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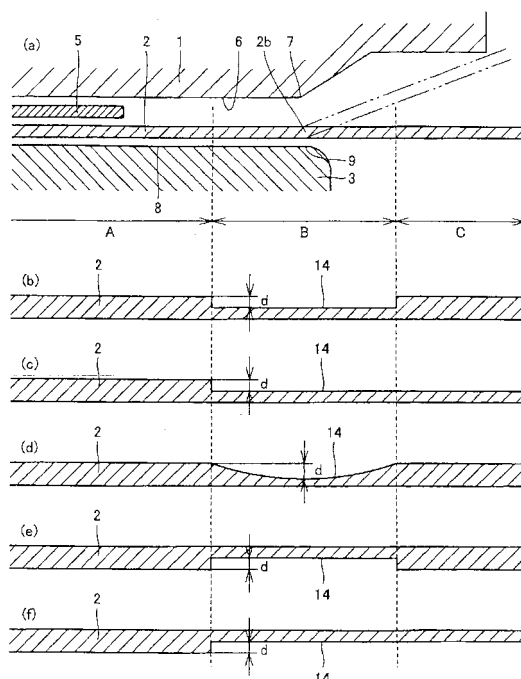
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(54) **PRESS BELT AND SHOE PRESS ROLL**

(57) A press belt 2 comprises both end corresponding regions B positioned so as to correspond to both ends of a press roll 1 or a pressing shoe 3 in the width direction and a center region A positioned between the both end corresponding regions B. The center region A has a pre-

determined thickness and constitutes a pressed part pressed by pressing means. The end corresponding regions B have a thickness smaller than that of the center region A to form recessed parts and constitute pressure escape parts for allowing the pressure from the pressing means to escape.

FIG. 4



Description

TECHNICAL FIELD

[0001] The present invention relates to a press belt and a shoe press roll used for pressing a press object in various kinds of industries such as a papermaking industry, a magnetic recording medium manufacturing industry and a fiber industry.

BACKGROUND ART

[0002] In the various kinds of industries, a belt press is used such that a band-shaped press object is put on a press belt and the press object is pressed between one pressing member positioned inside the periphery of the press belt and the other pressing member positioned outside the periphery of the press belt. Here, the pressing member includes a press roll and a pressing shoe. As one example of the belt press, there is a shoe press as a dewatering press in the papermaking industry.

[0003] To explain the shoe press briefly taking the papermaking industry as one example, it is a method for pressing (dewatering) a press object (wet paper web) by applying a surface pressure to the press object put on the outer peripheral surface of a press belt and sandwiched between a press roll positioned outside the periphery of the press belt as outer pressing means and a pressing shoe positioned inside the periphery of the press belt as inner pressing means. While a roll press performed with two rolls applies a linear pressure to a press object, the shoe press can apply the surface pressure to the press object with the pressing shoe having a predetermined width in its traveling direction. Therefore, when the dewatering press is performed with the shoe press, a nip width can be increased and dewatering effect can be enhanced.

[0004] In order to make the shoe press compact, Japanese Unexamined Patent Publication No. 61-179359, for example, discloses a roll-shape shoe press roll in which a pressing shoe as inner pressing means is covered with a flexible roll-shaped press belt (press jacket), which has been widely used.

[0005] The shoe press is performed instead of the roll press or in combination with the roll press in some cases to improve the quality of the press object in a calender process, for example in which the surface of the press object is flattened and calendered in the papermaking industry, magnetic recording medium manufacturing industry and fiber industry other than the above dewatering process. Required characteristics for the press belt in general includes strength, abrasion resistance, flexibility and impermeability to water, oil, gas and the like. As the material providing the above characteristics, polyurethane provided by the reaction with urethane prepolymer and a hardening agent is used in general. However, since harsh bending and pressing are repeated to the press belt, the shoe press belt especially, the fact that a

crack is likely to be generated in its outer peripheral surface is a serious problem in view of durability.

[0006] As a method of solving the above problem, Japanese Unexamined Patent Publication No. 10-298893 discloses a shoe press belt in which the hardness of a resin constituting the belt is changed such that the center region in the width direction is higher and both edge regions including a shoe edge corresponding part are lower to improve the abrasion resistance and crack resistance. In this case, it is considered that the abrasion resistance and press deformation resistance are maintained at the center region and the crack is hardly caused at the both edge regions.

[0007] A crack is likely to be caused intensively at both edge regions - corresponding to both ends of the pressing means such as the press roll and the pressing shoe in the width direction. It is considered that strict crack resistance is not required for the center region positioned between the both end corresponding parts and serving as a pressing surface for the press object, but rather abrasion resistance and press deformation resistance are to be emphasized at that part.

[0008] Although the Japanese Unexamined Patent Publication No. 10-298893 was made based on the above concept, it is necessary to increase the change in hardness between the center region and both edge regions to a certain level in order to implement both abrasion resistance and crack resistance by the change in hardness. When the hardness of polyurethane differs, its contraction force differs at the time of molding. Thus, according to the belt in which the change in hardness is increased between the center region and both edge regions in the width direction, its cylindricity deteriorates and its traveling performance could be damaged.

[0009] According to other conventional art documents, a crack is prevented from being caused at the both end corresponding regions corresponding to both ends of the pressing means in the width direction by improving the shape or structure of the press belt or varying the depth of a drain groove (water squeezing groove). For example, according to Japanese Unexamined Patent Publication No. 2002-180393, the thickness of the middle layer of a press belt positioned at parts corresponding to both ends of pressing means in the width direction is increased. According to Japanese Unexamined Patent Publication No. 2002-327389, the bottoms of drain grooves positioned at parts corresponding to both ends of pressing means in the width direction are brought close to a reinforcement layer as a middle layer. According to U.S. Patent No. 5,943,951, flexibility is enhanced by gradually varying the thickness of both ends of a press belt in the width direction. According to U.S. Patent No. 6,030,503, many recessed parts are provided at both ends of a press belt in the width direction separately from grooves. According to Japanese Unexamined Patent Publication No. 11-12975, the depth of drain grooves at both ends of a press belt in the width direction is reduced.

[0010] According to the above conventional art docu-

ments, the crack is prevented from being generated at the both end corresponding regions of the press belt positioned at the parts corresponding to both ends of the pressing means in the width direction by enhancing the flexibility at the regions. However, even when the flexibility at the both end corresponding regions of the press belt is improved, the crack is not satisfactorily prevented from being caused.

[0011] When the press object such as the wet paper web is pressed by the pressing means, the boundary part between the part pressed and constrained by the pressing means and the part not constrained by the pressing means is positioned at the both end corresponding regions of the press belt corresponding to both ends of the pressing means in the width direction, and bending force is applied to the press belt part positioned outside this boundary part. That is, the pressure from the pressing means and bending force generated by the pressing process inevitably are applied synergistically to the above boundary part. Therefore, even when the region in the vicinity of the boundary part has the flexibility, a crack is not satisfactorily prevented from being generated.

DISCLOSURE OF THE INVENTION

[0012] It is an object of the present invention to provide a press belt capable of effectively preventing a crack from being generated at both end corresponding regions positioned so as to correspond to both ends of a pressing member such as a press roll or pressing shoe in the width direction.

[0013] It is another object of the present invention to provide a shoe press roll using the above press belt as an outer roll.

[0014] A press belt according to the present invention is an endless rotating belt and used in a method of pressing a press object put on the outer peripheral surface of the press belt with pressing means positioned inside and/or outside the periphery of the press belt. The press belt comprises both end corresponding regions positioned so as to correspond to both ends of the pressing means in the width direction and a center region positioned between the both end corresponding regions. The center region has a predetermined thickness and constitutes a pressed part pressed by the pressing means, and the both end corresponding regions have a thickness smaller than that of the center region to form a recessed part and constitute pressure escape parts for allowing the pressure from the pressing means to escape.

[0015] Since the both end corresponding regions of the press belt are the recessed parts having the thickness smaller than that of the center region, the pressure from the pressing means escapes at the both end corresponding regions when the press object is pressed. Therefore, since only bending stress is applied at the both end corresponding regions in the pressing process, the high pressure from the pressing means is not applied thereto.

Thus, according to the present invention having the above constitution, a crack can be effectively prevented from being generated at the both end corresponding regions of the press belt.

[0016] In addition, the terms "traveling direction" and "width direction" means the traveling direction and the width direction of the press object if not otherwise specified. In addition, the press object is a band-shaped material such as a wet paper web, magnetic tape, and fabric although it is not limited in particular. Furthermore, the pressing means is the press roll and pressing shoe.

[0017] Preferably, the depth of the recessed part at the both end corresponding regions of the press belt is larger than the variation of the thickness of the center region when pressed by the pressing means. When the recessed part has such depth, the high pressure from the pressing means can surely escape at the both end corresponding regions of the press belt when the press object is pressed. For example, the depth of the recessed part is not less than 1.0mm.

[0018] According to one embodiment, the recessed part is formed in the outer peripheral surface of the press belt. According to another embodiment, the recessed part is formed in the inner peripheral surface of the press belt. As still another embodiment, the recessed parts may be formed in both outer and inner peripheral surfaces of the press belt.

[0019] According to one embodiment, the press belt comprises an endmost region having the same thickness as that of the both end corresponding regions, outside the both end corresponding regions in the width direction. According to another embodiment, the press belt comprises an endmost region having the same thickness as that of the center region, outside the both end corresponding regions in the width direction. When the endmost region has the same thickness as that of the center region in the press belt, since both ends of a felt can be stably supported, the free movement of the felt can be controlled.

[0020] For example, the press belt comprises a reinforcement layer extending at the center region and the both end corresponding regions, and an upper elastic layer formed thereon. In this case, the upper elastic layer has the recessed part serving as the pressure escape part.

[0021] According to another embodiment, the press belt comprises a reinforcement layer extending at the center region and the both end corresponding regions, and an upper elastic layer formed thereon and extending only at the center region. In this case, the exposed part of the outer peripheral surface of the reinforcement layer forms the recessed part.

[0022] Many drain grooves extending along the traveling direction of the belt may be formed in the outer peripheral surface of the upper elastic layer. In this case, preferably, the depth of the recessed part is the same as that of the drain groove or more. The bottom end of the drain groove at the both end corresponding regions of

the press belt is highly likely to become the starting point of the crack. In this embodiment, since the recessed parts are provided at the both end corresponding regions so that the pressure can escape, and the drain groove is not formed at this region, a crack is more effectively prevented from being generated.

[0023] According to another embodiment, the press belt comprises a reinforcement layer extending at the center region and the both end corresponding regions and a lower elastic layer formed thereunder. In this case, the lower elastic layer has the recessed part.

[0024] According to still another embodiment, the press belt comprises a reinforcement layer extending at the center region and the both end corresponding regions, and a lower elastic layer formed thereunder and extending only at the center region. In this case, the exposed part of the inner peripheral surface of the reinforcement layer forms the recessed part.

[0025] A shoe press roll according to the present invention comprises an outer roll comprising the endless press belt having the above-described characteristics, and a pressing shoe positioned inside the periphery of the outer roll as pressing means. Preferably, both ends of the center region of the press belt having a predetermined thickness are positioned inside both edge parts of the pressing shoe in the width direction.

BRIEF DESCRIPTION OF DRAWINGS

[0026]

Fig. 1 is a sectional view showing a shoe press machine in its traveling direction used in a pressing process of a paper machine;

Fig. 2 is a sectional view showing a pressing and dewatering part P as an essential part in the width direction in Fig. 1;

Fig. 3 is a sectional view showing the pressing and dewatering part P as an essential part in the width direction in Fig. 1 using another press belt;

Fig. 4 is a schematic sectional view showing structures in the vicinity of one ends of pressing means in the width direction in which (a) shows the structure of the machine and (b) to (f) show various kinds of press belts;

Fig. 5 is a view showing a press belt according to one embodiment of the present invention in which (a) is its sectional view and (b) is its plan view;

Fig. 6 is an enlarged sectional view according to one embodiment of the present invention;

Fig. 7 is an enlarged sectional view according to another embodiment of the present invention;

Fig. 8 is an enlarged sectional view according to still another embodiment of the present invention;

Fig. 9 is an enlarged sectional view according to still another embodiment of the present invention;

Fig. 10 is an enlarged sectional view according to still another embodiment of the present invention;

and

Fig. 11 is a sectional view showing a shoe press roll in the width direction according to one embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0027] Embodiments of the present invention will be described in detail with reference to the drawings hereinafter.

[0028] Fig. 1 is a sectional view showing a shoe press machine in its traveling direction used in a pressing process of a paper machine. The shoe press machine comprises a press roll as pressing means 1, a press belt 2 opposed to the press roll 1, and a pressing shoe positioned inside the periphery of the press belt 2 as pressing means 3. In addition, although the shoe press roll 30 is constituted such that the pressing shoe 3 is covered with the press belt 2 and the press belt 2 is formed into the shape of a roll as an outer roll according to the machine shown in Fig. 1, the press belt 2 can be used as an endless belt as it is without being formed into the roll.

[0029] According to the size of this kind of press belt 2, its width is 2 to 15m, its peripheral length is 1 to 30m and its thickness is 2 to 10mm in general.

[0030] The press roll 1 is positioned outside the periphery of the press belt 2 and functions as one pressing means. The pressing shoe 3 is positioned inside the periphery of the press belt 2 and functions as the other pressing means. A wet paper web 5 as a press object put on a felt 4 is sandwiched between the press belt 2 and the press roll 1 to be pressed. The outer peripheral surface of the press belt 2 and the felt 4 are directly in contact with each other.

[0031] A lubricant oil is supplied between the press belt 2 and the pressing shoe 3, so that the press belt 2 can slide smoothly on the pressing shoe 3. The press roll 1 is a driving roller and the press belt 2 is a driven roller while sliding on the pressing shoe 3 by friction force with the traveling felt 4.

[0032] The pressing shoe 3 presses the press object from the inside of the press belt 2 toward the press roll 1, and the wet paper web 5 is pressed by this pressing force and dewatered. The surface of the pressing shoe 3 is recessed so as to correspond to the surface of the press roll 1. Therefore, a pressing and dewatering part P having a large width in the traveling direction is formed between the press roll 1 and the press belt 2.

[0033] Fig. 2 is a sectional view showing the pressing and dewatering part P in the width direction in Fig. 1 as the essential part. As shown in Fig. 2, the press roll 1 and the pressing shoe 3 have certain lengths in their width direction. The press belt 2 comprises a center region A, both end corresponding regions B, and endmost regions C. The both end corresponding regions B are regions corresponding to parts including the both ends 7 of a press surface 6 of the press roll 1 and both ends 9 of a press surface 8 of the pressing shoe 3. The endmost

regions C are positioned outside the both end corresponding region B.

[0034] According to the press belt 2 shown in Fig. 2, the center region A has a predetermined thickness and constitutes a pressed part pressed by the press roll 1 and the pressing shoe 3, the both end corresponding parts B have a thickness smaller than that of the center region A so as to be recessed parts and constitute pressure escaping parts that allow the pressure from the press roll 1 and the pressing shoe 3, and the endmost regions C have almost the same thickness as that of the center region A.

[0035] Fig. 3 shows a press belt according to another embodiment. The same reference numeral as in Fig. 2 is allotted to the same or corresponding component. According to a press belt 2 shown in Fig. 3, the center region A has a predetermined thickness and constitutes a pressed part pressed by the press roll 1 and the pressing shoe 3, the both end corresponding parts B have a thickness smaller than that of the center region A so as to be recessed parts and constitute pressure escaping parts that allow the pressure from the press roll 1 and the pressing shoe 3, and the endmost regions C have almost the same thickness as that of the both end corresponding regions B.

[0036] Fig. 4(a) is an enlarged view showing a state in which the wet paper web 5 as the press object and the press belt 2 are sandwiched between the press roll 1 and the pressing shoe 3. The felt 4 is not shown in Fig. 4(a). In addition, it is to be noted that the press belt 2 has a uniform thickness for simplifying the drawing. Figs. 4(b) to 4(f) show various kinds of shapes of press belts according to embodiments of the present invention.

[0037] As shown in Fig. 4(a), the end of the wet paper web 5 as the press object is positioned inside the end 7 of the press surface 6 of the press roll 1 and the end 9 of the press surface 8 of the pressing shoe 3. The end corresponding region B of the press belt 2 corresponds to the parts of the end 7 of the press roll 1 and the end 9 of the pressing shoe 3. More specifically, the end corresponding region B extends toward both sides in the width direction to some extent centering on the end 7 of the press roll 1 and the end 9 of the pressing shoe 3. The wet paper web 5 is positioned at the center region A sandwiched by the both end corresponding regions B of the press belt 2. The boundary part between the end corresponding region B and the center region A is positioned halfway between the end of the wet paper web 5 and the ends of the pressing means (the press roll 1 and the pressing shoe 3). Although the endmost region C is positioned outside the end corresponding region B, the boundary part between both regions is positioned outside the ends of the pressing means in the width direction.

[0038] While the wet paper web 5 is pressed, the part in the press belt 2 sandwiched between the press surface 6 of the press roll 1 and the press surface 8 of the pressing shoe 3 is constrained by the pressing means. Meanwhile, the part in the press belt 2 positioned outside the end 7

of the press surface 6 of the press roll 1 and the end 9 of the press surface 8 of the pressing shoe 3 is not constrained by the pressing means. The boundary part 2b between the constrained part and the non-constrained part of the press belt 2 is positioned at the end 7 of the press roll 1 and the end 9 of the pressing shoe 3. At the time of pressing, as shown by a phantom line in Fig. 4 (a), bending force is applied to the part that is not constrained by the pressing means inevitably. When high pressure from the pressing means concentrates on this part in addition to the bending force, a crack is likely to be generated at this boundary part.

[0039] In order to effectively prevent the generation of the crack at the boundary part 2b of the press belt 2, the both end corresponding regions B of the press belt 2 according to this embodiment of the present invention provide the recessed parts having the thickness smaller than that of the center region A for allowing the pressure from the pressing means to escape and constitutes the pressure escape part.

[0040] According to a press belt 2 shown in Fig. 4(b), the center region A and the endmost region C have almost the same thickness and a recessed part 14 having a step difference is formed in the outer peripheral surface of the end corresponding region B between them. The depth d of the recessed part 14 is preferably not less than 1.0mm. Since the variation in thickness of the center region A of the press belt at the time of pressing is smaller than 1.0mm in general, when the recessed part 14 has the above depth, the high pressure from the pressing means can surely escape at the both end corresponding regions B. In addition, the recessed part 14 extends in the traveling direction of the press belt 2.

[0041] According to a press belt 2 shown in Fig. 4(c), the end corresponding region B has a thickness smaller than that of the center region A to be a recessed part 14 and constitutes a pressure escape part, and the endmost region C has almost the same thickness as that of the end corresponding region B. In this embodiment also, the depth of the recessed part 14, that is, the difference in thickness between the center region A and the end corresponding region B is preferably not less than 1.0mm. In addition, the recessed part 14 extends in the traveling direction of the press belt 2.

[0042] According to the press belts 2 shown in Figs. 4 (b) and 4(c), each recessed part has a flat bottom at the end corresponding region B. Meanwhile, according to a press belt 2 shown in Fig. 4(d), the end corresponding region B has a recessed part 14 having an arc-shaped section in its outer peripheral surface, and the recessed part 14 constitutes a pressure escape part for allowing the pressure from the pressing means to escape. The recessed part 14 having the arc-shaped section extends in the traveling direction of the press belt. The endmost region C has almost the same thickness as that of the center region A. In this embodiment also, a maximum depth of the recessed part 14 is preferably not less than 1.0mm.

[0043] According to a press belt 2 shown in Fig. 4(e), a recessed part 14 is formed in the inner peripheral surface of the end corresponding region B to constitute a pressure escape part. The recessed part 14 formed in the inner peripheral surface extends in the traveling direction of the press belt. In this embodiment, there is no step difference at the boundary part between the outer peripheral surface of the center region A and the outer peripheral surface of the end corresponding region B. The endmost region C has almost the same thickness as that of the center region A. Preferably, the depth d of the recessed part 14 in the inner peripheral surface of the press belt 2 is not less than 1.0mm.

[0044] According to a press belt 2 shown in Fig. 4(f), a recessed part 14 is formed in the inner peripheral surface of the end corresponding region B to constitute a pressure escape part and the endmost region C has almost the same thickness as that of the end corresponding region B. In this embodiment also, there is no step difference in the outer peripheral surface of the press belt 2. Preferably, the depth d of the recessed part 14 in the inner peripheral surface of the press belt 2 is not less than 1.0mm.

[0045] Fig. 5 is a view showing one example of the press belt 2, in which Fig. 5(a) shows its sectional view and Fig. 5(b) shows its plan view. The press belt 2 comprises a reinforcement layer 10 impregnated with an elastic material in its endless reinforcement base material, an upper elastic layer 11 positioned on the outer peripheral surface of the reinforcement layer 10 and integrated with the impregnated elastic material in the reinforcement base material of the reinforcement layer 10, and a lower elastic layer 12 positioned on the inner peripheral surface of the reinforcement layer 10 and integrated with the impregnated elastic material in the reinforcement base material of the reinforcement layer 10.

[0046] As the reinforcement base material of the reinforcement layer 10, a woven cloth formed of an organic fiber such as polyamide or polyester is used. The whole of the belt 2 is integrally formed of an elastic material such as thermoset polyurethane, so that the reinforcement base material is buried in the belt 2.

[0047] As shown in Fig. 5, many drain grooves 13 extending in the traveling direction of the belt are formed in the outer peripheral surface of the upper elastic layer 11. The drain grooves 13 extend spirally all over the press belt 2 in the width direction.

[0048] Fig. 6 is an enlarged sectional view showing the press belt 2. The thickness of the both end corresponding regions B positioned so as to correspond to both ends of the pressing means in the width direction, in the press belt 2 is formed so as to be smaller than those of the center region A and the endmost region C. More specifically, the both end corresponding regions B are recessed parts 14 extending circularly along the traveling direction of the belt, and the upper elastic layer 11 has a small thickness at the both end corresponding regions B as compared with the thickness of other regions.

[0049] In the embodiment shown in Fig. 6, when it is assumed that the depth of the drain groove 13 to its bottom is d1 and the depth of the recessed part 14 to its bottom is d2, the depths of the drain groove 13 and the recessed part 14 are selected so as to satisfy the relation $d2 \geq d1$. Thus, in this dimensional relation, the drain grooves 13 are formed at the center region A and the endmost region C, but the drain groove is not formed at the both end corresponding regions B.

[0050] Here, specific dimensions will be shown, for example. As described above, the press belt 2 is 2 to 15m in width, 1 to 30m in peripheral length and 2 to 10mm in thickness in general. In such press belt 2, the width of the end corresponding region B is about 2 to 15cm, the thickness of the upper elastic layer 11 is about 1.2 to 8mm, the depth d1 of the drain groove 13 is about 0.5 to 7mm, and the depth d2 of the recessed part 14 is about 1.0 to 7mm. In addition, the width of the drain groove 13 is about 0.6 to 1.2mm and the width of a land part positioned between the adjacent drain grooves 13 is about 0.9 to 3.6mm.

[0051] The embodiment shown in Fig. 6 provides the following advantages. First, since the thickness of the both end corresponding regions B is small, the flexibility of this region can be enhanced, and the pressure escape part for allowing the pressure from the pressing means to escape can be provided. Therefore, even then twist stress or bending stress is applied to this region, since excessive pressure is not applied from the pressing means, a crack is prevented from being generated.

[0052] Second, since the recessed parts 14 are formed in the upper elastic layer positioned at the both end corresponding regions B, no drain groove that is likely to be a starting point of the crack is formed there, so that a crack can be effectively prevented from being generated. Preferably, both side wall surfaces 14a of the recessed part 14 are tapered such that the distance between them becomes small as they go down. In a case both side wall surfaces of the recessed part 14 are perpendicular, a sharp corner could be provided at the intersection between the perpendicular wall surface and the drain groove 13. Thus, in order to prevent the sharp corner from being generated, it is preferable that both side wall surfaces 14a are tapered. In addition, in order to prevent the stress from concentrating on the bottom corner of the recessed part 14, the bottom corner may be curved.

[0053] Third, since the endmost region C of the press belt 2 has the same thickness as that of the center region A, both ends of a felt in the width direction can be stably supported by the endmost region C, so that the free movement of the felt can be controlled.

[0054] Fourth, since the many drain grooves are formed along the traveling direction of the belt in the outer peripheral surface of the endmost region C, the flexibility of the part from the end corresponding region B to the endmost region C can be improved and the effect to prevent the generation of a crack can be enhanced.

[0055] Figs. 7, 8, 9 and 10 show other embodiments

of the press belt.

[0056] A press belt 20 shown in Fig. 7 comprises a reinforcement layer 21, an upper elastic layer 22, and a lower elastic layer 23. According to this embodiment, drain grooves 24 are provided spirally all over the upper elastic layer 22 in the width direction. In the upper elastic layer 22, recessed parts 25 are formed at the both end corresponding regions B to constitute pressure escape parts. The depth of the recessed part 25 to its bottom is smaller than the depth of the drain groove 24 to its bottom. Therefore, the drain grooves 24 are formed in the bottom of the recessed part 25. In this embodiment also, since the both end corresponding regions B having a small thickness provide preferable flexibility and constitute the pressure escape parts, a crack can be prevented from being generated.

[0057] A press belt 40 shown in Fig. 8 comprises a reinforcement layer 41, an upper elastic layer 42, and a lower elastic layer 43. In this embodiment, there is no drain groove formed. In the upper elastic layer 42, since recessed parts 44 are formed at the both end corresponding regions B to provide pressure escape parts, a crack is effectively prevented from being generated at the both end corresponding regions B.

[0058] A press belt 60 shown in Fig. 9 comprises a reinforcement layer 61, an upper elastic layer 62 and a lower elastic layer 63. Drain grooves 64 extend spirally all over the upper elastic layer 62 in the width direction. In this embodiment, since the upper elastic layer is hardly formed on the both end corresponding regions B and the endmost regions C, the surface of them is essentially at the same level of the surface of the reinforcement layer 61. Here, the "essentially at the same level of the surface" includes concept that even when the upper elastic layer remains, its thickness is a skin layer having a thickness of 0.5mm or less. In addition, both ends 65 of the upper elastic layer 62 positioned at the boundary part between the center region A and the both end corresponding regions B are gradually curved slant surfaces. The upper and lower corners of the upper elastic layer 62 especially are chamfered so as to be gradually curved in order to prevent the stress concentration.

[0059] According to the embodiment shown in Fig. 9, in the outer peripheral surface of the press belt 60, the center region A extends in the traveling direction of the press belt as a raised part, and the both end corresponding regions B and the endmost regions C extend in the traveling direction of the press belt as recessed parts. The both end corresponding regions B as the recessed parts provide pressure escape parts for allowing the pressure from the pressing means to escape. In addition, it is preferable that the step difference between the center region A and the both end corresponding regions B in the outer peripheral surface of the press belt 60 is not less than 1.0mm. When such step difference is provided, the upper elastic layer having a thickness of 0.5mm or more may be left at the both end corresponding regions B.

[0060] A press belt 70 shown in Fig. 10 comprises a

reinforcement layer 71, an upper elastic layer 72 and a lower elastic layer 73. Drain grooves 74 are formed spirally all over the upper elastic layer 72 in the width direction. In this embodiment, the upper elastic layer is hardly formed at the endmost region C, so that its surface level is the same as that of the reinforcement layer 71. In addition, the upper elastic layer 72 positioned at the both end corresponding regions B has tapered parts 75 in which the thickness thereof is reduced toward the endmost regions C. As shown in Fig. 10, a recessed groove 76 deeper than the bottom of the drain groove 74 is formed in the middle of the tapered part 75. The tapered part 75 gradually reducing its thickness is provided to relieve the stress. In addition, since the drain groove that is likely to become a starting point of a crack is not formed at the recessed groove 76, a crack is prevented from being generated at this part. In addition, the width of the recessed groove 76 is about 1cm to 10cm. Furthermore, the recessed part 76 provides a pressure escape part for allowing the pressure from the pressing means to escape.

[0061] Next, an embodiment of the shoe press roll 30 according to the present invention will be described with reference to Fig. 11. Fig. 11 is a sectional view showing the shoe press roll in the width direction. The shoe press roll 30 is provided such that the pressing shoe 3 is covered with the press belt 2 and the press belt 2 is formed into a roll as an outer roll.

[0062] The pressing shoe 3 is supported by a hydraulic cylinder 32 on a supporting shaft 31, so that it can press the press belt 2 upward. End disks 33 are rotatably supported on both ends of the supporting shaft 31 through bearings 34. The edge of the press belt 2 is folded inward in a radius direction on the outer periphery 36 of the end disk 33. The folded part of the edge of the press belt 2 is sandwiched between the outer peripheral part of the end disk 33 and a ring-shaped fixing plate 35 and fastened and fixed by a bolt and the like. A lubricant oil is supplied between the press belt 2 and the pressing shoe 3. Thus, the press belt 2 fixed to the end disk 33 can rotate while sliding on the pressing shoe 3.

[0063] As the press belt 2, the ones described in the above embodiments can be used. As can be clear from the drawing, both ends of the press belt 2 at the center region A are positioned inside both edges of the pressing shoe 3 in the width direction.

[0064] Although the embodiments of the present invention have been described with reference to the drawings in the above, the present invention is not limited to the above-illustrated embodiments. Various kinds of modifications and variations may be added to the illustrated embodiments within the same or equal scope of the present invention.

INDUSTRIAL APPLICABILITY

[0065] According to the press belt in the present invention, since a crack is prevented from being generated at

the both end corresponding regions in which the crack has been easily generated conventionally, the press belt can be used for a long period of time. Therefore, the present invention can be advantageously applied to a press belt and a shoe press roll used in pressing an object in various kinds of industries such as a papermaking industry, magnetic recording medium manufacturing industry, and fiber industry.

Claims

1. A press belt in a press machine comprising an endless rotating press belt and pressing means positioned inside and/or outside the periphery of said press belt, comprising:

both end corresponding regions positioned so as to correspond to both ends of said pressing means in a width direction; and
a center region positioned between said both end corresponding regions, wherein said center region has a predetermined thickness and constitutes a pressed part pressed by said pressing means, and
said both end corresponding regions have a thickness smaller than that of said center region to form recessed parts and constitute pressure escape parts for allowing the pressure from said pressing means to escape.

2. The press belt according to claim 1, wherein the depth of said recessed part is larger than the variation of the thickness of said center region when pressed by said pressing means.
3. The press belt according to claim 1, wherein the depth of the recessed part is not less than 1.0mm.
4. The press belt according to claim 1, wherein said recessed part is formed in the outer peripheral surface of the press belt.
5. The press belt according to claim 1, wherein said recessed part is formed in the inner peripheral surface of the press belt.
6. The press belt according to claim 1, comprising an endmost region having the same thickness as that of said both end corresponding regions, outside said both end corresponding regions in the width direction.
7. The press belt according to claim 1, comprising an endmost region having the same thickness as that of said center region, outside said both end corresponding regions in the width direction.

8. The press belt according to claim 1, comprising a reinforcement layer extending at said center region and said both end corresponding regions, and an upper elastic layer formed thereon, wherein said upper elastic layer has said recessed part.

9. The press belt according to claim 1, comprising a reinforcement layer extending at said center region and said both end corresponding regions, and an upper elastic layer formed thereon and extending only at said center region, wherein the exposed part of the outer peripheral surface of said reinforcement layer forms said recessed part.

10. The press belt according to claim 8, wherein many drain grooves extending along the traveling direction of the belt are formed in the outer peripheral surface of said upper elastic layer.

11. The press belt according to claim 10, wherein the depth of said recessed part is the same as that of said drain groove or more.

12. The press belt according to claim 1, comprising a reinforcement layer extending at said center region and said both end corresponding regions and a lower elastic layer formed thereunder, wherein said lower elastic layer has said recessed part.

13. The press belt according to claim 1, comprising a reinforcement layer extending at said center region and said both end corresponding regions, and a lower elastic layer formed thereunder and extending only at said center region, wherein the exposed part of the inner peripheral surface of said reinforcement layer forms said recessed part.

14. A shoe press roll comprising:

an outer roll comprising an endless-shaped press belt and pressing shoe positioned inside the periphery of said outer roll as pressing means, wherein said outer roll is the press belt according to claim 1.

15. The shoe press roll according to claim 14, wherein both ends of the center region of said press belt having a predetermined thickness are positioned inside both edge parts of said pressing shoe in the width direction.

FIG. 1

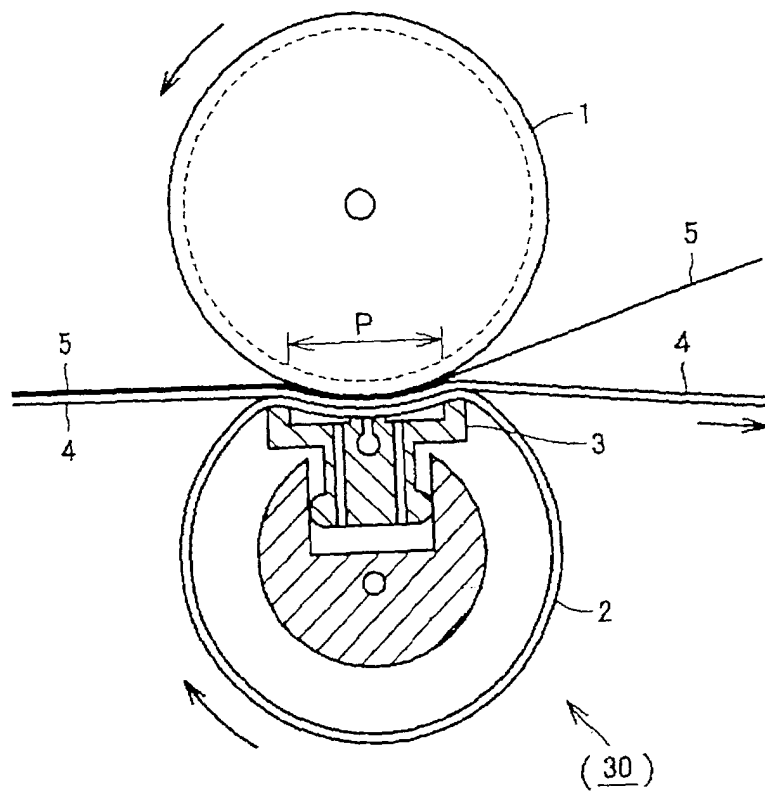


FIG. 2

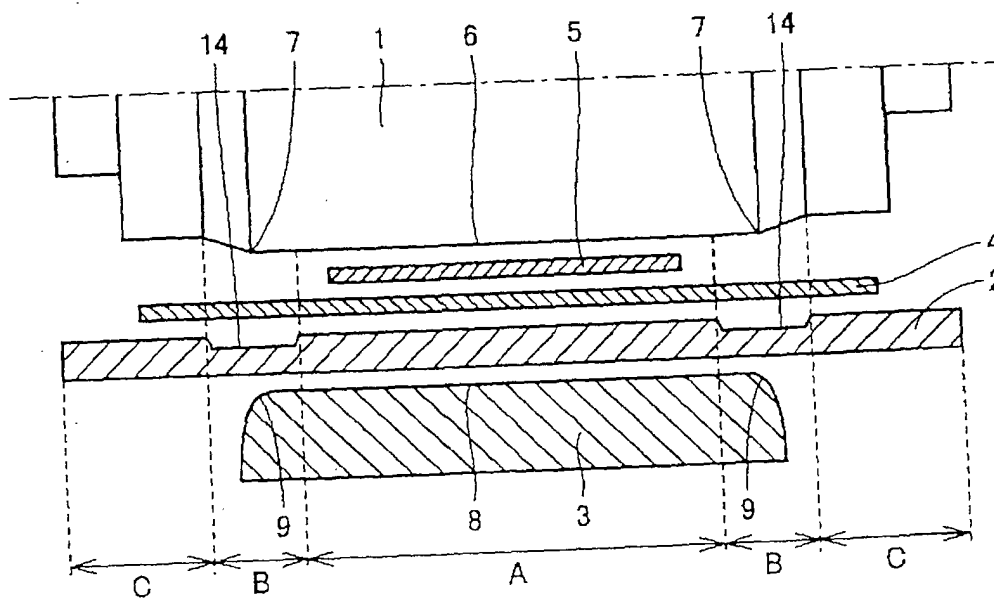


FIG. 3

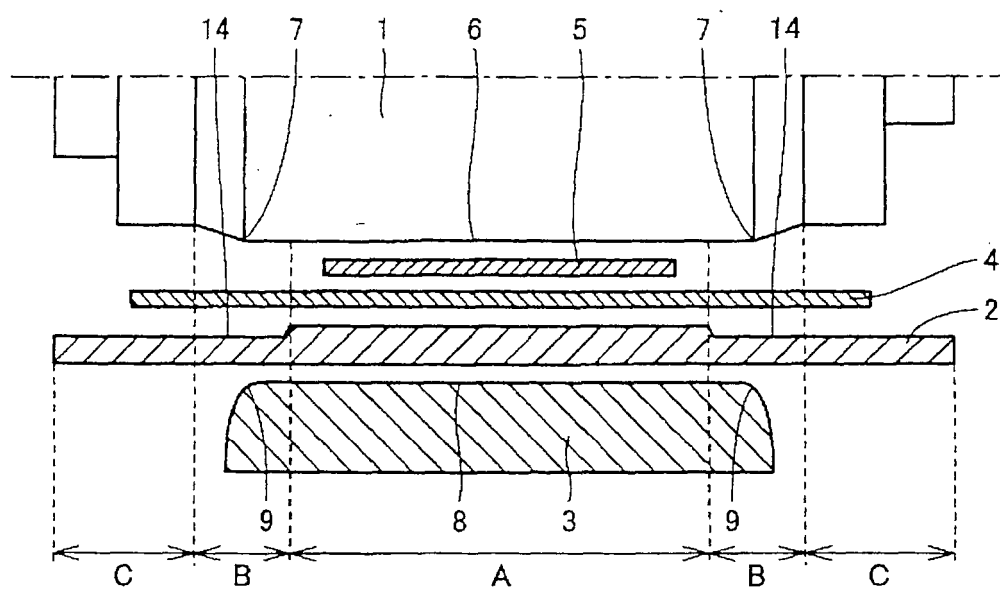


FIG. 4

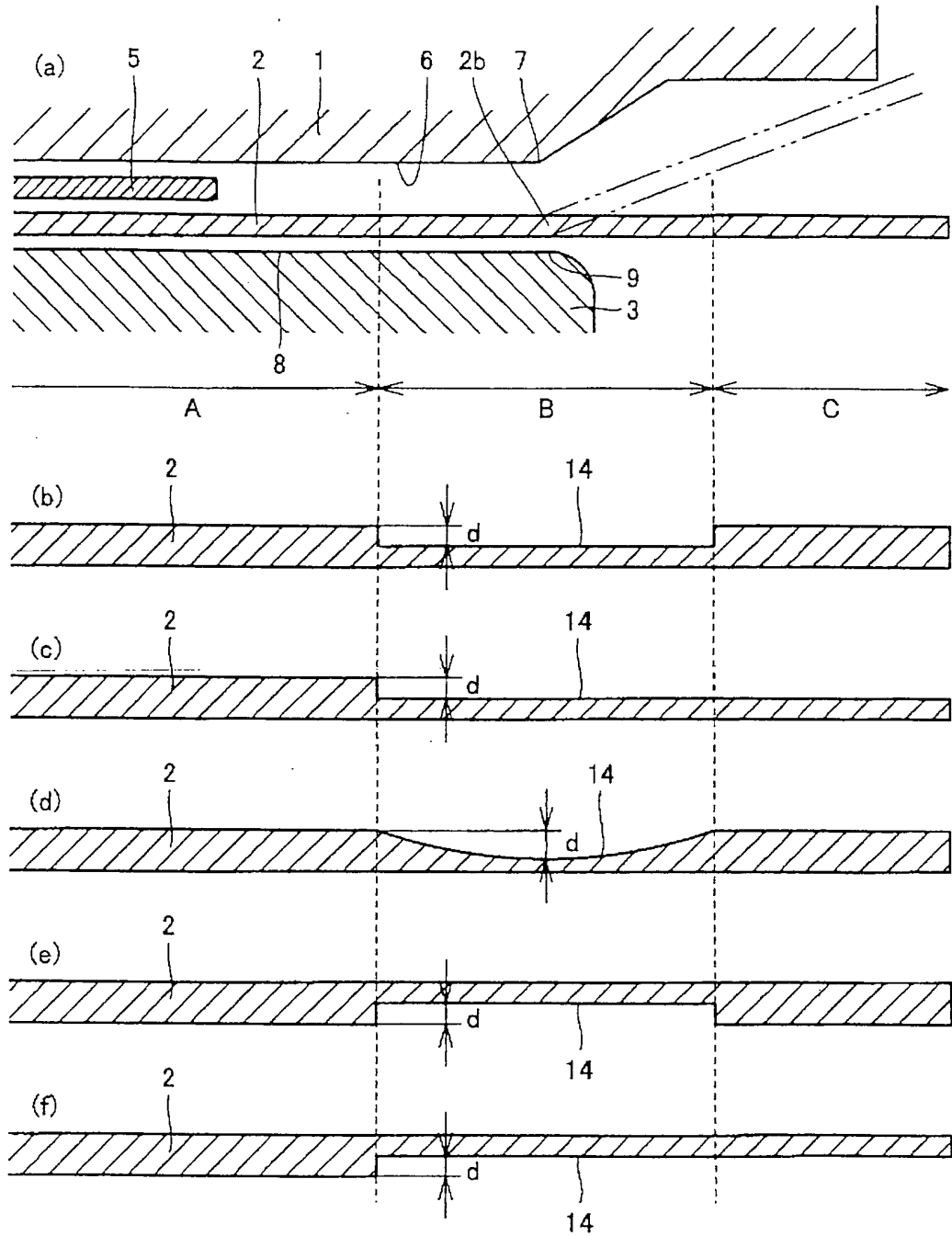


FIG. 5

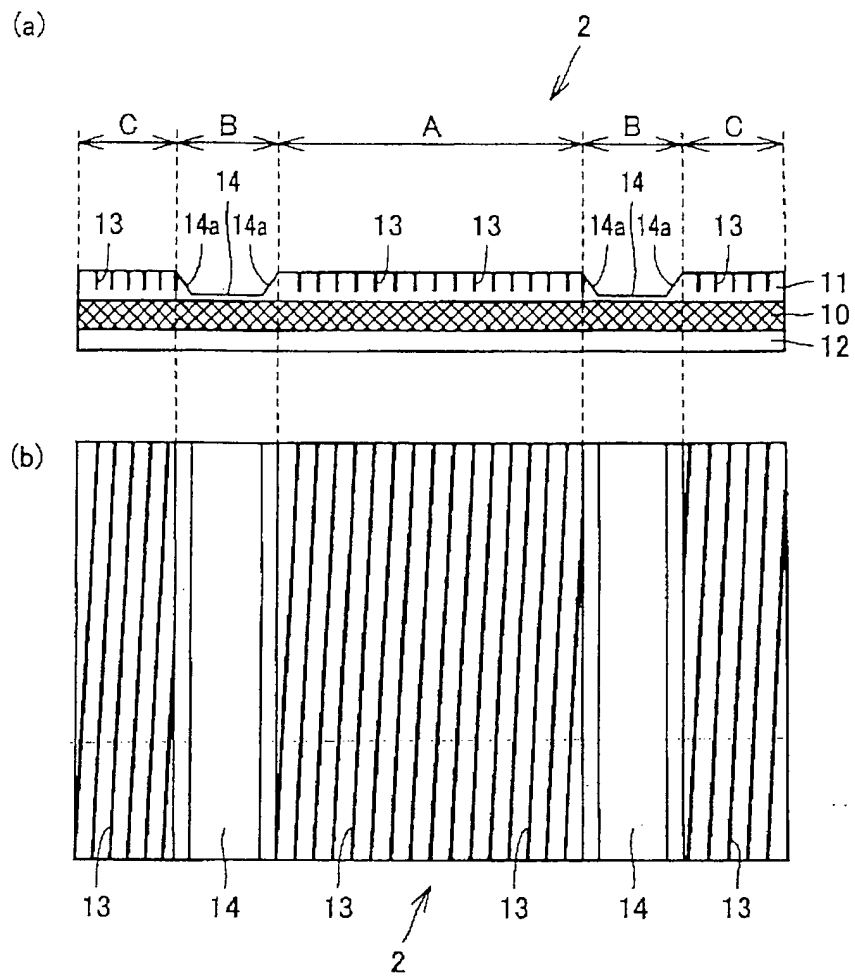


FIG. 6

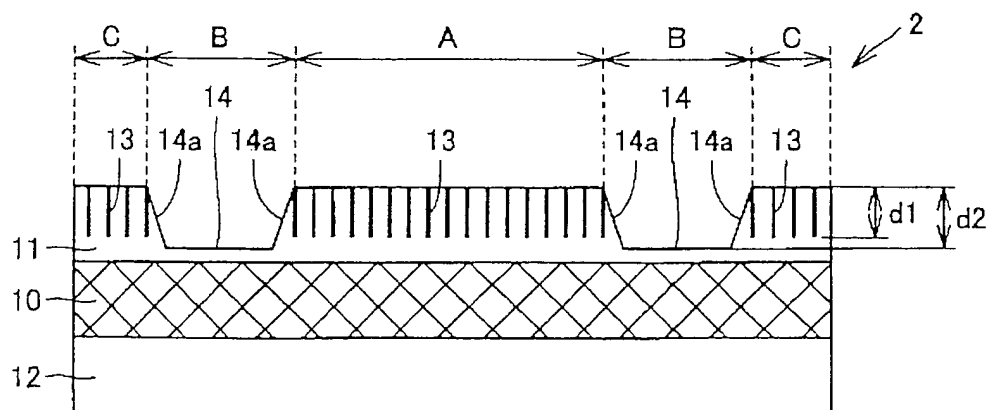


FIG. 7

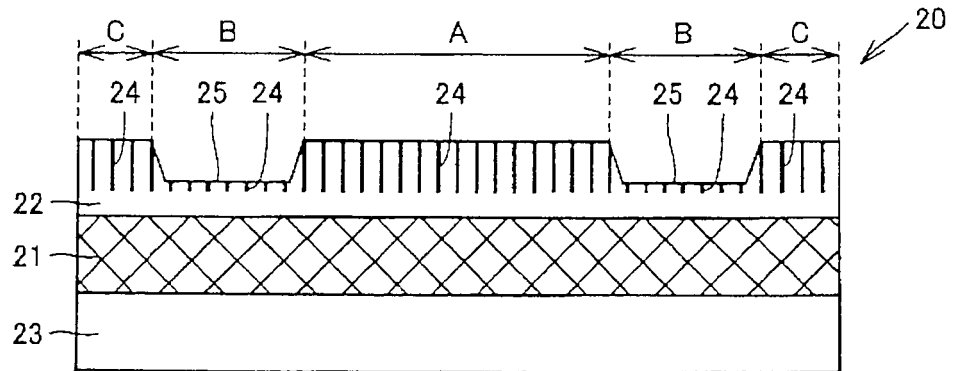


FIG. 8

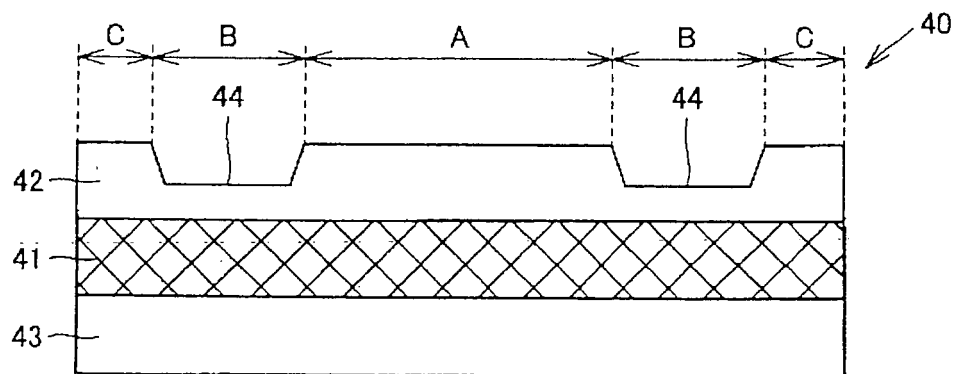


FIG. 9

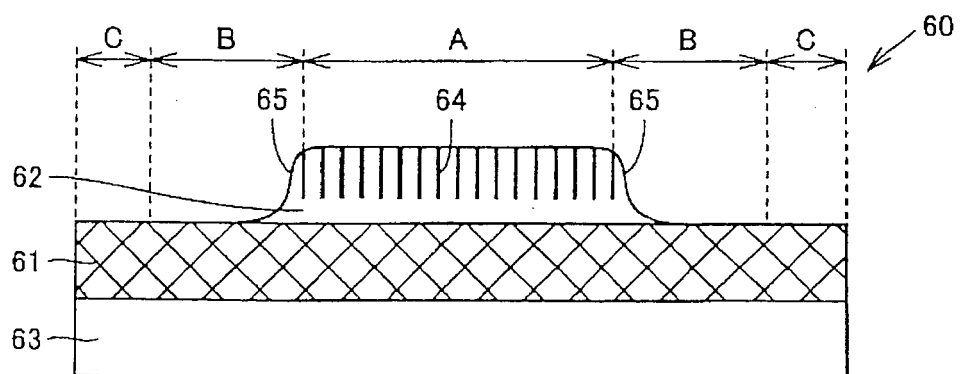


FIG. 10

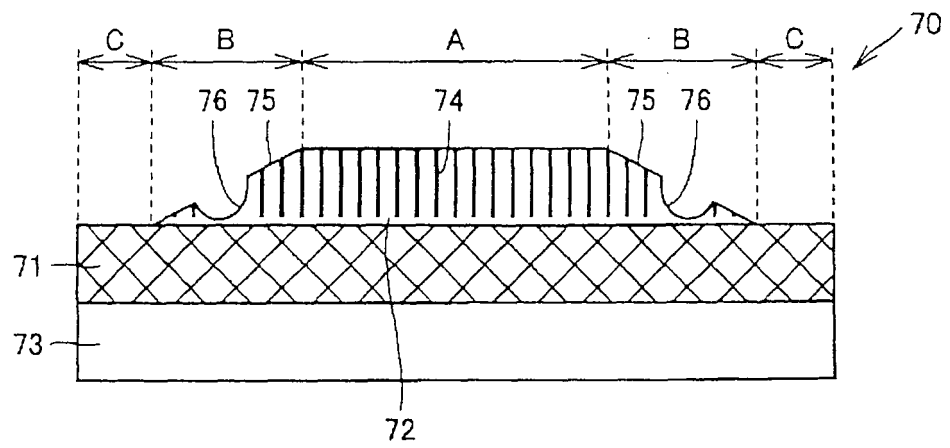
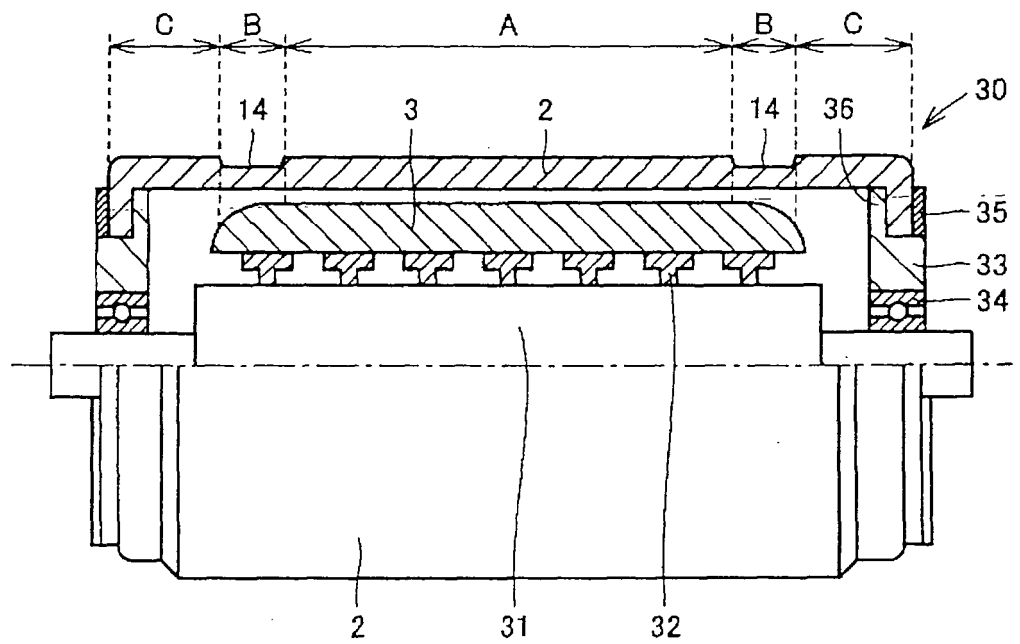


FIG. 11



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/303608

A. CLASSIFICATION OF SUBJECT MATTER

D21F3/00 (2006.01)

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)

D21F3/00-3/02

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.
X	US 5943951 A (Voith Sulzer Papiermaschinen GmbH),	1-4, 6, 8, 9, 14, 15
Y	31 August, 1999 (31.08.99),	10, 11
A	All references & DE 19652545 A	5, 7, 12, 13
X	JP 2000-110090 A (Ichikawa Keori Kabushiki Kaisha),	1-4, 6, 8, 9, 14, 15
Y	18 April, 2000 (18.04.00),	10, 11
A	All references & US 2002-28317 A1 & EP 978588 A2 & CN 1245846 A & TW 455640 B & ID 25889 A & CA 2279781 A	5, 7, 12, 13



Further documents are listed in the continuation of Box C.



See patent family annex.

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
08 March, 2006 (08.03.06)Date of mailing of the international search report
28 March, 2006 (28.03.06)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/303608

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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P, X P, A	WO 2005/24128 A1 (Yamauchi Kabushiki Kaisha), 17 March, 2005 (17.03.05), All references & JP 2005-97806 A	1-11, 14, 15 12, 13
Y A	WO 02/48456 A1 (Yamauchi Kabushiki Kaisha), 20 June, 2002 (20.06.02), All references & JP 2002-180393 A & US 2004-26057 A1 & EP 1350889 A1 & AU 2409102 A & CA 2431414 A & CN 1479823 A	10, 11 1-9, 12-15
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Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

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PCT/JP2006/303608

In the matter "forming the pressure releasing part " in Claim 1, it is not clear if what action acts thereon what degree, the matter is applicable. As a result, even if the relation of the matter with the pressurizing means is not mentioned in the invention, the invention cannot be distinguished from any invention in which the areas at both ends are smaller in thickness than the center area.

REFERENCES CITED IN THE DESCRIPTION

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