a closed side wall which, in some cases, has to be opened suitably during installation to prevent the creation of discontinuities in the cavity, thus also requiring the use of additional tools and manpower for installation.

[0013] Another solution consists in filling the empty space at the periphery of the positioned elements with pieces of polystyrene. These pieces are often shaped as necessary beforehand. When these elements are used at the periphery, however, an obstruction to the ventilation of the foundations results at the edge, thus limiting the expulsion of the moisture enclosed in the peripheral walls, particularly where reconstruction is involved.

[0014] The technical problem upon which the present invention is based is therefore that of providing a modular building element for forming cavities which overcomes the disadvantages discussed above with reference to the prior art. This problem is solved by the modular building element according to Claim 1. Secondary features of the present invention are defined in the corresponding dependent claims.

[0015] The present invention has some considerable advantages. The main advantage is that, by virtue of the variability of the interaxial spacing, the modular building element according to the present invention permits the formation of cavities, for example, under-floor spaces and ventilated floors and ceilings, in regular surfaces of any dimensions, without the need to use accessory elements or modifications to the structure of the modular element. Further advantages, features and methods of use of the present invention will become clear from the following detailed description of some embodiments which are given by way of non-limiting example. Reference is made to the figures of the appended drawings, in which:

Figure 1 is a perspective view which shows a modular building element according to the present invention;

Figure 2 is a side view of the modular element of Figure 1;

Figure 3 is a plan view of the modular element of Figure 1;

Figure 4 is a schematic side view which shows the connection of two modular elements according to the present invention in different operative positions;

Figures 5A to 5C are plan views which show three different examples of the installation of the modular elements according to the present invention in the

different operative positions of Figure 4; and

Figures 6A, 6B, 6C and 6D are schematic side views which show the connection between two modular elements formed in accordance with the embodiment of Figure 1 and in accordance with a further three different embodiments, respectively.

[0016] With reference initially to Figure 1, a modular building element is generally indicated 1. It comprises a covering surface 10 which is arranged substantially horizontally and, in particular, extends substantially parallel to a laying surface 100, shown schematically in Figure 2, on top of which laying surface 100 the cavity is formed in accordance with the procedures which will be described below.

[0017] Naturally, the term "horizontal" relates to the general orientation of the surface 10 relative to a support surface, which thus corresponds to the laying surface 100, after the laying of the modular element 1.

[0018] According to an embodiment illustrated in the appended drawings, the covering surface 10 is substantially dome-shaped and extends over a square base, as shown in Figure 3. Naturally, the covering surface could have many other shapes and could also have a rectangular base. For example, a triangular shape or a polygonal shape with a number of sides greater than four may also be provided for. The present description relates to the domed shape and is thus provided purely by way of non-limiting example.

[0019] The horizontal surface 10 is supported by four supports 11 which keep the surface 10 raised from a support surface in similar manner to the modular elements for forming cavities produced in accordance with the prior art.

[0020] The element 1 further comprises, between two adjacent supports 11, respective first and second connecting portions 2 and 3 which, in the embodiment described, are arch-shaped and which, when the modular element 1 is resting on the laying surface 100 on the supports 11, define four respective openings 12 and a space beneath the surface 10. In particular, when the element is resting on the laying surface 100, the connecting portions 2 and 3 extend from the laying surface 100, forming the above-mentioned arches.

[0021] In the embodiment described, the first connecting portion 2 has a plurality of seats 22 on each of which a projection 31 that is present on the portion 3 can be superimposed. More precisely, when the projection 31 of an element 1 is placed in one of the seats 22 of a further element 1, a male/female connection is formed between the two elements, thus creating a continuous covering surface which is thus suitable for forming a continuous cavity, as can be seen in Figure 5A. In other words, by means of the connection, the openings 12 of two modular elements 1 are put into communication, thus obtaining a single continuous space beneath the surfaces 10. In the embodiment described, the cavity thus formed extends along two intersecting axes x and y, that is, with a two-dimensional development. Moreover, with different shapes of the covering surface or with the presence of a different number of openings 12, the cavity may, of course, extend along a greater number of intersecting axes. For example, with a triangular shape, not shown in the drawings, there will be three openings 12 and the cavity will extend along three intersecting axes. Thus, with reference to Figure 4, the presence of a plurality of seats 22 enables two modular elements 1 to be connected in different operative positions in each of which the elements 1 will have different interaxial spacings i. In particular, by way of example, the drawing shows the situation in which the connecting portion 2 has three seats 22 so as to be able to make the connection between two modular elements 1 with interaxial spacings of i, i' and i", respectively.

[0022] The interaxial spacings i, i' and i" defined between two adjoining elements 1 may be different or equal along the intersecting axes (x, y) but may also be different or equal along the same axis.

[0023] The useful space defined beneath two adjoining elements 1 is variable in dependence on the actual value of the interaxial spacings i, i' and i" between the two adjoining modular elements.

[0024] The useful space defined beneath two adjoining elements 1, that is, the space defined beneath the two mutually connected adjoining modular elements, is less than the sum of the spaces of the two individual modular elements 1 since the two adjoining modular elements 1 are at least partially superimposed.

[0025] It is pointed out that, in this case, the interaxial spacing is evaluated with respect to an axis of symmetry A of the dome between adjoining elements and delimited by two half-surfaces 10 increased by the connecting portions 2 and 3 but, naturally, different references may also be taken into consideration for the evaluation of the spacing between two adjacent modular elements 1 during laying.

[0026] As is clear from a comparison of Figures 5A to 5C, the facility to connect the elements 1 with different interaxial spacings enables the same type of element 1 to be used for covering surfaces which have different dimensions, even along both axes x and y, and consequently permits complete or almost complete coverage of the designed cavity or the cavity to be formed. That is, the summation of the variations of the interaxial spacings covers the portion which would remain exposed if the interaxial spacing were constant as it is at the moment and in the prior art. More precisely, by virtue of the above-mentioned variations of the interaxial spacing, the adjoining elements can completely or almost completely cover the space which would remain between the series of elements and the actual periphery to be covered if the elements were of constant interaxial spacing, in any case forming a continuous cavity which extends along two intersecting axes.

[0027] With reference now to Figure 3, the modular element 1 preferably has a square or quadrangular shape

in plan with the supports 11 arranged at the corners thereof and the connecting portions 2 and 3 arranged at the sides of the square or rectangle. Conceptually similar solutions in which the same number of first and second connecting portions 2 and 3 are present and are also arranged on respective sides are also applicable to shapes that are polygonal in plan with even numbers of sides. For shapes with odd numbers of sides, modular elements with a different number of first connecting portions 2 in comparison with the number of second portions 3 will be used. To achieve the characteristic of modularity, two different types of elements 1 with complementary numbers of first and second portions will therefore be used. By way of example, for triangular elements, modular elements with one first connecting portion and two second connecting portions will be used, associated with modular elements which instead, have two first connecting portions and one second connecting portion. More generally, with reference to alternative embodiments of the modular element 1, this could have more than four supports 11 and a covering surface 10 which, by way of example, is concave, flat, or convex, with the upper portion arranged to form or accept a lid which permits inspection of the cavity.

[0028] More precisely, in the embodiment described, upon the assumption that the element 1 is characterized by four supports, the element 1 comprises two first connecting portions 2 arranged on adjacent sides and two second connecting portions 3 arranged on the other two adjacent sides.

[0029] Moreover, the first connecting portions 2 have a plurality of ridges 21 which define the seats 22 and enable two elements 1 to be kept locked in the preselected position once they have been connected.

[0030] This feature provides the structure with stability and renders it suitable for walking on during the laying stages.

[0031] Naturally, as will be explained in detail below with reference to other embodiments, different means suitable for achieving the locking of the modular elements 1 in the preselected operative position may also be used. The solution described hitherto has thus been found particularly advantageous since the modular element according to the present invention can be produced as a single item simply by moulding by procedures and with costs similar to those of conventional forms but with the capability to adapt to surfaces of any size without the need for modifications or the use of accessory elements. In fact, in this case, the connecting portions 2, 3 and the means which permit locking thereof are formed integrally with the modular element 1, with a considerable simplification in manufacture, storage, transportation and installation.

[0032] With reference now to Figures 6A to 6D, these show the connection between two modular elements 1 according to the embodiment described above and according to three further embodiments.

[0033] As can be seen in Figure 6A, the projection 31 formed in the connecting portion 3 is inserted in one of the seats 22 in the portion 2, thus enabling one of the three possible interaxial spacings between the elements to be achieved. This connection thus provides the surfaces 10 of the two elements with continuity, defining a continuous surface on top of which concrete can be poured so as to obtain the desired cavity, for example, to form under-floor spaces or ventilated floors and ceilings.

[0034] Figure 6B shows an alternative embodiment in which the portion 2 has a smooth surface 23 on which the second portion 3 will be placed, optionally in the region of the projection 31 which, if desired, can be fixed in the preselected position by any fixing means such as screws, nails, rivets, or the like, not shown in the drawing. It is suggested, although not necessary, that the portion 2 be provided with an end block 24 which enables the portion 3 to be held on the smooth surface 23, allowing one of the infinite number of possible interaxial spacings to be formed.

[0035] A third embodiment is shown in Figure 6C in which the first portion 2 is provided with one or more pins 25 which can be fixed in different positions on the smooth surface 23. The pin or pins is or are inserted in a suitable seat or seats 32 of the second connecting portion 3 enabling one of the infinite number of possible non-fixed interaxial spacings to be set.

[0036] Finally, a further embodiment is shown in Figure 6D in which, instead, there are one or more pins 33 in the second connecting portion 3; these pins 33 are housed in one or more suitable seats 26 formed in the portion 2, thus enabling a plurality of interaxial spacings to be achieved.

[0037] It can in any case be seen that, in all of the above-mentioned embodiments, installation takes place by the successive laying of elements 1 at the desired spacing relative to one another, achieving stable positioning thereof by means of various constructional solutions.

[0038] The present invention has been described above with reference to preferred embodiments. It should be understood that there may be other embodiments which are based on the same inventive concept and all of which fall within the scope of protection of the appended claims.

Claims

1. A modular building element (1) for forming cavities, for example, ventilated under-floor spaces, floors and ceilings, comprising a covering surface (10) and a plurality of supports (11) allowing the surface (10) to rest on a support surface (100) so as to define at least three openings (12) in first (2) and second (3) connecting portions and a space beneath said modular element (1), the first connecting portion (2) of the element (1) being superimposable on a second

connecting portion (3) of a further modular element (1) so as to define a continuous surface suitable for forming a continuous cavity, **characterized in that** said cavity extends along at least two intersecting axes (x, y), and **in that** said first and second connecting portions (2, 3) are superimposable on one another in a plurality of operative positions, each of which can achieve the connection of two modular elements (1) with different interaxial spacings (i, i', i") between adjoining elements (1).

2. A modular building element (1) according to Claim 1 wherein said first and second connecting portions (2, 3) of adjoining elements (1) are superimposable in a manner such that said interaxial spacings (i, i', i") between adjoining elements (1) are different from one another or equal along the same axis, the useful space defined by said two adjoining elements being variable in dependence on the values of said interaxial spacings.

3. A modular building element (1) according to Claim 1 or Claim 2 wherein said first and second connecting portions (2, 3) of adjoining elements (1) can be superimposed in a manner such that said interaxial spacings (i, i', i") between adjoining elements (1) are different from one another along the intersecting axes, the useful space defined by said two adjoining elements being variable in dependence on the values of said interaxial spacings.

4. A modular element (1) according to any one of the preceding claims, comprising means (21, 22, 31; 25, 32; 26, 33) for locking the modular elements (1) in a preselected operative position.

5. A modular element (1) according to any one of the preceding claims wherein said covering surface (10) and the supports (11) define a substantially square or rectangular shape in plan and comprise two first connecting portions (2) arranged on adjacent sides of the square or of the rectangle, respectively, and two second connecting portions (3) arranged on the other two adjacent sides of the square or of the rectangle, respectively.

6. A modular element according to any one of the preceding claims wherein said first and second connecting portions (2, 3) are formed integrally with the element (1) as a single body by moulding.

7. A modular element (1) according to any Claims 1 to 6 wherein said first connecting portions (2) comprise one or more seats (22) suitable for housing one or more projections (31) of said second connecting portion (3).

8. A modular element (1) according to Claim 7, comprising a plurality of seats (22) and wherein said first connecting portion (2) comprises one or more ridges (21) between said seats (22), said ridges (21) being suitable for locking the modular elements (1) in a preselected operative position, that is, with a predetermined interaxial spacing.

9. A modular element (1) according to Claim 7 or Claim 8 wherein said seat or seats (22) and/or said projection or projections (31) and/or said ridge or ridges (21) are formed integrally on said first and second connecting portions (2, 3), respectively.

10. A modular element (1) according to any one of Claims 1 to 6 wherein said first portion (2) comprises a smooth surface (23) on which said second portion (3) is superimposed in one of said plurality of operative positions.

11. A modular element (1) according to any one of Claims 1 to 6 and Claim 10 wherein said first portion (2) comprises, on said smooth surface (23), one or more pins (25) suitable for being housed inside one or more respective seats (32) formed in the second connecting portion (3).

12. A modular element (1) according to any one of Claims 1 to 6 and Claim 10 wherein said first connecting portion (2) comprises one or more seats (26) and said second connecting portion (3) comprises one or more pins (33) suitable for being inserted in one of said seats (26).

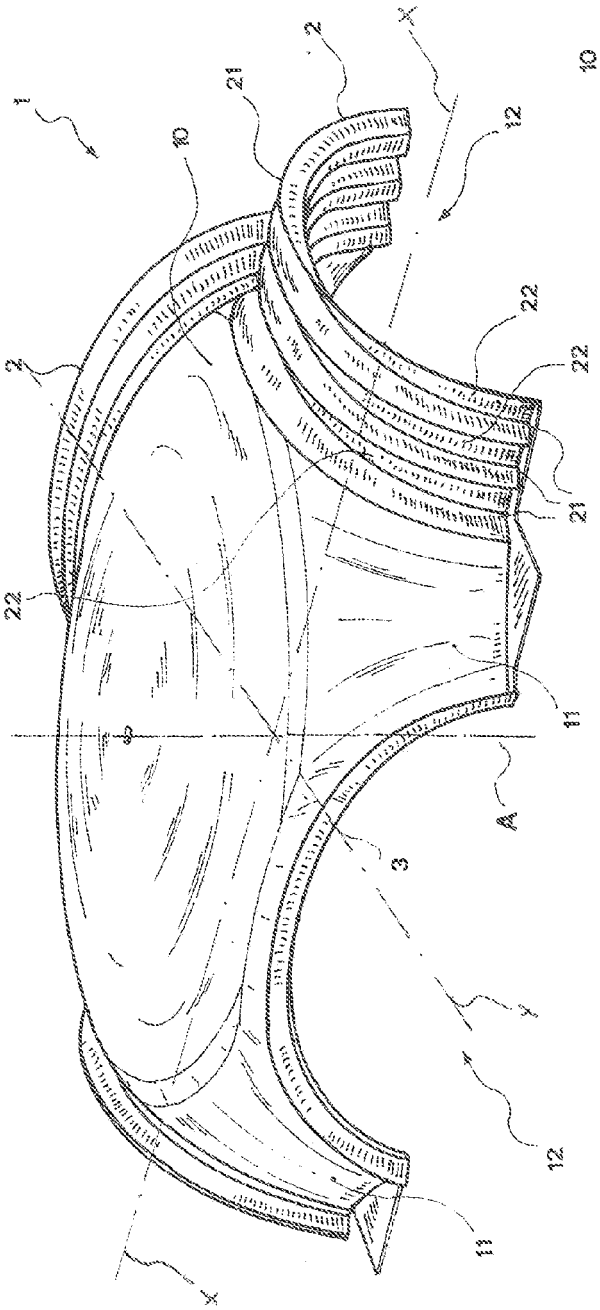

FIG.1

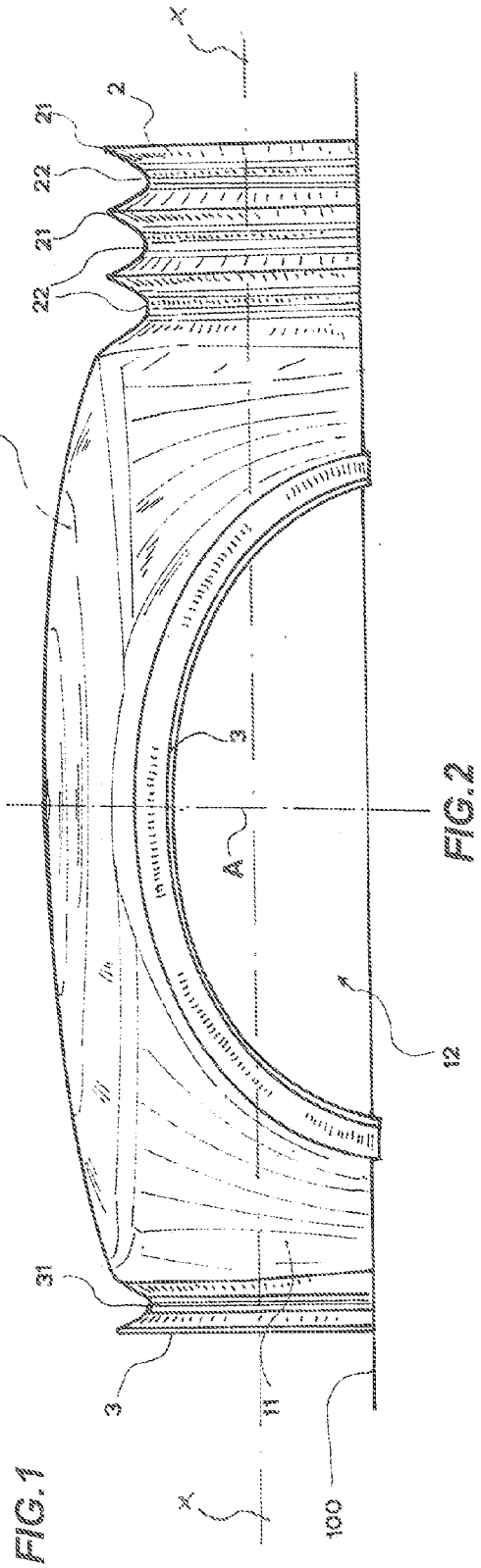

FIG.2

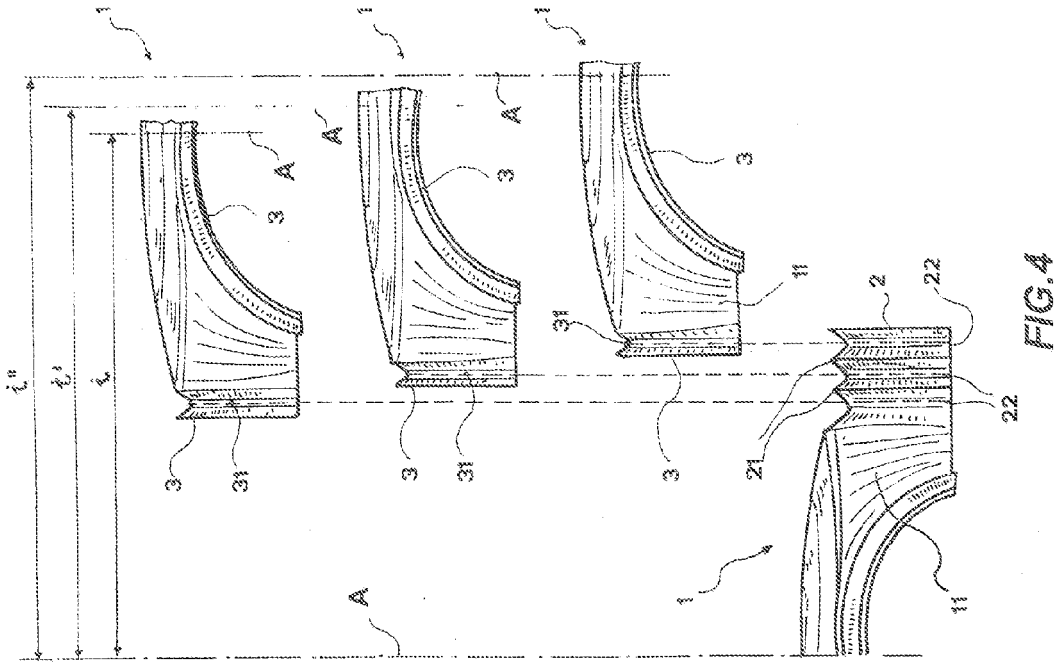

FIG.4

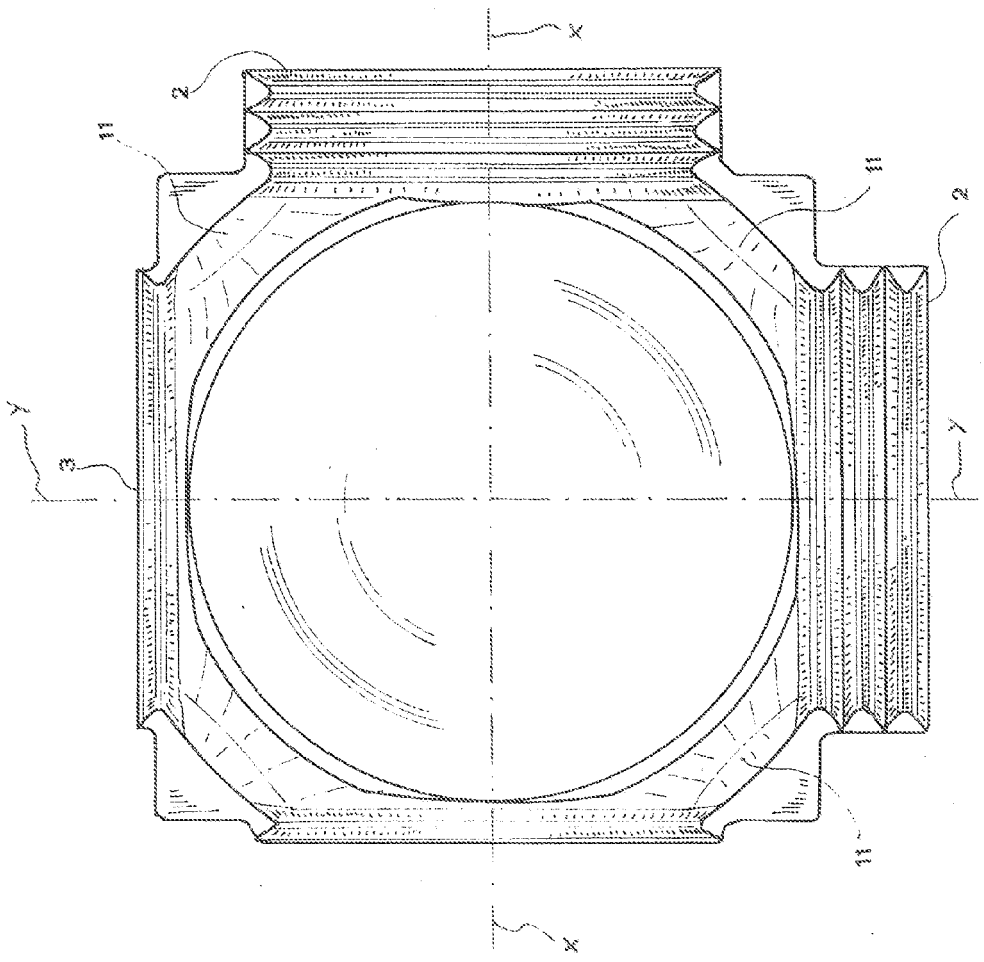

FIG.3

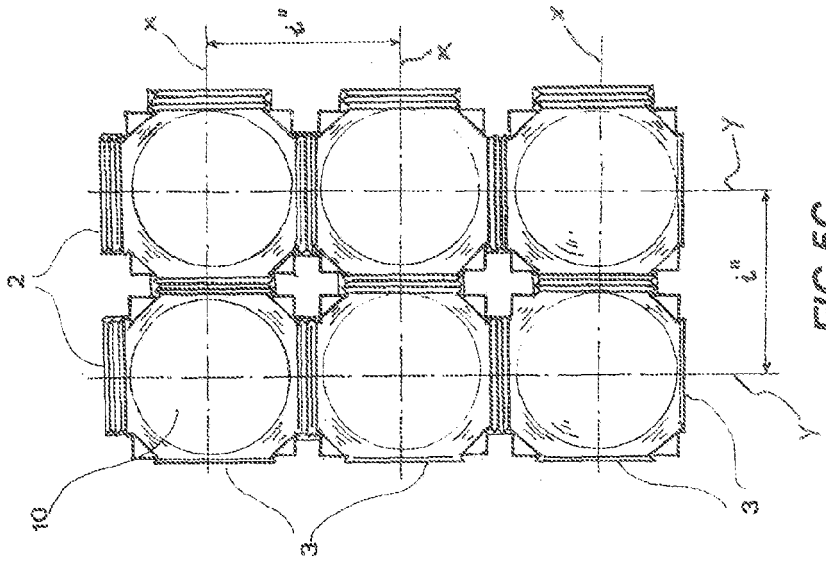

FIG.5C

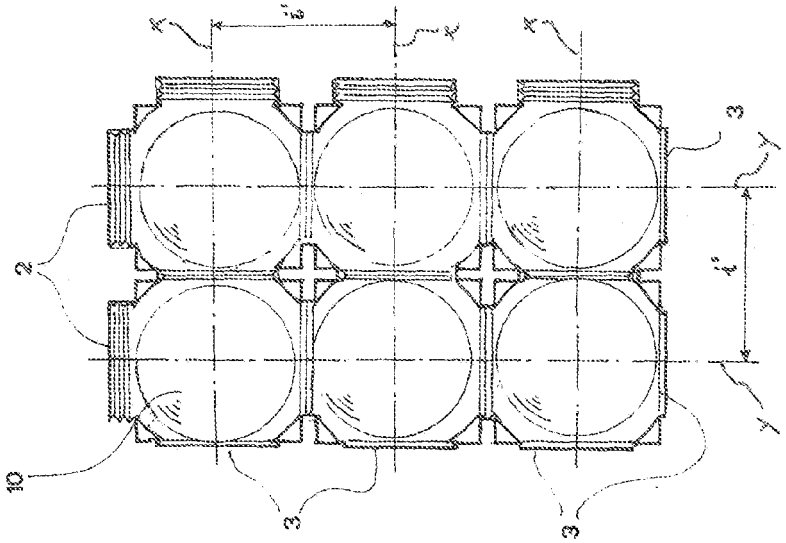

FIG.5B

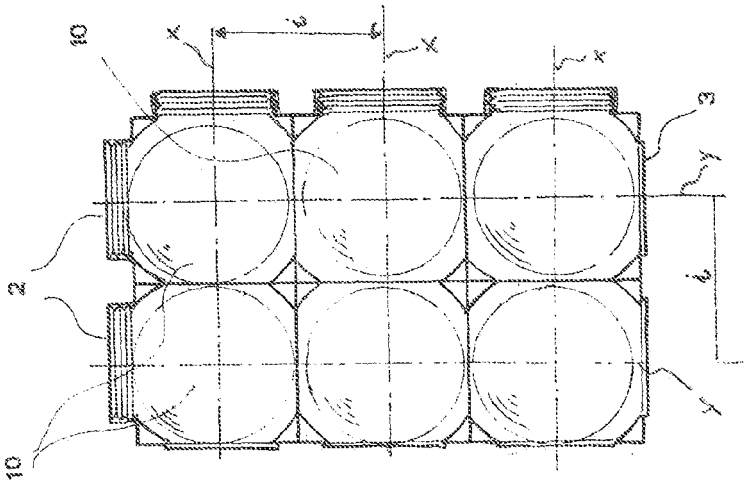

FIG.5A

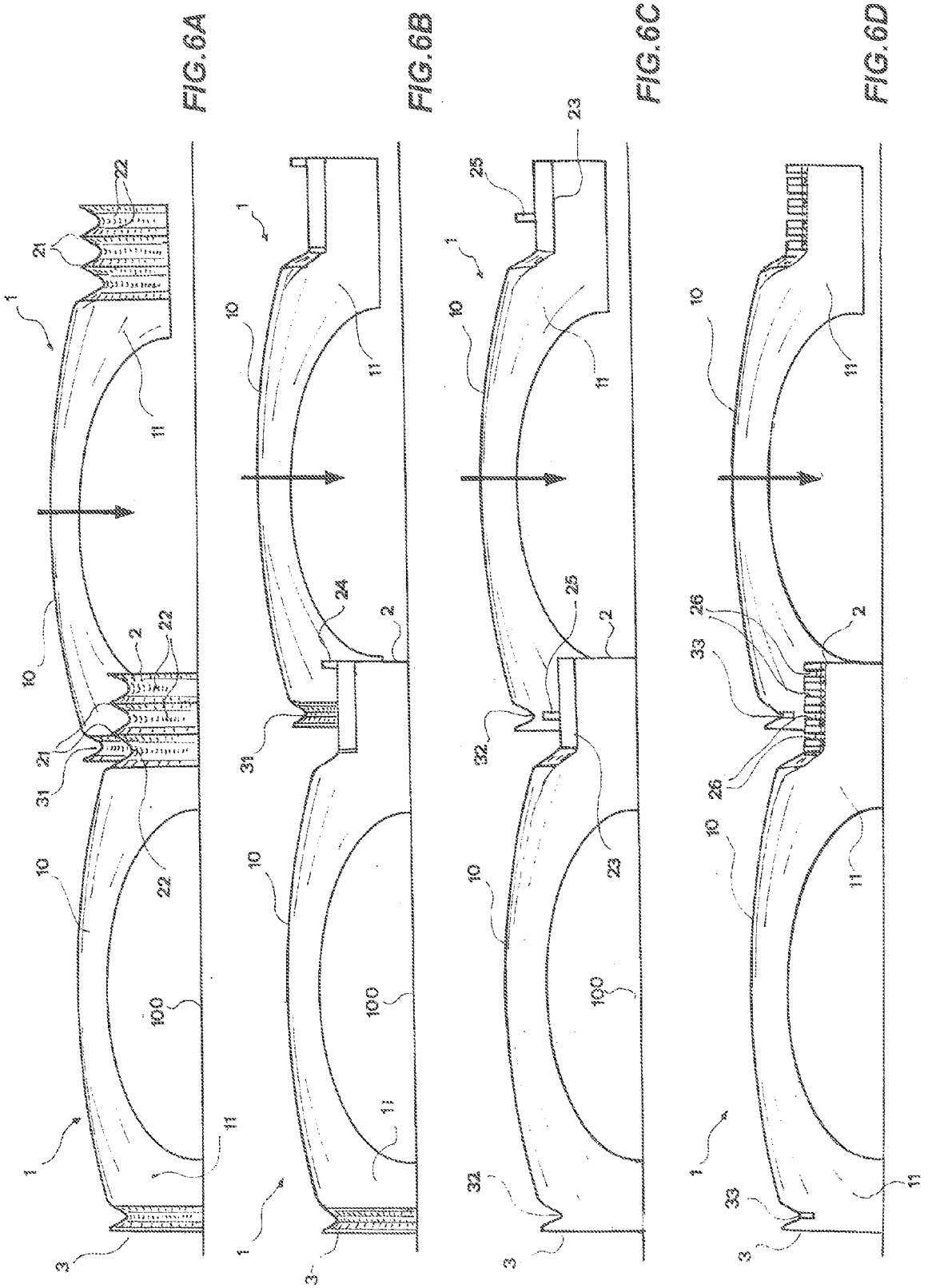
FIG.6A
FIG.6B
FIG.6C
FIG.6D

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EUROPEAN SEARCH REPORT

Application Number
EP 10 19 0908

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	11 March 2011	Righetti, Roberto

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