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(54) Title: COMPONENT MADE OF NON-WOVEN NATURAL TEXTILE FIBRES, AND METHOD AND MACHINE FOR THE PRODUCTION THEREOF

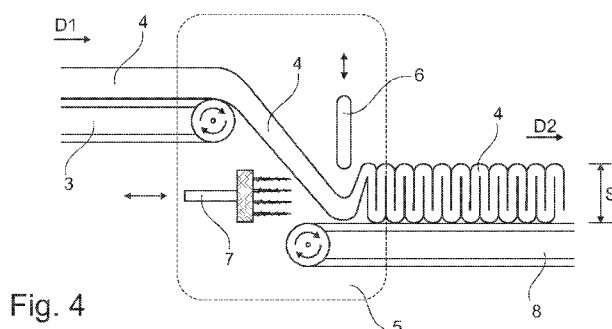


Fig. 4

(57) Abstract: The present invention relates to a component consisting exclusively of non-woven natural textile fibres, and to a method and machine for the production thereof; the component (1) comprises a web (2) consisting exclusively of carded natural textile fibres which is pleated in the direction of the length and/or width of the component and which is needle-punched in the direction of the length and/or width of the component; the needle-punching affects only a central portion of a thickness of the component; its production is effected by: - continuously feeding (3) a long web (4) consisting exclusively of carded natural textile fibres towards a processing area (5), - repeatedly performing pleating operations on said web (4) according to a direction corresponding to the length of said web (4) by means of a pleating head (6) in said processing area (5), - repeatedly performing needle-punching operations on said pleated web (4) according to a direction corresponding to the length of said web (4) by means of a needle-punching head (7) in said processing area (5), in such a way as to needle-punch only a central portion of said thickness of said component, said central portion being in particular less than 80% of said thickness, and - continuously advancing (8) said pleated and needle-punched web (4) while distancing it from said processing area (5).



COMPONENT MADE OF NON-WOVEN NATURAL TEXTILE FIBRES, AND
METHOD AND MACHINE FOR THE PRODUCTION THEREOF

Field of the invention

The present invention relates to a component made of non-woven natural textile
5 fibres, and to a method and machine for the production thereof.

Prior art

Before embarking majorly upon the merits of the present invention, it is
advantageous to begin with a general introduction on the subject of textile fibres.
Textile fibres are subdivided into two broad categories: natural fibres and high-tech
10 fibres; the natural fibres are in their turn subdivided into fibres of origin: vegetable
(for example, lino, hemp, jute, coir, cotton, etc), animal (for example, silk, and wool
of various animals such as the sheep, camel, etc), and mineral (for example,
asbestos or glass fibres, etc) which, although natural in certain ways in that they
are derived from minerals that are found in nature, are obtained only by means of
15 necessary thermal and/or chemical processes.

High-tech fibres are, for their part, usually subdivided into:

- "man-made" fibres (for example, rayon, viscose, acetate, etc), produced
from organic polymers of natural origin (for example, cellulose), and
- "synthetic" fibres produced from synthetic polymers (for example, polyamide,
20 polyethylene, polypropylene, etc), typically produced from petroleum.

It is important to remember that, to obtain products made of textile fibres, it is
common to combine different textile fibres, and that, at the end of the 70s, the
bicomponent fibres were added to the family of synthetic fibres, having a structure
of sheath+core and characterised by the differing melting points of the two
25 components.

Products made of textile fibres are used in various sectors of industry as well as,
of course, in the textile industry; for example, as heat-insulating and/or sound-
absorbent components in the construction industry, as upholstery components in
the furniture and automobile industries, as filtering components for various
30 applications, and in geotechnics.

In the textile industry, the fibres are generally woven; in this way the product
acquires density and durability; weaving is a known technology that has been used

for millennia.

It is also possible to join the fibres solidly together in other ways. For example, in the 50s, "non-woven fabric" technology was conceived; this technology uses "synthetic" fibres normally (frequently different ones mixed together), is more economical than weaving, and enables fairly elevated rates of production.

Components made from textile fibres are known, that are capable of performing functions of thermal insulation, acoustic isolation, padding, or filtering. To give this kind of product density and durability, binding material (for example, acrylic or styrolic resins, etc) is added to the textile fibres (the primary material) in aqueous solution, which performs its function following a necessary heat treatment, in particular, both by evaporation of the water and by polymerisation of the said resin used.

In the 80s, this process very gradually began to be replaced by the insertion of bicomponent synthetic fibres into the fibre mixtures of the products, which synthetic fibres, on account of the ability of one of the two components to melt at low temperatures, bind very closely to the other fibres; in this case the binding effect is provided by the thermoplastic portion of the bicomponent fibres.

Components of this type provide good performances.

However, according to the known technologies, the binding material and the heat treatment thereof involve a fairly complex and expensive production process; to give an example, the heat treatment must not damage the primary material of the component and so jeopardise the quality of the finished product, its production requires special machinery, uses large amounts of energy (some of this energy is wasted because it goes to heat the primary material of the component and the surrounding environment), and emits carbon dioxide (CO₂) and carbon monoxide (CO) into the atmosphere.

Moreover, the presence of binding material, in particular thermoplastic material, renders components of this type not fully environmentally compatible, even in the case wherein the primary material is made of natural textile fibres (and therefore environmentally compatible); thus, even the waste of energy and the emission of carbon dioxide (CO₂) and carbon monoxide (CO) into the atmosphere, that are due to the production process, contribute to the environmental non-compatibility.

From patent application EP0350627 a component and a process are known which necessarily use thermoplastic, i.e. non-natural, material; indeed, in all the embodiments, once formed, the component is treated thermally to melt the thermoplastic material. Furthermore, despite a head with stitches being employed,
5 these are not used for needle-punching, which is not necessary because density and durability are given to the component by the thermoplastic fibres following their melting; on the other hand, it would not be possible to achieve deep needle punching simply by stitching.

From patent application GB2268197 a component is known which is sewn (rather
10 than needle-punched) specifically on the outer surfaces of the component; in this way, the surfaces are well stabilised although softness and overall flexibility of the component are necessary sacrificed a little. Furthermore, internally the component presents no density or durability other than that of the starting web; thus, the process described in this document is for achieving components of small
15 thickness. Finally, by means of the process described and illustrated in this document, it is fairly difficult, if not impossible, to produce components of variable thickness.

Summary of the invention

The general object of the three present invention is to improve known components
20 and known technologies by providing a component having thermal insulation and/or acoustic isolation and/or padding and/or filtering functions made exclusively of environmentally compatible material or materials.

A first, more specific object of the present invention is to provide a component
25 having thermal insulation and/or acoustic isolation and/or padding and/or filtering functions which does not require heat treatments for its production.

A second more specific object of the present invention is to provide a component having thermal insulation and/or acoustic isolation and/or padding and/or filtering functions that can be produced in an environmentally compatible manner.

A third more specific object of the present invention is to provide a component
30 having thermal insulation and/or acoustic isolation and/or padding and/or filtering functions that is made exclusively of wool and produced in environmentally compatible manner.

These and other objects are achieved by the component and thanks to the method and the machine having the technical features set out in the attached claims, which form an integral part of the present description.

The underlying idea of the present invention is that of producing the component starting from a web of natural textile fibres that is first "pleated" and then "needle-punched" in a direction corresponding to the length of the web; in particular, the needle-punching is performed in a direction transversal, preferably perpendicular to the thickness of the pleated web; in this way, the component has a certain density and structure, but also considerable elasticity, softness and lightness.

It is stated that by "web" is meant a group of textile fibres not solidly connected to one another, and which is therefore soft, light and even transparent. In general, the component composed exclusively of non-woven natural textile fibres according to the present invention comprises a web of carded natural textile fibres which is pleated in the direction of the length and/or width of the component and which is needle-punched in the direction of the length and/or width of the component; the pleating gives a component thickness, and the needle-punching affects only a central portion of said thickness; this central portion is preferably less than 80% of the thickness of the pleated web (in particular 80% of the minimum thickness, in the case of variable thickness).

The needle-punching is preferably 4-10 cm deep, more preferably 5-9 cm.

Said natural textile fibres may be all of wool.

Said natural textile fibres may be of two or more materials.

Said component may comprise exclusively a web of carded natural textile fibres.

Said direction of needle-punching may correspond to said direction of pleating.

The thickness of said component may be constant and correspond to the pleating dimension.

Said pleating dimension may have a value selected from between 4 mm and 40 mm.

In general, the method for producing a component from non-woven textile fibres according to the present invention comprises the steps of:

- continuously feeding a long web consisting exclusively of carded textile fibres towards a processing area,

- performing repeated pleating operations on said web according to a direction corresponding to the length of said web by means of a pleating head in said processing area,

- 5 - performing repeated needle-punching operations on said pleated web according to a direction corresponding to the length of said web by means of a needle-punching head in said processing area, in such a way as to needle-punch only a central portion of a thickness of said component, said central portion being in particular less than 80% of said thickness, and
- 10 - continuously advancing said pleated and needle-punched web while distancing it from said processing area.

Thereby the pleats of the pleating will be in a transversal direction, more particularly in a direction perpendicular to the length of said web.

Said pleating operations may be alternated by said needle-punching operations.

- 15 Each pleating operation may be immediately followed by a needle-punching operation.

Said pleating head may perform an alternating translating movement in a direction corresponding to the length of said web.

- 20 Said needle-punching head may perform an alternating translating movement in a direction corresponding to the length of said web.

Said needle-punching head may perform an alternating translating movement in a direction perpendicular to the thickness of said web after said web has been pleated.

- 25 The movement of said needle-punching head may be such as to complete preceding pleating operations.

Said needle-punching head may comprise a plurality of needle-punch needles with a density of 1-9 needles per square centimetre.

Said needle-punching head may comprise a plurality of needle-punch needles with a length of 4-10 centimetres, preferably 5-9 centimetres.

- 30 Said needle-punching head may comprise a plurality of needle-punch needles, each equipped with lateral spikes preferably orientated as the needle itself.

In general, a machine for producing a component made with non-woven textile

fibres according to the present invention, comprising:

- means adapted to continuously feed a long web consisting exclusively of carded natural textile fibres towards a processing area,

5 - a pleating head located in said processing area and adapted to repeatedly perform pleating operations on said web,

- a needle-punching head located in said processing area and adapted to repeatedly perform needle-punching operations on said pleated web, in such a way as to needle-punch only a central portion of a thickness of said component, said central portion being in particular less than 80% of said
10 thickness, and

- means adapted to continuously feed said pleated and needle-punched web while distancing it from said processing area.

The needle-punching head may comprise a plurality of needle-punch needles with a density of 1-9 needles per square centimetre.

15 The needle-punching head may comprise a plurality of needle-punch needles with a length of 4-10 centimetres, preferably 5-9 centimetres.

The needle-punching head may comprise a plurality of needle-punch needles, each equipped with lateral spikes preferably orientated as the needle itself.

The machine may furthermore comprise means adapted to achieve the method as
20 set out above.

Brief description of the drawings

The technical features of the present invention, as well as its advantages, will be clear from the following description, which is to be considered in conjunction with the attached drawings, wherein:

25 Fig.1 is a diagrammatic view of a web of textile fibres,

Fig.2 is a diagrammatic view of the web of Fig. 1 after it has been pleated,

Fig.3 is a diagrammatic view of the web of Fig. 2 after it has been needle-punched,

Fig.4 is a schematic view of a portion of an embodiment of a machine according
30 to the present invention, and

Fig.5 is a schematic view of the needle-punching head of the machine of Fig.4 while it is punching a small piece of a web of textile fibres.

Detailed description of the invention

Both this description and these drawings are to be considered solely as illustrative and therefore as non-limiting; the present invention can therefore be implemented according to other, diverse embodiments; moreover, it must be borne in mind that
5 these drawings are schematic and simplified.

An embodiment of component 1 consisting exclusively of non-woven natural textile fibres according to the present invention is shown in Fig. 3. This component derived from a web 2 of carded natural textile fibres, in particular of carded wool, shown in Fig. 1 in a horizontal position before the processing that is the subject of
10 the present invention. The web 2 has been pleated, as can be seen in Fig. 2, in a horizontal direction. Thereafter, the web 2 has been needle-punched, as can be seen in figure 3, in a horizontal direction.

The needle-punching operation, performed with limited number of needles (in particular 1-9 per square centimetre) binds the web 2 in a horizontal direction even
15 without any support material, in particular without the use of thread, and compacts the web a little in the horizontal direction; in this way, the component 1 exhibits a certain density and structure; however, because the number of needle-punch needles is limited, component 1 maintains considerable elasticity, softness and lightness similar to that of the web 2 from which it derives.

As is understood from Fig. 1, Fig. 2, Fig. 3, the direction of needle-punching advantageously corresponds to the pleating direction, although this is not strictly
20 essential for the present invention.

Component 1 consists of a sort of soft and pliable mattress of constant thickness S corresponding to the pleating dimension; this pleating dimension is 20 mm; this
25 pleating dimension may alternatively have been selected from between 4 mm and 40 mm. The possibility is not excluded of the component – in accordance with alternative embodiments – having a variable thickness (deriving from a variable pleating dimension) and constituting a profiled mattress.

The present invention also relates to a machine for producing a component of non-
30 woven natural textile fibres such as that just described, or an analogous component.

In what follows, with the aid of Fig. 4 and Fig. 5, only the portion of this machine

which performs the more innovative processes will be described, the remaining processes are therefore carried out in the conventional manner.

Fig. 4 shows:

- 5 - means 3 adapted to continuously feed a long web 4 of carded natural textile fibres towards a processing area 5,
- a pleating head 6 located in said processing area 5 and adapted to repeatedly perform pleating operations on said web 4,
- a needle-punching head 7 located in said processing area 5 and adapted to repeatedly perform needle-punching operations on said web 4 after it
10 has been pleated, and,
- means 8 adapted to continuously feed said web 4 after it has been pleated and needle-punched, while distancing it from said processing area 5.

In Fig. 4, the web 4 is continuous, extends longitudinally from left to right,
15 and moves progressively from left to right, passing through the processing area 5 while the processing is taking place.

As has been said, methods and apparatus for producing webs of carded textile fibres are known and already in use; they will therefore not be described here.

20 After the processing shown diagrammatically in Fig. 4, the pleated and needle-punched web may be, for example, rolled to form a roll, or cut to form a plurality of squares.

The means 3 and 8 may be realised for example by means of conveyor belts.

25 The pleating head 6 is represented diagrammatically in Fig. 4 as a rectilinear bar adapted to bend the web.

The needle-punching head 7 is represented diagrammatically in Fig. 4 and Fig. 5 as a rectilinear bar 71 equipped with a plurality of (needle-punch) needles 72; needles 72 are of a length such as to pass through a plurality of layers
30 of web 4 (indeed, according to the present invention, a preferred needle length of 4-10 cm and a yet more preferred needle length of 5-9 cm is provided for); in Fig. 5, the needles 72 pass through seven layers of web 4 and reach the eighth layer.

Few details of needle-punching will be provided here, because this technique is known per se and is used in the non-woven textiles sector; however, it should be noted that according to the present invention, the material to be needle-punched does not come straight between plates, as happens in the case of non-woven tissues, and moreover the needle-punch needles are particularly long and tightly-packed (in fact, according to the present invention, a preferred density of 1-9 needles per square centimetre is provided for).

According to the embodiment in Fig. 4, the conveyor belt 3 feeds the web 4 longitudinally towards the processing area 5 from left to right; the processing area 5 is located in a lower position (for example 5-20 cm lower) than the area of advancement of the web 4 defined by the conveyor belt 3.

According to the embodiment in Fig. 4, by moving first from high to low, from a pre-arranged higher position (Fig. 4) to a pre-arranged lower position, and then from low to high, from the pre-arranged lower position to the prearranged higher position (Fig. 4), the pleating head first of all creates a downward-pointing pleat in the web 4 and then an upwardly pointing web pleat; in this way a pleating operation is performed on the web 4 according to a direction corresponding to the length of the web itself, that is, the pleats are crosswise to the length of the web).

According to the embodiment in Fig. 4, by moving first from left to right, from a pre-arranged position distant from the web (Fig. 4) to a pre-arranged position adjacent to the web (Fig. 5), and then from right to left, from the pre-arranged position adjacent to the web (Fig. 5) to the prearranged position distant from the web (Fig. 4), the needle-punching head 7 performs a needle-punching operation on the pleated web in a direction corresponding to the length of the web itself.

According to the embodiment of Fig. 4, the conveyor belt 8 continuously feeds the web 4 from left to right after it has been pleated and needle-punched, while distancing from the processing area 5.

In the preceding paragraphs, precise directions and arrangements have been indicated which are, in fact, those more typical and advantageous for implementing the present invention even if they are not necessarily the only ones possible.

As will be understood from Fig. 4, the pleating operations and the needle-punching

operations are repeated; in particular, the pleating operations are alternated with the needle-punching operations; more particularly and advantageously each pleating operation is immediately followed by a needle-punching operation.

According to the embodiment of Fig. 4, the pleating head 6 performs an alternating translating movement in a direction perpendicular to the web 4, the needle-punching head 7 performs an alternating translating movement in a direction longitudinal to the web 4 as it moves (direction D1) within the machine towards the processing area, and to that of the finished component as it moves (direction D2) within the machine via the processing area (be precise, the head 7 with its needles 72 operates on the web 4 in a direction perpendicular to the web 4, but after the web 4 been pleated, that is, pleated a plurality of times); specifically, the needle-punching head 7 is fashioned and moves in such a way as to complete preceding pleating operations, that is, when the one bar 71 of the head 7 moves towards the pre-arranged position adjacent to the web (Fig. 5), it drives it away a little and re-marks the pleats of the pleating.

According to the embodiment of Fig. 4 and Fig. 5, the needle-punching head 7 comprises a plurality of needle-punch needles 72 with a preferred needle density per square centimetre which ranges from 1 to 9 and with a preferred length which ranges from 4 to 10 cm, preferably which ranges from 5 to 9 centimetres. Furthermore, as can be seen in Fig. 5, the arrangement of the needles 72 on the head 7 is such as to needle-punch only a central portion of the thickness of said component, that is of the thickness of the pleated web; in particular, this central portion is less than 80% of the thickness (in particular 80% of the minimum thickness, in case of variable thickness); in this way, the component presents a good density and durability, but its softness and its flexibility independently of its thickness are not sacrificed.

According to the embodiment of Fig. 4 and Fig. 5, the needle-punching head 7 comprises a plurality of needle-punch needles 72, each equipped with a plurality of lateral spikes which allow the needle-punching effect of the needles themselves to be maximised; these spikes are disposed along the length of the needle; the spikes are orientated as the needle itself in such a way as to provide the needle-punching effect when the needle is inserted into the pleated web, but not when the

needle is withdrawn from the pleated web.

CLAIMS

1. Component (1) consisting exclusively of non-woven natural textile fibres, comprising a web (2) of carded natural textile fibres which is pleated in direction of the length and/or width of the component and which is needle-punched in direction
5 of the length and/or width of the component, wherein the pleating gives a component thickness, and wherein the needle-punching affects only a central portion of said thickness, said central portion being in particular less than 80% of said thickness.
2. Component according to claim 1, wherein said textile fibres are all of
10 wool.
3. Method for producing a component made with non-woven textile fibres, comprising the steps of:
 - continuously feeding (3) a long web (4) consisting exclusively of carded natural textile fibres towards a processing area (5),
 - 15 - repeatedly performing pleating operations on said web (4) according to a direction corresponding to the length of said web (4) by means of a pleating head (6) in said processing area (5),
 - repeatedly performing needle-punching operations on said pleated web (4) according to a direction corresponding to the length of said web (4) by
20 means of a needle-punching head (7) in said processing area (5), in such a way as to needle-punch only a central portion of a thickness of said component, said central portion being in particular less than 80% of said thickness, and
 - continuously advancing (8) said pleated and needle-punched web (4)
25 while distancing it from said processing area (5).
4. Method according to claim 3, wherein said pleating operations are alternated by said needle-punching operations.
5. Method according to claim 4, wherein each pleating operation is immediately followed by a needle-punching operation.
- 30 6. Method according to any one of claims 3 to 5, wherein said pleating head (6) performs an alternating translating movement in a direction corresponding to the length of said web (4).

7. Method according to any one of claims 3 to 6, wherein said needle-punching head (7) performs an alternating translating movement in a direction corresponding to the length of said web (4).

8. Method according to any one of claims 3 to 7, wherein said needle-punching head (7) performs an alternating translating movement in a direction perpendicular to the thickness of said web (4) after said web (4) has been pleated.

9. Method according to claim 7 or 8, wherein the movement of said needle-punching head (7) is such as to complete preceding pleating operations.

10. Method according to any one of claims 3 to 9, wherein said needle-punching head (7) comprises a plurality of needle-punch needles (72) with a density of 1-9 needles per square centimetre.

11. Method according to any one of claims 3 to 10, wherein said needle-punching head (7) comprises a plurality of needle-punch needles (72) with a length of 4-10 centimetres, preferably 5-9 centimetres.

12. Method according to one of claims 3 to 11, wherein said needle-punching head (7) comprising a plurality of needle-punch needles (72) each equipped with lateral spikes preferably orientated as the needle itself.

13. Machine for producing a component made with non-woven textile fibres, comprising:

- means (3) adapted to continuously feed a long web (4) consisting exclusively of carded natural textile fibres towards a processing area (5),
- a pleating head (6) located in said processing area (5) and adapted to repeatedly perform pleating operations on said web (4),
- a needle-punching head (7) located in said processing area (5) and adapted to repeatedly perform needle-punching operations on said pleated web (4), in such a way as to needle-punch only a central portion of a thickness of said component, said central portion being in particular less than 80% of said thickness, and
- means (8) adapted to continuously feed said pleated and needle-punched web (4) while distancing it from said processing area (5).

14. Machine according to claim 13, wherein said needle-punching head (7) comprises a plurality of needle-punch needles (72) with a density of 1 to 9 needles

per square centimetre.

15. Machine according to claim 13 or 14, wherein said needle-punching head (7) comprises a plurality of needle-punch needles (72) with a preferred length of 4 to 10 cm, preferably of 5 to 9 centimetres.

5 16. Machine according to claim 13 or 14 or 15, wherein said needle-punching head (7) comprises a plurality of needle-punch needles (72), each equipped with lateral spikes preferably orientated as the needle itself.

17. Machine according to claim 13 or 14 or 15 or 16, comprising means adapted to carry out the method according to any one of claims from 3 to

10 12.

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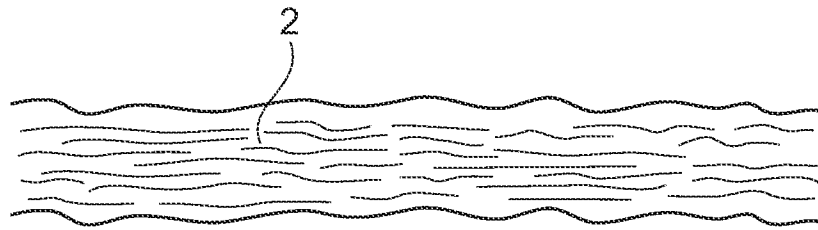


Fig. 1

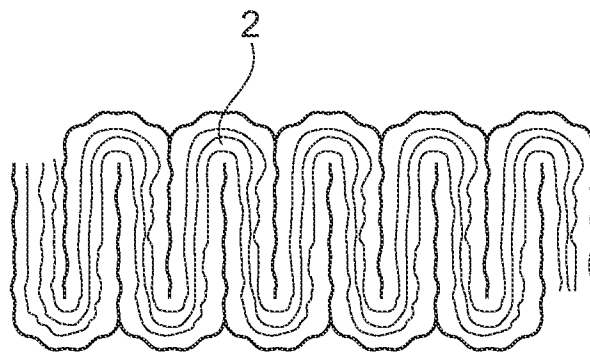


Fig. 2

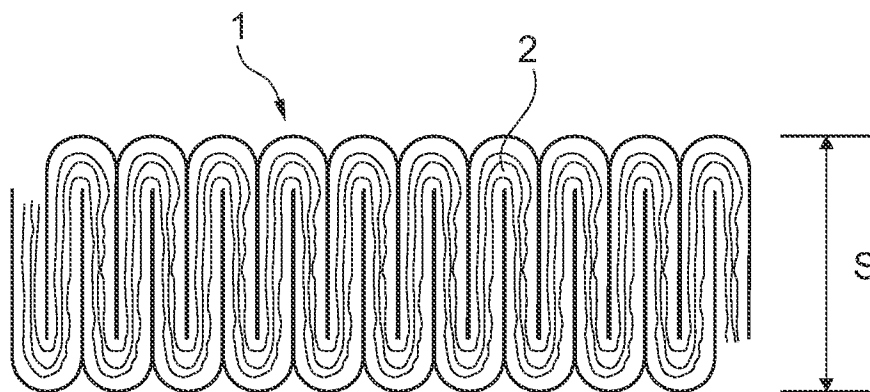


Fig. 3

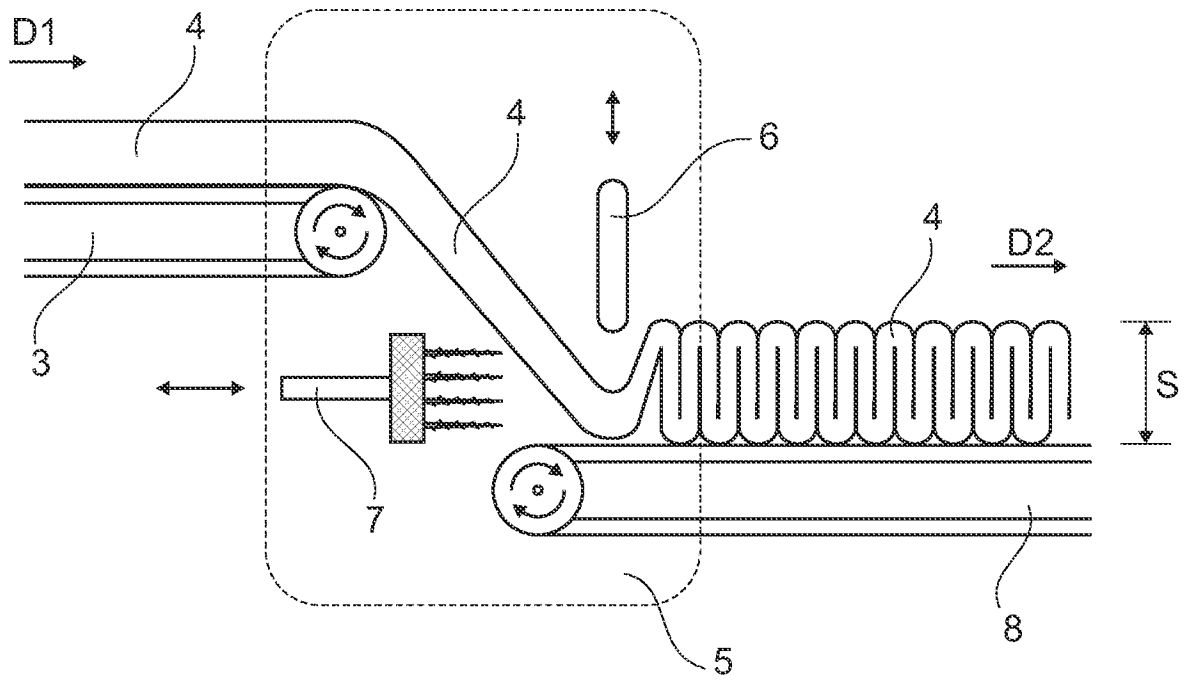


Fig. 4

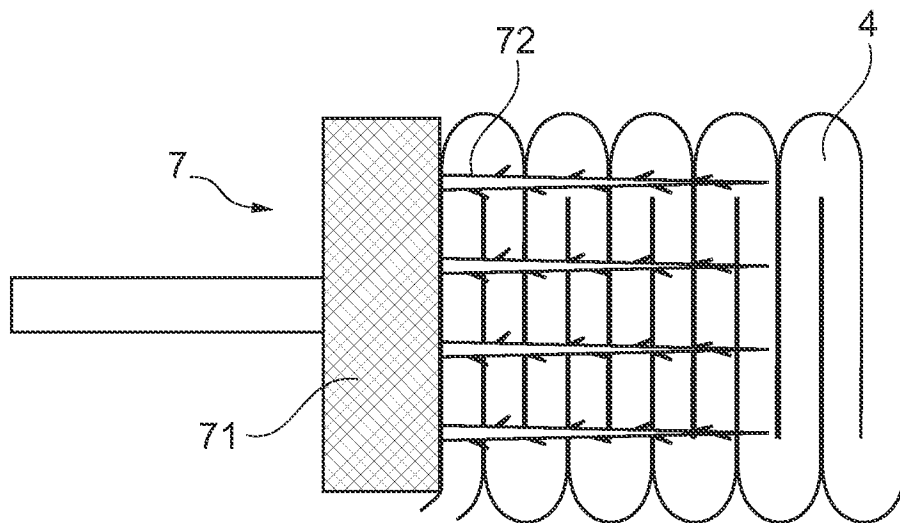


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/052941

A. CLASSIFICATION OF SUBJECT MATTER
INV. D04H1/04 D04H1/46 D04H1/74 D04H18/00 D06J1/02
ADD.

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)
D04H D06J B01D E04B B68G

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 practicable, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2006/092029 A1 (V LAP PTY LTD [AU]; COOPER JASON IAN [AU]; ROBERTS ERIC [AU]) 8 September 2006 (2006-09-08)	13,16,17
Y	figures 3,4,8 page 7, line 31 - page 8, line 2	1-12
X	EP 0 350 627 A1 (VYSOKA SKOLA STROJNI TEXTILNI [CS] INCOTEX SRO [CZ]) 17 January 1990 (1990-01-17)	13,16,17
Y	the whole document	1-12
A	GB 2 268 197 A (MALIMO MASCHINENBAU [DE]) 5 January 1994 (1994-01-05) page 17, lines 1-26; claim 20; figures 8,9	1-17
Y	AT 259 U1 (TUMFART KURT TUMFART KURT [AT]) 26 June 1995 (1995-06-26) page 1 - page 2; claim 1; figure	1-12
	----- -/--	

Further documents are listed in the continuation of Box C. See patent family annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance	"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
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Date of the actual completion of the international search 17 August 2012	Date of mailing of the international search report 23/08/2012
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Barathe, Rainier
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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/052941

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 42 26 342 C1 (GÜNTHER WOLFF) 24 June 1993 (1993-06-24) column 1, lines 1-4; figure -----	1-12
A	CH 689 984 A5 (TUMFART KURT [AT]) 29 February 2000 (2000-02-29) claims 1-5 -----	1,2
A	US 2010/212560 A1 (HOLLAND-MORITZ JAN [DE] ET AL) 26 August 2010 (2010-08-26) the whole document -----	1,2
A	US 5 246 760 A (KRICKL LUDWIG [DE]) 21 September 1993 (1993-09-21) column 3, line 35 - column 4, line 37 -----	1,3
A	EP 0 900 948 A1 (GEN MOTORS CORP [US] DELPHI TECH INC [US]) 10 March 1999 (1999-03-10) paragraphs [0008], [0018]; figure 2 -----	1,3

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2012/052941

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
WO 2006092029	A1	08-09-2006	CN 101142349 A	12-03-2008
			EP 1853754 A1	14-11-2007
			JP 2008538130 A	09-10-2008
			US 2008155787 A1	03-07-2008
			WO 2006092029 A1	08-09-2006
EP 0350627	A1	17-01-1990	AT 111538 T	15-09-1994
			CS 8804102 A1	12-09-1989
			DD 287544 A5	28-02-1991
			DE 58908348 D1	20-10-1994
			EP 0350627 A1	17-01-1990
GB 2268197	A	05-01-1994	DE 4220338 A1	05-01-1994
			DE 4244904 C2	22-04-1999
			FR 2692602 A1	24-12-1993
			GB 2268197 A	05-01-1994
			IT 1264868 B1	17-10-1996
AT 259	U1	26-06-1995	NONE	
DE 4226342	C1	24-06-1993	NONE	
CH 689984	A5	29-02-2000	NONE	
US 2010212560	A1	26-08-2010	DE 112008003094 A5	12-08-2010
			DE 202007012632 U1	03-01-2008
			EP 2190281 A1	02-06-2010
			US 2010212560 A1	26-08-2010
			WO 2009033449 A1	19-03-2009
US 5246760	A	21-09-1993	NONE	
EP 0900948	A1	10-03-1999	DE 69819639 D1	18-12-2003
			DE 69819639 T2	15-04-2004
			EP 0900948 A1	10-03-1999
			US 5894049 A	13-04-1999