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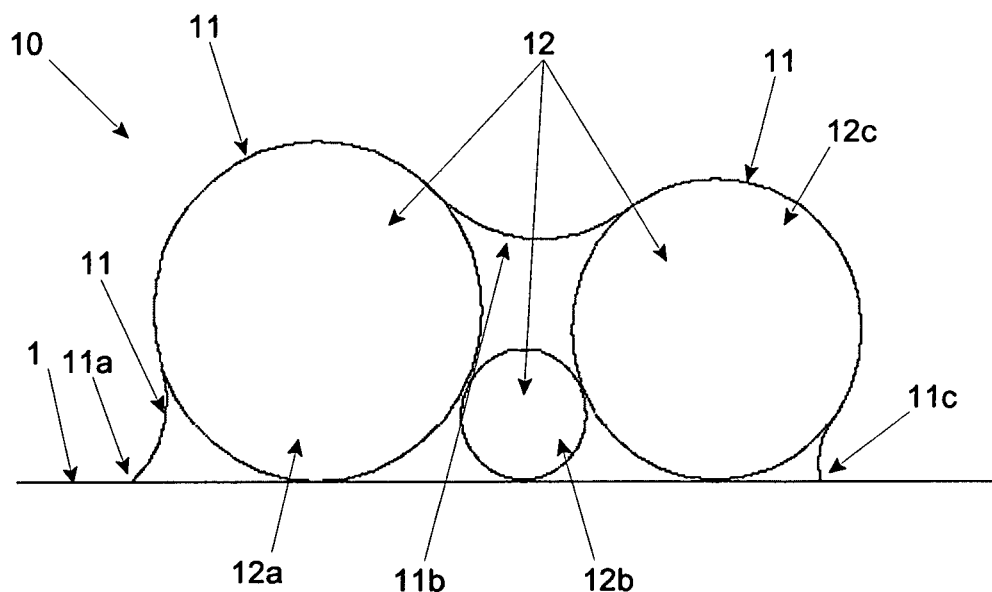
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(54) **A spacial structure and a method to build such a structure**

(57) The invention relates to a spatial structure built up of a support body to be placed on a support surface; a reinforcing layer to be arranged over the support body; and a curable substance to be poured over the reinforcing layer.

The invention also relates to a method for constructing a spatial structure, comprising the steps of:

- i) placing an inflatable support body on a support surface;
- ii) arranging a reinforcing layer over the inflatable support body;
- iii) inflating the inflatable support body with a medium under pressure;
- iv) pouring a curable substance on top of the reinforcing layer.



**Fig. 1**

## Description

**[0001]** The invention relates to a spatial structure built up of a support body to be placed on a support surface; a reinforcing layer to be arranged over the support body; and a curable substance to be poured over the reinforcing layer.

**[0002]** The invention also relates to a method for constructing a spatial structure, comprising the steps of:

- i) placing an inflatable support body on a support surface;
- ii) arranging a reinforcing layer over the inflatable support body;
- iii) inflating the inflatable support body with a medium under pressure;
- iv) pouring a curable substance on top of the reinforcing layer.

**[0003]** Such a spatial structure is generally known. It is frequently used in the construction industry for constructing structures having a convex (synclastic) or a cylindrical shape. When a reinforcing layer (or reinforcing net) arranged over an inflatable construction is used, however, only shapes comprising a circle or a segment of a circle can be realised. Accordingly, only a limited number of shapes can be realised with the current, known structures, and consequently it is the object of the invention to provide a more versatile spatial structure which makes it possible to realise other shapes as well.

**[0004]** According to the invention, the spatial structure is characterised in that the support body is made up of several support elements, and in that the reinforcing layer comprises a net structure, which has been pre-tensioned to a specific surface contour, with the inflatable support elements giving the reinforcing layer its shape.

**[0005]** In a functional embodiment, at least one support element is furthermore configured as a membrane that can be inflated with a medium.

**[0006]** The combination of inflatable support elements (or forms) with a pre-tensioned reinforcing layer configured as a net structure arranged thereover makes it possible to realise various types of shapes. Thus it is possible to realise not only synclastic (convex) or cylindrical shapes, but also anticlastic or concave shapes.

**[0007]** More specifically, the spatial structure is characterised in that the pre-tensioned surface contour comprises at least the minimum surface area between one or several surface points and/or one or several surface lines.

**[0008]** More specifically, it is simpler to configure the reinforcing layer as a net having little flexural strength. In that case the mesh is given its shape by being tensioned. The shape of the net will in that case form the minimum surface area between a number of given elements. The shape of the mesh in tensioned condition is different from said minimum surface shape on account of

- the dimensions and the direction of the meshes of the net,
- the net's own weight,
- the creation, whether or not locally, of extra tension in the net,
- the shape of the mesh in the starting position thereof.

**[0009]** Said pre-tensioned surface contour may furthermore be influenced in that according to the invention one or more lines of tension are created over the pre-tensioned surface contour. According to another embodiment, said at least one line of tension can create a deformation in the reinforcing layer towards or away from the inflatable form, so that this also makes it possible to design the spatial structure to comprise various concave or convex shapes.

**[0010]** In a more functional embodiment, the reinforcing layer may be provided with one or more tensionable cables, which may or may not be incorporated in the reinforcing layer, whilst in another embodiment, with which various concave or convex shapes can be realised, the reinforcing layer is tensionably attached to the support surface.

**[0011]** It is furthermore possible to effect a deformation in the opposite direction by the provision of a bar, a surface, a beam, an arch or a volume that presses the reinforcing layer outwards.

**[0012]** In another functional embodiment, the curable substance is a grout, for example concrete, but the curable substance may also be a synthetic material, for example a polymer resin.

**[0013]** In another functional embodiment, the curable substance is ice.

**[0014]** The invention also relates to a method for constructing a spatial structure, which method is according to the invention characterised by the further step of forming a surface contour counteracting the shape of the inflated support body in the reinforcing layer configured as a net structure prior to the execution of step iii).

**[0015]** The invention will now be explained in more detail with reference to the drawing, in which:

Figures 1-7 schematically show a few embodiments of a spatial structure according to the invention. For a better understanding of the invention, like parts will be indicated by identical numerals in the description of the figures below.

**[0016]** In figure 1, numeral 10 indicates a spatial structure according to a first embodiment, which is built up of a reinforcing layer 11 to be arranged over an inflatable form 12 that can be placed on a support surface 1.

**[0017]** According to the invention, the inflatable support body 12 is made up of several, three in this embodiment, inflatable support elements 12a-12c. The inflatable support elements 12a-12c may have identical dimensions but also mutually different dimensions in order to thus realise random, irregular shapes of the spatial struc-

ture. According to the invention, the reinforcing layer 11, which is provided with a net structure, is tensioned over the inflatable support body 12 and fastened down near the ends or edges 11a-11c. In this way it is possible to realise not only a convex (synclastic) shape at the location where the reinforcing layer 11 is arranged over the inflatable support elements 12a and 12c, but also a concave (anticlastic) shape, as is indicated at 11 b in figure 1.

[0018] By subsequently applying a curable substance, such as a grout, a polymer resin or ice, to the pre-tensioned net structure 11, a self-supporting spatial structure can be realised, after which the various inflatable support elements 12a-12c can be deflated and be removed from the spatial structure.

[0019] A different shape of a spatial structure is shown in figure 2, in which the inflatable support body 12 is made up of four inflatable support elements 12a-12d, so that a more complex spatial structure can be realised by fastening down the tensioned reinforcing layer 11 at the edges 11a-11c. Also in this embodiment the spatial structure comprises a number of convex (synclastic) portions as well as a few concave (anticlastic) portions 11 b.

[0020] A similar embodiment comprising four inflatable support elements 12a-12d is disclosed in figure 3.

[0021] Figure 4 discloses yet another, more symmetric spatial structure made up of three inflatable support elements 12a-12c to obtain a convex shape alternated with a concave (anticlastic) shape 11 b-11 b'.

[0022] It will be understood that the construction according to the invention makes it possible to realise more functional and more complex spatial structures.

[0023] Thus, figures 5 and 6 show embodiments in which the reinforcing layer in the form of a net structure is deformed in outward direction by a pillar 20 (figure 5) or a post 20 (figure 6).

[0024] Although the shape of the spatial structure of the illustrated embodiments is realised by the shapes of the support elements on the one hand and by fastening down the tensioned reinforcing layer at the edges 11 a-11 b on the other hand, it is also possible to influence the shapes by creating lines of tension in the reinforcing layer 11, for example by providing the reinforcing layer with cables 20, which are tensioned somehow or other, for example pulled upwards or downwards, as is shown in figure 7.

## Claims

1. A spatial structure built up of:

- a support body to be placed on a support surface;
- a reinforcing layer to be arranged over the support body; and
- a curable substance to be poured over the reinforcing layer,

**characterised in that** the support body is made up of several support elements, and **in that** the reinforcing layer comprises a net structure, which has been pre-tensioned to a specific surface contour, with the inflatable support elements giving the reinforcing layer its shape.

2. A spatial structure according to claim 1, **characterised in that** at least one support element is furthermore configured as a membrane that can be inflated with a medium.

3. A spatial structure according to claim 1 or 2, **characterised in that** the pre-tensioned surface contour comprises at least the minimum surface area between one or several surface points and/or one or several surface lines.

4. A spatial structure according to any one or more of the preceding claims, **characterised in that** the pre-tensioned surface contour of the reinforcing layer is different from the surface contour of said minimum surface area as a result of its own weight, an uneven distribution of the tensions in the reinforcing layer or of external forces exerted on the reinforcing layer and the dimensions and the direction of the meshes of the net and the form of the net.

5. A spatial structure according to any one or more of the preceding claims, **characterised in that** there are one or more lines of tension in the pre-tensioned surface contour.

6. A spatial structure according to claim 5, **characterised in that** said at least one line of tension creates a deformation in the reinforcing layer towards or away from the support elements.

7. A spatial structure according to claim 5, **characterised in that** the reinforcing layer is provided with one or more tensionable cables incorporated in the reinforcing layer.

8. A spatial structure according to any one or more of the preceding claims, **characterised in that** the reinforcing layer is tensionably attached to the support surface.

9. A spatial structure according to any one or more of the claims 1-8, **characterised in that** the curable substance is a grout, for example concrete.

10. A spatial structure according to any one or more of the claims 1-8, **characterised in that** the curable substance is a synthetic material, for example a polymer resin.

11. A spatial structure according to any one or more of

the claims 1-8, **characterised in that** the curable substance is ice.

- 12.** A method for constructing a spatial structure, comprising the steps of:

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i) placing an inflatable support body on a support surface;

ii) arranging a reinforcing layer over the inflatable support body;

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iii) inflating the inflatable support body with a medium under pressure;

iv) pouring a curable substance on top of the reinforcing layer, and

v) forming a surface contour counteracting the shape of the inflated support body in the reinforcing layer configured as a net structure prior to the execution of step iii).

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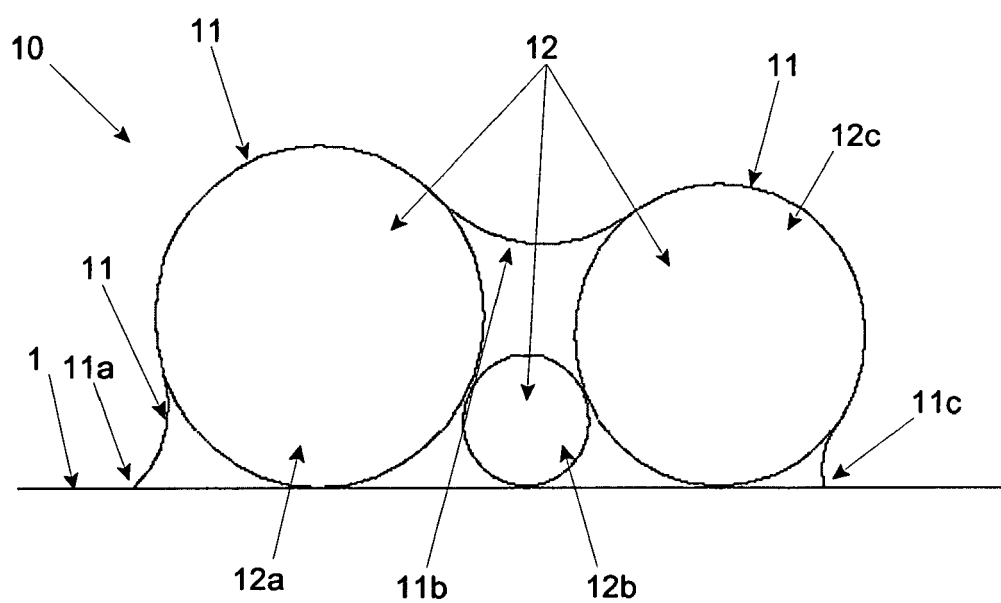


Fig. 1

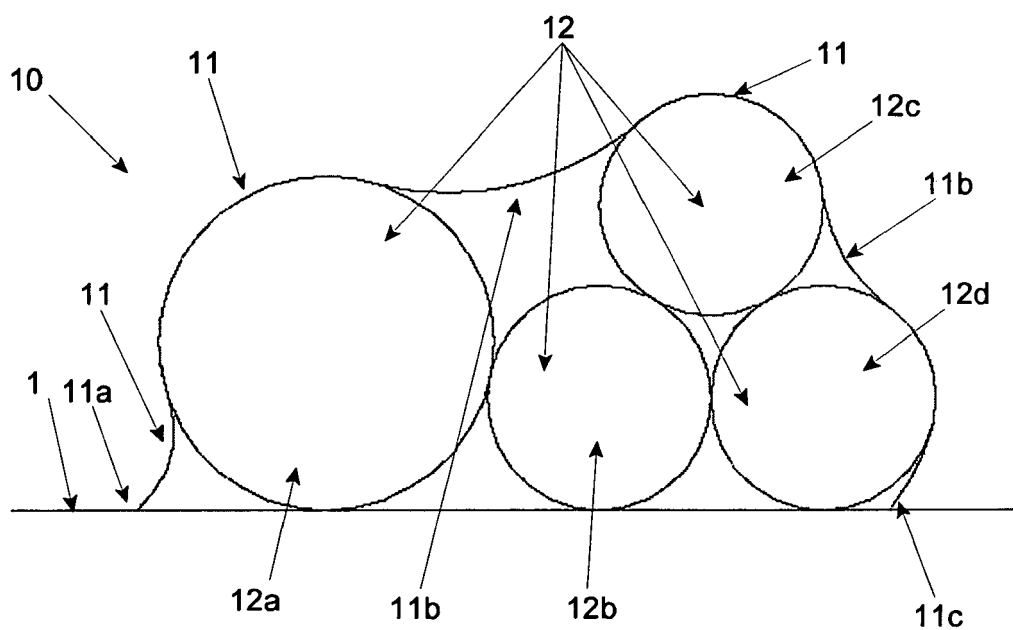


Fig. 2

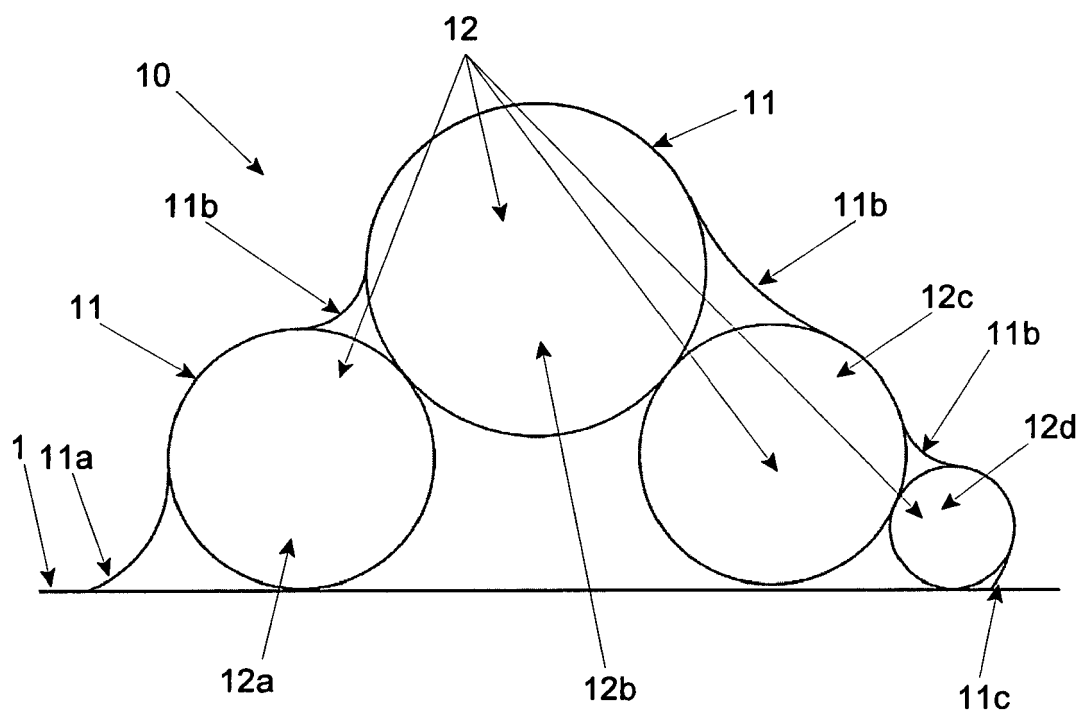


Fig. 3

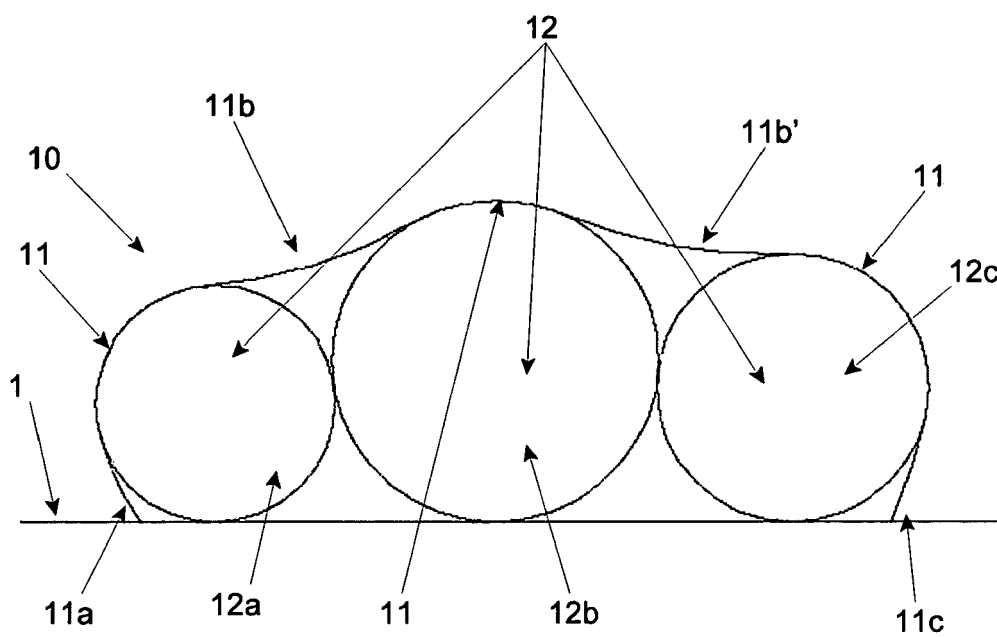


Fig. 4

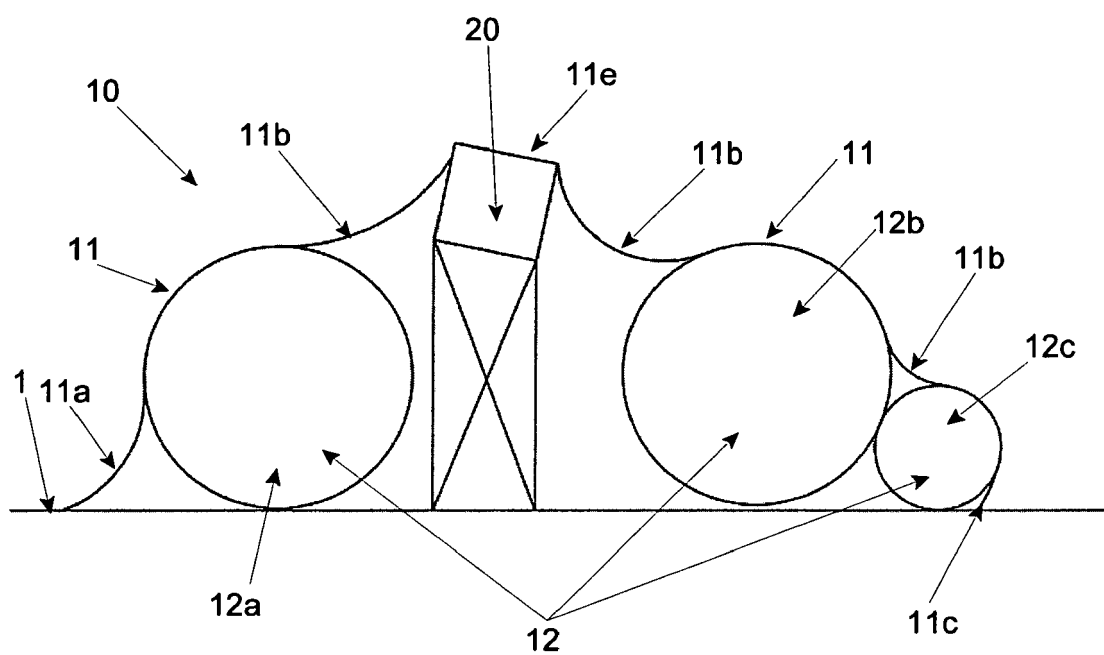


Fig. 5

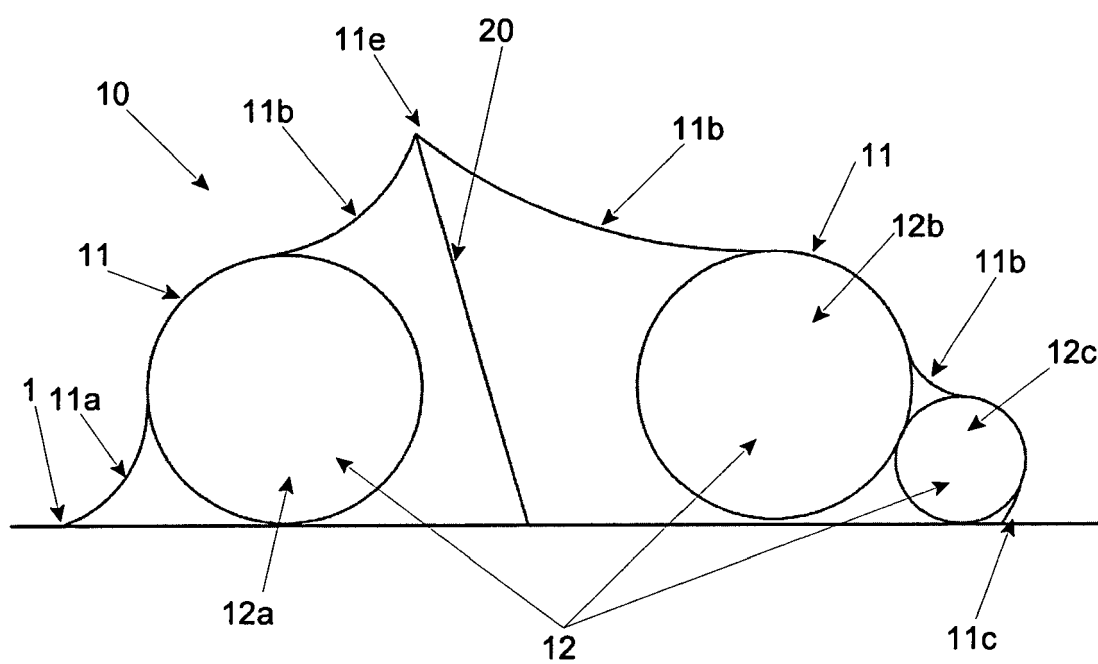


Fig. 6

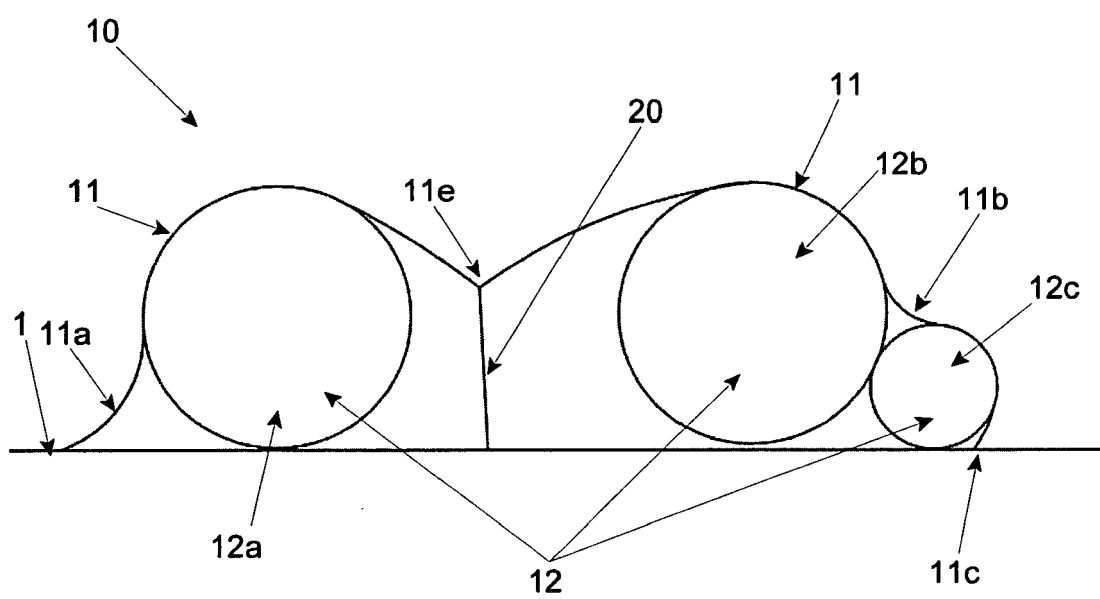


Fig. 7



European Patent  
Office

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Application Number  
EP 07 07 5873

| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                             |                                                    |                                         |
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| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone<br/>Y : particularly relevant if combined with another document of the same category<br/>A : technological background<br/>O : non-written disclosure<br/>P : intermediate document</p> <p>T : theory or principle underlying the invention<br/>E : earlier patent document, but published on, or after the filing date<br/>D : document cited in the application<br/>L : document cited for other reasons<br/>&amp; : member of the same patent family, corresponding document</p> |                                                                                                                             |                                                    |                                         |

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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