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(71) Applicant *(for all designated States except US)*: **CUBIT OY** [FI/FI]; Utinkatu 85, FI-45200 Kouvola (FI).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **TIRRONEN, Soili** [FI/FI]; Utinkatu 85, FI-45200 Kouvola (FI). **GARCIA ZORRILLA, Viviana** [MX/FI]; Rukkilantie 7 A 9, FI-00410 Helsinki (FI). **JAAKKONEN, Liisa** [FI/FI]; Neulastie 8 as. 12, FI-45200 Kouvola (FI). **KIVELÄ, Terhi** [FI/FI]; Mustanlahdenkatu 1 B 104, FI-33210 Tampere (FI). **PIETILÄ, Hanna** [FI/FI]; Tanhuankatu 20 as. 5, FI-37130 Nokia (FI). **KOPONEN, Joonas** [FI/FI]; Kalevankatu 4 B 18, FI-45100 Kouvola (FI). **PYHÄLAMMI, Päivi** [FI/FI]; Poutamäentie 11 B 20, FI-00360 Helsinki (FI). **VUORIVIRTA, Anne** [FI/FI]; Haminantie 26, FI-46900 ANJALANKOSKI (FI).

(74) Agent: **PAPULA OY**; P.O. Box 981, (Fredrikinkatu 61 A), FI-00101 Helsinki (FI).

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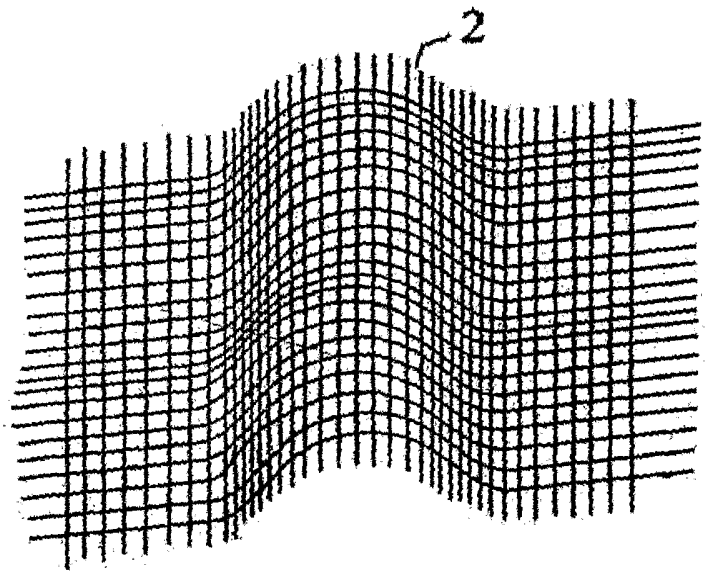
(54) Title: METHOD FOR FORMING A PREDETERMINED PATTERN IN AN OPTICAL FIBRE TEXTILE AND AN OPTICAL FIBRE TEXTILE



(57) Abstract: The present invention relates to a method for forming a predetermined pattern in an optical fibre textile, in which method a permanent predetermined three-dimensional pattern deviating from the plane of the optical fibre textile is formed in the optical fibre textile by changing the optical properties of the optical fibres by means of heating and shaping so that the optical fibres partly permeate the light being conducted in them in the predetermined pattern for illuminating the pattern. Further, the present invention relates to an optical fibre textile having a predetermined pattern formed therein.

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METHOD FOR FORMING A PREDETERMINED PATTERN IN AN OPTICAL FIBRE TEXTILE AND AN OPTICAL FIBRE TEXTILE

The invention relates to a method as defined in the preamble of claim 1 for forming a predetermined pattern in an optical fibre textile and an optical fibre textile as defined in the preamble of claim 10.

PRIOR ART

An optical fibre textile is used to mean a fabric, a woven fabric, a knitted fabric, a yarn, a fibre, a rope and/or any other similar material which partly or wholly uses an optical fibre in making the material. An optical fibre can be used as a warp and/or as a weft in making an optical fibre textile. Apart from the optical fibre, an optical fibre textile may contain any other material conventionally used in a textile.

An optical fibre is used to mean any element used to carry optical power, such as light. Optical fibres can be used e.g. for illumination or for displaying a bulletin so that light is conducted from a light source to the fibre from the first end thereof, and is conducted through the fibre at the opposite end of the fibre to a predetermined point where one wishes to conduct the light.

Known in prior art is to form patterns on a surface formed by optical fibres. Known in prior art is also to break the surface of optical fibres, to change their optical properties in a predetermined spot so that the optical fibres permeate light in the aforementioned spot, enabling illumination of a predetermined pattern. Previously, sandblasting has been used to break the surface of optical fibres and to form a predetermined pattern. In addition, known from US publication 3,508,589 is a textile product with op-

tical fibres being placed in a textile structure and with spots on the surface of the fibre, achieved by heating, from which the light is released.

A problem with the prior-art methods and in particular with sandblasting is that the method also damages the textile area around the pattern. By heating it is possible to achieve a change in the optical properties of an optical fibre, but the pattern thus formed cannot be precisely formed so that the contours of the pattern would be distinctly defined.

The objective of the present invention is to eliminate the drawbacks referred to above.

One specific objective of the invention is to disclose a novel and simple method for forming a predetermined, permanent pattern in an optical fibre textile. The objective of the invention is to disclose a method that enables one to form an accurate three-dimensional pattern deviating from the plane of the optical fibre textile in an optical fibre textile. Further, the objective of the invention is to disclose a rollable and foldable optical fibre textile having an accurately defined predetermined pattern whose colour and illuminance can be varied by controlling the light source that conducts light to the optical fibres.

SUMMARY OF THE INVENTION

The method of the invention for forming a predetermined pattern in an optical fibre textile is characterised by what has been presented in the claims.

The invention is based on a research work carried out in which it was surprisingly found that it is possible to form even very accurate predetermined patterns in an optical fibre textile partly or wholly formed from optical fibres by suitably heating and

shaping the optical fibre textile. The predetermined pattern may be in the form of a symbol, a letter, a text, an arrow, a straight line, a circle, a rectangle and/or any other graphic image and/or figure.

In the method of the present invention for forming a predetermined pattern in an optical fibre textile, a predetermined permanent three-dimensional pattern deviating from the plane of the optical fibre textile is formed in the optical fibre textile by changing the optical properties of the optical fibres by means of heating and shaping so that the optical fibres partly permeate the light being conducted in them in the predetermined pattern for illuminating the pattern. The method of the present invention can be used to form in an optical fibre textile various illuminated patterns having a predetermined shape.

An optical fibre textile can be heated so that the optical properties of the optical fibres do not substantially change due to heating. In other words, the structure of the optical fibre textile does not substantially weaken. During the heating it is possible to modify the optical fibres and the optical fibre textile so that the optical fibres and the optical fibre textile can be shaped, e.g. moulded by means of a mould. After this, the optical properties of optical fibres can be changed while at the same time shaping a three-dimensional pattern deviating from the plane, the shaping of an optical fibre textile enabling one to form definite confines of a predetermined pattern. When shaping, i.e. bending the optical fibre textile, breakage is taking place due to the bending, emphasizing the contours of the three-dimensional shape.

The optical properties of optical fibres can also be changed by heating the optical fibre textile. The optical properties of optical fibres can also be changed by means of the combination of heating and

shaping the optical fibre textile, i.e. by means of a combined effect.

When heating an optical fibre textile, the amount of the heat being used and the temperature can be adjusted so that the optical properties of the optical fibres can be adjusted at the same time. By adjusting the optical properties of optical fibres it is also possible to accurately adjust the amount of light being released from the optical fibres and thus also the illumination of a predetermined pattern. The optical properties of optical fibres can be adjusted so that they permeate different amounts of light in the different spots of the pattern made in the optical fibre textile.

To heat an optical fibre textile, any conventional heat forming source can be used. Also the shaping element, such as a mould, to be used to shape an optical fibre textile can function as a heat source. Preferably, the optical fibre textile is heated to a temperature of 75°C-260°C. However, the temperature may vary for each case specifically, depending on the material and properties of the optical fibre being used. An optical fibre textile cannot be heated to too high a temperature so that the structures of the optical fibres will not be damaged so that the light being conducted in them does not propagate in the desired manner.

An optical fibre textile can be shaped by using vacuum moulding, overpressure moulding, mechanical compression, pressing and/or any other similar procedure for forming a predetermined three-dimensional pattern deviating from the plane in an optical fibre textile. To shape an optical fibre textile it is possible to use moulds, counterparts and/or any other similar elements used for shaping an article. The three-dimensional pattern can conform to any predetermined relief of surface.

In forming a predetermined pattern in an optical fibre textile it is possible to use a protective film on the surface of the optical fibre textile. The protective film can be placed on the surface of the optical fibre textile prior to heating and shaping the optical fibre textile. The protective film can be e.g. a coloured, transparent and/or patterned plastic film. Apart from protecting against malicious damage and dirt, the protective film can function as a so-called counterpart of the mould when shaping an optical fibre textile e.g. using vacuum moulding. In this case, the protective film prevents the air from flowing through the optical fibre textile. The optical fibre textile can also be protected using other materials such as resins and/or any other coatings suitable for protecting an optical fibre textile.

Further, the present invention relates to an optical fibre textile having a predetermined pattern formed therein using the method in accordance with the present invention. The optical fibre textile may have been further treated so that on the opposite sides of one edge thereof, mouldings have been glued for attaching the ends of the optical fibre textile and enabling their equalising so that the optical fibres of the optical fibre textile receive the light being conducted to them from the light source.

The mouldings to be glued to the opposite sides of one edge of the optical fibre textile can be stiff or flexible.

After gluing the mouldings, the ends of the optical fibre textile can be equalised, e.g. smoothed or polished so that the optical fibres of the optical fibre textile are capable of receiving the light being conducted to them. The edge of the optical fibre textile can alternatively be cut e.g. with a laser beam in the manufacturing phase.

The light sources can be so arranged that one light source produces and conducts light to one optical fibre of the optical fibre textile. Alternatively, the light sources can be so arranged that one light source produces and conducts light to several optical fibres of the optical fibre textile. Densely placed light sources can produce light to several optical fibres without e.g. bending and placing the optical fibre textile, or bundling the optical fibres in the light source, which would harm the properties thereof.

The light source to be attached to an optical fibre textile can be any light source suitable for illuminating an optical fibre textile.

In one embodiment of the invention, the light source is a LED component. Apart from producing light, the use of LED components enables the bending and rolling of the optical fibre textile. The LED component can be round in shape having e.g. a diameter of 5 mm. Alternatively, the LED component can be elongated so that it is capable of conducting light to several optical fibres of the optical fibre textile. The LED components can be switched e.g. to a film circuit board which is used to conduct the operating voltage to the LED components. The LED components can also be switched to any other unit that conducts operating voltage.

The light sources attached to an optical fibre textile, such as LED components, can be controlled e.g. one at a time so that different light sources are turned on and off at different moments of time. In this manner it is possible to control a pattern formed in an optical fibre textile. In the same manner it is also possible to control the illumination and colour of the pattern at different moments of time.

Further, the edge of the optical fibre textile, which has been treated in a manner referred to

above, can be used as the suspension rail of the optical fibre textile.

Substantial in the invention is the accurate and controlled treating of the optical fibre so that its optical properties, i.e. light conducting properties, are not damaged; instead they are made suitably weaker so that the formed patterns are illuminated throughout their entire area in the desired manner.

An advantage of the method of the invention compared to prior-art methods is that by heating and shaping an optical fibre textile including optical fibres in the predetermined spots thereof it is possible to achieve, more accurately and carefully, permanent predetermined three-dimensional patterns deviating from the plane on the surface of an optical fibre textile. The invention further has the advantage that the edges of the pattern formed in the optical fibre textile are very definite and precise. Further, the method of the invention has the advantage that solely the predetermined spots of the optical fibre textile are treated, whereby the rest of the textile remains untreated and undamaged.

Further, the optical fibre textile treated with the method in accordance with the present invention has the advantage that it can be used in various different embodiments such as providing information such as a guide, in interior decoration, as a work of art or a part thereof, as a decoration, in implementing mood lightning and/or in any other similar embodiment. It is possible to conduct to the optical fibres of an optical fibre textile lights of any colour. By conducting light from the light source to the optical fibres of an optical fibre textile in accordance with the invention and by controlling the light being conducted from the light source it is possible to accurately and simply adjust e.g. the illuminance of the formed optical fibre textile and the predetermined

pattern thereof. By controlling the light being conducted from a light source one can give the impression of a moving pattern. A further advantage is that by shaping an optical fibre textile using the method in accordance with the invention it is possible to form illuminating surfaces having the desired predetermined shape in places such as interior decoration of cars, for which e.g. standard sized light fitting is unsuited.

LIST OF FIGURES

In the following section, the invention will be described in detail by means of embodiment examples with reference to accompanying drawings, in which

Figs. 1a and 1b illustrate one embodiment of the present invention for forming a predetermined pattern in an optical fibre textile;

Fig. 2 represents an optical fibre textile formed in accordance with one embodiment of the present invention in a permanent predetermined pattern;

Fig. 3 is an image illustrating an optical fibre textile including optical fibres that has been treated using the method in accordance with the present invention; and

Figs. 4a and 4b schematically represent an optical fibre textile in accordance with one embodiment of the present invention having mouldings glued to one edge thereof, and light is conducted to the optical fibres of the optical fibre textile from a light source.

DETAILED DESCRIPTION OF THE INVENTION

Figs. 1a and 1b illustrate the treatment of an optical fibre textile in accordance with one embodiment of the present invention.

Figs. 1a and 1b show a procedure in accordance with one embodiment of the present invention for forming a pattern in an optical fibre textile. The optical fibre textile presented in Figs. 1a and 1b may have been formed in a manner as presented in Figs. 4a and 4b. In other words, if desired, one edge of the optical fibre textile 2, i.e. the one from which one wishes to conduct light to the optical fibres 4 of the optical fibre textile 2, may have been so treated that mouldings 5a, 5b have been glued to the opposite sides of the edge for attaching the ends of the optical fibre textile. The mouldings can be stiff or flexible according to the target of application. After this, the attached ends have been equalised by using e.g. a laser so that the optical fibres 4 of the optical fibre textile 2 are capable of receiving light being conducted to them. For example, after the formation of a predetermined pattern, light sources 6a, 6b, 6c, 6d, 6e, herein LED components, which are used to produce light to the aforementioned optical fibres 4, can be attached to the fastened and equalised ends of the optical fibres 4 of the optical fibre textile 2. In the embodiment as shown in Fig. 4b, one LED component 6a, 6b, 6c, 6d, 6e produces light to three optical fibres 4.

In Figs. 1a and 1b, an optical fibre textile 2 partly formed from optical fibre is placed on top of a predetermined mould 3. Furthermore, on top of the optical fibre textile there is placed a protective film 1, which may be e.g. a transparent plastic film. The plastic film 1 can function as an element preventing air flow when using vacuum pressure for shaping the optical fibre textile. The plastic film 1 can also be left on the surface of the optical fibre textile 2 to protect the optical fibre textile 2 e.g. against dirt.

In the embodiments as shown in Figs. 1a and 1b, the optical fibre textile 2 and protective film 1 are heated and shaped by means of a predetermined mould 3 so that the optical properties of the optical fibres change, i.e. their structure is damaged, while forming a three-dimensional pattern deviating from the plane. In this embodiment, heat is conducted to the optical fibre textile via the mould 3 for treating a particular, limited, predetermined spot in the optical fibre textile. The optical fibre textile can be heated e.g. to a temperature of 75-260°C.

After this, the optical fibre textile 2 and the protective film 1 on the surface thereof are left to cool, thereby obtaining in the optical fibre textile a predetermined three-dimensional pattern deviating from the plane thereof. As the structure of the optical fibres changes, the optical fibres partly permeate the light being conducted in them, and an illuminated pattern is formed in the optical fibre textile in this manner (Figs. 2 and 3).

In the optical fibres of an optical fibre textile 2 one can conduct e.g. coloured such as green light. By controlling the light source of the light being conducted in an optical fibre one can give an impression of a moving pattern. The sharper shapes of a pattern of an optical fibre textile emphasize the breakage of the surface of an optical fibre, and light is released more abundantly from the optical fibre.

The invention is not limited merely to the embodiment examples referred to above; instead many modifications are possible within the scope of the inventive idea defined by the claims.

CLAIMS

1. A method for forming a predetermined pattern in an optical fibre textile, characterised in that a permanent predetermined three-dimensional pattern deviating from the plane of the optical fibre textile is formed in the optical fibre textile by changing the optical properties of the optical fibres by means of heating and shaping so that the optical fibres partly permeate the light being conducted in them in the predetermined pattern for illuminating the pattern.

2. The method as defined in claim 1, characterised in that the optical fibre textile is heated so that the properties of the optical fibres do not substantially change during the heating.

3. The method as defined in claim 1, characterised in that the optical properties of the optical fibres are changed by heating the optical fibre textile.

4. The method as defined in any one of claims 1-3, characterised in that the optical properties of the optical fibres are changed by shaping the optical fibre textile.

5. The method as defined in any one of claims 1-4, characterised in that the amount of heat and the temperature are adjusted when heating the optical fibre textile for adjusting the optical properties of the optical fibres and the amount of light being emitted from the optical fibres in the different sections of the pattern.

6. The method as defined in any one of claims 1-5, characterised in that the optical fibre textile is heated to a temperature of 75°C-260°C.

7. The method as defined in any one of claims 1-6, characterised in that the optical fibre textile is shaped using vacuum moulding, overpres-

sure moulding, by mechanically compressing and/or pressing.

8. The method as defined in any one of claims 1-7, c h a r a c t e r i s e d in that a protective film is placed on top of the optical fibre textile prior to heating and shaping the optical fibre textile.

9. The method as defined in any one of claims 1-8, c h a r a c t e r i s e d in that the predetermined pattern is in the form of a symbol, a letter, a text, an arrow, a straight line, a curve, a circle and/or a rectangle.

10. An optical fibre textile having a predetermined pattern formed therein in accordance with the method as defined in any one of claims 1-9.

11. The optical fibre textile as defined in claim 10, c h a r a c t e r i s e d in that on the opposite sides of one edge of the optical fibre textile (2), mouldings (5) have been glued for attaching the ends of the optical fibre textile (2) and enabling their equalising so that the optical fibres (4) of the optical fibre textile (2) receive the light being conducted to them from a light source (6).

12. The optical fibre textile as defined in claim 10 or 11, c h a r a c t e r i s e d in that the light source (6) conducts light to one or more optical fibres (4) of the optical fibre textile (2).

13. The optical fibre textile as defined in any one of claims 10-12, c h a r a c t e r i s e d in that the light source (6) is an LED component.

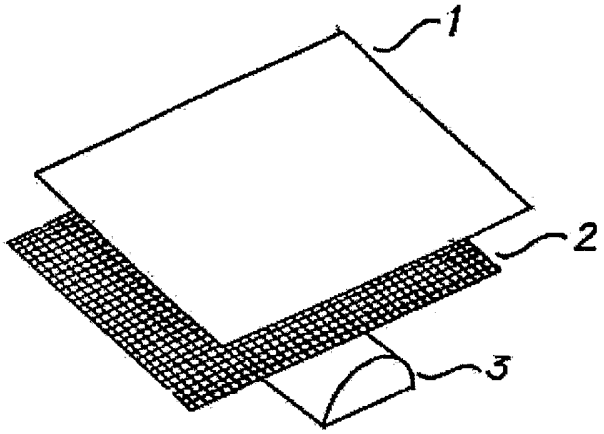

Fig. 1a

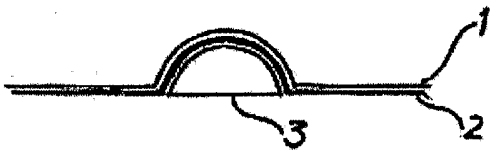

Fig. 1b

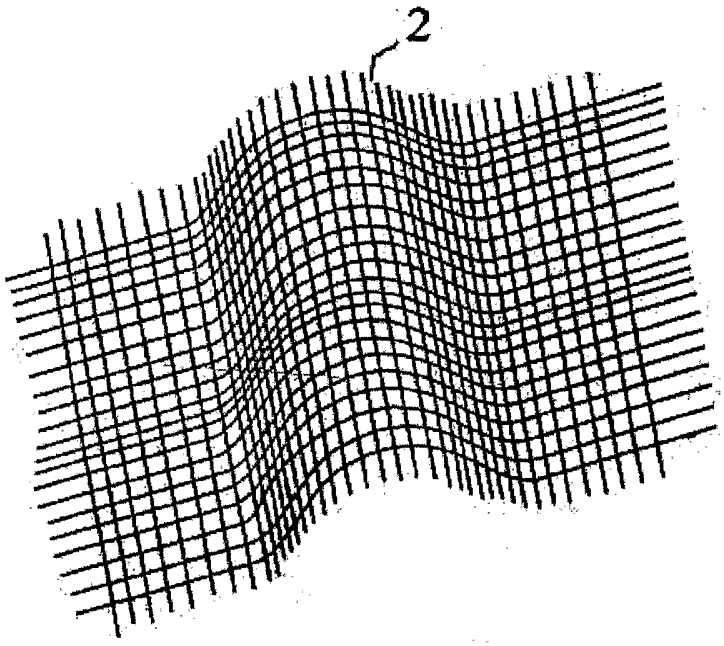

Fig. 2

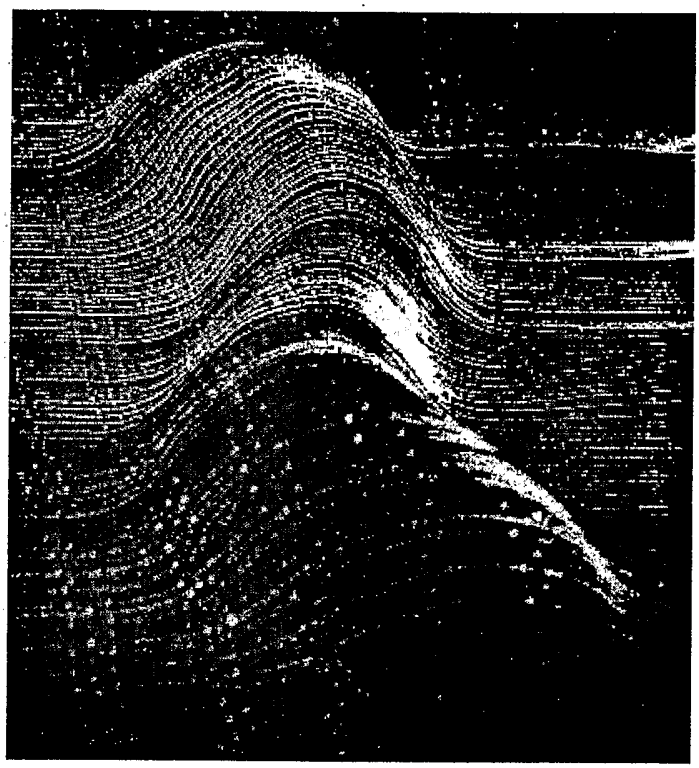

Fig. 3

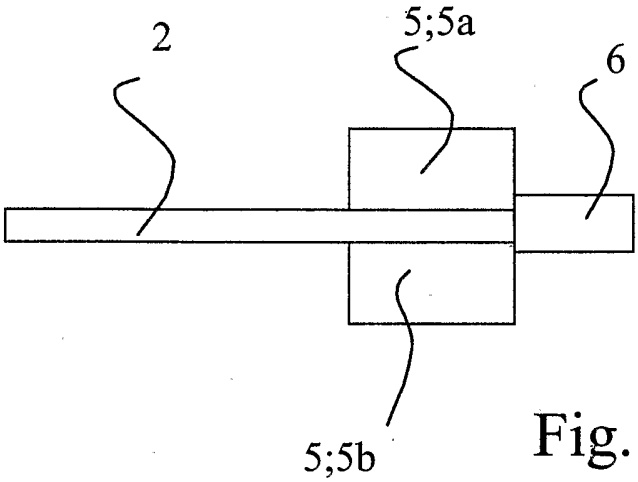

Fig. 4a

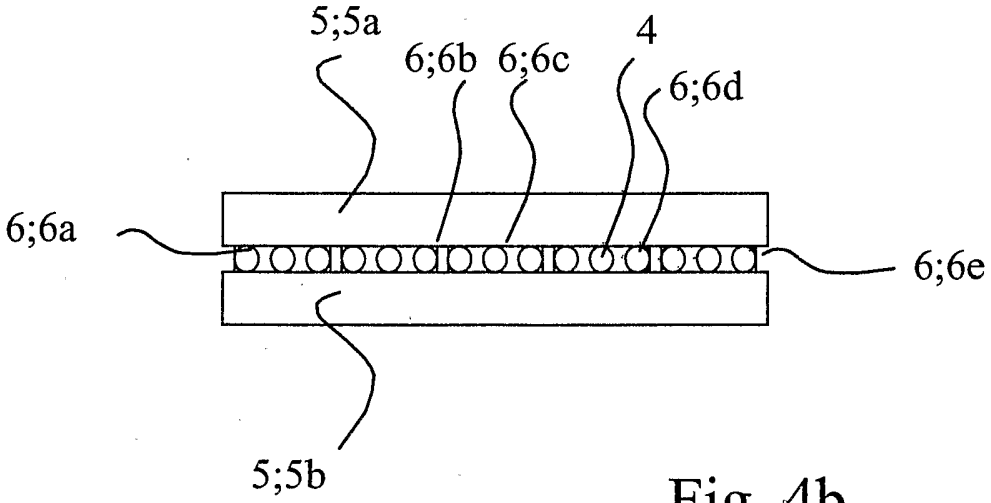

Fig. 4b

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 2004/000702

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D03D 15/00, G02B 6/00
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)

IPC7: D03D, G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL,WPI,PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3508589 A (B.N.DERICK ET AL), 28 April 1970 (28.04.1970), abstract ---	1-13
A	US 5709448 A (K.L.JENNINGS ET AL), 20 January 1998 (20.01.1998), abstract ---	1-13
A	US 4885663 A (J.R.PARKER), 5 December 1989 (05.12.1989), abstract ---	1-13

[X] Further documents are listed in the continuation of Box C. [X] See patent family 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 application or patent but published on or after the international filing date
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"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
16 March 2005	17 -03- 2005
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Åsa Malm /itw Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 2004/000702

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DATABASE WPI week198826 Derwent Publications Ltd.,London,GB; Class A94,an1988-180039 & JP 63118102(TOYM)TOYOBO KK, 23 May 1988 (1988-05-23) abstract -- --------	1-13

US	3508589	A	28/04/1970	BE	722890	A	01/04/1969
US	5709448	A	20/01/1998	NONE			
US	4885663	A	05/12/1989	US	4907132	A	06/03/1990