(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 703 009 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
20.09.2006 Bulletin 2006/38

(51) Int Cl.:
D06C 21/00 *(2006.01)*

(21) Application number: **05425155.8**

(22) Date of filing: **16.03.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR LV MK YU

(71) Applicant: **Sperotto Rimar S.r.l. Unipersonale**
20121 Milano (IT)

(72) Inventor: **Bertoldo, Franco**
36070 Brogliano (Vicenza) (IT)

(74) Representative: **Colombo, Stefano Paolo et al**
Marchi & Partners S.r.l.,
Via G.B. Pirelli, 19
20124 Milano (IT)

(54) Elastically deformable belt for use in an apparatus for treating a continuous textile substrate

(57) A belt (1) which is substantially longitudinally deformable elastically for use in an apparatus for treating a continuous textile substrate is described. The belt (1) comprises: a textile support structure (111) and at least one additional layer (112a,112b,122a,122b) fixed to the textile structure (111). The textile structure (111) is formed by an interlacement of a plurality of substantially longitudinal adjacent yarns (01,02,...On) and a plurality of substantially transverse adjacent yarns (T1,T2,...Tn). The substantially longitudinal yarns (01,02,...On) comprise substantially extensible and elastic fibre. The substantially transverse yarns (T1,T2;...Tn) comprise substantially non-extensible fibre. The additional layer (112a, 112b,122a,122b) may be a substantially resilient and extensible mass (for example of natural or synthetic rubber) or a fibrous layer.

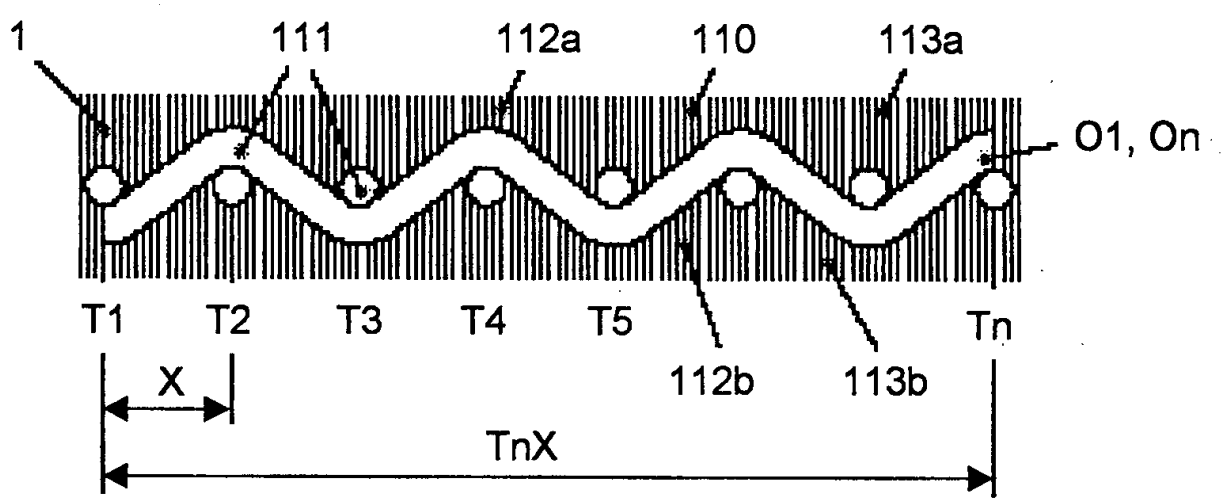

Fig. 1a

EP 1 703 009 A1

(Cont. next page)

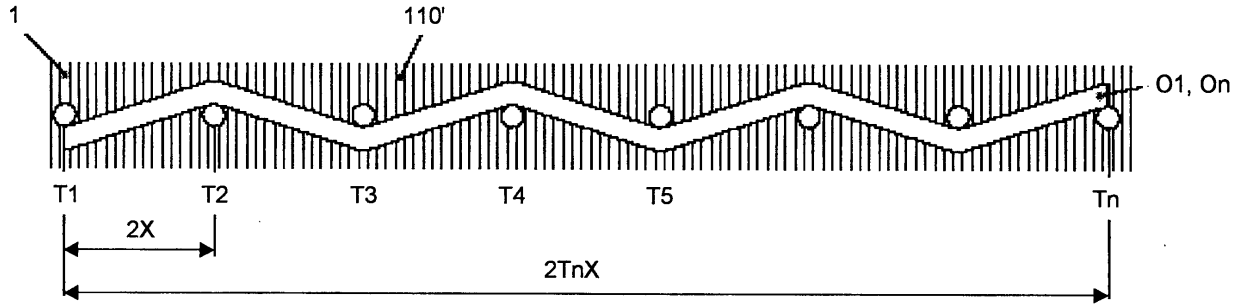

Fig. 2a

Description

[0001] The present invention relates to the textile sector and in particular relates to the sector of apparatus for compacting continuous textile substrates. Even more particularly it relates to a suitably deformable belt for use in an apparatus for shrinking a continuous textile substrate.

[0002] Various apparatus for shrinking, or compacting, continuous textile substrates are known. Some of these apparatus use a belt for supporting and conveying textile substrates to be treated.

[0003] In particular, US 4,908,918 describes a belt in which a non-extensible textile structure supports a deformable component on which the textile substrate being treated is placed.

[0004] US 2,021,975 describes a method and an apparatus for treating orthogonal weave fabrics, where a rubber belt is used. Compression of a length of the belt causes a small deformation in elongation of the said belt along this compressed length. The textile material to be shrunk is fed onto the surface of the belt along the length which has undergone the small deformation in elongation and is caused to shrink by the surface of the belt which, following compression, returns into the untensioned state.

[0005] EP04425854.9, in the name of the present Applicant, describes an apparatus and a method for shrinking a continuous textile substrate. The apparatus comprises: a first motorized roller, a second motorized roller, an endlessly wound belt for conveying and supporting the textile substrate and a pre-tensioning means for applying a longitudinal tension to the belt and a means for guiding the belt. The pre-tensioning means comprises a third roller, which is preferably idle, and the belt guiding mean comprises a rotating drum for guiding the belt along a length between the second motorized roller and the first motorized roller. The textile substrate is transported, arranged between the belt and the rotating drum. The belt is substantially deformable elastically in elongation. The belt has a high elastic deformability and may consist, for example, also of fibrous material.

[0006] The main object of the present invention is to provide a belt elastically deformable in elongation, typically formed as a closed loop, preferably for use in an apparatus according to the abovementioned application EP04425854.9 or a similar apparatus.

[0007] These and other objects are achieved by means of a belt according to Claim 1. Further advantageous characteristics are described in the dependent claims.

[0008] According to the present invention a belt substantially longitudinally deformable elastically for use in an apparatus for treating a continuous textile substrate is provided, said belt comprising: a textile support structure and at least one additional layer fixed to said textile structure. The textile structure is formed by an interlacement of a plurality of substantially longitudinal adjacent yarns and a plurality of substantially transverse adjacent yarns, said substantially longitudinal yarns comprising substantially extensible and elastic fibre and said substantially transverse yarns comprising substantially non-extensible fibre.

[0009] Preferably the at least one additional layer comprises a substantially resilient and extensible mass which envelopes said textile structure. Preferably, the mass comprises natural rubber and/or synthetic rubber.

[0010] According to one embodiment, the at least one additional layer is a fibrous layer which comprises an upper fibrous layer and a lower fibrous layer.

[0011] Preferably, the substantially longitudinal yarns of said textile structure comprise polyurethane elastomer.

[0012] Preferably, the substantially longitudinal yarns of said textile structure comprise a mixture of substantially extensible and elastic fibre and substantially non-extensible fibre, for example a mixture of fibre of the polyurethane elastomer and polyester fibre type, or fibre of the polyamide and polyurethane elastomer type, or fibre of the polyaramide and polyurethane elastomer type.

[0013] Preferably, the substantially transverse yarns of said textile structure comprise synthetic fibre, for example of the polyester, polyamide or polyaramide type or a combination thereof.

[0014] The fibrous layer preferably comprises synthetic fibre, for example of the polyester or polyamide or polyaramide type or a combination thereof.

[0015] According to a preferred embodiment, the interlacement is of the orthogonal type.

[0016] During use, the belt is conveniently configured as a closed loop and is used in an apparatus for shrinking a continuous textile substrate.

[0017] With use of the belt according to the present invention, the performance features as regards shrinkage of the treated textile substrates are greatly increased. Owing to the use of a belt according to the present invention in an apparatus according to EP04425854.9, the productivity of this apparatus is increased. Consequently, the processing costs per unit of product are considerably lower than the processing costs of known apparatus.

[0018] Owing to the high extensibility and elasticity properties of the belt according to the present invention and the possibility of deforming it in elongation and contraction by a predetermined and adjustable amount by means of the application of a longitudinal tensile force, the degree of shrinkage/compaction of the textile substrate is increased. In addition, the degree of shrinkage/compaction of the textile substrate may also be varied in proportion to the specific shrinkage limit for the textile substrate in question.

[0019] The present invention will become clear from the detailed description which follows, provided purely by way of a non-limiting example, with reference to the accompanying drawings in which:

- Fig. 1a shows a longitudinal section through a belt portion in the untensioned state;
- Figure 1 b shows a cross-section through a belt portion in the untensioned state;
- Figure 1c shows a longitudinal section through a belt portion according to an alternative embodiment, in the untensioned state;
- Figure 2a shows a longitudinal section through a belt portion in the tensioned state;
- Figure 2b shows a cross-section through a belt portion in the tensioned state;
- Figure 2c shows a longitudinal section through a belt portion, according to an alternative embodiment, in the tensioned state;
- Figure 3 is a diagram showing the relationship between the tensile force applied to the belt and its dimensional variations;
- Figure 4a shows an operating condition of the belt in the untensioned state;
- Figure 4b shows an operating condition of the belt in the tensioned or pre-tensioned state;
- Figures 5 shows an operating condition of the belt during use in an apparatus for shrinking continuous textile substrates;
- Figure 5a is a view, from below, along the line A-A shown in Figure 5; and
- Figures 5b is a view, from above, along the line A-A of Figure 5.

[0020] According to an embodiment of the present invention, a belt comprises a textile support structure, an upper fibrous layer and a lower fibrous layer which enclose in sandwich form the textile support structure.

[0021] With reference initially to Figures 1 a and 1 b, a first embodiment of the belt according to the invention is described and in particular a length 110 of the belt 1 in the untensioned state is shown. Said length comprises substantially a textile structure 111 supporting an upper fibrous layer 112a and a lower fibrous layer 112b. Preferably, the upper and lower fibrous layers have substantially the same thickness. According to another embodiment (not shown), said fibrous layers have different thicknesses. According to yet another embodiment of the present invention (not shown) a single fibrous layer connected to the textile support structure is provided. Preferably, the upper and lower fibrous layers are fixed to the textile support structure by means of needle-punching. According to the embodiment described and illustrated, the belt, the length 110 of which represents a portion thereof, is substantially a textile product of the felt type.

[0022] In particular, the structure 111 is formed by the interlacement of a plurality of adjacent longitudinal yarns 01, 02 .... On and a plurality of adjacent transverse yarns T1, T2, ... Tn. The longitudinal yarns consist, at least partially, of substantially extensible and elastic fibre. The transverse fibres instead preferably consist of substantially non-extensible fibre. The longitudinal yarns and transverse yarns have preferably a diameter of the order of tenths of a mm and typically have a diameter of about 0.5 mm.

[0023] The adjacent transverse yarns T1, T2, ... Tn are spaced from each other by a predefined value X, so that the longitudinal dimension of said support structure is TnX (Fig. 1a). The adjacent longitudinal yarns 01, 02, ... On are spaced by a predefined value Y, so that the transverse dimension of said support structure is OnY (Fig. 1 b). The values X and Y are of the order of tenths of mm, and typically they range between about 0.5 mm and about 1.0 mm.

[0024] Although the upper fibrous layer 112a and lower fibrous layer 112b have been shown for the sake of clarity as parallel and equidistant lines, they comprise a substantially unordered mass of fibres which are substantially not joined together by an interlacement. As a result of this solution, the fibrous layers are capable of adapting better to the dimensional variations of the textile structure 111 to which they are fixed.

[0025] According to Figures 2a and 2b, in a legth 110' of said belt in the tensioned state the longitudinal component of the structure 111, consisting of the plurality of yarns 01, 02, ... On, is capable of extending longitudinally under the action of the tensile force. Consequently the transverse component of said structure, consisting of the plurality of yarns T1, T2 ... Tn, becomes more spaced out owing to the movement away from each other of the yarns in the longitudinal direction. The distance between two transverse yarns in the tensioned state assumes a value greater than X. Supposing that the distance between two transverse yarns situated longitudinally in succession in the tensioned state is twice the distance in the untensioned state (namely equal to 2X), the longitudinal dimension of the support structure increases in a corresponding manner, being equal to 2TnX (Fig. 2a).

[0026] However, according to the present invention, in response to this longitudinal extension, the transverse component of the structure 111, consisting of the plurality of yarns T1, T2, ... Tn, undergoes correspondingly a transverse contraction owing to the movement towards each other of the adjacent longitudinal yarns. The distance between two adjacent longitudinal yarns assumes a value less than Y, for example 0.75Y and, consequently, the transverse dimension of said support decreases, for example, to 0.750nY (Fig. 2b).

[0027] A person skilled in the art will understand that, with reference to Figure 2b, the shortening of the transverse yarns does not occur as a result of the intrinsic properties of the yarn itself. On the contrary, the transverse yarns contract

lengthwise and expand widthwise since they are deformed mechanically by the pulling action of the longitudinal yarns which move towards each other and become denser. Basically, the legth 110' of the belt 1 in the tensioned state is deformed, extending longitudinally and contracting transversely, when subjected to a tensile force which stresses the elasticity of the structure 111.

[0028] These elastic deformations of the structure 111 situated in the internal or central part of the belt 1 are transmitted towards the periphery of the belt by the upper fibrous layer 112a and lower fibrous layer 112b until they reach the respective external surfaces 113a and 113b.

[0029] An alternative embodiment of the belt according to the invention is described hereinbelow with reference to Figures 1c and 2c. According to this alternative embodiment, the structure 111, devoid of the upper fibrous layer 112a and lower fibrous layer 112b, is impregnated with natural rubber, for example based on caoutchouc, or with a synthetic rubber, for example based on silicone. In this way a substantially resilient and extensible mass 122 is formed and envelopes said structure 111. In turn, the structure 111 defines an upper layer 122a and a lower layer 122b of said resilient and extensible mass.

[0030] Owing to a tensile force which stresses the elasticity of the structure 111, the consequent elastic deformations of said structure situated in the internal or central part of the belt 1 are transmitted towards the periphery of the belt by the upper layer 122a and lower layer 122b of the resilient and extensible mass 122 until they reach the respective external surfaces 123a and 123b. The belt 1 is thus deformed from the untensioned state into the tensioned state, extending longitudinally and contracting transversely.

[0031] Fig. 3 shows the effect of the tensile force applied to the belt 1, on its longitudinal extension, on the one hand, and on its transverse contraction, on the other hand. It is pointed out how the belt is able to reach and exceed an extension of about 100% if subjected to a tensile force of about 9-10 kg/cm and how the transverse contraction is equal to about 25%.

[0032] Consequently, the values for longitudinal extension of the belt compared to its normal untensioned state, range between about 5% and about 100% and preferably between about 40% and about 60% and advantageously said value is about 45-50% with a tensile force of about 5-6 kg/cm.

[0033] The transverse contraction values of the belt range between about 2% and about 25% and, preferably, between about 15% and about 20% with a tensile force of about 5-6 kg/cm.

[0034] As mentioned, the textile structure 111 is formed by the interlacement of a plurality 01, 02, ... On of adjacent longitudinal yarns and a plurality T1, T2, ... Tn of adjacent transverse yarns. Advantageously, the interlacement may be of the orthogonal type. In this case the longitudinal yarns are the warp yarns and the transverse yarns are the weft yarns. Alternatively, the interlacement may be of the knitted type and, in particular, of the warp-knitted type.

[0035] According to a preferred embodiment, the longitudinal (or warp) yarns consist, at least partially, of substantially extensible and elastic fibre, in particular synthetic fibre. Fibres suitable for this purpose are fibres of the polyurethane elastomer type. Preferably, the transverse (or weft) yarns consist of substantially non-extensible fibres, in particular synthetic fibre. Fibres suitable for this purpose are fibres of the polyester, or polyamide or polyaramide type or a combination thereof.

[0036] Alternatively, said longitudinal (or warp) yarns consist of a mixture of substantially extensible and elastic fibre and substantially non-extensible fibre and, in particular, of fibre of the polyurethane elastomer type and polyester or polyamide or polyaramide fibre. Advantageously, the weight ratio between said polyurethane fibre and said polyester or polyamide or polyaramide fibre ranges between 0.2 and 1.0.

[0037] The upper fibrous layer 112a and lower fibrous layer 112b preferably consist of substantially non-extensible fibre, in particular synthetic fibre and preferably fibre of the polyester or polyamide or polyaramide type or a combination thereof.

[0038] The thickness of said belt ranges between about 2.00 mm and about 30.0 mm. Preferably, said thickness ranges between about 4.0 mm and about 16.0 mm. Advantageously, said belt has a thickness of about 8.0 to 10.0 mm.

[0039] With reference to Figures 4a, 4b, 5, 5a and 5b a detailed description is now provided with regard to the operating principle of the belt 1 according to the present invention when used in an apparatus for shrinking continuous textile substrates such as, for example, orthogonal weave fabrics, knitted fabrics, non-woven fabrics, etc.

[0040] The apparatus for shrinking a continuous textile substrate 6, advancing in a direction A-B, comprises, in addition to the belt 1, a first motorized roller 4, a second motorized roller 2, an idle transmission and pre-tensioning roller 3 and a drum 5 for guiding the textile substrate.

[0041] The belt 1, in the normal untensioned state (shown in Figure 4a), is wound at least partially around the first and the second motorized rollers 2, 4, the idle roller 3 (which is in the rest or inactive position) and around the guide drum 5.

[0042] In the operating condition shown in Fig. 4b, the belt 1 is tensioned by means of the tensioning idle roller 3. The belt 1 is thus subject to a longitudinal extension with respect to its original, normally untensioned state shown in Fig. 4a, namely is pre-tensioned.

[0043] The longitudinal deformation of the belt 1 used in an apparatus for shrinking continuous textile substrates, such as, for example, that described in the application EP04425854.9 and shown schematically in Fig. 5, comprises essentially a first extension phase and a second contraction phase performed in immediate succession.

[0044] As described in the Application EP04425854.9 and with reference to Fig. 5, these phases involving extension and contraction of the belt 1 in the pre-tensioned state by the tensioning means 4 are essentially determined by a difference in tangential speed of the motorized rollers 2 and 4 and, in particular, by the fact that the tangential speed of the motorized roller 2 is greater than that of the motorized roller 4.

[0045] Consequently, the belt 1, along a first length 11 of its travel path from the first motorized roller 4 to the idle tensioning roller 3 and to the second motorized roller 2, is subject to a tensile force which causes a longitudinal extension thereof which progressively increases and is greater than the longitudinal extension of the belt in its original pre-tensioned state.

[0046] Along the length section 12 of its travel path from the second motorized roller 2 to the guide drum 5 and to the first motorized roller 4, the tensile force is slackened off and the belt contracts elastically in a progressively decreasing manner until it recovers at least partially its original pre-tensioned state (substantially along the length where it is partially wound onto the second motorized roller 4).

[0047] In other words, the belt 1, with respect to its original pre-tensioned state, accumulates an additional longitudinal tension and then releases this surplus tension by means of a reverse elastic contraction.

[0048] A continuous textile substrate 6 is fed in contact with the external surface 113a or 123a of the upper layer 112a or 122a of the belt 1 substantially where it undergoes maximum elongation (around the second motorized roller 2). The textile substrate is closely arranged between the external surface of the drum 5 and the surface of the belt. Conveniently, the surface of the drum 5 is heated to a certain temperature. The second length 12 of the belt and the textile substrate 6 supported by the surface of the belt 1 are fed rotationally by the second motorized roller 2 around the drum 5 and pulled out from the drum by the first motorized roller 4.

[0049] The textile substrate 6, which is initially received by the belt in a fully elongated state, is then transported on the surface of the length 12 of the belt in a fully contracted and progressively untensioned state.

[0050] However, the textile substrate 6 is not firmly constrained to the belt 1. Therefore, while the belt 1 contracts until it recovers almost entirely its original pre-tensioned state (under static or dynamic conditions) and the textile substrate substantially follows the belt during this contraction, the textile substrate is able to slide lightly on the surface of the belt and on the side surface of the drum 5 in the opposite direction to the direction of contraction, namely in the same direction as the feeding direction.

[0051] The tangential speed of the second motorized roller 2 is variable and adjustable with respect to that of the first motorized roller 4 so that the tensile force exerted on the length 11 may be correspondingly set to a predetermined value. Consequently, the additional longitudinal extension imparted to the belt, with respect to its original pre-tensioned state, may be predefined depending on the desired degree of shrinkage of the textile substrate and depending on the characteristics of the latter.

[0052] In particular, the additional longitudinal extension values of the belt, with respect to its pre-tensioned state, range between about 5% and about 50% and, preferably, between about 20% and about 40%.

[0053] With reference to Fig. 5a, the first length 11 of the belt, subjected to the tensile force which causes a longitudinal extension thereof, undergoes a gradual transverse contraction such that its side edges 114, 114' converge in the direction of feeding and the width of said belt section decreases with respect to that of its original pre-tensioned state.

[0054] The next length 12 of the belt (Fig. 5b), following its longitudinal elastic contraction, expands gradually in the transverse direction, such that the side edges diverge in the feeding direction and the width of said length increases until it recovers at least partially the width of its original pre-tensioned state.

[0055] The degree of shrinkage undergone by the textile substrate is essentially predetermined on the basis of the value of additional longitudinal extension imparted to the belt length 11 with respect to its original pre-tensioned state and depending on the pre-tensioning value imparted to the belt with respect to its normally untensioned state.

[0056] Since the longitudinal shrinkage imparted to said textile substrate, in particular if it is of the knitted fabric, is normally accompanied and compensated by a transverse expansion in order to readjust and balance its overall dimensional structure, the second belt length 12 (Fig. 5b), as a result of its transverse expansion, is able to exert on said textile substrate a complementary expanding action.

[0057] The degree of said transverse expansion is substantially related to the degree of longitudinal shrinkage imparted and depends substantially on the value of additional longitudinal extension imparted to the belt length 11 with respect to its original pre-tensioned state.

Claims

1. Belt (1) which is substantially longitudinally deformable elastically for use in an apparatus for treating a continuous textile substrate, comprising: a textile support structure (111) and at least one additional layer (112a, 112b; 122a, 122b) fixed to said textile structure, said textile structure being formed by an interlacement of a plurality of substantially longitudinal adjacent yarns (O1 , 02, ... On) and a plurality of substantially transverse adjacent yarns (T1, T2, ... Tn),

said substantially longitudinal yarns comprising substantially extensible and elastic fibre and said substantially transverse yarns comprising substantially non-extensible fibre.

2. Belt (1) according to Claim 1, **characterized in that** said at least one additional layer comprises a substantially resilient and extensible mass (122) which envelopes said textile structure (111).

3. Belt (1) according to Claim 1 or 2, **characterized in that** said substantially resilient and extensible mass (122) comprises an upper layer (122a) and a lower layer (122b).

4. Belt (1) according to Claim 1, 2 or 3, **characterized in that** said substantially and extensible mass (122) comprises natural rubber and/or synthetic rubber.

5. Belt (1) according to Claim 1, **characterized in that** said at least one additional layer is a fibrous layer (112a, 112b) which comprises an upper fibrous layer (112a) and a lower fibrous layer (112b).

6. Belt (1) according to Claim 1, 2 or 3, **characterized in that** said at least one fibrous layer (112a, 112b) comprises an unordered agglomerate of substantially non-extensible fibres.

7. Belt (1) according to any one of the preceding claims, **characterized in that** said textile support structure (111) undergoes an elastic deformation when subjected to a tensile force in the longitudinal direction.

8. Belt (1) according to Claim 7, **characterized in that** said at least one additional layer (112a, 112b; 122a, 122b) follows said elastic deformation of said textile structure (111).

9. Belt (1) according to Claim 7 or 8, **characterized in that** said elastic deformation comprises a deformation consisting of a longitudinal extension and a deformation consisting of a longitudinal contraction with respect to a pre-tensioned state.

10. Belt (1) according to Claim 7, 8 or 9, **characterized in that** said elastic deformation comprises a deformation consisting of a transverse contraction and a deformation consisting of a transverse expansion with respect to a pre-tensioned state.

11. Belt (1) according to any one of the preceding claims, **characterized in that** said substantially longitudinal yarns of said textile structure (111) comprise polyurethane elastomer.

12. Belt (1) according to any one of the preceding claims, **characterized in that** said substantially longitudinal yarns of said textile structure comprise a mixture of substantially extensible and elastic fibre and substantially non-extensible fibre.

13. Belt (1) according to Claim 12, **characterized in that** said substantially longitudinal yarns of said textile structure comprise a mixture of fibre of the polyurethane elastomer and polyester fibre type, or fibre of the polyamide and polyurethane elastomer type, or fibre of the polyaramide and polyurethane elastomer type.

14. Belt (1) according to any one of the preceding claims, **characterized in that** said substantially transverse yarns of said textile structure comprise synthetic fibre, for example of the polyester, polyamide or polyaramide type or a combination thereof.

15. Belt (1) according to any one of the preceding claims, **characterized in that** said at least one fibrous layer (112a, 112b) comprises a synthetic fibre, for example of the polyester or polyamide or polyaramide type or a combination thereof.

16. Belt (1) according to any one of the preceding claims, **characterized in that** said interlacement is of the orthogonal type.

17. Belt (1) according to any one of Claims 1-15, **characterized in that** said interlacement is of the knitted and preferably warp-knitted type.

18. Belt (1) according to any one of the preceding claims, **characterized in that** it is configured as a closed loop.

19. Belt (1) according to any one of the preceding claims, **characterized in that** said apparatus for treating a continuous textile substrate is an apparatus for shrinking a continuous textile substrate.

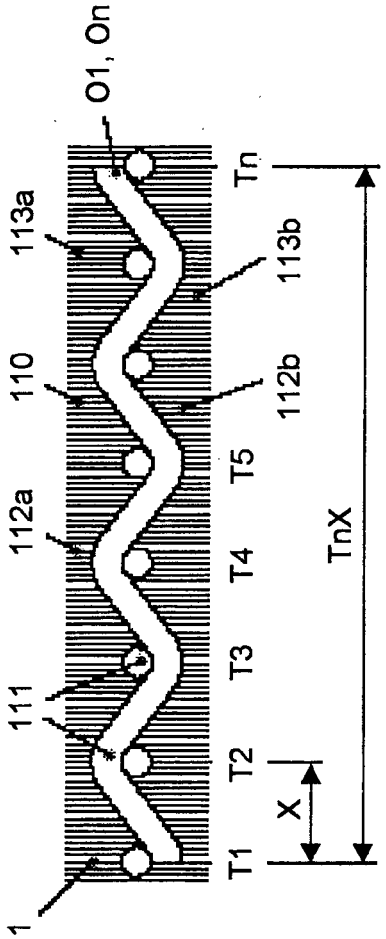
O1, On
113a
113b
110
112b
112a
111
T1
T2
T3
T4
T5
Tn
X
TnX
1

Fig. 1a

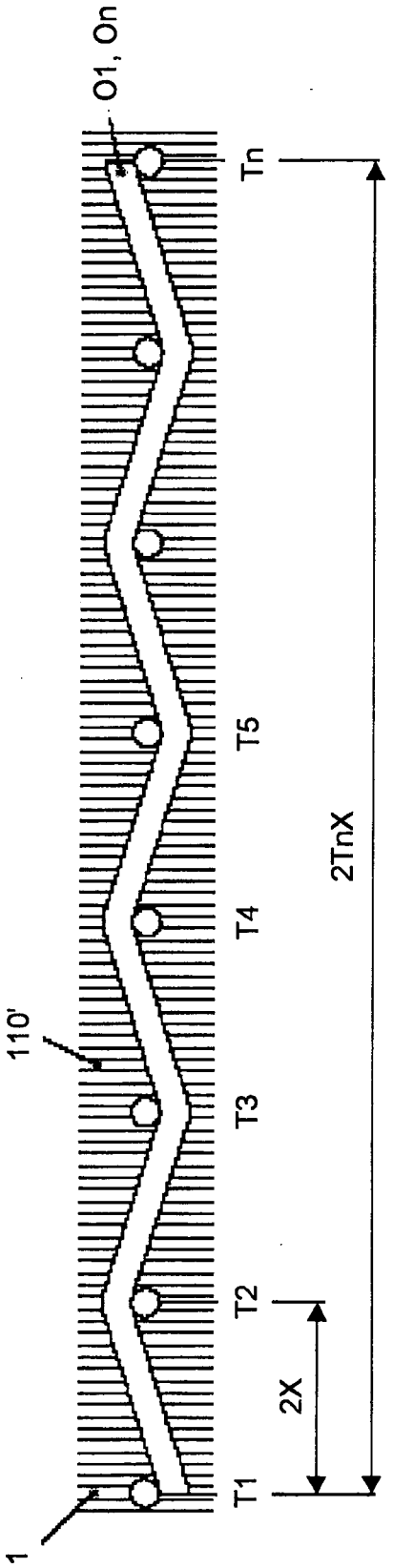
O1, On
110'
T1
T2
T3
T4
T5
Tn
2X
2TnX
1

Fig. 2a

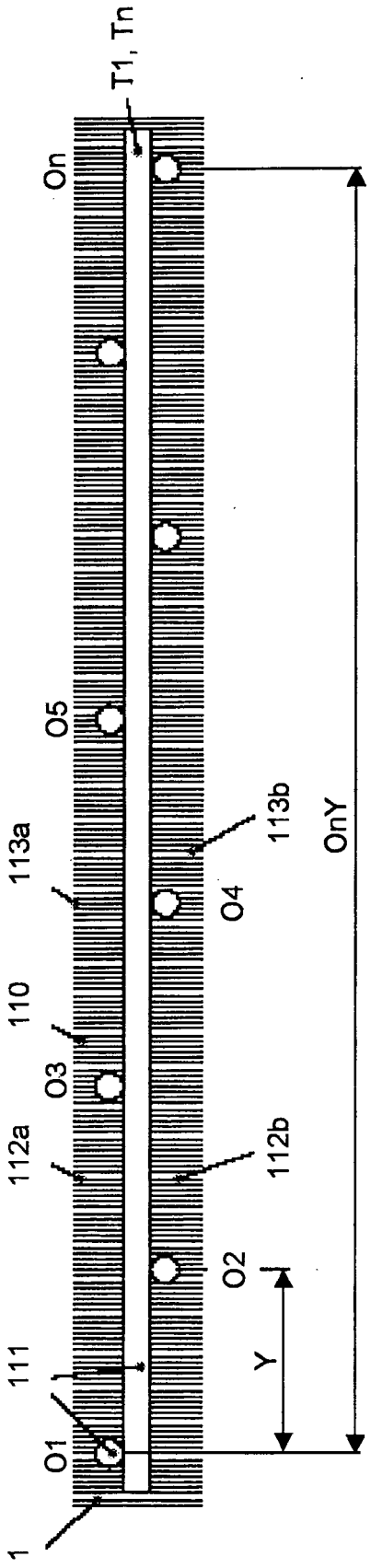
T1, Tn
On
O5
113a
113b
O4
OnY
110
O3
112a
112b
O2
Y
111
O1
1

Fig. 1b

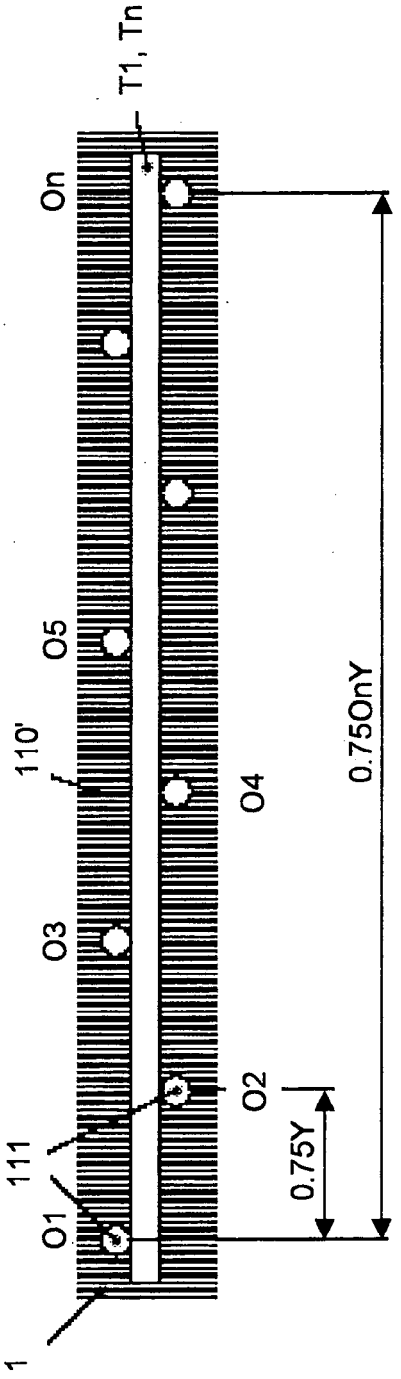
T1, Tn
On
O5
110'
O4
0.75OnY
O3
O2
0.75Y
111
O1
1

Fig. 2b

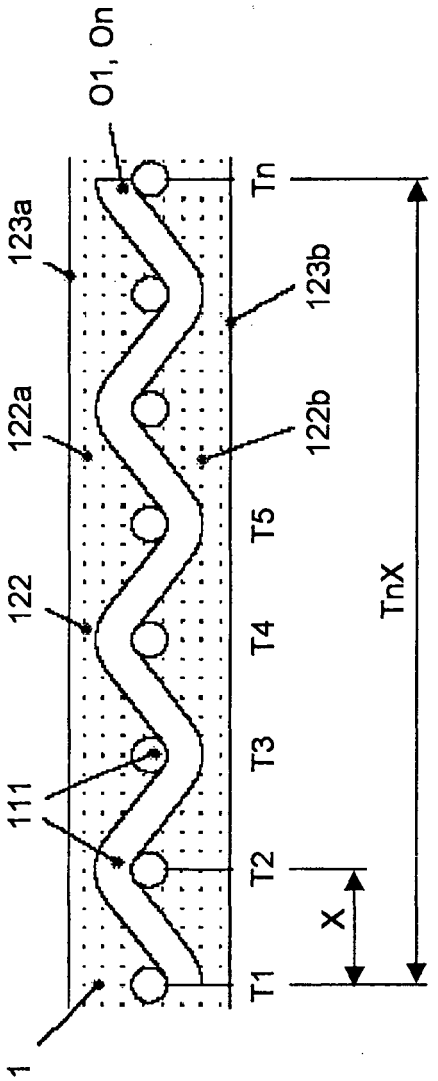
O1, On
123a
123b
122a
122b
122
111
1
T1
T2
T3
T4
T5
Tn
X
TnX

Fig. 1c

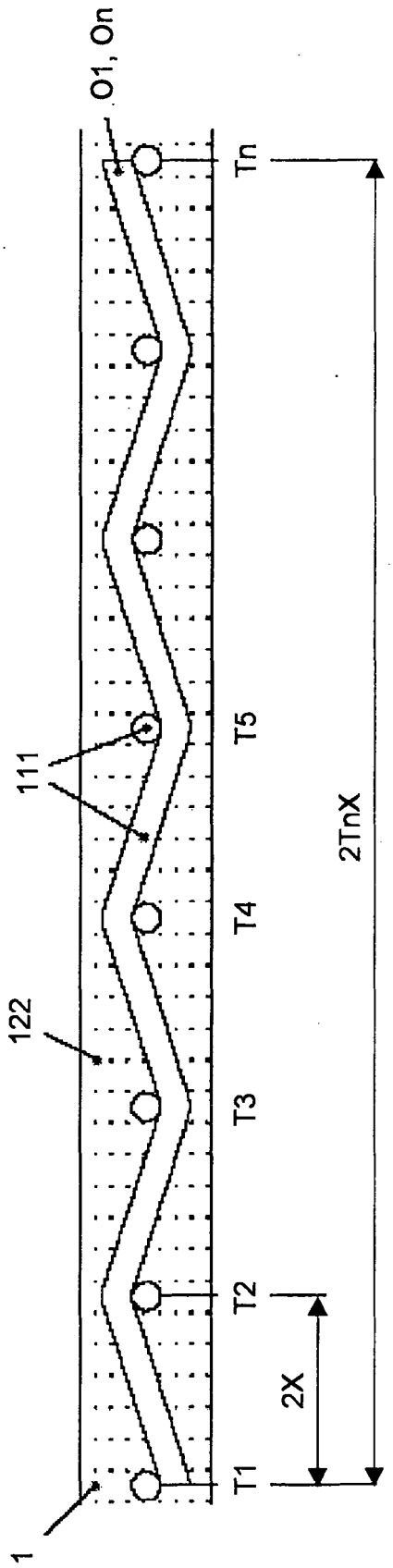
O1, On
111
122
1
T1
T2
T3
T4
T5
Tn
2X
2TnX

Fig. 2c

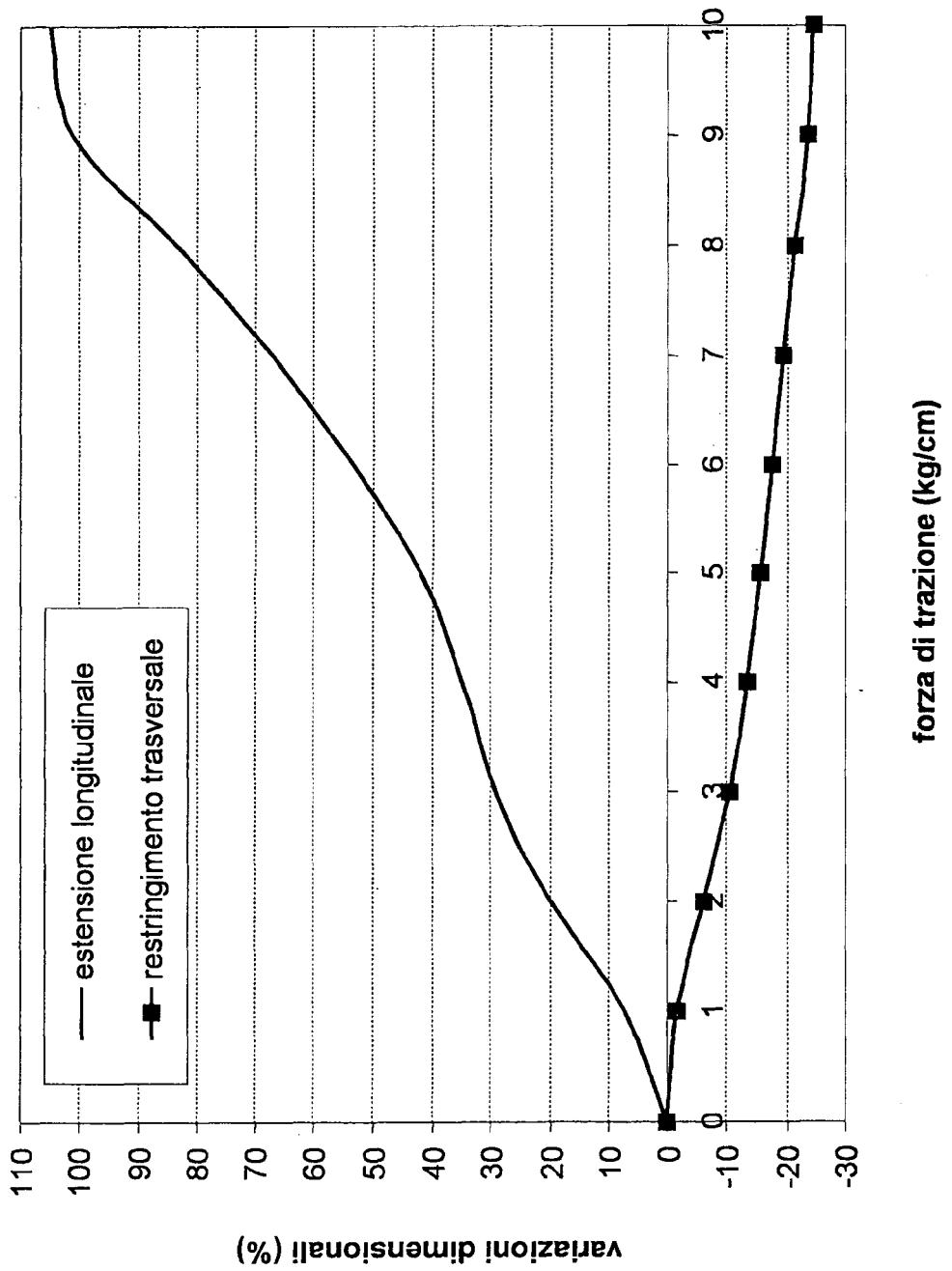
estensione longitudinale
restringimento trasversale
variazioni dimensionali (%)
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
0
1
2
3
4
5
6
7
8
9
10
forza di trazione (kg/cm)

Fig. 3

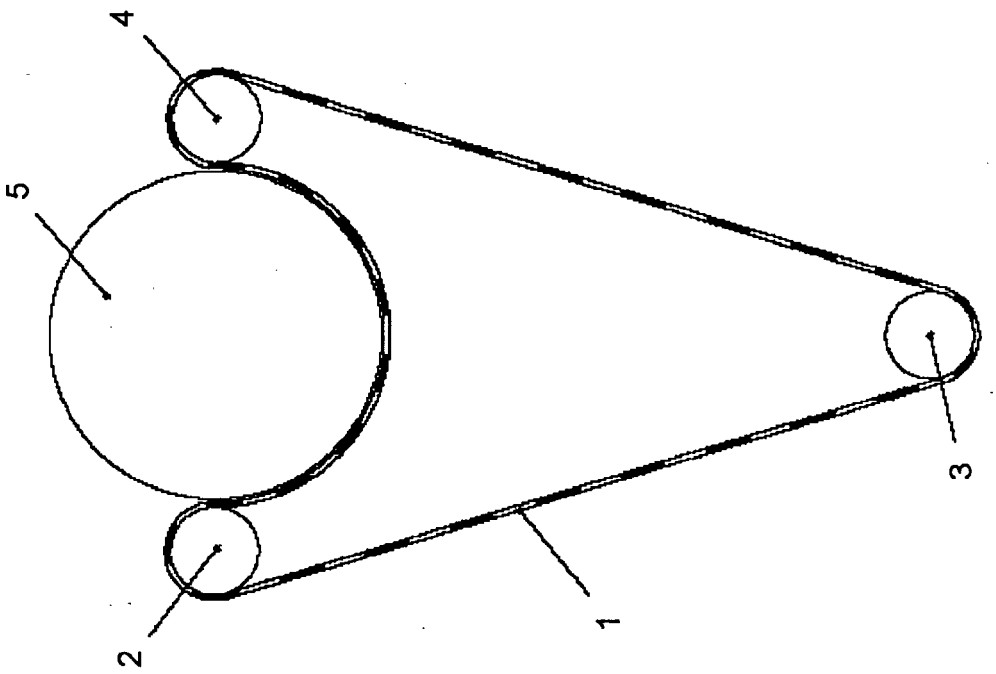

Fig. 4b

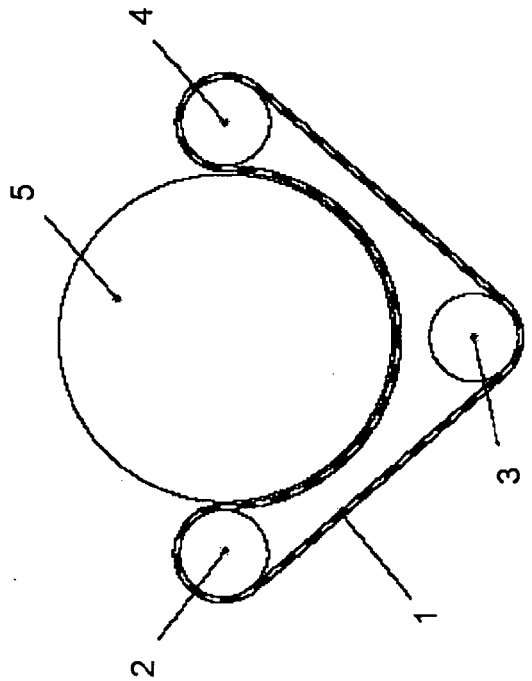

Fig. 4a

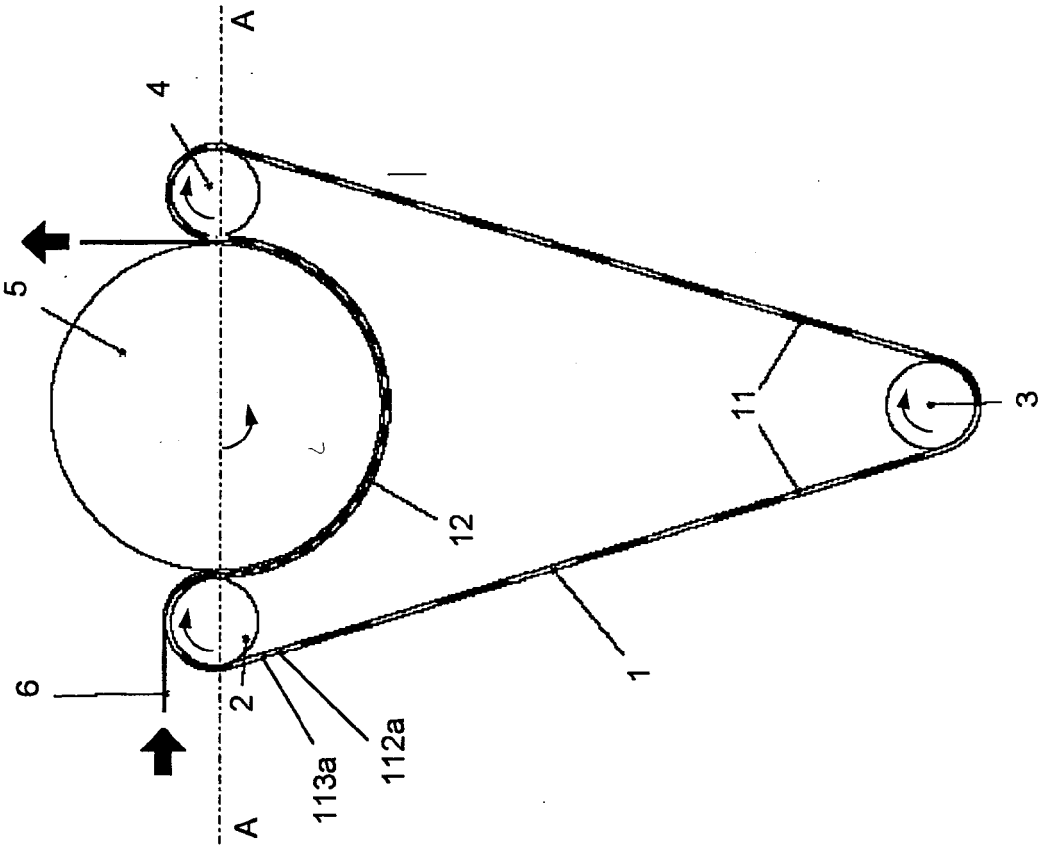

Fig. 5

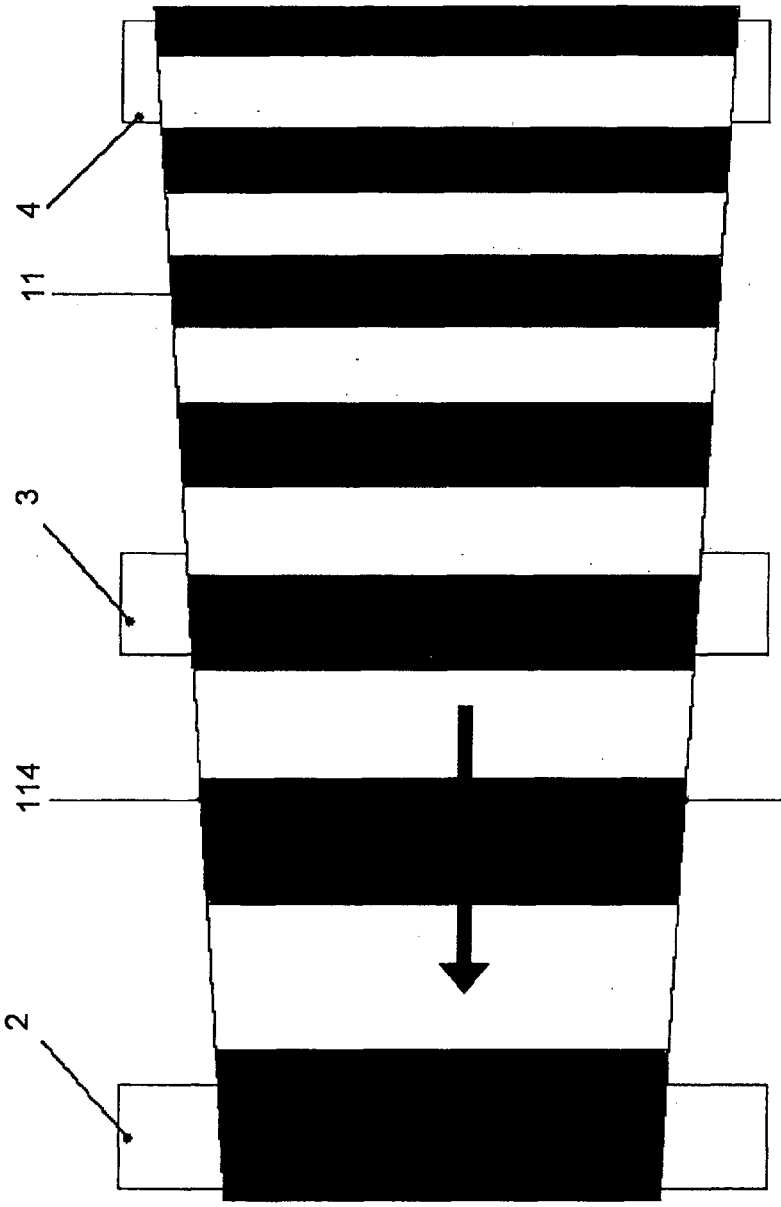

Fig. 5a

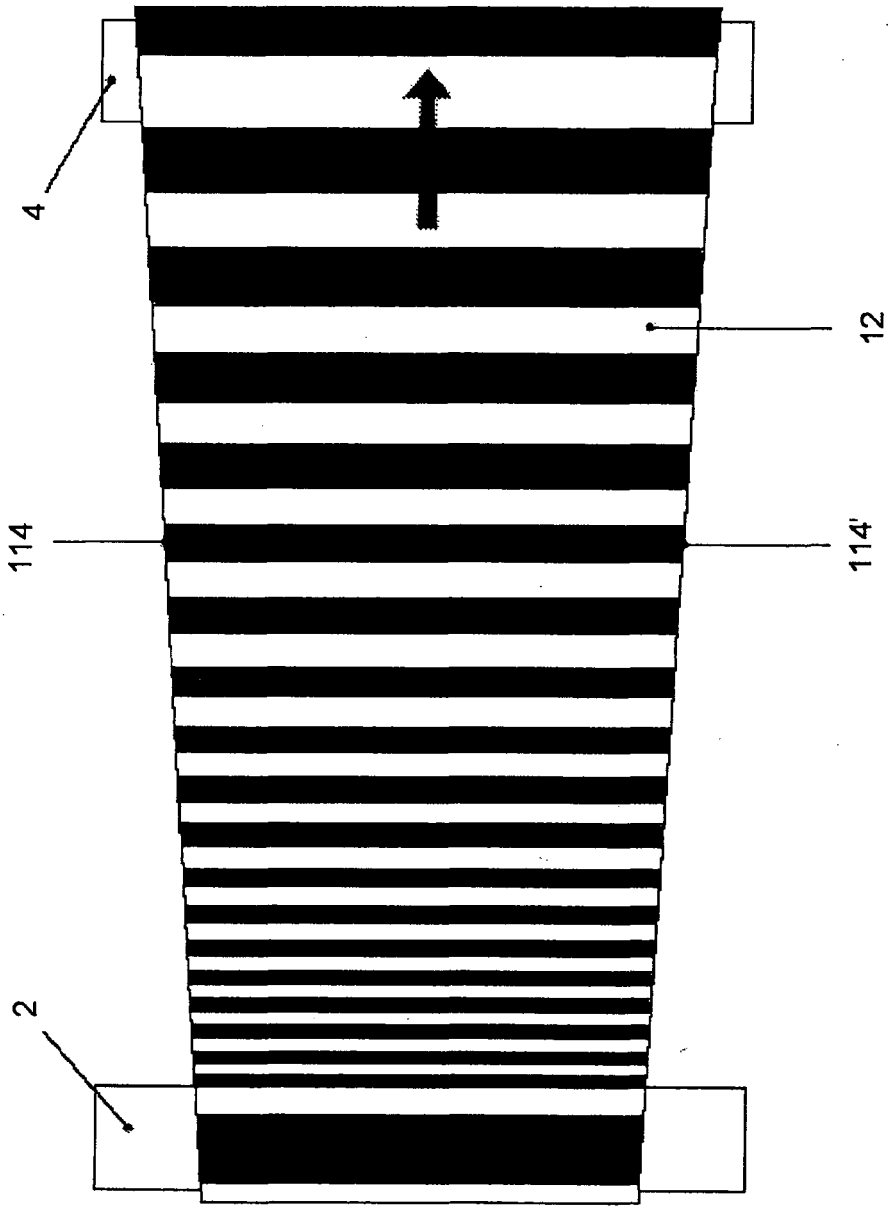

Fig. 5b

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 42 5155

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
D,A	US 2 021 975 A (J.H. WRIGLEY; A. MELVILLE) 26 November 1935 (1935-11-26) * page 2, column 2, line 2 - line 30 *	1,18,19	D06C21/00
D,A	US 4 908 918 A (C. STRAHM; P. SUESS) 20 March 1990 (1990-03-20) * column 3, line 22 - line 44 *	1,18,19	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

D06C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 July 2005	Goodall, C

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 42 5155

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

27-07-2005

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2021975 A	26-11-1935	NONE	
US 4908918 A	20-03-1990	EP 0295354 A1	21-12-1988
		AT 57545 T	15-11-1990
		DE 3765639 D1	22-11-1990

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 4908918 A **[0003]**
- US 2021975 A **[0004]**
- EP 04425854 A **[0005] [0006] [0017] [0043] [0044]**