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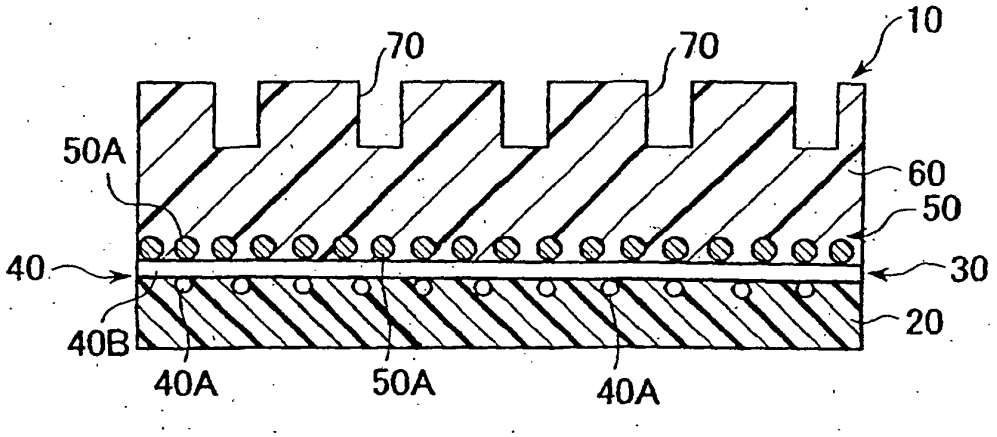
(54) **BELT FOR SHOE PRESS**

(57) A belt (10) for shoe press comprising a shoe side layer (20), a substrate (30) formed in the outer side of the shoe side layer (20), and a wet paper side layer (60) formed on the outer circumference of the substrate (30). The substrate (30) consists of a lattice-like material (40) formed by bonding the intersection of a warp (40A) and a waft (40B), and a thread winding layer (50) formed by winding a thread (50A) spirally. Bonding at the intersection of the warp (40A) and waft (40B) is separated easily and friction takes place between, but since the warp (40A) is made to wear earlier than the weft (40B), the weft (40B) does not wear in the early stage as compared with prior art. Consequently, strength and dimensional stability of the belt for shoe press are enhanced.

FIG. 1



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Description

FIELD OF THE INVENTION

[0001] The invention relates to a belt used for a shoe press mechanism such as a shoe press for papermaking, and especially to a belt used for a closed type shoe press (referred to as "belt" or "shoe press belt" hereinafter.).

BACKGROUND OF THE INVENTION

[0002] In the field of a press for papermaking, the use of shoe presses is on the increase because they contribute to a reduction in the total manufacturing costs. Above all, there is a trend toward the use of a closed type shoe press because it requires less space for setting and avoids scattering of oil.

[0003] Compared to conventional belts used in open type shoe presses, belts used in a closed type shoe press are subject to more severe conditions in terms of papermaking speed and nip pressure during papermaking process. Accordingly, there has been a strong demand by users for improvement in belt durability.

[0004] Among typical technologies used for producing belts for closed type shoe presses, various manufacturing technologies using mandrels are known. For example, Examined Japanese Patent Publication No. 57236/1991 and Unexamined Japanese Patent Publication No. 45888/1989 disclose a manufacturing method using an endless woven fabric as a core member. In addition, Japanese Patent No. 3213589 discloses a manufacturing method using an endless mesh for a core member. However, these manufacturing methods have deficiencies, especially difficulties encountered in adjusting machine direction dimension of a belt.

[0005] In addition, PCT Patent application No. 503315/1989 and Unexamined Japanese Patent Publication No. 209578/1996 disclose a manufacturing method wherein a woven fabric is not used. These manufacturing methods form threads in the axial direction of a mandrel at regular intervals around the entire circumference of the mandrel. However, it is difficult to position threads substantially parallel to the axial direction of a mandrel and without threads being loosen under even tensile force. With these methods, excessive time is required for forming threads.

[0006] Unexamined Japanese Patent Publication No. 298292/1989 and PCT Patent application No. 505428/1993 disclose a manufacturing method wherein a mat-shaped fiber band or a woven fabric impregnated with uncured resin is wound in helix and then cured. However, with these manufacturing methods, exfoliation can easily occur at joints of the helix.

[0007] Figure 10 shows a manufacturing method for a conventional shoe press belt.

[0008] An endless woven fabric (a woven fabric, which was woven endlessly) C is arranged on two rolls A and B. After a shoe side layer E is impregnated and coated on an external surface of the woven fabric C by a coating apparatus D and is then cured, the endless woven fabric C is removed from the rolls A and B, turned inside-out, and reset on the rolls with its original inner surface facing outward. After a wet paper web side layer F is impregnated and coated on the external surface of the fabric and is cured with its entire thickness adjusted, concave grooves G are formed, and a belt 1 is produced.

[0009] The above-described conventional method had the following two deficiencies: 1) in order to impregnate and coat the shoe side layer E on one surface of the endless woven fabric and the wet paper web side layer F on the other side, the belt needed to be reversed, and reversal caused distortion to occur inside the belt; 2) the distortion that existed when weaving the endless woven fabric is released as the resin is cured, which results in instability of the form of the belt due to flapping of the belt.

[0010] Japanese Patent No. 3408416 and Unexamined Japanese Patent Publication No. 303377/2000 disclose a manufacturing method wherein a resin layer is firstly formed on a mandrel followed by formation of a base body, i.e., a substrate, around the external circumference of the resin layer, and formation of another resin layer, which is connected with first resin layer through the base body.

[0011] According to this manufacturing method, after forming the first resin layer, there is no need to grind or reverse the resin layer, and therefore manufacturing efficiency and productivity can be improved.

DISCLOSURE OF THE INVENTION

[0012] However, the shoe press belt manufactured according to the manufacturing method disclosed in the Japanese Patent No. 3408416 has relatively large undulations at the joints of warp yarns and weft yarns in the woven fabric because a woven fabric piece is used as a base body. In the use of the belt, these undulations result in large stress concentration at the joints of warp yarns and weft yarns, which can result in cracking of a resin layer, and impairment of the durability of the belt.

[0013] In the case of a manufacturing method disclosed in the Unexamined Japanese Patent Publication No. 303377/2000, similarly to the methods disclosed in the PCT Patent application No. 503315/1989 and Unexamined

Japanese Patent Publication No. 209578/1996, threads have to be formed in the axial direction of the mandrel at regular intervals, and be distributed around the entire circumference of the mandrel. The need for this arrangement causes manufacture of the belt to be very time consuming and labor intensive.

[0014] In the light of above, prior Japanese Patent Application No. 76216/2005 proposed a shoe press belt comprising a base body having a lattice material made by joining the crossing points of warp yarns and weft yarns crossing one another at crossing points and joined at the crossing points and a layer comprising thread wound in helix, a wet paper web side layer; and a shoe side layer formed on a mandrel having a polished surface. However, since compressed air indwells in press rolls wearing the above shoe press belt, it is employed in the condition that tensile force is loaded on the entire belt. The shoe press belt runs in the MD direction with drive at a roll axis and said tensile force increases at a position immediately before the press and decreases at the press exit.

[0015] Therefore, as the tensile force on the warp yarns of the lattice material varies before and after the press, the warp yarns move back and forward while the weft yarns remain almost still, and the warp yarns and the weft yarns rub against each other.

[0016] If the warp yarns and the weft yarns of the lattice material are made of same material, the problems are that the strength of the belt in the CMD direction be deteriorated or that the belt is subject to dilatation in the CMD direction since the weft yarns are more easily worn than the warp yarns.

[0017] Crossing points of the warp yarns and the weft yarns are joined. However, joints are so simple that they easily come off by running and inflection of the lattice material. It is, therefore, inevitable that the friction occurs between the warp yarns and the weft yarns.

[0018] Thus, it is the object of the invention to provide a belt for a shoe press that overcomes the above problems.

[0019] The invention solved above problems by a shoe press belt to be disposed between press rolls and a shoe of a shoe press apparatus, comprising a base body consisting of a lattice material made by joining the crossing points of warp yarns and weft yarns and a thread layer wound in a helix, a wet paper web side layer and a shoe side layer formed on a mandrel having a polished surface, characterized in that said warp yarns are so formed as to wear earlier than said weft yarns.

[0020] In the invention, since the warp yarns of the lattice material are more likely to be worn than the weft yarns, the weft yarns do not wear off early as before. As a result, strength and dimensional stability of the belt are improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Figure 1 is a sectional view of a part of a shoe press belt of the invention.
Figure 2 shows a mandrel in a process of forming a shoe side layer; Figure 2(a) is a side view of a mandrel and a coating apparatus and Figure 2(b) is a perspective view of a mandrel.
Figure 3 is a perspective view of a shoe press mechanism.
Figure 4 is an enlarged view of a feature of a lattice material.
Figure 5 is a perspective view showing the process of positioning a lattice material on a mandrel.
Figure 6 is a perspective view showing the process of winding a thread layer.
Figure 7 is a perspective view showing the process of joining after forming a thread layer.
Figure 8 is a side view showing the process of separating a shoe press belt from a mandrel.
Figure 9 is a schematic view of an apparatus used for examining abrasion resistance.
Figure 10(a) is a sectional view showing a conventional manufacturing process of a shoe press belt; and Figure 10 (b) is a partial sectional view of a shoe press belt produced by the conventional method.

BEST MODES FOR CARRYING OUT THE INVENTION

[0022] An embodiment of the invention is explained referring to Figures 1 to 7.

[0023] Figure 1 is a sectional view of a part of a belt 10 for shoe press of the invention. Figure 2 shows a mandrel M in a process of forming a shoe side layer; Figure 2(a) is a side view of a mandrel M and a coating apparatus T and Figure 2(b) is a perspective view of a mandrel M. Figure 3 is a perspective view of a shoe press mechanism 100 applying the belt 10 for shoe press of the invention. Figure 4 is a partial enlarged view of a lattice material used for a base body. Figure 5 is a perspective view showing the process of positioning a lattice material 40 as a base body on the external surface of a shoe side layer 20 formed on the surface of the mandrel M, Figure 6 is a perspective view showing the process of winding a wound layer 50 and Figure 7 is a perspective view showing the process of joining after winding the wound layer 50.

[0024] As shown in Figure 1, the belt 10 for shoe press of the invention comprises a shoe side layer 20, a base body 30 formed on the external circumference of the shoe side layer 20 and a wet paper web side layer 60 formed on the

external circumference of the base body 30.

[0025] The shoe side layer 20 is formed on the mandrel M having a polished surface.

[0026] The base body 30 comprises a lattice material 40, composed of warp yarns 40A and weft yarns 40B, joined at their crossing points, and a wound layer 50 composed of a thread 50A wound in a helix.

[0027] As shown in Figure 2(b), the shoe side layer 20 is formed on the surface of the mandrel M. Preferably, the mandrel M is pre-coated with a remover material (not shown), or a removing sheet (not shown) is applied to the surface of the mandrel M. Afterwards, as shown in Figure 2(a), the shoe side layer 20 is formed to a thickness in the range from about 0.5mm to 2.0mm by using a coating apparatus (a doctor bar, a coater bar, or the like.) T.

[0028] Polishing the surface of the mandrel M not only ensures smoothness of the shoe side layer 20 of the shoe press belt running constantly in close sliding contact with a shoe 104, but also facilitates removal of the belt 10 for shoe press from the mandrel M after the manufacturing process. The mandrel M may include a heating apparatus (not shown), which facilitates curing of the resin including the shoe side layer 20.

[0029] Next, the base body 30 is formed on the external circumference of the shoe side layer 20.

[0030] The base body 30 comprises a lattice material 40 which is composed of warp yarns 40A and weft yarns 40B, joined at their crossing points, and a wound layer composed of a thread 50A wound in a helix toward the mandrel M.

[0031] As shown in Figure 4, the lattice material 40 is composed of warp yarns 40A and weft yarns 40B, joined and latticed at their crossing points. As for the lattice material 40, a material such as disclosed in the Unexamined Japanese Patent Publication No. 194855/2002 may be used. The warp yarns 40A and the weft yarns 40B may be joined at their crossing points by adhesion or gluing by resin, by thermal bonding, or by other means.

[0032] The warp yarns 40A of the lattice material 40 are made to wear earlier than the weft yarns 40B. As for warp yarns 40A, for example, various kinds of yarns such as twisted yarns or spun yarns made of various kinds of materials including inorganic fiber such as carbon fiber or fiberglass, natural fiber such as cotton; or synthetic fiber such as polyester cotton, multi-filament of polyester, acryl cotton, multi-filament of acryl or the like may be used.

[0033] As for weft yarns 40B, for example, synthetic fiber having high modulus and high elastic modulus such as nylon, PET, aromatic polyamide, aromatic polyimide or high strength polyethylene; twisted yarns of multi-filament of polyester; or spun yarns made of polyester cotton may be used, though it is not limited to these.

[0034] It is preferable that the strength of the lattice of the lattice material 40 is in the range of 50-250kg/cm and 1% modulus is in the range of 5-40kg/cm.

[0035] As shown in Figure 5, one or more lattice materials 40 are positioned on the external circumference of the shoe side layer 20 placed on the mandrel M in such a way that the weft yarns 40B are along the axial direction of the mandrel M.

[0036] In order to improve the strength of the belt, it is preferable to position the lattice material 40 so that their edges of widthwise direction overlap one another along the axial direction of the mandrel M.

[0037] The lattice material 40 can also be positioned, for example, in a way that it is wound in a helix towards the shoe side layer 20. Also in this case, it is preferable to position the lattice material 40 so that both edges of widthwise direction overlap one another.

[0038] By turning the mandrel M gradually before the shoe side layer 20 stiffens completely, the lattice material 40 is positioned on the external circumference of the shoe side layer 20 so that the weft yarns 40B are along the axial direction of the mandrel M.

[0039] Next, the wound layer 50 is formed by winding a thread 50A in helix onto the lattice material 40.

[0040] In figure 6, wound layer 50 is formed by winding a thread 50A led out from a bobbin Bo installed in a thread supplier, which is not shown, in a helix about the lattice material 40 with rotating the mandrel M. At this time, plural bobbins Bo may be used for winding the thread 50A on the lattice material 40. The thread supplier also comprises a mobile unit which moves parallel to the axial direction of the mandrel M interlocking with formation of the wound layer 50, which is composed of the thread 50A wound in a helix.

[0041] This wound layer 50 provides the belt 10 for shoe press especially with strength in the machine direction.

[0042] For the material of thread 50A of the wound layer 50, monofilament yarn, multifilament yarn or twisted yarn thereof comprising synthetic fiber having high strength, high modulus and high elastic modulus, such as nylon, PET, aromatic polyamide, aromatic polyimide and high strength polyethylene etc. may be used; however, it is not limited to these.

[0043] It is preferable that the thread 50A be wound in the range from 10 pieces/5cm to 50 pieces/5cm when the thread 50A is multifilament comprising nylon or PET (7000 dtex); and from 10 pieces/5cm to 30 pieces/5cm when the thread 50A is multifilament comprising aromatic polyamide (3000 dtex). The strength of the thread 50A preferably is in the range from 100kg/cm to 300kg/cm.

[0044] After forming the wound layer 50, as shown in Figure 7, the base body 30 is joined by coating it with resin while rotating the mandrel M so that resin covers the lattice material 40 and the wound layer 50. The resin in this case preferably has a viscosity which facilitates impregnation of the resin into gaps between the lattice material 40 and the wound layer 50.

[0045] Described above is an example of the base body 30 formed by positioning one layer of the lattice material 40 on the external surface of the shoe side layer 20, and forming the wound layer 50 on the external surface thereof.

However, it is needless to say that how the lattice material 40 and the wound layer 50 are arranged is not limited to above example. For example, following ways may be possible other than above example: (1) the wound layer 50 is formed first, and then the lattice material 40 is positioned; (2) plural layers of the lattice material 40 are positioned; (3) the wound layer 50 is formed first, and then, after positioning the lattice material 40, the wound layer 50 is further formed; and (4) the lattice material 40 is positioned first, and then after forming the wound layer 50, the wound layer 50 is further formed with positioning the lattice material 40.

[0046] When applying plural layers of the lattice material 40, it is preferable to position the layers in a way that the sections where the edges of widthwise direction overlap one another are not positioned at the same region through the plural layers, in order that unnecessary undulations do not occur on the base body 30.

[0047] Next, an endless wet paper web side layer 60 is further formed on the external circumference of the wound layer 50.

[0048] Resin forming the wet paper web side layer 60 impregnates through the base body 30 and connects and integrates with the base body 30 side surface of the shoe side layer 20. The extent of integration between the shoe side layer 20 and the wet paper web side layer 60 may be improved using a primer or an adhesive agent if necessary.

[0049] Polyurethane resin is preferable as the resin for the shoe side layer 20 and the wet paper web side layer 60, and rubbers or other elastomer can be used other than it.

[0050] As a polyurethane resin, considering its physical property, thermosetting urethane resin is desirable, preferably having a hardness in the range from 80 to 98 degree (JIS-A). Needless to say, the hardness of the shoe side layer 20 and the wet paper web side layer 60 can either be the same or different.

[0051] After the wet paper web side layer 60 is formed by heat-curing the resin, its surface is polished to achieve a predetermined thickness and, if necessary, grooves 70 are formed on the surface of the wet paper web side layer 60.

[0052] After that, the belt 10 for shoe press is removed from the mandrel M.

[0053] As described above, it is preferable that a remover (not shown) or a removing sheet (not shown) etc. be applied to a position between the surface of the mandrel M and the shoe press belt 10, so that the belt 10 for shoe press can easily be removed from the mandrel M.

[0054] As shown in Figure 8, one end of the belt 10 is fixed to a ring R which has a larger diameter than that of the mandrel M and which can be removed from the mandrel M. Removal of the belt 10 for shoe press from the mandrel M can be achieved easily by above structure.

(EMBODIMENT)

[0055] Examples 1 to 3 and a comparative example 1 of a shoe press belt of the invention according to the above structure were produced in the following process.

(EXAMPLE 1)

[0056] PROCESS 1: An appropriate amount of a remover (KS-61: Shin-Etsu Chemical Co., Ltd.) was applied onto the polished surface of the rotatable mandrel having a diameter of 1500mm, using a driving means. Thermosetting urethane resin (prepolymer: Takenate L2395 from Takeda Chemicals Co., Ltd., curing agent: 3, 3'-dichloro-4, 4'-Diaminodiphenylmethane) was applied to the surface of the mandrel to a thickness of 1mm using a doctor bar, and it was left for 10 minutes.

[0057] PROCESS 2: Spun yarns of 500 dtex comprising polyester cotton of 6.7 dtex were applied as the warp of the lattice material and twisted yarns of 500 dtex multifilament yarns of polyester (75 filament) were used as the weft of the lattice material. A lattice material made by sandwiching the warp yarns in the weft yarns, and joining the crossing points of the weft yarns and the warp yarns with a urethane type resin adhesive (the mesh (pitch) of the warp is the same 1 piece/cm in all embodiments from example 1 to example 3 and a comparative example 1, and the mesh (pitch) of the weft is the same 4 pieces/cm in all embodiments from example 1 to example 3 and a comparative example 1) was prepared. Plural layers of the lattice material comprising plural sheets were positioned on the external circumference of the shoe side layer in such a way that the weft yarns extended axially along the mandrel and that the edges in the widthwise direction overlapped one another. After that, a wound layer was formed by winding a 4500 dtex multifilament yarn of polyester (50 filaments) in a helix with a pitch of 30 pieces/5cm onto the external circumference of the lattice material. Then, the lattice material and the wound layer were joined to form the base body by coating resin to the extent that the gaps of the two were covered.

[0058] PROCESS 3: The shoe press belt of the invention was obtained by first impregnating and coating the same thermosetting urethane resin as used for said shoe side layer onto the wound layer to a thickness of 5.5mm, secondly curing it with heat at 100 degrees Celsius for 5 hours, and thirdly polishing the surface of the wet paper web side layer until the overall thickness of the wet paper web side layer was brought to 5.2mm.

(EXAMPLE 2)

[0059] In the process 2, spun yarns of 500 dtex comprising cotton of 6.7 dtex were used as the warps of the lattice material. Spun yarns of 500 dtex comprising polyester cotton of 6.7dtex were used as the wefts of the lattice material. A lattice material was prepared by sandwiching the warp yarns in the weft yarns, and joining the crossing points of the weft yarns and the warp yarns with a urethane type resin adhesive.

(EXAMPLE 3)

[0060] In the process 2, twisted yarns of 500 dtex multifilament yarn of polyester (75 filaments) were used as the warps of the lattice material. Twisted yarns of 1000 dtex multifilament yarn of polyester (150 filaments) were used as the wefts of the lattice material. A lattice material was prepared by sandwiching the warp yarns in the weft yarns, and joining the crossing points of the weft yarns and the warp yarns with a urethane type resin adhesive.

(COMPARATIVE EXAMPLE 1)

[0061] In the process 2, twisted yarns of 1000dtex multifilament yarn of polyester (150 filaments) were used as the warps of lattice material. Twisted yarns of 1000dtex multifilament yarn of polyester (150 filaments) were used as the wefts of the lattice material. A lattice material was prepared by sandwiching the warp yarns in the weft yarns, and joining the crossing points of the weft yarns and the warp yarns with a urethane type resin adhesive.

[0062] Abrasion resistance of the lattice material was examined about above examples 1 to 3 and comparative example 1.

[0063] The apparatus employed to examine abrasion resistance is shown in Figure 9. In this test apparatus, both edges of the experimental piece 13 are pinched by clamp hands CH, CH, which are interlocked with one another and reciprocally movable in the same direction as the arrow A. An evaluation surface of the experimental piece 13 faces the rotating roll RR1. The experimental piece 13 is compressed by moving the press shoe PS toward the roll RR1.

[0064] With this apparatus, since strong inflection is applied to the shoe side of the experimental piece 13, stress from the inflection occurs at the crossing points of the weft yarns and the warp yarns of the lattice material.

[0065] On the other hand, the lattice material and the thread layer wound in a helix are on the rotating roll side of the experimental piece 13, and stress from the inflection therein is not so much high. By means of this apparatus, therefore, abrasion degree at the crossing points of the warp yarns and the weft yarns of the lattice material can be examined.

[0066] Using this apparatus, the test was continued until the number of reciprocation reaches 500000 times, and by measuring breaking strengths of the experimental piece 13 both in the warp direction and the weft direction after the test, abrasion property of the lattice material of the experiment piece 13 was observed.

[0067] In addition, the tensile force applied to the experimental piece 13 was 3kg/cm, the pressure was 36kg/cm2 and the speed of reciprocation was 40cm/second.

[0068] Breaking strengths of examples 1 to 3 and a comparative example 1 and abrasion property of the lattice material are shown in Table 1.

(TABLE 1)

	Warps of Lattice Material	Wefts of Lattice Material	Change Rate of Tensile Stress after Test (Warp direction)	Change Rate of Tensile Stress after Test (Weft Direction)	Observation of Abrasion Property of Lattice Material
Example 1	Spun Yarns of Polyester Cotton (1 piece/cm)	Twisted Yarns of 500 dtex multifilament (75 filaments) of Polyester (4 pieces/cm)	30%	80%	Abrasion Warps (High) Wefts (Low)
Example 2	Spun Yarns of Cotton (1 piece/cm)	Spun Yarns of Polyester Cotton (4 pieces/cm)	20%	90%	Abrasion Warps (High) Wefts (Low)

(continued)

	Warps of Lattice Material	Wefts of Lattice Material	Change Rate of Tensile Stress after Test (Warp direction)	Change Rate of Tensile Stress after Test (Weft Direction)	Observation of Abrasion Property of Lattice Material
Example 3	Twisted Yarns of 500 dtex multifilament (75 filaments) of Polyester (1 piece/cm)	Twisted Yarns of 1000dtex multifilament (150 filaments) of Polyester (4 pieces/cm)	40%	60%	Abrasion Warps (Fair) Wefts (Fair)
Comparative Example 1	Twisted Yarns of 1000dtex multifilament (150 filaments) of Polyester (1 piece/cm)	Twisted Yarns of 1000dtex multifilament (150 filaments) of Polyester (4 pieces/cm)	70%	30%	Abrasion Warps (Low) Wefts (High)
❖ Change Rate of Tensile Stress after Test ~ Measuring Breaking Strength using Instron Type Tensile Tester ❖ Rate (%) = (Breaking Strength after Test / Breaking Strength before Test) × 100					

[0069] The breaking strength and the abrasion property of the lattice material in Table 1 are the results of the measurement of breaking strengths of the warp yarns and the weft yarns of the lattice material by digesting the belt of the invention after the test in an organic solvent of dimethyl formamide, dissolving polyurethane covering the lattice material, taking out the lattice material which remains without being dissolved; and measuring breaking strengths of the warp yarn and the weft yarns of the lattice material and observing the condition of the crossing points of the lattice material.

[0070] As shown in Table 1, for all embodiments of examples from 1 to 3 of the invention, it is found that abrasion resistance of the weft yarns is superior in particular in comparison with that of the comparative example.

[0071] It is understood that abrasion resistance of the weft yarns is superior in all the embodiments is because the warp yarns crossing the weft yarns are made by threads that have more tendency to be worn, so that when friction occurs in the crossing points of the weft yarns and the warp yarns along with the experimental piece 13 under the experiment curves, the warp yarns are torn prior to the weft yarns. As a result, damage to the weft yarns was reduced. Therefore, since less abrasion occurs to the weft yarns of the invention, breaking strength in the latitudinal direction is held and dimensional stability is also maintained.

[0072] In addition, spun yarns of polyester cotton are formed by making and twisting a carding web using short fibers of polyester, and in general, crimps (curl) are formed in the short fibers in a manufacturing process thereof. Therefore, the spun yarns obtained in such a way have a convexo-concave surface. On the other hand, since the twisted yarns of multi-filament have smooth surfaces, polyester cotton having a convexo-concave surface is more likely to be worn than the twisted yarns of multi-filament. The above are verified by example 1.

[0073] Cotton as a material has a greater tendency to be worn than polyester cotton. This can be drawn from example 2.

[0074] From example 3, it is found out that thinner thread is more likely to be worn if the same materials are used.

[0075] As thus, in order to make the warp yarns have more tendency to be worn, the forms of the fibers (including the thickness) or the combination of the materials may be selected appropriately.

[0076] In the invention, since the thread-wound layer of polyester having high-strength is formed on the external circumference of the lattice material, strength of the belt as a whole is not so much reduced even though the warp yarns of the lattice material are worn while using the belt. In other words, a thread 50A of the wound layer has a strength of 100 to 300kg/cm, so that the strength of the warp yarns of the belt can be kept sufficiently by the wound layer.

INDUSTRIAL APPLICABILITY

[0077] As described above, the invention reduced the abrasion of the weft yarns when the belt is in use, by applying the lattice material comprising the warp yarns being more likely to be worn than the weft yarns. As a result, the dimensional stability in the CMD direction of the belt is improved and accordingly the strength and the durability of the belt are also improved.

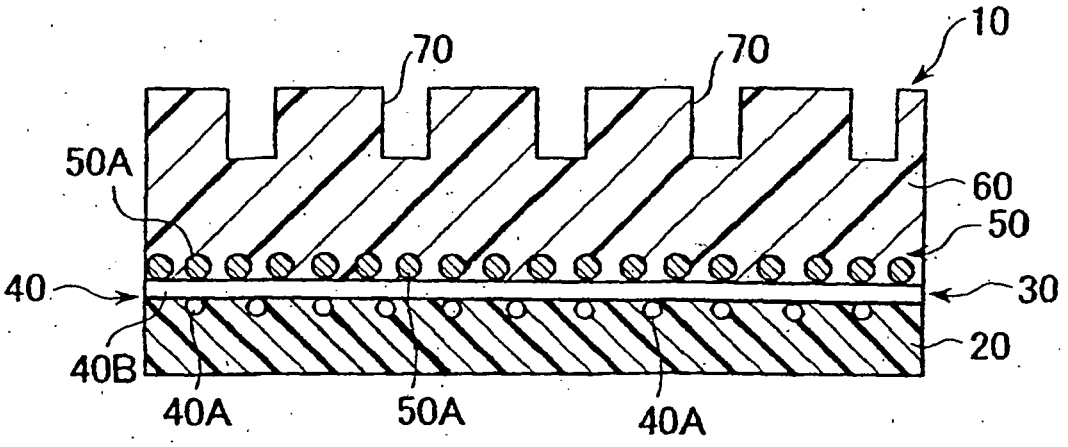
Claims

1. A shoe press belt to be disposed between press rolls and a shoe of a shoe press apparatus, comprising a base body consisting of a lattice material made by joining the crossing points of warp yarns and weft yarns and a thread layer wound in helix, a wet paper web side layer and a shoe side layer formed on a mandrel having a polished surface, **characterized in that** said warp yarns are so formed as to wear earlier than said weft yarns.

2. A shoe press belt according to claim 1, wherein said warp yarns are in a form or made of a material that is more easily worn than said weft yarns.

3. A shoe press belt according to claims 1 or 2, wherein said warp yarns are thinner than said weft yarns.

FIG. 1



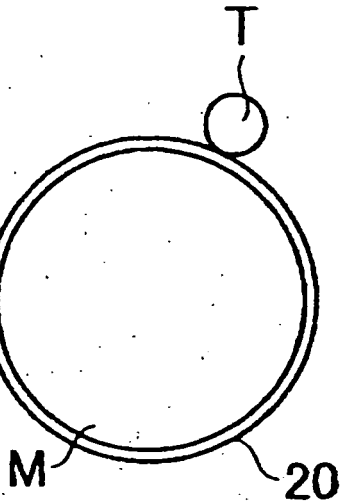


FIG. 2(A)

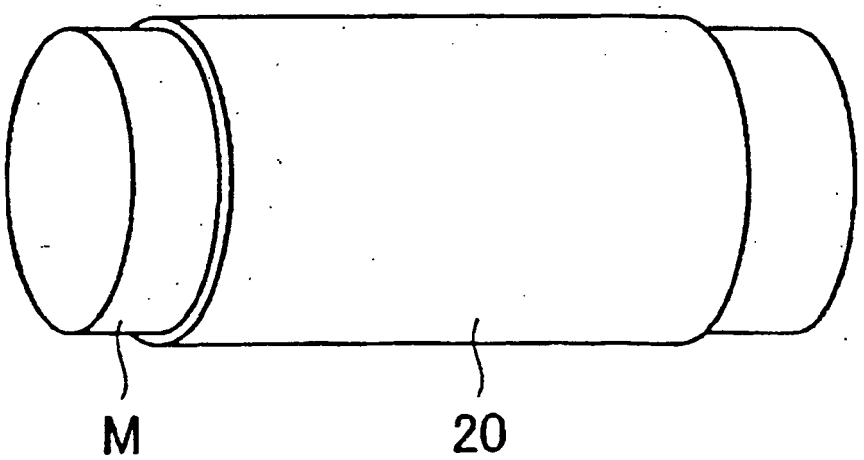


FIG. 2(B)

FIG. 3

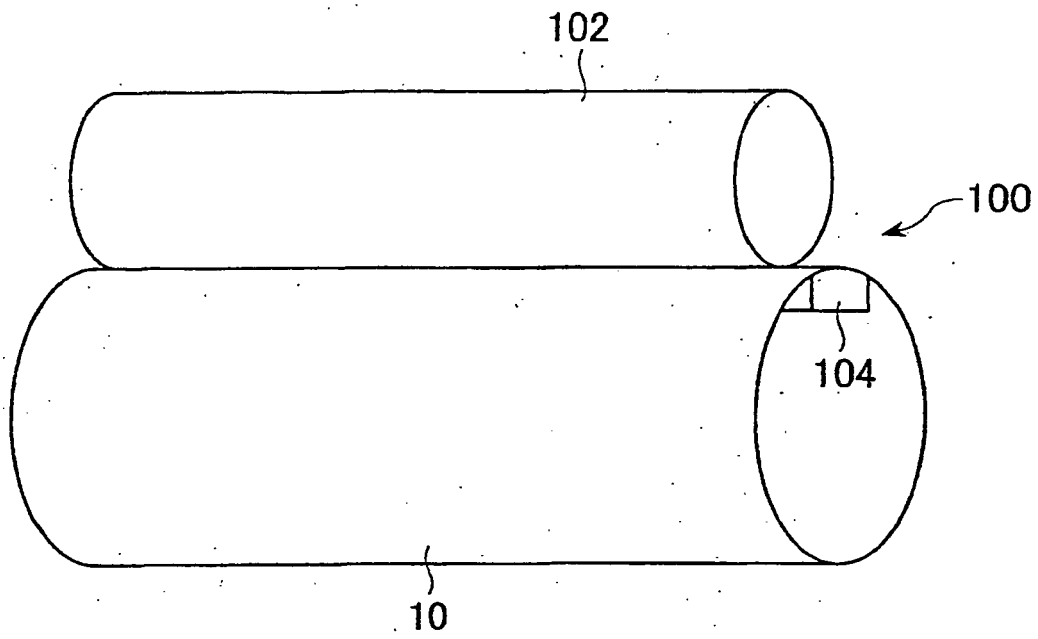


FIG. 4

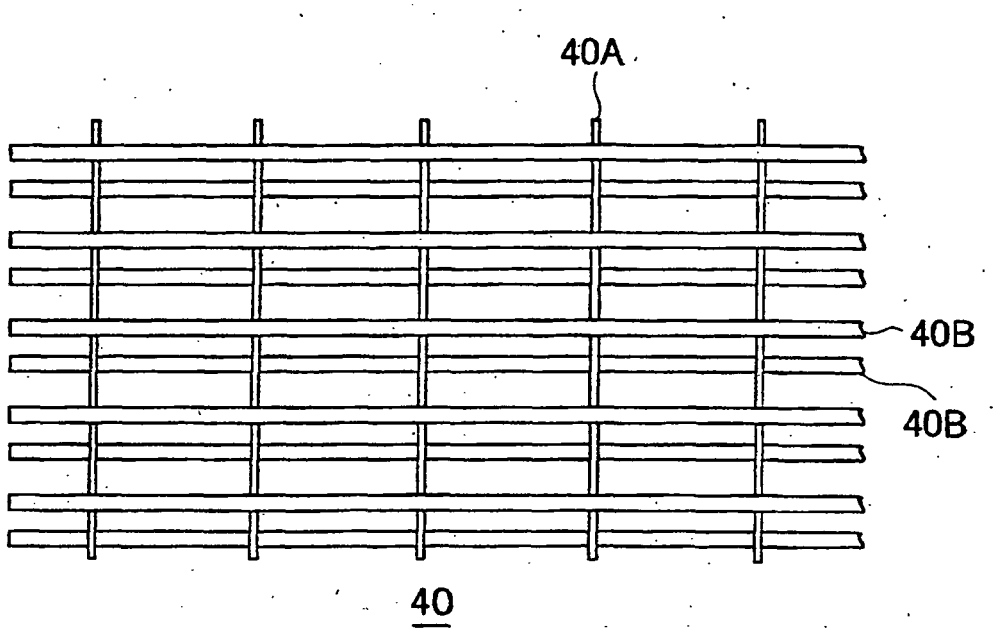


FIG. 5

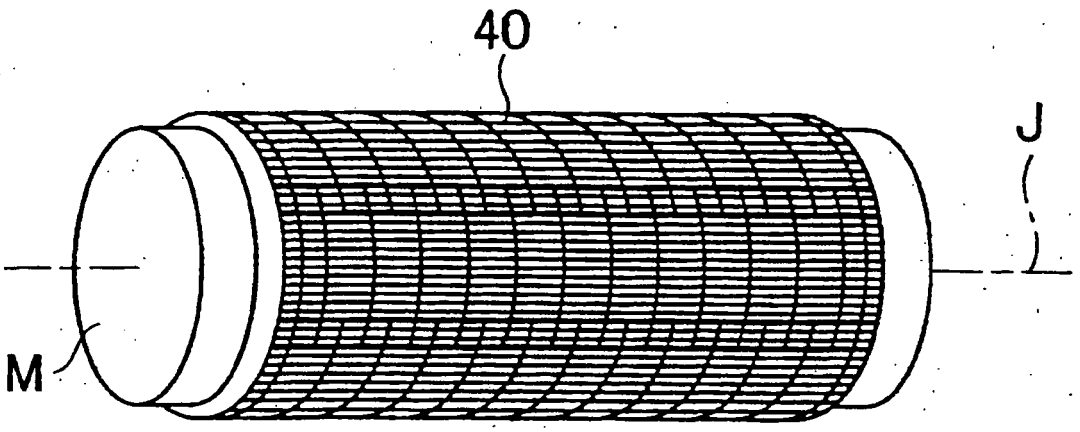


FIG. 6

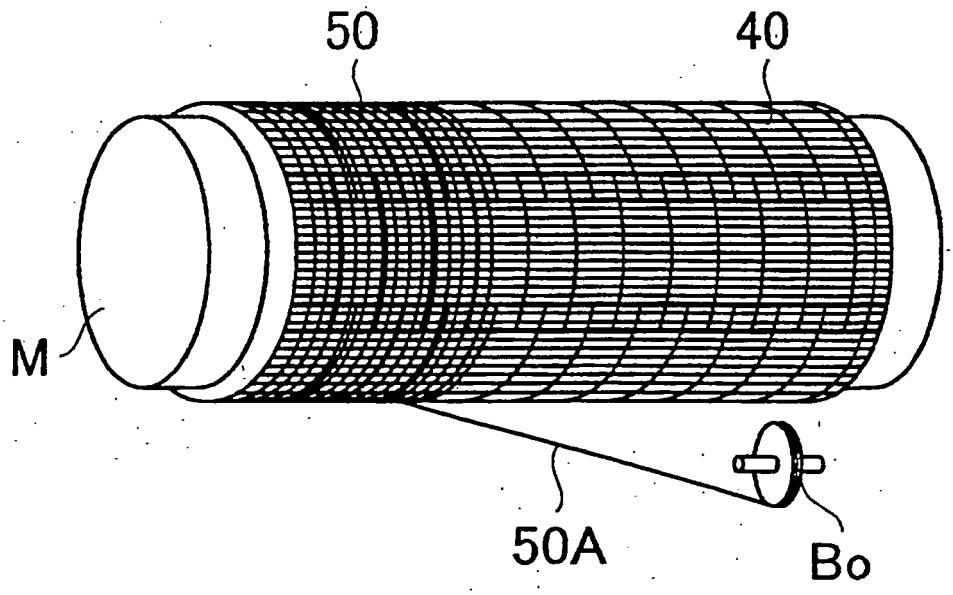


FIG. 7

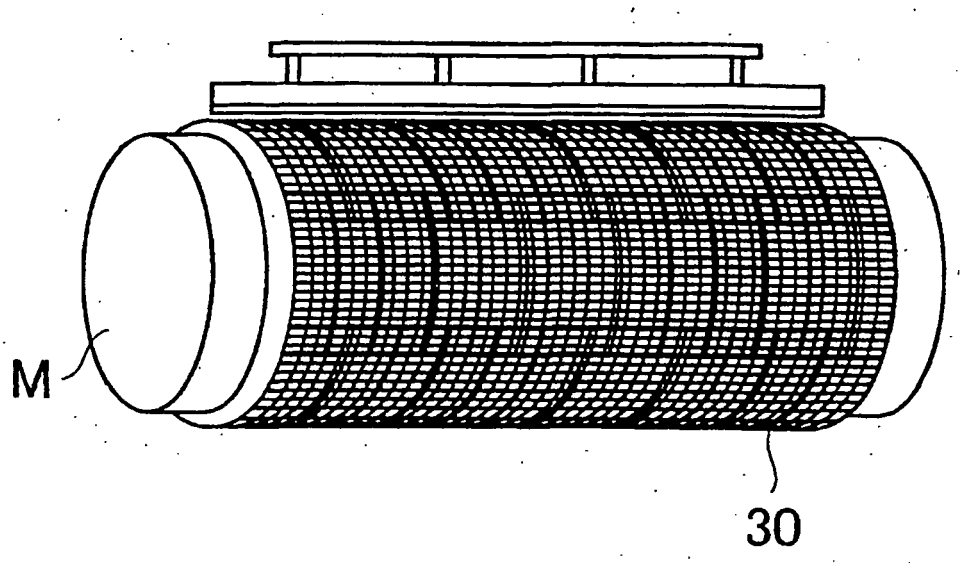


FIG. 8

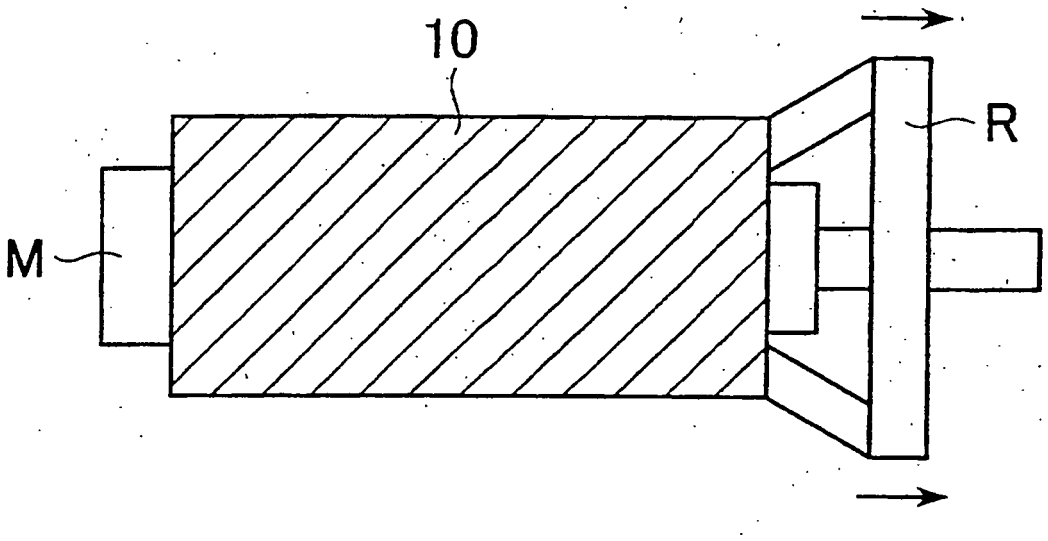
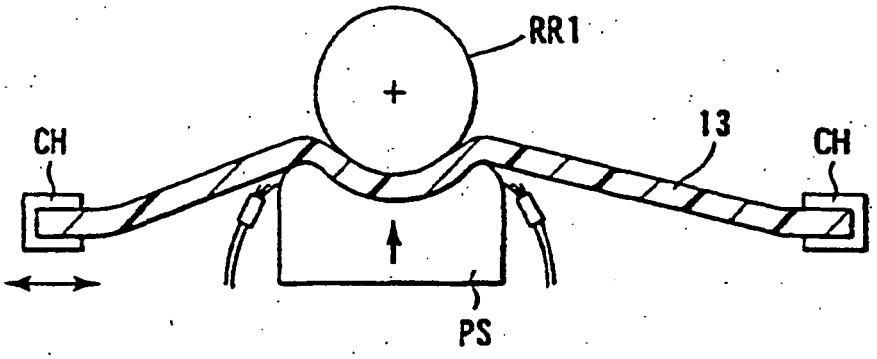


FIG. 9



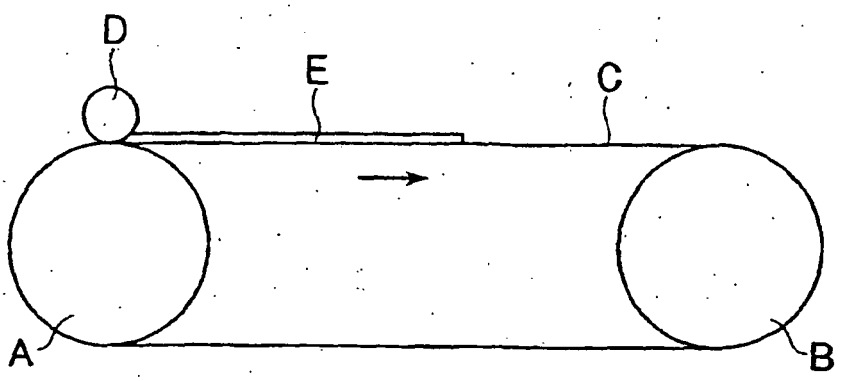


FIG. 10(A)

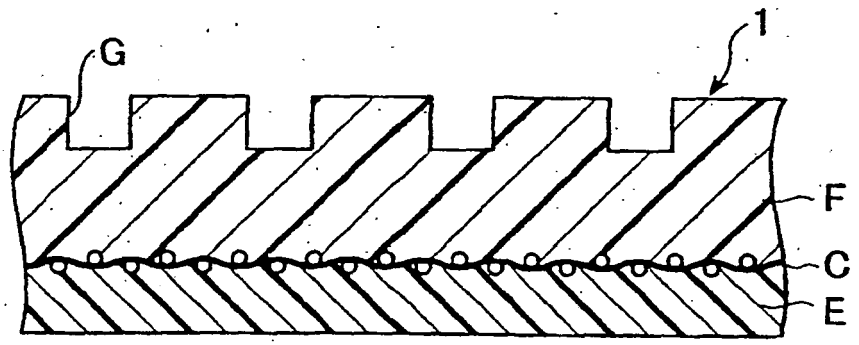


FIG. 10(B)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/318804

A. CLASSIFICATION OF SUBJECT MATTER
D21F3/02(2006.01)i, *D21F7/08*(2006.01)i

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)
D21F3/02, D21F7/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2006
Kokai Jitsuyo Shinan Koho 1971-2006 Toroku Jitsuyo Shinan Koho 1994-2006

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 11-247086 A (Ichikawa Keori Kabushiki Kaisha), 14 September, 1999 (14.09.99), Claim 1; Par. Nos. [0018], [0023], [0031]; Fig. 14 & US 6086719 A & EP 939162 A2	1-3
Y	JP 11-256492 A (Albany International Corp.), 21 September, 1999 (21.09.99), Claim 1; Par. No. [0048] & US 6174825 B1 & EP 922806 A2	1-3
P,X	JP 2005-307421 A (ICHIKAWA Co., Ltd.), 04 November, 2005 (04.11.05), Claims; Par. Nos. [0021], [0029], [0030]; Fig. 4 & US 2005/0211533 A1 & EP 1580316 A1	1-3

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

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Date of the actual completion of the international search	Date of mailing of the international search report
19 December, 2006 (19.12.06)	26 December, 2006 (26.12.06)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/318804

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 11-021781 A (Ichikawa Keori Kabushiki Kaisha), 26 January, 1999 (26.01.99), Claim 1; Par. Nos. [0021], [0022]; & US 5968218 A & EP 889164 A1	1-3
A	JP 2000-303377 A (Ichikawa Keori Kabushiki Kaisha), 31 October, 2000 (31.10.00), Abstract & US 6284102 B1 & EP 1055773 A2	1-3
A	JP 5-505428 A (Beloit Technologies Inc.), 12 August, 1993 (12.08.93), Claims 1, 3 to 10 & WO 92/02678 A1	1-3

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3057236 A **[0004]**
- JP 1045888 A **[0004]**
- JP 3213589 B **[0004]**
- JP 1503315 W **[0005] [0013]**
- JP 8209578 A **[0005] [0013]**
- JP 1298292 A **[0006]**
- JP 5505428 W **[0006]**
- JP 3408416 B **[0010] [0012]**
- JP 2000303377 A **[0010] [0013]**
- JP 2005076216 A **[0014]**
- JP 2002194855 A **[0031]**