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(71) Applicant: **Fundacio Cetemmsa**
08302 Mataro Barcelona (ES)

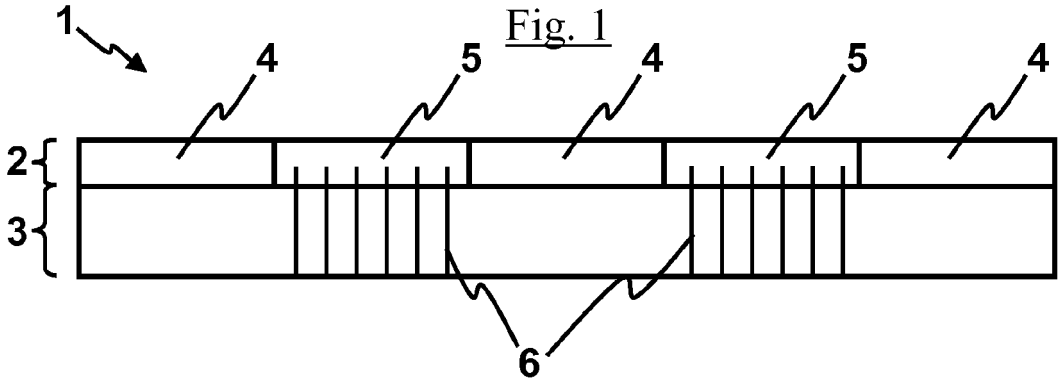
(72) Inventors:
- **Torrent Poch, Marc**
  08302 Mataró (ES)
- **Planaguma Vila, Jordi**
  08302 Mataró (ES)
- **Perez Saez, Carlos**
  08302 Mataró (ES)
- **Garcia-Milá Mateu, Meritxell**
  08302 Mataró (ES)
- **Santana Roma, Urbez**
  08302 Mataró (ES)

(74) Representative: **Oficina Ponti, SLP**
C. Consell de Cent, 322
08007 Barcelona (ES)

(54) Fabric product and sensing fabric made thereof

(57) Fabric product 1 comprising a top layer 2 and a lower layer 3, the top layer 2 comprising a series of alternate insulating strips 4 and conductive strips 5, the bottom layer 3 having low conductivity properties, which comprises cross-yarns 6 of low conductivity material extending from the bottom layer 3 to the conductive strips 5 of the top layer 2.

Fig. 1



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Description

[0001] The present invention relates to a fabric destined to be used in a fabric sensor, that can be made in a single process and obtained as a single product.

BACKGROUND OF THE INVENTION

[0002] The state of the art comprises many fabric products comprising a top layer and a lower layer, and an intermediate nonconductive layer therebetween, such that when pressing the layers towards each other, its electrical properties change at the pressure points, and a sensor is obtained.

[0003] Such structure is found, for example in EP1756538, which discloses a textile pressure sensor with a flexible design which can be adapted to different shapes of load and comprising a sandwich construction with electrodes at each side of a central compressible layer. The compressible layer has a reversible effect and is applied onto a flexible base electrode layer and is covered by an insulating layer. The sensor is completed by a pattern of flexible electrodes of selected shapes applied to the insulating layer and with each electrode with a separate connection to a processor.

[0004] As another example, GB2443208 discloses a textile pressure sensing element constructed from electro-conductive yarns as a single sheet of fabric. The elements include multiple compressible junctions, each junction comprising two overlapping electro-conductive yarns separated by a gap. The gap is filled with a resilient compressible material. The sensor may be a capacitive sensor where the gap is filled with a dielectric material. By measuring the capacitance of the overlapping conductors the size of the gap, and thus the force applied to the junction is measured in order to determine pressure. Alternatively the sensor may be a resistive sensor where the gap is filled with a compressible conductive material whose resistance varies with compression, and resistance is measured to determine applied force. CA2665555 discloses a capacitance pressure mapping system which includes a plurality of sensor cells created by the intersection of electrode columns and rows, and a solid elastomer dielectric separating the electrode columns and rows.

[0005] All those sensing fabrics have the drawback of having a complex configuration and complex manufacturing process, that is, are multiple processes.

[0006] On the other hand, there are many heating fabrics belonging to the state of the art, and that are related to some embodiments of the present invention.

[0007] US7712826, EP2204482, W02011117413 and EP2108724 disclose a heating fabrics, some of them specially designed for vehicle seats.

[0008] However, none of the preceding documents discloses fabric sensors provided with heating function, and that can be obtained in a single process.

DESCRIPTION OF THE INVENTION

[0009] To overcome the above-mentioned drawbacks, the present invention proposes a fabric product comprising a top layer and a lower layer, the top layer comprising a series of alternate insulating strips and conductive strips, the bottom layer having low conductivity properties, **characterised in that** it comprises cross-yarns of low conductivity material extending from the bottom layer to the conductive strips of the top layer.

[0010] This fabric can be made in a warp knitting machine, i.e., in a single process, and provides for the basic part of a sensing fabric, when a third conductive layer equal to top layer is added at the bottom of the lower layer. This conductive surface could be the fabric itself, as shown below and claimed in claim 12.

[0011] Preferably, the fabric product comprises an intermediate layer having low conductivity or insulating properties knitted with the top layer and the lower layer, the cross yarns extending through said intermediate layer. In this case, the fabric can be a spacer warp knitting machine too.

[0012] This intermediate layer ensures a positive relation between pressure and conductivity, such that the sensor made with the fabric is able to measure electrical response in a direct relation with the applied pressure with high dimensional stability.

[0013] The inventive fabric can have the following optional features, taken alone or in combination:

- the top layer comprises a series of alternate insulating strips, conductive strips and heating strips, the insulating strips being inserted between the conductive strips and the heating strip, thus providing for a multi-functional fabric. Its capabilities can be further enhanced by relating, by means of a control system, both functions, for example for heating conditioned to pressure.
- the heating strips are made of polyester and acerinox, or copper-plated or copper-silver or carbon, or any polymeric, ceramic or metallic conductive material yarns).
- the insulating strips are made of polymeric yarns.
- the conductive strips are made of copper-plated or copper-silver, or any polymeric, ceramic or metallic conductive material.
- the cross-yarns have a nylon core coated with carbon particles or any yarn with piezoresistive properties.
- all the layers are preferably made of multi-filaments yarns.
- the intermediate layer of the spacer fabric is preferably made of monofilament yarns.

[0014] A second object of the invention is a sensing fabric comprising two inventive fabrics as set above, wherein the two fabrics are placed with the lower layers of both fabrics in contact, the strips of the two fabrics

being non-parallel, and preferably perpendicularly arranged.

[0015] Another object of the invention is a seat, mattress or floor provided with the latter sensing fabric.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] For a better understanding of the aforementioned, drawings are attached wherein, schematically and only by way of non-limitative example, several practical embodiments are represented.

Figure 1 is a schematic cross-section of a fabric according to a first embodiment of the invention.

Figure 2 is a schematic cross-section of a fabric according to a second embodiment of the invention.

Figure 3 is a schematic cross-section of a fabric according to a third embodiment of the invention.

Figure 4 is a schematic cross-section of a fabric according to a fourth embodiment of the invention.

Figure 5 is yarn diagram for a single bar Raschel machine Fabric, that provides for a warp knitted fabric.

Figure 6 is a yarn diagram for a double bar Raschel machine Fabric, that provides for a spacer warp knitted fabric

DESCRIPTION OF PREFERRED EMBODIMENTS

[0017] As shown in Figs. 1 to 4, the invention relates to a fabric product 1 comprising a top layer 2 and a lower layer 3, the top layer 2 comprising a series of alternate insulating strips 4 and conductive strips 5, the bottom layer 3 having low conductivity properties.

[0018] According to a first embodiment shown in Fig. 1, the inventive fabric comprises cross-yarns 6 of low conductivity material extending from the bottom layer 3 to the conductive strips 5 of the top layer 2. This fabric can be made in a single bar Raschel machine.

[0019] This inventive fabric, when arranged on a conductive surface, will behave as a sensor. By establishing a voltage between the conductive surface and the conductive strips and pressing the fabric, the fabric becomes conductive at the pressure points, thus allowing it to be used as a switch or a pressure sensor.

[0020] Specifically, the fabric is structured in different layers, each layer with its material and knitting properties to make the fabric change its electrical properties when pressure applied to it. The top and the bottom layer are conductive and act as electrodes. Between these both conductive layers a certain configuration of yarns with insulating and specific conductivity properties are knitted. When the fabric is not pressed, there is no physical contact between the conductive yarns and the yarns of specific conductivity properties, so that conductivity between both electrodes is zero. When the fabric is pressed, physical contacts between the conductive and these yarns with specific conductivity start to happen and conductivity paths are created. The more pressure applied, the more physical contacts between these yarns, and the higher is the conductivity (lower the resistance).

[0021] According to a second embodiment shown in Fig. 2, the inventive fabric comprises a top layer 2 provided with a series of alternate insulating strips 4, conductive strips 5 and heating strips 8, the insulating strips 4 being inserted between the conductive strips 5 and the heating strips 8.

[0022] The heating function is ensured because conductive yarns increase their temperature when current circulates along them. Specific heating strips with certain conductive yarns are knitted to obtain this function separately from the pressure sensor function. Between both functions - that means, between both strips- insulating strips are knitted to avoid any current circulating between the heating and the sensing yarns.

[0023] According to a third embodiment shown in Fig. 3, the fabric comprises an intermediate layer 7 having low conductivity properties weaved with the top layer 2 and the lower layer 3, the cross yarns 6 extending through said intermediate layer 7. This intermediate layers also avoid a direct contact between the electrode layers to avoid any short circuit.

[0024] According to a fourth embodiment shown in Fig. 4, the inventive fabric comprises a top layer 2 provided with a series of alternate insulating strips 4, conductive strips 5 and heating strips 8, the insulating strips 4 being inserted between the conductive strips 5 and the heating strips 8 and an intermediate layer 7 having low conductivity properties weaved with the top layer 2 and the lower layer 3.

[0025] Another object of the invention is a sensing fabric comprising two fabrics 1 according to any of the inventive embodiments previously described, wherein the two fabrics are placed with the lower layers of both fabrics in contact, the strips of the two fabrics being non-parallel, and preferably perpendicularly arranged, i.e., in an analogous manner as disclosed in CA2665555.

[0026] The sensing fabric can be applied to seats, for example a vehicle seat, a theatre or stadium seat. It can be applied to mattresses or heating floors too.

[0027] In its basic configuration, without an intermediate layer, the sensing fabric can be used in keyboards, button boards or joysticks.

[0028] Figure 4 shows a yarn arrangement that can be carried out with a single bar Raschel machine. Specifically it comprises a multi-filament of bottom layer 3, a cross-yarn with piezoresistive properties 6, a multifilament of intermediate layer 7, a conductive yarn 5, an Insulating yarn 4 and a heating yarn 8.

[0029] Figure 5 shows a yarn arrangement that can be carried out with a double bar Raschel machine, which allow for obtaining a spacer warp knitting fabric, which has to be understood as a fabric with an intermediate that provides for a relatively thick fabric. This one comprises two multi-filaments of bottom layer 3a and 3b, a cross-yarn with piezoresistive properties 6, a monofila-

ment of intermediate layer 7, a conductive yarn 5, an Insulating yarn 4 and a heating yarn 8.

[0030] Although reference has been made to specific embodiments of the invention, it is apparent to one skilled in the art that the fabrics and the sensing fabrics described are susceptible to numerous variations and modifications, and that all the details mentioned can be substituted by other technically equivalent, without departing from the scope of protection defined by the appended claims.

Claims

1. Fabric product (1) comprising a top layer (2) and a lower layer (3), the top layer (2) comprising a series of alternate insulating strips (4) and conductive strips (5), the bottom layer (3) having low conductivity properties, **characterised in that** it comprises cross-yarns (6) of low conductivity material extending from the bottom layer (3) to the conductive strips (5) of the top layer (2).

2. Fabric product according to claim 1, comprising an intermediate layer (7) having low conductivity or insulating properties weaved with the top layer (2) and the lower layer (3), the cross yarns (6) extending through said intermediate layer (7).

3. Fabric product according to claim 2, said product (1) being a warp knitting technology.

4. Fabric product according to claim 2, said product (1) being a spacer warp knitting technology.

5. Fabric according to any of the previous claims, wherein the top layer (2) comprises a series of alternate insulating strips (4), conductive strips (5) and heating strips (8), the insulating strips (4) being inserted between the conductive strips (5) and the heating strips (8).

6. Fabric according to claim 5, wherein the heating strips (8) are made of polyester and Acerinox, or copper-plated or copper-silver or carbon, or any polymeric, ceramic or metallic conductive material yarns).

7. Fabric according to any of the previous claims, wherein the insulating strips (4) are made of Polymeric yarn.

8. Fabric according to any of the previous claims, wherein the conductive strips (5) are made of copper-plated or copper-silver or carbon, or any polymeric, ceramic or metallic conductive material.

9. Fabric according to any of the previous claims, wherein the cross-yarns (6) have a polymeric core coated with carbon particles or any yarn with piezoresistive properties or any yarn with specific conductive properties.

10. Fabric according to any of the preceding claims, wherein any layer (3) is made of multi-filament yarns.

11. Fabric according to claim 2 or claim 4, wherein the intermediate layer (7) is made of monofilament yarns.

12. Sensing fabric comprising a fabric according to any of the preceding claims with the bottom layer in contact with a conductive surface.

13. Sensing fabric comprising two fabrics according to any of claims 1 to 11, wherein the two fabrics are placed with the free surfaces of the bottom layer in contact, the strips of the two fabrics being non-parallel, and preferably perpendicularly arranged.

14. Seat provided with a sensing fabric according to claim 10.

15. Mattress provided with a sensing fabric according to claim 10.

Fig. 1

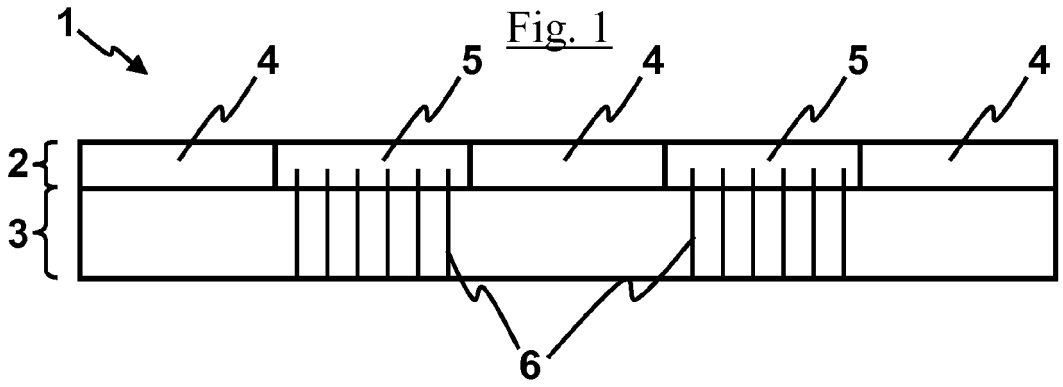


Fig. 2

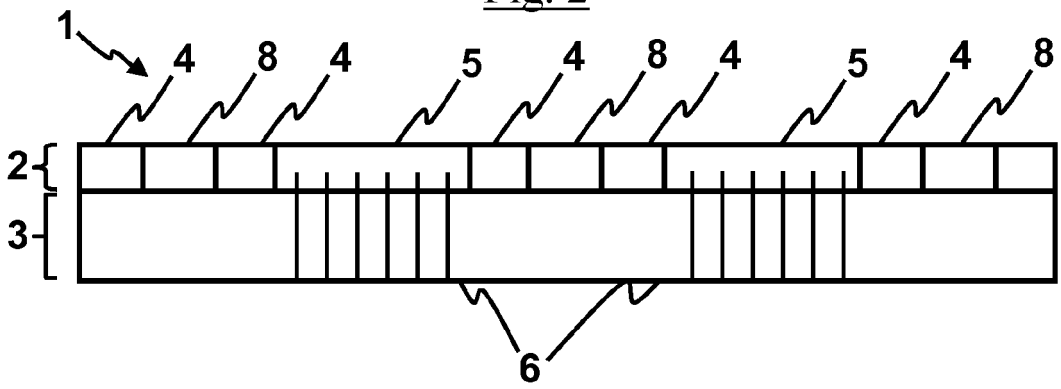


Fig. 3

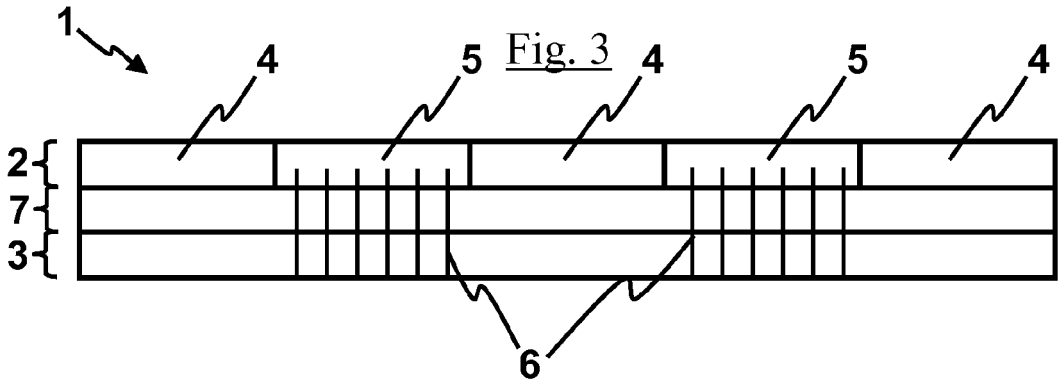


Fig. 4

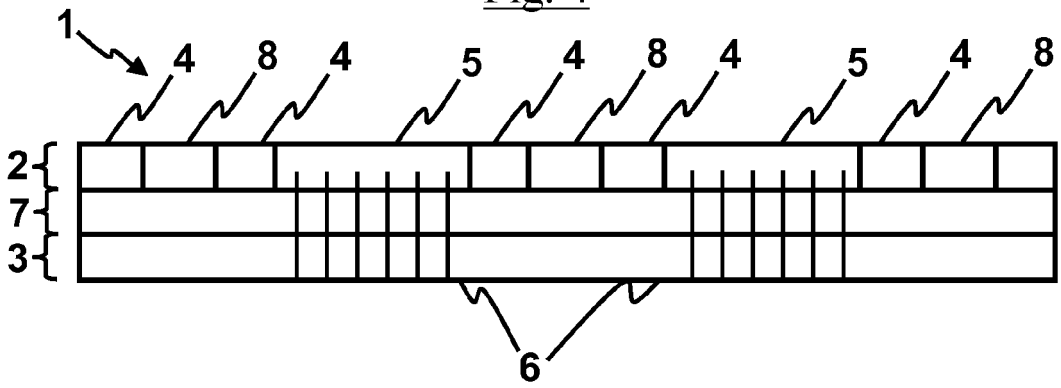


Fig. 5

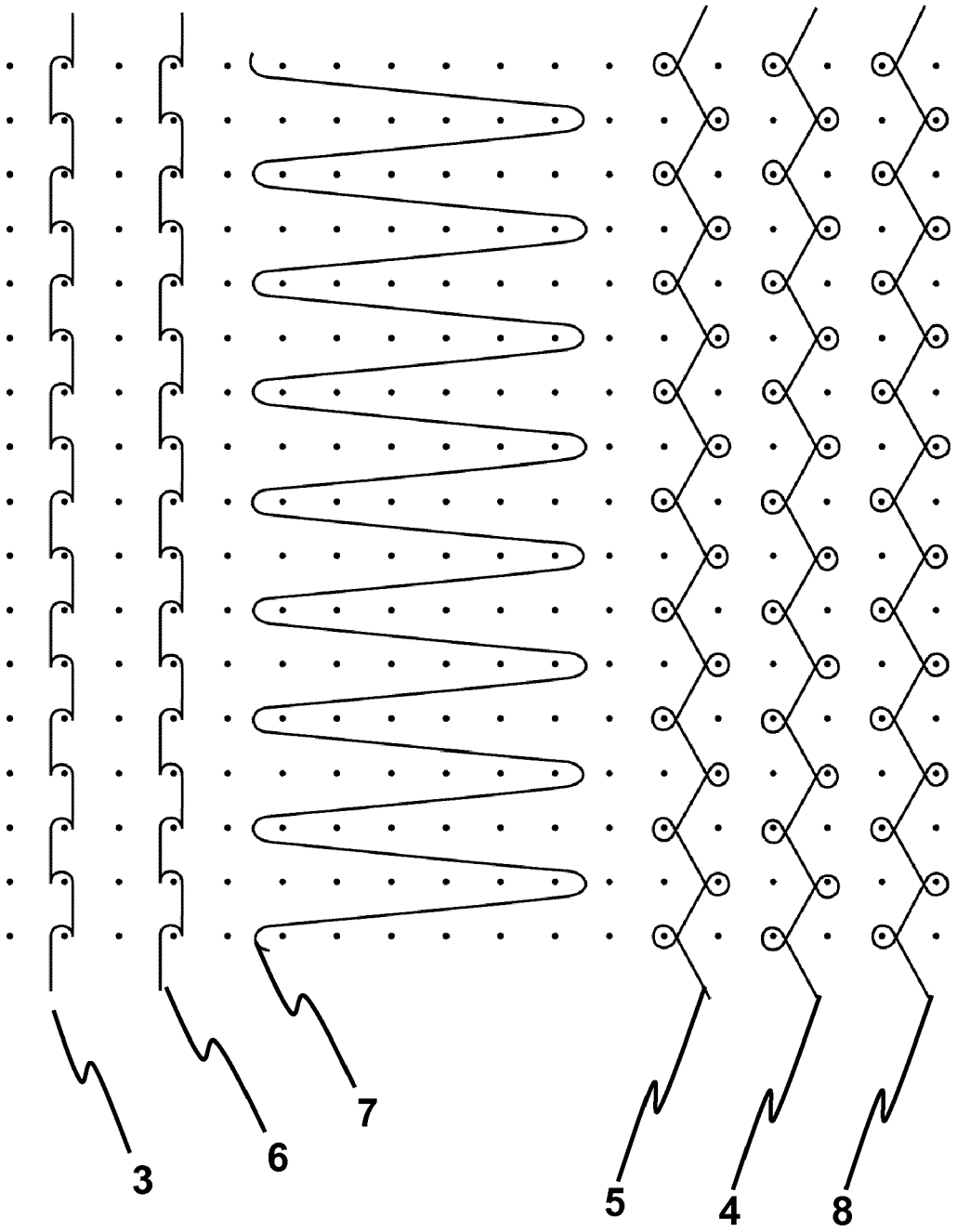
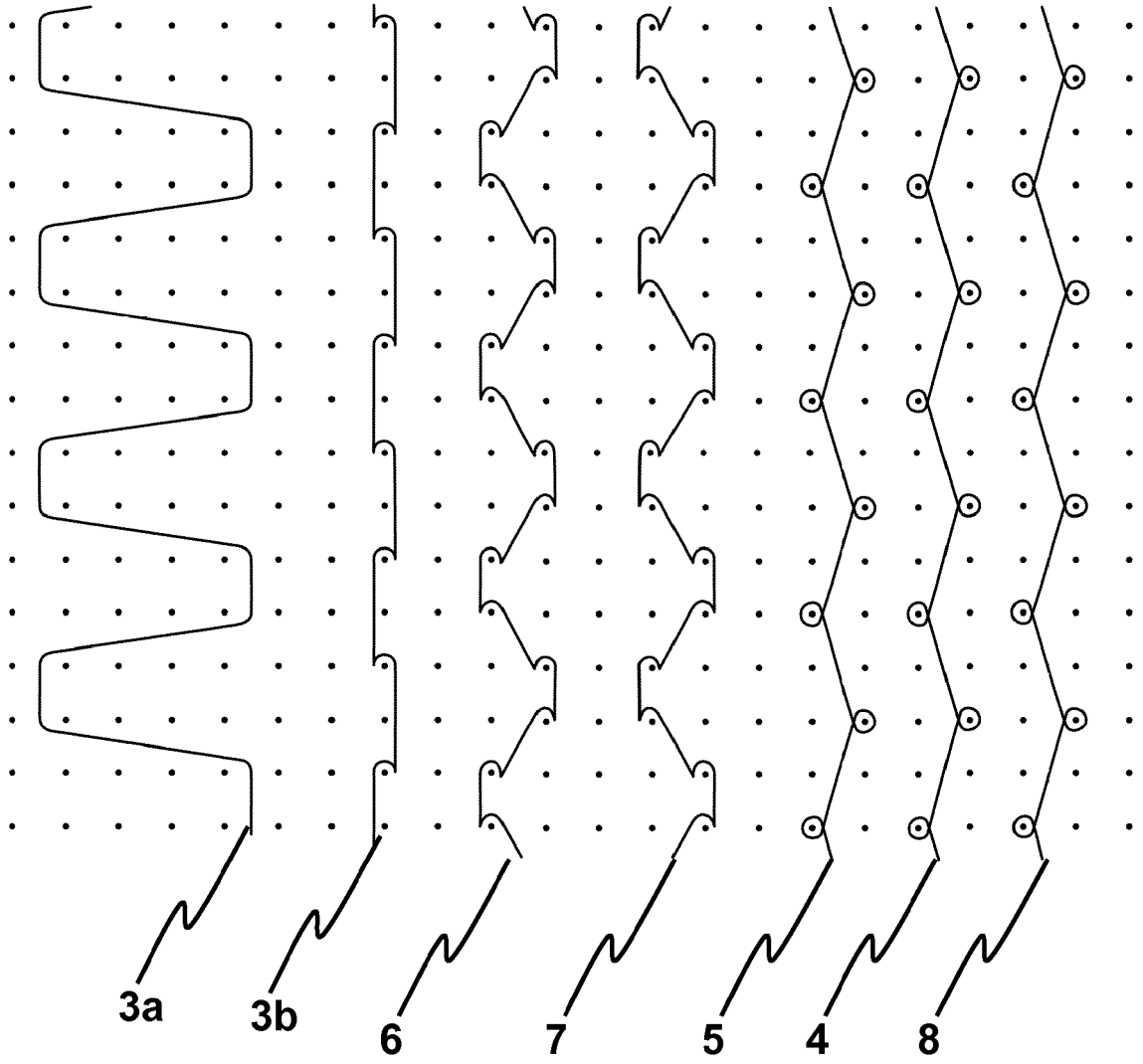


Fig. 6



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EUROPEAN SEARCH REPORT

Application Number
EP 12 19 7198

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	DE 10 2008 034937 A1 (MUELLER TEXTIL GMBH [DE]) 4 February 2010 (2010-02-04) * paragraphs [0001], [0008], [0011], [0015] - [0021]; claims 1, 7, 9, 10; figures 1, 2 *	1-4,6,7, 10-12 14,15	INV. D04B21/14 ADD. D04B21/04
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			TECHNICAL FIELDS SEARCHED (IPC) D04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 August 2013	Sterle, Dieter

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 19 7198

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20-08-2013

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DE 102009013250 B3	15-07-2010	NONE	
DE 102006038612 A1	28-02-2008	NONE	

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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