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(54) **Shoe press belt and method for manufacturing the same**
Band für eine Schuhpresse und Verfahren zu seiner Herstellung
Bande pour presse à patin et son procédé de fabrication

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(73) Proprietor: ICHIKAWA CO., LTD.
Tokyo (JP)

(72) Inventors:
• Ikeda, Harushige
  14-15 Hongo 2-chome, Bunkyo-ku (JP)

• Inoue, Kenji
  14-15 Hongo 2-chome, Bunkyo-ku (JP)

• Misawa, Hironori
  14-15 Hongo 2-chome, Bunkyo-ku (JP)

(74) Representative: Meddle, Alan Leonard
FORRESTER & BOEHMERT,
Pettenkoferstrasse 20-22
80336 München (DE)

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EP-A- 0 336 876

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Description

Summary of the Invention

[0001] This invention relates to a shoe press belt according to the preamble of claim 1 and to a method of manufacturing a shoe press belt according to the preamble of claim 4. Such a shoe press belt and a method of manufacturing a shoe press belt are known e.g. from EP 0 336 876 A2 (JP1 298 292A).

[0002] A shoe press is an apparatus used to squeeze water out of a web of pulp in the pressing stage of a papermaking machine. There are two types of shoe presses: open and closed. The open type shoe press takes up a large amount of space and has the drawback that it diffuses oil. Therefore, the current trend is toward the use of the closed shoe press.

[0003] In a closed-type shoe press, a shoe press belt passes between a press roll and a shoe. A pulp web containing water is sandwiched between upper and lower felts, which pass between the shoe press belt and the press roll. Water contained in the web is squeezed out, and transferred to the felts.

[0004] A conventional shoe press belt is typically composed of an endless layer of a high molecular weight elastic substance, and is reinforced by a base member, typically a woven fabric. The circumferential length of the belt is relatively short, and consequently its working conditions are severe. There has been a need for improvement in the durability of such belts.

[0005] Various proposals have been made for improving durability. According to EP 0 336 876 A2, a base member of a shoe press belt is formed by winding a narrow, belt-shaped member in a helix-like spiral in which successive layers overlap but are axially displaced from one another. The base member is covered by polyurethane, which is cured, cut to a desired thickness, and grooved.

[0006] The spirally wound base member is unable to impart adequate strength to the belt in the sideward (axial) direction, and consequently, the belt is likely to stretch sideward. In addition, the winding of the narrow belt-shaped member is time-consuming, and it is difficult to control the overlap of its successive layers. Hardness of the resulting belt may be affected, and its service life may be shortened as a result.

[0007] It is an object of this invention to address the above-mentioned problems. More specifically, one object of this invention is to provide an improved shoe press belt having overall uniform hardness and improved durability. Another object of the invention is to simplify the manufacture of shoe press belts.

[0008] The shoe press belt in accordance with the invention is characterized in that the base member is embedded within the tubular member in a form of a belt which is wound in substantially axially coextensive layers. Preferably, the cylindrical member has inner and outer walls substantially coaxially disposed about an ax-

Brief Description of the Drawings

[0013] FIG. 1 is a schematic sectional view of a belt in accordance with the invention;
FIG. 2 is a partial enlarged sectional view showing the positional relationship of the starting and terminal ends of a woven fabric belt-shaped base member within a high molecular weight elastic member;
FIG. 3 is a schematic view of an apparatus for applying a resin to a woven fabric belt-shaped base member;
FIG. 4 is a schematic view showing the stage of the manufacturing process prior to the formation of an inner, shoe-contacting, resin layer;
FIG. 5 is a schematic view showing the formation of the inner, shoe-contacting portion of the resin layer;
FIG. 6 is schematic view showing the attachment of the starting end of the belt-shaped base member;
FIG. 7 is a schematic view showing the attachment of the terminal end of the belt-shaped base member;
FIG. 8 is a schematic view showing the formation of the outer, felt-contacting portion of the resin layer;
FIG. 9 is a schematic view of a conventional shoe press; and
FIGs. 10(a) - 10(c) are schematic views showing the
manufacture of a typical conventional shoe press belt.

Detailed Description

[0014] First, referring to FIGs. 9 and 10(a) - 10(c), the structure and operation of a closed-type shoe press and the structure and formation of a typical prior art shoe press belt will be discussed.

[0015] As shown in FIG. 9, the closed-type shoe press 20 comprises a press roll 21 and a shoe 22. A belt 23 passes between the press roll and the shoe. A web P, containing water, is sandwiched between an upper needle felt 24 and a lower needle felt 25, which are arranged to pass between the shoe press belt 23 and the press roll 21. Water contained in the web P is pressurized in the nip formed by the press roll and the shoe, squeezed out of the web, and transferred to the upper and lower felts.

[0016] The shoe press belt 23 is composed of an endless layer of a high molecular weight elastic substance, and is reinforced by a base member, typically a woven fabric. An oil supply (not shown) is provided to supply oil to reduce friction between the shoe press belt 23 and the shoe 22. However, since the circumferential length of the belt is relatively short, the working conditions are very severe, and, as mentioned above, there has been a need for improvements in durability of such belts.

[0017] One of the proposals for improving shoe press belt durability is represented by the technology disclosed in EP 0 336 876 A2. According to this technology, illustrated in FIG. 10(a), a base member is first made by winding a narrow, belt-shaped member 23a about a cylindrical, rotating mandrel M in a helix-like spiral in which the successive layers overlap but are axially displaced from one another. The belt-shaped member consists of a fiber mat impregnated with polyurethane. As shown in FIG. 10(b), polyurethane 23b spread onto the base member by a nozzle (not shown). The diameter of mandrel M corresponds to the diameter of the shoe press belt to be obtained. A heater (not shown) is used to cause the polyurethane 23b to gel. The polyurethane is then cured in an oven and the belt is then subjected to cooling in a cooler after curing.

[0018] The outer surface of the layer of cured polyurethane 23b, which has been formed on the spirally wound belt-shaped member 23a, is next cut to a predetermined thickness by a cutting roll G. Then, as shown in FIG. 10(c), water-draining grooves are formed in the surface of the polyurethane layer by a cutter N, completing the formation of the belt.

[0019] The spirally wound base member is unable to impart adequate strength to the belt in the sideward (axial) direction, and consequently, the belt is likely to stretch sideward. Moreover, the manufacturing process is time-consuming since it is necessary to wind the narrow, belt-shaped member 23a onto the mandrel M. In addition, it is difficult to adjust the overlap of the successive layers of the spirally wound belt-shaped member. The degree of overlap must be carefully controlled because, if the degree overlap is not appropriate, the hardness of the belt will be affected or may vary along the width of the belt. In such cases, cracks may occur in the belt, shortening its service life.

[0020] Embodiments of the invention will be now be described referring to FIGs. 1 to 8. The terms "cylinder" and "cylindrical" are used herein in the broad sense, to refer to non-circular as well as circular cylinders and cylindrical shapes. It should be understood that the shape of a shoe press belt may depart from a true cylindrical shape during installation. However, in use, the belt will generally be substantially cylindrical.

[0021] The belt 1 in accordance with the invention comprises a cylindrical, high molecular weight elastic member 2 and a base member 3 disposed between the inner and outer walls, i.e. in the wall thickness, of the high molecular weight elastic member 2.

[0022] The base member 3 comprises a belt-shaped member 4 cylindrically rolled in plural layers, so that the layers of the belt-shaped member are substantially axially coextensive. That is, the side edges of the belt-shaped member are disposed substantially in planar spirals, so that the layers are not axially displaced from one another. For the belt-shaped member 4, it is preferable to use a woven fabric consisting of warp and weft, impregnated with the same resin that constitutes the high molecular weight elastic member 2.

[0023] To ensure that the shoe press belt has an overall uniform thickness when the base member 3 comprises a belt-shaped member 4 wound to form plural layers, it is necessary to consider the positions of the starting end 4a and the terminal end 4b. The starting end 4a and the terminal end 4b of the belt-shaped member should lie approximately an imaginary radial plane (represented by arrow S in FIG. 1) in which the central axis O of the cylindrical belt 1 lies. It has been confirmed experimentally that no problem arises if the ends 4a and 4b are located within a narrow space A, about 100 mm in width, centered on the above-mentioned plane S. In case of FIG. 2, the starting end 4a and the terminal end 4b coincide with the same imaginary radial plane.

[0024] It is preferable that the belt-shaped member 4 be impregnated with the same resin as that to be used in forming the high molecular weight elastic member 2, and that the impregnated resin be semi-cured before the belt-shaped member is rolled. Use of the resin strengthens the interlayer bonding of the plural layers of the base member. Further, the use of the same resin improves the integration of the base member 3 with the high molecular weight elastic member 2. It has been confirmed experimentally that 1.5 - 5 mm is preferable as the thickness of the base member 3. It follows that the thickness of the woven fabric 4 itself should be 1.5 mm or less.

[0025] For the above-mentioned high molecular weight elastic member 2, polyurethane elastomer, etc. of hardness 80-98° (JIS-A) is a suitable resin. It is pos-
sible to use different resins for the inner, shoe-contacting portion 2b and for the outer, felt-contacting portion 2a. However, it is also possible to form all portions of the elastic member from the same materials. In the latter case, the integration of the joining surfaces may be improved while minimizing manufacturing costs.

[0026] It is preferable that the thickness F1 between the outer surface of portion 2a of the elastic member 2 and the base member 3 be 1 mm or more. Water draining grooves (not shown) may be provided if necessary so that the outer portion 2a can serve to carry a wet web. Moreover, for satisfactory durability, it is necessary that the thickness F2 between the base member 3 and shoe-contacting surface of inner portion 2b of the elastic member 2 be 0.5 mm or more.

[0027] In the manufacture of the shoe press belt, first, a base member 3 is prepared. The base member is made from a belt-shaped member 4 (preferably a woven fabric and hereafter simply called the “woven fabric”). The base member 3 is prepared by unwinding the woven fabric from a supply roll 31 as shown in FIG. 3. One end of the woven fabric is drawn out from the supply roll, and secured to a roll 34. Between rolls 31 and 34, the woven fabric passes through a resin applicator 32 and a heater 33. This woven fabric is slightly wider than the full width of the belt 1 to be obtained.

[0028] The resin applicator 32 is composed of a set of three rolls 32a, 32b and 32c, and a resin tank 32d. The resin material dropped from the tank 32d to the uppermost roll 32a is applied both to the outside and to the inside of the woven fabric which passes between the middle roll 32b and the bottom roll 32c. The woven fabric, thus impregnated with the resin, passes through the heater 33, and is wound onto the roll 34 in a semi-cured state.

[0029] A releasing agent is then applied on the surface of a mandrel M, shown in FIG. 5. A resin layer 2", constituting the inner portion 2b of the shoe press belt, which becomes the shoe contacting side of the belt, is formed with a uniform thickness while rotating the mandrel M, utilizing a resin applicator 35 and a coater bar 36 above the mandrel M.

[0030] The roll 34 is positioned next to a mandrel M, as shown in FIG. 4, and one end of the woven fabric (the starting end 4a) is drawn out from roll 34 and secured to a predetermined position on mandrel M as shown by the dot dash line. The starting end 4a of the woven fabric drawn out from the roll 34 is secured to the mandrel M after the resin layer 2’ has cured.

[0031] As shown in FIG. 6, at the position indicated by arrow S a base line is drawn on the surface of the mandrel M parallel to the central axis O of the mandrel, and the starting end 4a of the woven fabric is positioned to register with this base line. Since a semi-cured resin is impregnated and in the woven fabric, the resin functions as a bonding agent when the starting end 4a of the woven fabric is secured to the resin layer 2’.

[0032] Next, as shown in FIG. 7, a predetermined number of turns of woven fabric 4 are rolled onto the mandrel M as the mandrel is rotated, forming layers of woven fabric. The terminal end 4b is cut at a position which corresponds to the position of the starting end 4a. Since the resin impregnated into the woven fabric is semi-cured, excellent bonding between the layers of the woven fabric is achieved.

[0033] After the base member 3 is formed, the outer resin layer 2", constituting the outer portion 2a of the shoe press belt, is formed by spreading the resin of the high molecular weight elastic member 2 onto the outer surface of the base member 3, using an applicator 35 and a coater bar 36, as shown in FIG. 8. The resin is impregnated into the base member. This process is also carried out while the mandrel M rotates.

[0034] Thereafter, the resin layer 2" of the outer portion 2a is left at room temperature or semi-cured by means of a heater (not shown); and fully cured thereafter, throughout the shoe press belt structure, by means of a heater (not shown). After curing, the resin layer 2" is ground to obtain a belt of a desired thickness. In addition, if necessary, water draining grooves are formed, and the belt 1 is completed. Then, the belt may be detached from the mandrel M, and ear portions (not shown), for facilitating installation on a papermaking machine, are formed at both ends of the belt.

[0035] In the above-described example, the base member 3 is made from a belt-shaped member 4 in the form of a woven fabric impregnated with a semi-cured resin material. But, the invention is not limited to such an example, and it is possible to adopt a manufacturing method in which no resin material is initially impregnated into the woven fabric as in FIG. 3. In this alternative process, as shown in FIG. 5, a resin is spread on the mandrel M. Then, a woven fabric 4 is rolled onto the spread resin in the manner described with reference to FIGs. 6 and 7 to form a base member 3 with layers. Thereafter, the resin is further spread on the base member 3 as shown in FIG. 8. In this case especially, it is important to make sure that the resin spread onto the base member 3 fully penetrates into the lowermost layer of the woven fabric 4.

[0036] According to the above-described alternative method of manufacture, shortening of manufacturing time as well as reduction in the costs of equipment can be achieved, because the process of impregnating the woven fabric with the resin material and semi-curing it is not required. But, if a woven fabric with impregnated semi-cured resin is employed, it is possible to obtain a highly durable shoe press belt easily, inasmuch as the resin material positively penetrates into voids of the fibrous structure of the woven fabric 4, and into the gaps between the layers of the woven fabric.

Example

[0037] A fabric 0.4 mm in thickness, woven in a 1/3 broken plain weave, was prepared with a warp of 1500d/
A shoe press belt as claimed in Claim 1, wherein

A shoe press belt comprising a tubular member (2)

1. A shoe press belt comprising a tubular member (2) of high molecular weight material and uniform wall thickness and a base member (3), characterised in that the base member (3) is embedded within the tubular member (2) in a form of a belt (4) which is wound in substantially coaxially coextensive layers.

2. A shoe press belt as claimed in Claim 1, wherein the tubular member (2) has inner (2b) and outer (2a) walls substantially coaxially disposed about an axis and spaced from each other radially, and the base member (3) is embedded between the inner (2b) and outer (2a) walls.

3. A shoe press belt according to Claim 1 or 2, wherein the base member (3) comprises a woven fabric impregnated with the same material as that of which the tubular member (2) is formed.

4. A method of manufacturing a shoe press belt comprising the steps of winding a base member (3) onto a support body (M) having a cylindrical surface, and forming, from a resin, a cylindrical, high molecular weight elastic member (2) on the base member (3) so that the elastic member (2) has a wall thickness, characterised in that the base member (3) is wound onto the support body (M) in multiple, substantially axially coextensive layers and the elastic member (2) is formed on the base member (3) so that the base member (3) is embedded within the wall thickness of the elastic member (2).

5. A method of manufacturing a shoe press belt in accordance with claim 4, in which the base member (3) is wound from a woven fabric impregnated with the same resin from which the elastic member (2) is made.

Patentansprüche

1. Band für eine Schuhpresse, das ein röhrenförmiges Teil (2) aus Material mit hohem Molekulargewicht und gleichförmiger Wanddicke und ein Basisteil (3) umfaßt, durch gekennzeichnet, daß das Basisteil (3) innerhalb des röhrenförmigen Teils (2) in Form eines Bandes (4) eingebettet ist, das in im wesentlichen axial sich gemeinsam erstreckenden Schichten aufgewickelt ist.

2. Band für eine Schuhpresse nach Anspruch 1, dadurch gekennzeichnet, daß das röhrenförmige Teil (2) Innenwände (2b) und Außenwände (2a) besitzt, die im wesentlichen koaxial um eine Achse angeordnet und radial voneinander beabstandet sind, und das Basisteil (3) zwischen den Innenwänden (2b) und Außenwänden (2a) eingebettet ist.

3. Band für eine Schuhpresse nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das Basisteil (3) ein Gewebe umfaßt, das mit demselben Material imprägniert ist wie dasjenige, aus dem das röhrenförmige Teil (2) hergestellt ist.

4. Verfahren zur Herstellung eines Bandes für eine Schuhpresse, das die Schritte des Aufwickelns eines Basisteils (3) auf einen Trägerkörper (M) mit einer zylindrischen Oberfläche und des Ausbildens, aus einem Harz, eines zylindrischen, elastischen
Teils (2) mit hohem Molekulargewicht auf dem Bāsisteil, so daß das elastische Teil (2) eine Wanddicke besitzt, umfaßt, dadurch gekennzeichnet, daß das Basis teil (3) auf den Trägerkörper (M) in mehreren, im wesentlichen axial sich gemeinsam erstreckenden Schichten aufgewickelt wird und das elastische Teil (2) auf dem Basisteil ausgebildet wird, so daß das Basisteil (3) innerhalb der Wanddicke des elastischen Teils (2) eingebettet ist.

5. Verfahren zur Herstellung eines Bandes für eine Schuhpresse nach Anspruch 4, dadurch gekennzeichnet, daß das Basisteil (3) aus einem Gewebe gewickelt wird, das mit demselben Harz imprägniert ist, aus dem das elastische Teil (2) hergestellt ist.

Revendications

1. Courroie de presse à sabot comprenant un élément tubulaire (2) de matière au poids moléculaire élevé et d'une épaisseur de paroi uniforme et un élément de base (3), caractérisé en ce que l'élément de base (3) est inséré à l'intérieur de l'élément tubulaire (2) sous forme de courroie (4) qui est enroulée en couches s'étendant substantiellement coaxiallement.

2. Courroie de presse à sabot selon la revendication 1, dans laquelle l'élément tubulaire (2) comporte des parois interne (2b) et externe (2a) disposées substantiellement coaxiallement autour d'un axe et espacées l'une de l'autre radialement, et l'élément de base (3) est inséré entre les parois interne (2b) et externe (2a).

3. Courroie de presse à sabot selon la revendication 1 ou 2, dans laquelle l'élément de base (3) comprend un tissu tissé imprégné de la même matière que celle dans laquelle est formé l'élément tubulaire (2).

4. Procédé de fabrication d'une courroie de presse à sabot comprenant les étapes d'enroulement d'un élément de base (3) sur un corps de support (M) ayant une surface cylindrique, et de formation, à partir d'une résine, d'un élément élastique de poids moléculaire élevé, cylindrique (2) sur l'élément de base (3) de telle sorte que l'élément élastique (2) ait une épaisseur de paroi, caractérisé en ce que l'élément de base (3) est enroulé sur le corps de support (M) en de multiples couches s'étendant substantiellement coaxiallement et l'élément élastique (2) est formé sur l'élément de base (3) de telle sorte que l'élément de base (3) soit inséré dans l'épaisseur de paroi de l'élément élastique (2).

5. Procédé de fabrication d'un courroie de presse à