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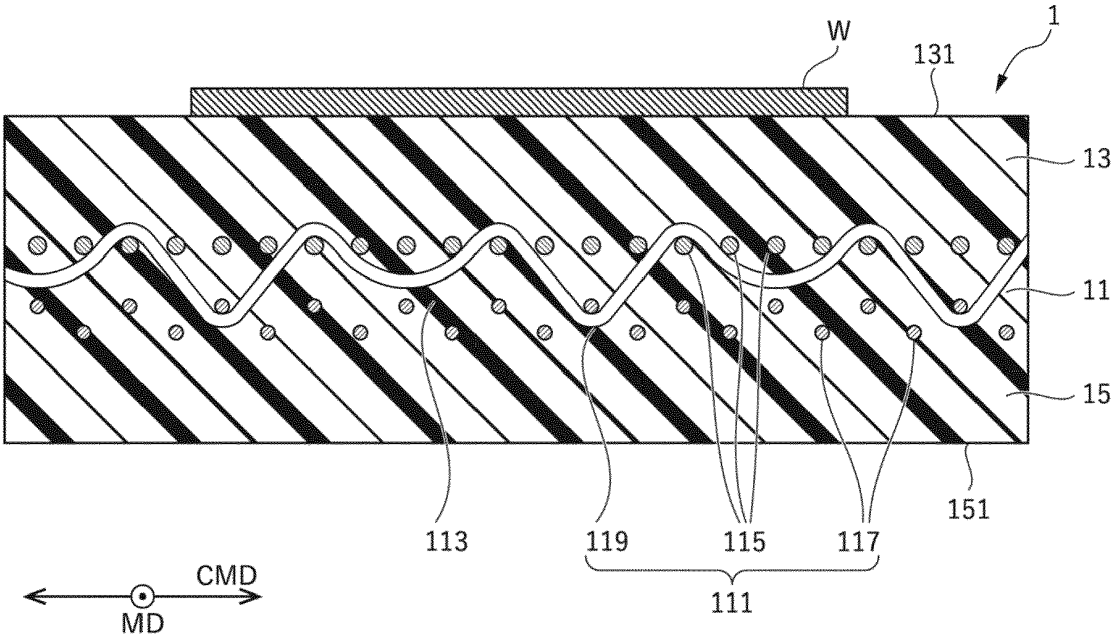
(54) **PAPERMAKING BELT**

(57) The object of the invention is to provide a papermaking belt whose warping at the end part during its use has been suppressed.

Provided is a papermaking belt that is used in a papermaking machine and that comprises a first plane on which a wet paper web is placed and a second plane on the opposite side to the first plane, wherein the papermaking belt comprises a reinforcing fibrous substrate layer comprising at least one layer of a woven fabric, at least one layer of said woven fabric comprises a double or more combination weave pattern, said combination weave pattern comprises first yarns and second yarns that are placed in parallel; said first yarns are placed closer to the first plane-side than said second yarns, and said second yarns are placed closer to the second plane-side than said first yarns, and the fineness of said first yarns are greater than the fineness of said second yarns.

FIG. 1



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Description

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is based upon and claims benefit of priority from Japanese Patent Application No. 2022-138602, filed on August 31, 2022, the entire contents of which are incorporated herein by reference.

BACKGROUND

[Technical Field]

[0002] The present disclosure relates to a papermaking belt.

[Background Art]

[0003] A papermaking machine for removing moisture from a source material of paper is generally equipped with a wire part, a press part, and a dryer part. These parts are placed in the order of the wire part, the press part, and the dryer part in a wet paper web transfer direction.

[0004] In each part of such a papermaking machine, various papermaking belts are used for the purpose of transferring and compressing a wet paper web, etc. Such papermaking belts include such as, for example, a wet paper transfer belt (transfer belt) for transferring and delivering a wet paper web, and a shoe press belt used in a shoe press mechanism.

[0005] Regarding the delivery of a wet paper web using a wet paper transfer belt in the press part, a closed-draw papermaking machine that delivers a wet paper web in the closed-draw manner is currently known as a papermaking machine. In a press part of the closed-draw papermaking machine, the wet paper web is transferred while being mounted on a papermaking felt or wet paper transfer belt. Thus, the wet paper web never run alone, preventing the generation of paper breaking. Therefore, the closed-draw papermaking machine exhibits an excellent high speed running suitability and operation stability.t

[0006] WO 03/071030 A1 proposes, for the purposes of preventing warping at an end part that is caused by the different shrinkage properties and finishing steps, etc., of different materials, a papermaking belt having two layers consisting of resin materials, of which one layer is placed on the cd supporting layer-side and the other layer is placed on the front-side.

SUMMARY

[Technical Problem]

[0007] Incidentally, a papermaking belt may be used with an automatic guiding apparatus, so-called a "guider", in order to prevent meandering of the papermaking belt. The guider generally detects an end part in the width direction of the running papermaking belt, and adjusts the running position of the papermaking belt. Here, if there is warping at the end position of the papermaking belt, the guider cannot detect the precise position of the papermaking belt, and it becomes incapable of appropriately adjusting the running position of the papermaking belt. As a result, it becomes difficult that the papermaking belt is stably used.

[0008] Moreover, a papermaking belt is generally used in presence of water, i.e., in a wet state. Therefore, conditions under which warping is developed at the end part of the papermaking belt need to be considered taking the wet state into account. The papermaking belt described in WO 03/071030 A1 is merely aimed at preventing warping at the end part of the papermaking belt, but it does not consider the warping at the end part in a wet state.

[0009] Accordingly, an object of the present disclosure is to provide a papermaking belt whose warping at the end part during its use has been suppressed.

[Solution to Problem]

[0010] The present inventor has made an intensive investigation in order to achieve the above-described object, and as a result, found that a base fabric layer that constitutes the papermaking belt has a relatively large influence on the warping at the end part of the papermaking belt when being used. Furthermore, the present inventor found that the warping at the end part of the papermaking belt could be suppressed by employing a woven fabric having a combination weave pattern in the base fabric layer and controlling the yarn fineness of the combination weave pattern. The present inventor has further proceeded the investigation and as a result accomplished the present invention.

[0011] A gist of the present invention is as follows:

[1] A papermaking belt that is used in a papermaking machine and that comprises a first plane on which a wet paper web is placed and a second plane on the opposite side to the first plane, wherein:

the papermaking belt comprises a reinforcing fibrous substrate layer comprising at least one layer of a woven fabric;
at least one layer of said woven fabric comprises a double or more combination weave pattern;
said combination weave pattern comprises first yarns and second yarns that are placed in parallel;
said first yarns are placed closer to the first plane-side than said second yarns, and said second yarn are placed closer to the second plane-side than said first yarns; and
the fineness of said first yarns are greater than the fineness of said second yarns.

[2] The papermaking belt according to [1], wherein said second yarns are crimped yarns.
[3] The papermaking belt according to [1] or [2], wherein said second yarns are multifilament twist yarns.
[4] The papermaking belt according to any one of [1] to [3], wherein said first yarns and said second yarns are placed along the machine direction of the papermaking belt.
[5] The papermaking belt according to any one of [1] to [4], comprising no batt fiber layer.
[6] The papermaking belt according to any one of [1] to [5], wherein:

said woven fabric comprising said combination weave pattern further comprises third yarns that are woven into said first yarns and said second yarns; and
said third yarn are monofilament twist yarns.

[7] The papermaking belt according to any one of [1] to [6], wherein:

said woven fabric comprising said combination weave pattern further comprises third yarns that are woven into said first yarns and said second yarns; and
said combination weave pattern is a weave pattern that comprises a repeat unit that is capable of concurrent formation of a repeat in which each said third yarn passes through *K* said first yarns on the side of said first plane while it passes through *L* said first yarns on the side of said second plane and a repeat in which each said third yarn passes through *M* said second yarns on the side of said first plane while it passes through *N* said second yarns on the side of said second plane;
wherein the relation $K/L \geq N/M$ is satisfied.

[8] The papermaking belt according to any one of [1] to [7], wherein:

said woven fabric comprising said combination weave pattern further comprises third yarn that are woven into said first yarns and said second yarns; and
the number of crossing points of said first yarns and said third yarns in a weave repeat is greater than the number of crossing points of said second yarns and said third yarns in the weave repeat.

[9] The papermaking belt according to any one of [1] to [8], wherein the papermaking belt is a wet paper transfer belt.
[10] The papermaking belt according to any one of [1] to [8], wherein the papermaking belt is a shoe press belt.

[Advantageous Effects of Invention]

[0012] By the above-mentioned configuration, it is possible to provide a papermaking belt whose warping at the end part during its use has been suppressed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

FIG. 1 is a cross-sectional view in a cross machine direction showing an example of a papermaking belt according to a preferred embodiment of the present disclosure.
FIG. 2 is an enlarged cross-sectional view of a reinforcing fibrous substrate provided in a papermaking belt according to a preferred embodiment of the present disclosure.
FIG. 3 is a diagram of a weave repeat of a woven fabric of a reinforcing fibrous substrate provided in a papermaking belt according to a preferred embodiment of the present disclosure.

FIG. 4 is a diagram of a weave repeat of a woven fabric of a reinforcing fibrous substrate provided in a papermaking belt according to a preferred embodiment of the present disclosure.

FIG. 5 is an enlarged cross-sectional view of a reinforcing fibrous substrate provided in a papermaking belt according to a modified example of the present disclosure.

FIG. 6 is a diagram of a weave repeat of a woven fabric of a reinforcing fibrous substrate provided in a papermaking belt according to a modified example of the present disclosure.

FIG. 7 is a diagram of a weave repeat of a woven fabric of a reinforcing fibrous substrate provided in a papermaking belt according to a modified example of the present disclosure.

FIG. 8 is a cross-sectional view in a cross machine direction of a papermaking belt according to another modified example of the present disclosure.

FIG. 9 is a schematic diagram for illustrating a preferred embodiment of a method of producing a papermaking belt according to the present disclosure.

FIG. 10 is a schematic diagram for illustrating a preferred embodiment of a method of producing a papermaking belt according to the present disclosure.

FIG. 11 is a schematic diagram for illustrating another preferred embodiment of a method of producing a papermaking belt according to the present disclosure.

FIG. 12 is a schematic diagram for illustrating another preferred embodiment of a method of producing a papermaking belt according to the present disclosure.

FIG. 13 is a schematic diagram for illustrating a method for evaluating the warping at the end part of the wet paper transfer belt used in examples.

FIG. 14 is a schematic diagram for illustrating a method for evaluating the warping at the end part of the wet paper transfer belt used in examples.

FIG. 15 is an overview showing an example of a papermaking belt and an automatic guiding apparatus loaded on a papermaking machine.

FIG. 16 is an overview illustrating the relationship between the warping at the end part of a papermaking belt and a detection part (a palm) of an automatic guiding apparatus.

DESCRIPTION OF THE EMBODIMENTS

[0014] Hereinafter, referring to the appended drawings, preferred embodiments of a papermaking belt according to the present disclosure will be described in detail.

<1. Relationship between Papermaking Belt and Automatic Guiding Apparatus>

[0015] First, prior to the description of a papermaking belt according to the present disclosure, the relationship between a papermaking belt and an automatic guiding apparatus is to be explained.

[0016] FIG. 15 is an overview showing an example of a papermaking belt and an automatic guiding apparatus loaded on a papermaking machine, and FIG. 16 is an overview illustrating the relationship between the warping at the end part of a papermaking belt and a detection part (palm) of the automatic guiding apparatus.

[0017] A papermaking belt 101 shown in FIG. 15 is an endless belt that runs via a roll. An automatic guiding apparatus 110 is an apparatus that adjusts the running position of the papermaking belt 101 such that the running position of the papermaking belt 101 will not lean towards either drive-side or non-drive-side of the papermaking machine during the operation. The automatic guiding apparatus 110 regularly detects the position of the papermaking belt 101 and at the same changes the angle of a guide roll 102 against the running direction of the papermaking belt 101, thereby adjusting the running position of the papermaking belt 101 so that the papermaking belt 101 will be in an adequate position.

[0018] For controlling the angle of the guide roll 102, a structure is generally used in which an end part of an actuator 106 such as an air spring is connected to a bearing on one side of the guide roll 102, and at the same time, a coil spring 107 is installed in order to balance the actuator 106 with the coil spring 107. By adding a pneumatic pressure to the actuator 106, a bearing 108 on one side moves using a bearing 109 on the side of the other end as a fulcrum. Then, the position of the guide roll 102 (the angle of the papermaking belt 101 against the running direction) is determined such that the force by which the actuator 106 pushes the bearing 108 is in equilibrium with the reaction force by the coil spring 107.

[0019] Moreover, a pneumatic pressure adjusting apparatus 104 provided with a palm-type position detector is often used as an apparatus for detecting the position of the papermaking belt 101 and supplying pneumatic pressure corresponding to that position to the actuator 106 of the guide roll 102. A constant pneumatic pressure (supply pressure) is supplied to the pneumatic pressure adjusting apparatus 104 through a pressure reducing valve 105, while a palm 103 is brought into contact with an end part of the running papermaking belt 101. Then, a change in the position of an end part 1011 of the papermaking belt 101 is detected as a displacement of the palm 103 that is brought into in contact, and,

by means of this displacement of the palm 103, a part of or whole supply air inside the pneumatic pressure adjusting apparatus 104 is released into atmosphere, leaving a residual pressure as an output pressure of the pneumatic pressure adjusting apparatus 104. By supplying the air of this output pressure to the actuator 106, the position of the guide roll 102 can be adjusted.

[0020] Here, the relationship between the palm 103 and the end part 1011 of the papermaking belt 101 is to be examined. As shown in FIG. 16, when there is no warping in the papermaking belt 101 (a papermaking belt 101'), the end part 1011' of the papermaking belt 101' will be in contact with the palm 103 in an appropriate position, and the automatic guiding apparatus 110 is capable of detecting an exact position of the papermaking belt 101'. On the other hand, when there is warping in the end part 1011 of the papermaking belt 101, because the end part 1011 will be located at a distance D from the position where it should originally be detected as a result of the warping of the end part 1011, problems may occur, such as that the palm 103 becomes incapable of being in contract with the end part 1011, that the palm 103 is brought into contact with the end part 1011 in a position away from where they should be in contact, and that the contact occurs in a part other than the palm 103 of the automatic guiding apparatus 110.

[0021] Accordingly, when there is warping in the papermaking belt 101, it becomes difficult to stably use the papermaking belt 101, because the automatic guiding apparatus 110 cannot detect the exact position of the papermaking belt 101. In the description above, problems that may occur due to warping of a papermaking belt have been explained with reference to as an example a palm-type automatic guiding apparatus that uses a palm as an automatic guiding apparatus, though similar problems may occur in other mechanical automatic guiding apparatuses or optical automatic guiding apparatuses, which also detect the end part of the papermaking belt to adjust the position of the papermaking belt.

[0022] In view of such circumstance, the present inventors have developed a papermaking belt as described below, in which the warping at its end part during use is suppressed.

<2. Wet Paper Transfer Belt (Papermaking Belt)>

[0023] Next, a papermaking belt according to a preferred embodiment of the present disclosure will be described.

[0024] FIG. 1 is a cross-sectional view in a cross machine direction showing an example of a wet paper transfer belt (papermaking belt) according to a preferred embodiment of the present disclosure, FIG. 2 is an enlarged cross-sectional view of a reinforcing fibrous substrate provided in the wet paper transfer belt shown in FIG. 1, and FIGs. 3 and 4 are diagrams of weave repeats of a woven fabric of the reinforcing fibrous substrate provided in the wet paper transfer belt shown in FIG. 1. Note that, in the drawing, each member has been emphasized in size as appropriate for ease of illustration and thus does not indicate the actual proportion and size of each member. Herein, the aforementioned cross machine direction may be referred to as "CMD", and the machine direction may be referred to as "MD". Also note that, in the present embodiment, a wet paper transfer belt is to be described as an example of a papermaking belt, though the papermaking belt of the present invention is not to be limited thereto.

[0025] The wet paper transfer belt (papermaking belt) 1 shown in FIG. 1 is to be used for transferring and delivering a wet paper web W in a press part of the papermaking machine. The wet paper transfer belt 1 forms an endless band-shaped body. That is, the wet paper transfer belt 1 is an annular belt. Moreover, the wet paper transfer belt 1 is normally placed such that its circumferential direction runs along the machine direction (MD) of the papermaking system.

[0026] The wet paper transfer belt 1 comprises a reinforcing fibrous substrate layer 11, a first resin layer (a wet paper web carrying-side resin layer) 13 placed on one principal plane (a first plane 131) on the outer surface-side of the reinforcing fibrous substrate layer 11, and a second resin layer (a roll-side resin layer) 15 placed on the other principal plane (a second plane 151) on the inner surface-side of the reinforcing fibrous substrate layer 11, and these layers are laminated to form the wet paper transfer belt 1. Moreover, the first resin layer 13 is a layer that forms the outer surface of an annulus that is formed by the wet paper transfer belt 1.

[0027] The reinforcing fibrous substrate layer 11 comprises a reinforcing fibrous substrate 111 and a resin 113. The resin 113 is present as a matrix resin in the reinforcing fibrous substrate layer 11 such that it fills the interspace between fibers in the reinforcing fibrous substrate 111. That is, a part of the resin 113 is impregnated in the reinforcing fibrous substrate 111, whereas the reinforcing fibrous substrate 111 is embedded in the resin 113.

[0028] The reinforcing fibrous substrate 111 in the present embodiment is a woven fabric having a double weave pattern comprising first warp yarns 115, second warp yarns 117, and weft yarns 119. In the double weave pattern of the reinforcing fibrous substrate 111, the first warp yarns 115 are placed on the first plane 131-side (the wet paper web carrying-side), whereas the second warp yarns 117 are placed on the opposite side to the first plane 131-side, i.e., the second plane 151-side (the roll-side). Moreover, the first warp yarns 115 and the second warp yarns 117 are placed in parallel. Furthermore, the first warp yarns 115 and the second warp yarns 117 are, in FIGs. 1 and 2, placed in the direction that is perpendicular to the paper face, i.e., along the machine direction (MD). On the other hand, the weft yarns 119 are placed approximately perpendicular to the first warp yarns 115 and the second warp yarns 117, i.e., along the cross machine direction (CMD). The weft yarns 119 are woven into the first warp yarns 115 and the second warp yarns 117.

[0029] Note that, in FIGs. 1 and 2, in order to facilitate understanding, a part of the structure of the reinforcing fibrous substrate 111 is schematically described.

[0030] Herein, a "warp yarn" is a yarn that is placed along the machine direction (MD) of a wet paper transfer belt (papermaking belt), i.e., in the circumferential direction, whereas a "weft yarn" is a yarn that is placed along the cross machine direction (CMD) of the wet paper transfer belt (papermaking belt), i.e., in the direction that is perpendicular to the circumferential direction and parallel to the first plane of the papermaking belt. In other words, the direction of a warp yarn is set on the basis of the machine direction in a papermaking belt and a papermaking machine, i.e., a wet paper web transfer direction, the direction of a weft yarn is set on the basis of the cross machine direction in a papermaking belt and a papermaking machine, i.e., a direction that is perpendicular to the wet paper web transfer direction. Also, the warp yarn may not be in parallel with the machine direction (MD) of the papermaking belt, and it may be placed, for example, such that it has an angle within $\pm$ 10° against the machine direction (MD) of the papermaking belt. Also, the weft yarn may not be in parallel with the cross machine direction (CMD) of a papermaking belt, and it may be placed, for example, such that it has an angle within $\pm$ 10° against the cross machine direction (CMD) of a papermaking belt.

[0031] Furthermore, in the present embodiment, the fineness of the first warp yarns 115 are greater than the fineness of the second warp yarns 117. By this, it is possible to suppress the warping of the wet paper transfer belt 1 at its end part, i.e., the end part in the cross machine direction (CMD), during its use.

[0032] For further details, the present inventors have found that, regarding the warping of a wet paper transfer belt at its end part during its use, there is not only an early stage warping in the finished product just after the production, but also a warping developed by getting wet with water, etc. during use and by a mechanical action in the papermaking machine. Furthermore, the present inventors have focused on a possibility that, above all, the warping developed by swelling of the wet paper transfer belt with water, etc. during use may cause the greatest influence among the warping at the end part of the papermaking belt.

[0033] Then, the present inventors have found that it is possible to control warping of a wet paper transfer belt at its end part by employing a woven fabric having a combination weave pattern in a reinforcing fibrous substrate and further adjusting the fineness of two parallel yarns in the woven fabric. Specifically, by increasing the fineness of first yarns on the side of a first plane on which a wet paper web is placed as compared to the fineness of second yarns on the opposite second plane side, the density of the woven fabric on the wet paper web carrying-side will be increased, resulting in an increase in its rigidity on the wet paper web carrying-side. This would suppress the warping of the end part of the reinforcing fibrous substrate provided with the woven fabric towards the wet paper web carrying-side. As a result, the warping at the end part of the wet paper transfer belt during its use, and the warping towards the wet paper web carrying-side are suppressed. Note that, in the present embodiment, the first warp yarns 115 are used as the first yarns and the second warp yarns 117 are the second yarns.

[0034] As mentioned above, the fineness of the first warp yarns 115 is not limited as long as it is greater than the fineness of the second warp yarns 117. For example, the fineness of the first warp yarns 115 is greater than the fineness of the second warp yarns 117 by a range of equal to or higher than 50 dtex, preferably equal to or higher than 100 dtex, more preferably equal to or higher than 200 dtex. This makes it possible to more efficiently suppress warping of the wet paper transfer belt 1 at its end part during its use. Moreover, the fineness of the first warp yarns 115 may be greater than the fineness of the second warp yarns 117 by a range of, for example, equal to or less than 3000 dtex, preferably equal to or less than 2500 dtex, more preferably equal to or less than 1000 dtex. This makes it possible to suppress warping of the wet paper transfer belt 1 at its end part towards the roll-side due to an excessive increase in the fineness of the first warp yarns 115 as compared to the fineness of the second warp yarns 117.

[0035] The fineness of the first warp yarn 115 is greater than the fineness of the second warp yarns 117, and it is, for example, equal to or higher than 500 dtex and equal to or lower than 8000 dtex, preferably equal to or higher than 1000 dtex and equal to or lower than 6000 dtex, more preferably equal to or higher than 2000 dtex and equal to or lower than 4000 dtex. This ensures a sufficient rigidity of the reinforcing fibrous substrate 111, while making it possible to more efficiently suppress warping of the wet paper transfer belt 1 at its end part towards the wet paper web carrying-side and the roll-side.

[0036] The fineness of the second warp yarns 117 is smaller than the fineness of the first warp yarns 115, and it is, for example, equal to or higher than 500 dtex and equal to or lower than 8000 dtex, preferably equal to or higher than 1000 dtex and equal to or lower than 6000 dtex, more preferably equal to or higher than 2000 dtex and equal to or lower than 4000 dtex. This ensures a sufficient strength of the reinforcing fibrous substrate 111 and thus a sufficient strength of the wet paper transfer belt 1, while making it possible to more efficiently suppress warping of the wet paper transfer belt 1 at its end part.

[0037] The fineness of the weft yarns 119 is not particularly limited, and it is, for example, equal to or higher than 500 dtex and equal to or lower than 6000 dtex, preferably equal to or higher than 800 dtex and equal to or lower than 3000 dtex, more preferably equal to or higher than 1000 dtex and equal to or lower than 2000 dtex. This ensures a sufficient strength of the reinforcing fibrous substrate 111 and thus a sufficient strength of the wet paper transfer belt 1, while making it possible to sufficiently suppress the waving associated with the weaving of the reinforcing fibrous substrate 111.

[0038] The materials which constitute the first warp yarns 115, the second warp yarns 117 and the weft yarns 119 are not particularly limited, and either one type or a combination of two or more types of the followings can be used: a polyester (polyethylene terephthalate, polytrimethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate, etc.), an aliphatic polyamide (polyamide 6, polyamide 66, polyamide 11, polyamide 12, polyamide 610, polyamide 612, etc.), an aromatic polyamide (aramid), polyvinylidene fluoride, polypropylene, polyether ether ketone, polytetrafluoroethylene, polyethylene, sheep wool, cotton, metals, etc.

[0039] Two or more of the first warp yarns 115, the second warp yarns 117 and the weft yarns 119 may comprise identical materials or may comprise different materials to each other.

[0040] Among those mentioned above, the first warp yarns 115 preferably comprise one or more types selected from a group consisting of a polyester, an aliphatic polyamide and an aromatic polyamide (aramid), more preferably comprise one or more types selected from a group consisting of polyethylene terephthalate, polytrimethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate, polyamide 6, polyamide 66, polyamide 11, polyamide 12, polyamide 610 and polyamide 612. This makes it possible to achieve both the maintenance of the strength and the stability of the dimensions of the wet paper transfer belt 1 when being used.

[0041] Among those mentioned above, the second warp yarns 117 preferably comprise one or more types selected from a group consisting of a polyester, an aliphatic polyamide and an aromatic polyamide (aramid), more preferably comprise one or more types selected from a group consisting of polyethylene terephthalate, polytrimethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate, polyamide 6, polyamide 66, polyamide 11, polyamide 12, polyamide 610 and polyamide 612. This makes it possible to achieve both the maintenance of the strength and the stability of the dimensions of the wet paper transfer belt 1 when being used. Moreover, because a polyester, especially polyethylene terephthalate is a material that has a relatively low water absorbance property, its use in the second warp yarns 117 can suppress the water swelling of the second warp yarn 117 during the time when the wet paper transfer belt 1 is being used, and can more efficiently suppress the warping of the wet paper transfer belt 1 at its end part.

[0042] Among those mentioned above, the weft yarns 119 preferably comprise one or more types selected from a group consisting of a polyester, an aliphatic polyamide and an aromatic polyamide (aramid), more preferably comprise one or more types selected from a group consisting of polyethylene terephthalate, polytrimethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate, polyamide 6, polyamide 66, polyamide 11, polyamide 12, polyamide 610 and polyamide 612. This makes it possible to achieve both the maintenance of the strength and the stability of the dimensions of the wet paper transfer belt 1 when being used.

[0043] The first warp yarns 115, the second warp yarns 117 and the weft yarns 119 may be yarns of any form, may be spun yarns (spun threads) or filament yarns. However, in view of ensuring the strength of the reinforcing fibrous substrate 111, thus of the wet paper transfer belt 1, the first warp yarns 115, the second warp yarns 117 and the weft yarns 119 are all preferably filament yarns. Each of the first warp yarn 115, the second warp yarn 117 and the weft yarn 119 may be a yarn of a different form, or they may be yarns of an identical form.

[0044] A filament yarn includes, for example, a multifilament or monofilament twist yarn, a multifilament and/or monofilament paralleled yarn and a monofilament single yarn, etc.

[0045] Herein, a "multifilament" is a filament that comprises two or more single yarns. Normally, a single yarn that constitutes a multifilament has the fineness that is not enough to be used alone as a yarn for a reinforcing fibrous substrate. Specifically, the fineness of a single yarn that constitutes a multifilament is, for example, less than 100 dtex, preferably equal to or higher than 5 dtex and equal to or less than 50 dtex. On the other hand, a monofilament is a filament consisting of one yarn. Normally, a single yarn that constitutes a monofilament has the fineness that is enough to be used alone as a yarn for a reinforcing fibrous substrate. The fineness of a monofilament is, for example, equal to or higher than 100 dtex and equal to or less than 6000 dtex, preferably equal to or higher than 200 dtex and equal to or less than 2500 dtex.

[0046] A "multifilament twist yarn" refers to a twist yarn that uses a multifilament as the original yarn. On the other hand, a "multifilament paralleled yarn" refers to a yarn that uses a plurality of parallelly placed single yarns that constitute a multifilament as described above as the original yarns.

[0047] When a multifilament or monofilament paralleled yarn is used, the paralleled yarn can be obtained by parallelly placing the original yarns such that the resulting filament yarn has the intended fineness, for example. In that case, the fineness of a single yarn that constitutes the original yarn of the multifilament is preferably equal to or higher than 5 dtex and less than 100 dtex, more preferably equal to or higher than 5 dtex and equal to or less than 50 dtex. The fineness of the original yarn of a monofilament is preferably equal to or higher than 100 dtex and equal to or less than 1000 dtex, more preferably equal to or higher than 100 dtex and equal to or less than 500 dtex.

[0048] When a multifilament or monofilament twist yarn is used, a plied or single twist yarn may be used. In a case of plied yarn, for example, a plurality of original yarns are arranged in parallel such that the fineness will be equal to or higher than 200 dtex and equal to or less than 2500 dtex, preferably equal to or higher than 300 dtex and equal to or less than 2000 dtex, and these parallelly placed original yarns are twisted. Then, several, for example, from 2 to 10 of the twisted, parallelly placed original yarns are arranged in parallel to achieve an intended fineness, further twisted to

yield a multifilament or monofilament plied yarn. In this case, the number of primary twists is not particularly limited, for example, equal to or more than 0.05 twists/cm and equal to or less than 20.0 twists/cm, preferably equal to or more than 0.1 twists/cm and equal to or less than 10.0 twists/cm. The number of final twists is not particularly limited, for example, equal to or more than 0.05 twists/cm and equal to or less than 20.0 twists/cm, preferably equal to or more than 0.1 twists/cm and equal to or less than 10.0 twists/cm.

[0049] In a case of single twist, a plurality of original yarns are arranged in parallel to achieve intended fineness, and these parallelly placed original yarns are twisted to yield a multifilament or monofilament single twist yarn. In this case, the number of twists is not particularly limited, for example, equal to or more than 0.05 twists/cm and equal to or less than 20.0 twists/cm, preferably equal to or more than 0.1 twists/cm and equal to or less than 10.0 twists/cm.

[0050] When a twist yarn is used, the fineness of the single yarn that constitutes the multifilament original yarn is preferably equal to or higher than 5 dtex and less than 100 dtex, more preferably equal to or higher than 5 dtex and equal to or less than 50 dtex. The fineness of the monofilament original yarn is preferably equal to or higher than 200 dtex and equal to or less than 1500 dtex, more preferably equal to or higher than 300 dtex and equal to or less than 1000 dtex.

[0051] Moreover, the first warp yarns 115, the second warp yarns 117 and the weft yarns 119 may appropriately be processed. Such processing includes stretching process, crimping process, etc.

[0052] The first warp yarns 115 comprise, among those mentioned above, preferably monofilaments, more preferably monofilament twist yarns, and further preferably comprise monofilament plied yarns.

[0053] The second warp yarns 117 comprise, among those mentioned above, preferably multifilament, more preferably multifilament twist yarns, and further preferably comprise multifilament plied yarns. By using multifilament as the second warp yarns 117, the rate at which the resin material impregnates from the second plane 151-side can be decreased during the production of the wet paper transfer belt 1, and a second resin layer 15 having a sufficient thickness can be formed without forming a batt fiber layer. As a result thereof, it becomes possible to omit the batt fiber layer, and the warping of the wet paper transfer belt 1 at its end part is further suppressed.

[0054] Furthermore, it is preferred that the second warp yarns 117 have been crimped. This makes it possible to decrease the rate at which the resin material impregnates from the second plane 151-side during the production of the wet paper transfer belt 1, and the second resin layer 15 having a sufficient thickness can be formed.

[0055] The weft yarns 119 comprise, among those mentioned above, preferably monofilament, more preferably monofilament twist yarns, and further preferably comprises monofilament plied yarns. By this, the warping of the wet paper transfer belt 1 at the end part during its use can more efficiently be suppressed.

[0056] Moreover, as mentioned above, the reinforcing fibrous substrate 111 is a woven fabric having a double weave pattern comprising the first warp yarns 115 and the second warp yarns 117 as warp yarns, and the weft yarns 119 as weft yarns. Hereinbelow, the weave pattern of the reinforcing fibrous substrate 111 is described with reference to FIGs. 2 to 4.

[0057] As shown in FIG. 2, and also as mentioned above, in the double weave pattern of the reinforcing fibrous substrate 111, the first warp yarns 115 are placed on the first plane 131-side (the wet paper web carrying-side), whereas the second warp yarns 117 are placed on the opposite side to the first plane side, i.e., the second plane 151-side (the roll-side). Moreover, the weft yarns 119 are woven into the first warp yarns 115 and the second warp yarns 117 to form a fabric weave pattern of the reinforcing fibrous substrate 111.

[0058] Specifically, in context with the relationship between the first warp yarns 115 and the weft yarns 119, they have repeats in which each weft yarn 119 passes through the first plane 131-side of one first warp yarn 115 (in FIG. 2; 1, 5, 9, 13, 17), and subsequently passes through the second plane 151-side of three first warp yarns 115 (in FIG. 2; 2-4, 6-8, 10-12, 14-16, 18-20). Also, in context with the relationship between the second warp yarns 117 and the weft yarns 119, they have repeats in which each weft yarn 119 passes through the first plane 131-side of seven second warp yarns 117 (in FIG. 2; 4-10, 12-18), and subsequently passes through the second plane 151-side of one second warp yarn 117 (in FIG. 2; 3, 11, 19). Furthermore, the combination weave pattern of the reinforcing fibrous substrate 111 has a repeat unit R, so that it is possible to form this repeating relationship between the first warp yarns 115 and the weft yarns 119 and that between the second warp yarns 117 and the weft yarns 119 at the same time.

[0059] In the description below, a fabric weave pattern that has a repeat unit that is capable of forming at the same time a repeat in which each weft yarn passes through the first plane-side of K first warp yarns, and subsequently passes through the second plane 151-side of L first warp yarns 115, and a repeat in which each weft yarn passes through the first plane-side of M second warp yarns, and subsequently passes through the second plane-side of N second warp yarns is also described as "L/K N/M". Therefore, the fabric weave pattern shown in FIG. 2 can be written as a "3/1 1/7" double weave pattern.

[0060] Furthermore, it is preferred that the aforementioned K, L, M and N satisfy the relation $K/L \geq N/M$. This increases the density of the reinforcing fibrous substrate 111 on the wet paper web carrying (the first plane 131)-side of the woven fabric, resulting in an increase in its rigidity on the wet paper web carrying-side. Therefore, the warping of the reinforcing fibrous substrate 111 at the end part towards the wet paper web carrying-side is suppressed, the warping of the wet

paper transfer belt 1 at the end part during its use, the wet paper web carrying-side is more effectively suppressed. Further preferably K, L, M and N satisfy the relationship K/L > N/M.

[0061] FIG. 3 is a diagram of a weave repeat showing the relationship between the first warp yarns 115 and the weft yarns 119 of the reinforcing fibrous substrate 111. From this diagram of the weave repeat, it is possible to tell which of the first warp yarn 115 and the weft yarn 119 is exposed on the first plane 131-side when the reinforcing fibrous substrate 111 is observed in a planar view from the first plane 131-side. In FIG. 3, in a black part, the first warp yarns 115 are exposed on the first plane 131-side, whereas, in a white part, the weft yarns 119 are exposed on the first plane 131-side. In other words, in the white part, the weft yarns 119 intersects with the first warp yarns 115 and turns back, forming a crossing point (knuckle part). In the present embodiment, the number of crossing points between the weft yarns 119 and the first warp yarns 115 in the weave repeat is 16.

[0062] FIG. 4 is a diagram of a weave repeat showing the relationship between the second warp yarns 117 and the weft yarns 119 of the reinforcing fibrous substrate 111. From this diagram of the weave repeat, it is possible to tell which of the second warp yarns 117 and the weft yarns 119 are exposed on the second plane 151-side when the reinforcing fibrous substrate 111 is observed in a planar view from the second plane 151-side. In FIG. 4, in a black part, the second warp yarns 117 are exposed on the second plane 151-side, whereas, in a white part, the weft yarns 119 are exposed on the second plane 151-side. In other words, in the white part, the weft yarns 119 intersect with the second warp yarns 117 and turns back, forming a crossing point (knuckle part). In the present embodiment, the number of crossing points between the weft yarns 119 and the second warp yarns 117 in the weave repeat is 8.

[0063] Thus, in the present embodiment, the number of crossing points between the weft yarns 119 and the first warp yarns 115 in the weave repeat is greater than the number of crossing points between the weft yarns 119 and the second warp yarns 117 in the weave repeat. This increases the density of the reinforcing fibrous substrate 111 on the wet paper web carrying (the first plane 131)-side of the woven fabric, resulting in an increase in its rigidity on the wet paper web carrying-side. Therefore, the warping of the reinforcing fibrous substrate 111 at the end part towards the wet paper web carrying-side is suppressed, the warping of the wet paper transfer belt 1 at the end part during its use, and the warping towards the wet paper web carrying-side is more effectively suppressed.

[0064] Moreover, the reinforcing fibrous substrate 111 may comprise, in addition to the specific woven fabrics as mentioned above, other woven fabrics and/or other fiber materials such as an unwoven grid-like material in which columns of warp yarns and rows of weft yarns are overlaid to each other. Furthermore, the reinforcing fibrous substrate 111 may comprise a yarn placed spirally along the circumferential direction.

[0065] Moreover, the fineness of a fiber that constitutes the reinforcing fibrous substrate 111 may be different depending on the part in which the fiber is used.

[0066] Materials for the resin 113 contained in the reinforcing fibrous substrate layer 11 are not particularly limited, and a thermosetting resin such as an urethane resin, an epoxy resin and an acrylic resin, or a thermoplastic resin such as a polyamide resin, a polyarylate resin and a polyester resin can be used alone or in combination of two or more types. Preferably, an urethane resin can be used.

[0067] The urethane resin used in the resin 113 is not particularly limited, though it can be, for example, a urethane resin obtained by curing a urethane prepolymer having a terminal isocyanate group obtained by reacting a polyisocyanate compound and a polyol with a curing agent having an active hydrogen group. An anionic, nonionic or cationic, self-emulsifying or forcibly-emulsifying aqueous urethane resin can also be used.

[0068] As mentioned above, urethane resin comprises, for example, an aqueous urethane resin, and/or urethane resin obtained by curing a urethane prepolymer having a terminal isocyanate group obtained by reacting a polyisocyanate compound and a polyol with a curing agent having an active hydrogen group. Note that any urethane resin is formed using a polyisocyanate compound, a polyol and a curing agent as necessary. Therefore, hereinbelow, polyisocyanate compounds, polyols and curing agents that constitutes the urethane resin will be described.

[0069] The polyisocyanate compound includes an aromatic polyisocyanate compound and an aliphatic polyisocyanate compound, which can be used either alone or in combination of two or more types. The aromatic polyisocyanate compound includes, for example, 2,4-tolylene-diisocyanate (2,4-TDI), 2,6-tolylene-diisocyanate (2,6-TDI), 4,4'-methylenebis(phenylisocyanate) (MDI), p-phenylene-diisocyanate (PPDI), dimethylbiphenylene diisocyanate (TODI), naphthalene-1,5-diisocyanate (NDI), 4,4-dibenzyldiisocyanate (DBDI), xylylene diisocyanate (XDI), tetramethylxylylenediisocyanate (TMXDI), polymethylene polyphenyl polyisocyanate (polymeric MDI), etc.

[0070] The aliphatic polyisocyanate compound is not particularly limited, though includes, for example, a chainlike aliphatic polyisocyanate such as 1,6-hexamethylene diisocyanate (HDI) and 1,5-pentamethylene diisocyanate, and an alicyclic polyisocyanate such as 1-isocyanate-3-isocyanatemethyl-3,5,5-trimethylcyclohexane (IPDI), dicyclohexylmethane-4,4'-diisocyanate (H12MDI), 1,3-cyclohexyldiisocyanate, 1,4-cyclohexyldiisocyanate (CHDI) and 1,4-bis-(isocyanatemethyl)cyclohexane (H6XDI), which can be used either alone or in combination of two or more types.

[0071] Among those mentioned above, the polyisocyanate compound preferably comprises one or more types selected from a group consisting of 2,4-tolylene-diisocyanate (2,4-TDI), 2,6-tolylene-diisocyanate (2,6-TDI), 4,4'-methylenebis(phenylisocyanate) (MDI), 1-isocyanate-3-isocyanatemethyl-3,5,5-trimethylcyclohexane (IPDI) and dicyclohexylmeth-

ane-4,4'-diisocyanate (H12MDI). By this, each of the crack resistance, abrasion resistance, wet paper web-transferring ability (balance between the adhesion and detachability of the wet paper web W with the wet paper transfer belt 1) of the wet paper transfer belt 1 can be improved.

[0072] The polyol compound is not particularly limited, and includes a long-chain polyol compound, for example, a polyester polyol such as polycaprolactone polyol and polyethylene adipate, a polyether polyol such as polyethylene glycol, polyoxypropylene glycol, polyhexamethylene ether glycol and polytetramethylene ether glycol (PTMG), a polycarbonate polyol such as polycarbonate diol, polyether carbonate diol, polybutadiene polyol, perfluoropolyether polyol, a silicon polyol such as silicon diol, which can be used either alone or in combination of two or more types.

[0073] The polycarbonate polyol is not particularly limited, though it includes, for example, a polycarbonate polyol synthesized from a polyol as a raw material of the polycarbonate polyol and a polycarbonate source. The polyol as a raw material of the polycarbonate polyol is not particularly limited, though it includes, for example, a straight chain or branched chain alkylene glycol having 2 or more and 20 or less of carbon atoms, a hydrogen-containing cyclic hydrocarbon having 2 or more and 20 or less of carbon atoms, etc., which can be used either alone or in combination of two or more types. The above-described straight chain alkylene glycol includes, for example, ethylene glycol, propanediol, butanediol, pentanediol, hexanediol, heptanediol, octanediol, nonanediol, decanediol, undecanediol, dodecanediol, etc. The above-described branched chain alkylene glycol includes, for example, 2-methyl-1,3-propanediol, 2,2-dimethyl-1,3-propanediol, 3-methyl-1,5-pentanediol, 2-methyl-1,8-octanediol, etc. The above-described hydrogen-containing cyclic hydrocarbon includes, for example, a hydroxyl group-containing alicyclic alkane such as 1,3-cyclohexane diol, 1,4-cyclohexane diol and 1,4-cyclohexane dimethanol.

[0074] Among those mentioned above, the polyol compound preferably comprises one or more types selected from a group consisting of polyether polyol, polycarbonate polyol and polyether carbonate diol, more preferably one or more types selected from a group consisting of polytetramethylene ether glycol (PTMG) and a polycarbonate polyol synthesized from hexanediol and a polycarbonate source. By this, each of the crack resistance, abrasion resistance, wet paper web-transferring ability (balance between the adhesion and detachability of the wet paper web W with the wet paper transfer belt 1) of the wet paper transfer belt 1 can be improved.

[0075] The curing agent having an active hydrogen group is not particularly limited, and one or more type(s) of compound(s) selected from a group consisting of polyol compounds and polyamines can be used.

[0076] As the polyol compound that can be contained in the curing agent, in addition to the aforementioned long-chain polyol compounds, various aliphatic polyol compounds and various alicyclic or aromatic polyol compounds can be used.

[0077] The aliphatic polyol compound is not particularly limited, and include, for example, a alkylene glycol compound such as ethylene glycol, diethylene glycol, triethylene glycol, tetraethylene glycol, 1,2-propanediol, 1,3-propanediol, dipropylene glycol, tripropylene glycol, 1,2-butanediol, 1,3-butanediol, 1,4-butanediol, 2,3-butanediol, 1,5-pentanediol, 1,5-hexanediol, 1,6-hexanediol, 2,5-hexanediol, 1,7-heptanediol, 1,8-octanediol, 1,9-nonanediol, 1,10-decanediol, 1,11-undecanediol, 1,12-dodecanediol, 1,13-tridecanediol, 1,14-tetradecanediol, 1,16-hexadecanediol, 1,18-octadecanediol, 1,20-icosanediol, 2-methyl-1,3-propanediol, neopentylglycol, 2-butyl-2-ethyl-1,3-propanediol, 3-methyl-1,5-pentanediol, 2-ethyl-1,3-hexanediol and 2-methyl-1,8-octanediol, and a glycerin, ditrimethylolpropane, trimethylolpropane (TMP), pentaerythritol, and dihydroxymethyl propionic acid (DHPA), etc.

[0078] The alicyclic polyol compound is not particularly limited, and includes, for example, 1,4-cyclohexane dimethanol, hydrogenated bisphenol A, etc.

[0079] The aromatic polyol compound is not particularly limited, and includes for example, hydroquinone bis-β-hydroxyethylether (HQEE), hydroxyphenylether resorcinol (HER), 1,3-bis(2-hydroxyethoxybenzene), 1,4-bis(2-hydroxyethoxybenzene), bisphenol A, an alkylene oxide adduct of bisphenol A, bisphenol S, an alkylene oxide adduct of bisphenol S, etc.

[0080] The polyamine is not particularly limited, and include hydrazine, ethylenediamine, 4,4'-methylene-bis-(2-chloroaniline) (MOCA), dimethylthiotoluene diamine (DMTDA), diethyltoluene diamine (DETDA), trimethylene glycol di(p-aminobenzoate) (TMAB), 4,4'-methylene-bis-(3-chloro-2,6-diethylaniline) (MCDEA), 4,4'-methylene-bis-(2,6-diethylaniline) (MDEA), triisopropanolamine (TIPA), p-bis(aminocyclohexyl)methane (PACM), naphthalene-1,5-diamine, xylylene diamine, phenylenediamine, toluene-2,4-diamine, t-butyltoluene diamine, 1,2-bis(2-aminophenylthioethane), 2-(2-aminoethylamino)ethanol, etc.

[0081] Among those mentioned above, the curing agent preferably comprises one or more types selected from a group consisting of an aliphatic polyol compound and a polyamine, more preferably one or more types selected from a group consisting of ethylene glycol, butanediol, trimethylolpropane (TMP), dimethylthiotoluene diamine (DMTDA) and diethyltoluene diamine (DETDA). By this, each of the crack resistance, abrasion resistance, wet paper web-transferring ability (balance between the adhesion and detachability of the wet paper web W with the wet paper transfer belt 1) of the wet paper transfer belt 1 can be improved.

[0082] The resin 113 of the reinforcing fibrous substrate layer 11 may be crosslinked with a crosslinking agent. The crosslinking agent includes various crosslinking agents such as that of a carbodiimide-type, a melamine-type, an epoxy-type and an isocyanate-type, which can be used either alone or in combination of two or more types. Furthermore, the crosslinking agent may be a crosslinking agent composition comprising a solvent, a dispersing agent, a surfactant, etc.,

or may be a liquid (for example, a solution, a dispersion, or an emulsion). When the crosslinking agent is in a form of a solution, the crosslinking agent may be an aqueous solution.

[0083] The above-described crosslinking agent may be used being admixed with materials for constituting a urethane resin, for example, a urethane prepolymer and a curing agent, or may be used being admixed with a dispersion of an aqueous urethane resin.

[0084] Moreover, the resin 113 may comprise an inorganic filler such as titanium oxide, kaoline, clay, talc, diatomaceous earth, calcium carbonate, calcium silicate, magnesium silicate, silica and mica, either alone or in combination of two or more types.

[0085] Moreover, the composition and type of the resin 113 in the reinforcing fibrous substrate layer 11 may be different or identical depending on the part in the reinforcing fibrous substrate layer 11.

[0086] The first resin layer 13 is a layer which principally be constituted with a resin provided on one principal plane of the reinforcing fibrous substrate layer 11.

[0087] The first resin layer 13 constitutes a first plane 131 on which a wet paper web W is placed on a principal plane that is opposite to the principal plane joined to the reinforcing fibrous substrate layer 11. That is, the wet paper transfer belt 1 can carry the wet paper web W on the first plane 131 of the first resin layer 13 and transfer the wet paper web W In an embodiment shown in the drawings, the wet paper web W is placed directly on the first plane 131. However, the wet paper web W may also be placed indirectly on the first plane 131. For example, depending on the embodiment used, a different device, for example, a felt, etc., may be placed between the first plane 131 and the wet paper web W, and the wet paper web W may be placed via the different device on the first plane 131.

[0088] A material for a resin that constitutes the first resin layer 13 is not particularly limited, and, for example, aforementioned various resins that can be used as the resin 113 of the reinforcing fibrous substrate layer 11 can be used either alone or in combination of two or more types. The resin that constitutes the first resin layer 13 may be identical to or different from the resin 113 of the reinforcing fibrous substrate layer 11 for their types or compositions.

[0089] Moreover, a resin that constitutes the first resin layer 13 may comprise an inorganic filler such as titanium oxide, kaoline, clay, talc, diatomaceous earth, calcium carbonate, calcium silicate, magnesium silicate, silica and mica, either alone or in combination of two or more types. By including such an inorganic filler in the resin that constitutes the first resin layer 13, the surface state of the first plane 131 such as a state of irregularity, surface roughness and hydrophilicity of the first plane 131 of the first resin layer 13 can be more easily controlled, and functions, which are required for the wet paper transfer belt 1, of transferring a wet paper web W adhered thereto (wet paper web adhesion) and smoothly detaching the wet paper web W while delivering the wet paper web W to a following step (wet paper web detachability) can more certainly be achieved.

[0090] On the other hand, the inorganic filler is, when using the wet paper transfer belt 1, less easy to absorb moisture compared to other parts that constitute the wet paper transfer belt 1, and therefore it tends to become one of the causes for developing the warping of the wet paper transfer belt 1 at its end part. However, in the present embodiment, by providing the wet paper transfer belt 1 with the aforementioned reinforcing fibrous substrate 111, the warping of the wet paper transfer belt 1 at its end part is sufficiently suppressed even when using the inorganic filler.

[0091] Moreover, the first resin layer 13 preferably has a characteristic that water does not permeate it. That is, the first resin layer 13 preferably is water-impermeable.

[0092] The second resin layer (roll-side resin layer) 15 is a layer which principally be constituted with a resin provided on one principal plane of the reinforcing fibrous substrate layer 11.

[0093] The second resin layer 15, on a principal plane that is opposite to the principal plane joined to the reinforcing fibrous substrate layer 11, constitutes a second plane 151 that is to be in contact with a roll mentioned later. The wet paper transfer belt 1 can obtain a motive power from a roll for transferring a wet paper web via the contact of the second plane 151 with the roll when being used. Furthermore, in the second plane 151, an irregularity can be formed by placing the second warp yarns 117 on the second plane 151, which can prevent slipping of the roll on the wet paper transfer belt 1, so-called hydroplaning phenomenon.

[0094] As a resin that constitutes the second resin layer 15, the resin materials that can be used in the first resin layer 13 as mentioned above can be used either alone or in combination of two or more. The resin that constitutes the second resin layer 15 may be identical to or different from the resin that constitutes the first resin layer 13 or the resin 113 that constitutes the reinforcing fibrous substrate layer 11 for their types and compositions.

[0095] Moreover, the second resin layer 15 may comprise one or more inorganic filler(s) in a similar way to the first resin layer 13.

[0096] Note that the composition and type of the resin material and the inorganic filler in the second resin layer 15 may be different or identical between the parts in the second resin layer 15.

[0097] The dimensions of the wet paper transfer belt 1 is not particularly limited, and can appropriately be set according to its application.

[0098] For example, the width of the wet paper transfer belt 1 is not particularly limited, though it can be from 700 mm to 13500 mm, preferably, from 2500 mm to 12500 mm.

[0099] Moreover, for example, the length (circumference) of the wet paper transfer belt 1 is not particularly limited, though it can be from 4 m to 35 m, preferably from 10 m to 30 m.

[0100] The thickness of the wet paper transfer belt 1 is not particularly limited, though for example, can be from 1.5 mm to 7.0 mm, preferably from 2.0 mm to 6.0 mm.

[0101] The thickness of the wet paper transfer belt 1 may be different or identical between parts.

[0102] The wet paper transfer belt 1 as described above can be produced by, for example, a method of producing a wet paper transfer belt according to the present embodiment mentioned later.

[0103] As above, the wet paper transfer belt 1 according to the present embodiment comprises a reinforcing fibrous substrate 111 comprising a woven fabric having double weave pattern, and the fineness of the first warp yarns 115 in the woven fabric is greater than the fineness of the second warp yarns 117. By this, the warping the end part of the wet paper transfer belt 1 during its use, i.e., at the end part in the width direction (CMD) is suppressed. As a result, the automatic guiding apparatus can detect the position of the wet paper transfer belt 1 with a higher accuracy, and can more appropriately control the position of the wet paper transfer belt 1. Such a wet paper transfer belt 1 is capable of being stably used.

<3. Modified Examples>

[0104] Next, some modified examples of the papermaking belts according to the aforementioned embodiments are to be explained. Hereinbelow, differences from the aforementioned embodiments are mainly explained, and the description about similar matters is omitted. Characteristics of the modified examples described below and embodiments mentioned above may each be applied alone, though two or more may be applied in combination as long as it is technically acceptable.

(3.1 First Modified Example)

[0105] FIG. 5 is an enlarged cross-sectional view of a reinforcing fibrous substrate provided in a wet paper transfer belt (papermaking belt) according to a first modified example, and FIG. 6 and FIG. 7 is a diagram of a weave repeat of a woven fabric of the reinforcing fibrous substrate provided in the wet paper transfer belt of FIG. 5.

[0106] The wet paper transfer belt 1A according to the first modified example is different from the aforementioned embodiments only in that it comprises a reinforcing fibrous substrate 111A as described in FIGs. 5 to 7 in place of the reinforcing fibrous substrate 111 in the aforementioned embodiments, but others are basically similar. Hereinbelow, the reinforcing fibrous substrate 111A is to be explained.

[0107] The reinforcing fibrous substrate 111A is a woven fabric having double weave pattern, comprising a first warp yarns 115A, a second warp yarns 117A, and a weft yarns 119A. In a double weave pattern of the reinforcing fibrous substrate 111A, the first warp yarns 115A are placed on a first plane-side (the wet paper web carrying-side, not illustrated), and the second warp yarns 117A are placed on the opposite side to the first plane side, i.e., a second plane-side (the roll-side, not illustrated). Moreover, the first warp yarns 115A and the second warp yarns 117A are placed in parallel. Furthermore, the first warp yarns 115A and the second warp yarns 117A are placed along the machine direction (MD). On the other hand, the weft yarns 119A are placed approximately perpendicular to the first warp yarns 115A and the second warp yarns 117A, i.e., along the cross machine direction (CMD). The weft yarns 119A are woven into the first warp yarns 115A and the second warp yarns 117A.

[0108] Specifically, in context with the relationship between the first warp yarns 115A and the weft yarns 119A, they have repeats in which each weft yarn 119A passes through the first plane-side of one first warp yarn 115A (in FIG. 5; 1, 5, 9, 13, 17), and subsequently passes through the second plane-side of three first warp yarns 115A (in FIG. 5; 2-4, 6-8, 10-12, 14-16). Also, in context with the relationship between the second warp yarns 117A and the weft yarns 119A, they have repeats in which each weft yarn 119A passes through the first plane-side of three second warp yarns 117A (in FIG. 5; 4-6, 8-10, 12-14, 16-18), and subsequently passes through the second plane-side of one first warp yarn 115A (in FIG. 5; 3, 7, 11, 15). Furthermore, the combination weave pattern of the reinforcing fibrous substrate 111A has a repeat unit R', so that it is possible to form this repeating relationship between the first warp yarns 115A and the weft yarns 119A and that between the second warp yarns 117A and the weft yarns 119A at the same time. As described above, the fabric weave pattern of the reinforcing fibrous substrate 111 shown in FIG. 5 can be written as a "3/1 1/3" double weave pattern.

[0109] FIG. 6 is a diagram of a weave repeat showing the relationship between the first warp yarns 115A and the weft yarns 119A of the reinforcing fibrous substrate 111A. From this diagram of the weave repeat, it is possible to tell which of the first warp yarn 115A and the weft yarn 119A is exposed on the first plane-side when the reinforcing fibrous substrate 111A is observed in a planar view from the first plane-side. In FIG. 6, in a black part, the first warp yarn 115A is exposed on the first plane-side, whereas, in a white part, the weft yarn 119A is exposed on the first plane-side. In other words, in the white part, the weft yarn 119A intersects with the first warp yarn 115A and turns back, forming a crossing point

(knuckle part). In this modified example, the number of crossing points between the weft yarn 119A and the first warp yarn 115A in the weave repeat is 4.

[0110] FIG. 7 is a diagram of a weave repeat showing the relationship between the second warp yarns 117A and the weft yarns 119A of the reinforcing fibrous substrate 111A. From this diagram of the weave repeat, it is possible to tell which of the second warp yarn 117A and the weft yarn 119A is exposed on the second plane-side when the reinforcing fibrous substrate 111A is observed in a planar view from the second plane-side. In FIG. 7, in a black part, the second warp yarn 117A is exposed on the second plane-side, whereas, in a white part, the weft yarn 119A is exposed on the second plane-side. In other words, in the white part, the weft yarn 119A intersects the second warp yarn and turns back, forming a crossing point (knuckle part). In this modified example, the number of crossing points between the weft yarn 119A and the second warp yarn 117A in the weave repeat is 4.

[0111] In the wet paper transfer belt 1A as above, too, the fineness of the first warp yarns 115A are greater than the fineness of the second warp yarns 117A. By this, an effect that is similar to those of the aforementioned embodiments is exhibited.

(3.2 Second Modified Example)

[0112] FIG. 8 is a cross-sectional view in a cross machine direction of a wet paper transfer belt (papermaking belt) according to a second modified example. A wet paper transfer belt 1B according to the second modified example is different from the aforementioned embodiments in that it comprises a first resin layer 13B in which batt fibers are impregnated with a resin material and a second resin layer 15B in which batt fibers are impregnated with a resin material in place of the first resin layer 13 and the second resin layer 15 in the aforementioned embodiments.

[0113] The first resin layer 13B is obtained by impregnating a batt fiber layer formed on the reinforcing fibrous substrate layer 11B with a resin material. Therefore, the first resin layer 13B comprises the batt fibers, and the resin as a matrix. As the resin material for the first resin layer 13B, materials that are similar to the resin materials for the first resin layer 13 in the aforementioned embodiments can be used. Moreover, as materials for the batt fibers, the materials that can be used for the reinforcing fibrous substrate 111 in the aforementioned embodiments can be used either alone or in combination of two or more types.

[0114] The second resin layer 15B is obtained by impregnating a batt fiber layer formed on the reinforcing fibrous substrate layer 11B with a resin material. Therefore, the second resin layer 15B comprises the batt fibers, and the resin as a matrix. As the resin material for the second resin layer 15B, materials that are similar to the resin materials for the first resin layer 13 in the aforementioned embodiments can be used. Moreover, as materials for the batt fibers, the materials that can be used for the reinforcing fibrous substrate 111 in the aforementioned embodiments can be used either alone or in combination of two or more types.

[0115] Furthermore, on both sides of the reinforcing fibrous substrate layer 11B, batt fiber layers are placed together with the formation of the first resin layer 13B and second resin layer 15B as mentioned above. Such batt fiber layers are formed by placing batt fibers on both sides of the reinforcing fibrous substrate layer 11B, and needling the batt fibers so that the batt fibers get entangled in the reinforcing fibrous substrate layer 11B. Therefore, although it is not illustrated, the batt fibers are entangled in the reinforcing fibrous substrate 111B of the reinforcing fibrous substrate layer 11B. Moreover, other constituents of the reinforcing fibrous substrate layer 11B are similar to those of the reinforcing fibrous substrate 111 of the aforementioned embodiments.

[0116] As described above, in this modified example, the first resin layer 13B and the second resin layer 15B comprise not only resins but also batt fibers. When the first resin layer 13B and the second resin layer 15B thus comprise batt fibers, the first plane 131B of the first resin layer 13B and the second plane 151B of the second resin layer 15B will have an appropriate irregularity. This makes it easier to control adhesion to and detaching from the wet paper web W in the first plane 131B. Moreover, in the second plane 151B, sufficient friction can be obtained against the roll in contact, and the motive power from the roll can more efficiently be transferred to the wet paper transfer belt 1. Furthermore, in the second plane 151B, an irregularity can be formed by placing the batt fibers on the second plane 151B, which can prevent slipping of the roll on the wet paper transfer belt 1B, so-called hydroplaning phenomenon.

[0117] Furthermore, when a resin material is applied during the formation of the first resin layer 13B and the second resin layer 15B, the speed at which the resin material is impregnated in the batt fibers and the reinforcing fibrous substrate layer 11B is smaller as compared to the case when there is no batt fiber. This can result in a sufficient thickness of the first resin layer 13B and the second resin layer 15B, providing a sufficient durability and strength of the wet paper transfer belt 1.

[0118] On the other hand, as is the case of the first resin layer 13B and the second resin layer 15B, when batt fibers are included within a resin layer, because the batt fibers absorb moisture and swell, the end part of the wet paper transfer belt generally tends to develop warping. However, by providing the wet paper transfer belt 1B with the reinforcing fibrous substrate layer 11B as mentioned above, the development of the warping of the wet paper transfer belt 1B at the end part is suppressed.

(3.3 Other Modified Examples)

[0119] In the aforementioned embodiments, the woven fabric included in the reinforcing fibrous substrate layer 11 had double weave pattern, though the present invention is not limited thereto, it may have a triple or higher combination weave pattern. In this case, any two parallelly running warp yarns or weft yarns of the combination weave pattern of the woven fabric may have the aforementioned relationship of the fineness. Preferably, among the parallelly running warp yarns or weft yarns of the combination weave pattern of the woven fabric, the fineness of the yarns that are the closest to the first plane (the wet paper web carrying-side) is greater than the fineness of the yarns that are the closest to the second plane (roll-side).

[0120] Moreover, in the aforementioned embodiments, the first warp yarns 115 and the second warp yarns 117 of the woven fabric included in the reinforcing fibrous substrate layer 11 had the aforementioned relationship of the fineness, though the present invention is not limited thereto, and when the woven fabric included in the reinforcing fibrous substrate layer is a weft multiple weave pattern, the fineness of weft yarns on the first plane-side (the wet paper web carrying-side) of two parallelly running weft yarns can be greater than the fineness of another weft yarns on the second plane-side (roll-side).

[0121] Furthermore, in the aforementioned second modified example, the first resin layer 13B and the second resin layer 15B comprising batt fibers on both sides of the reinforcing fibrous substrate layer 11B was formed, though the present invention is not limited thereto, and a resin layer comprising batt fibers only on one plane of the reinforcing fibrous substrate layer may be formed.

<4. Methods of Producing Papermaking Belts>

[0122] Next, some examples of preferred embodiments of methods of producing the aforementioned papermaking belts of the present disclosure are to be explained. In the present embodiments, as an example of a papermaking belt, a method of producing the wet paper transfer belt 1 is to be explained as a representative. The wet paper transfer belt 1 may be produced by any method. Hereinbelow, as a method of producing the wet paper transfer belt 1, Rear Surface Coating Turn-over Method and Front Surface Coating Penetration Method are explained as representatives.

[0123] First, with reference to FIGs. 9 and 10, Rear Surface Coating Turn-over Method is to be explained. FIGs. 9 and 10 are schematic diagrams for illustrating a preferred embodiment of a method of producing a papermaking belt according to the present disclosure. First, as shown in FIG. 9, an endless reinforcing fibrous substrate 111 is hung over two parallelly placed rolls 21 such that the substrate is in contact with the rolls. At this time, the reinforcing fibrous substrate 111 is placed such that a first warp yarns 115 of the reinforcing fibrous substrate 111 are in contact with the rolls 21. Next, while rotating the rolls 21, from the side of the reinforcing fibrous substrate 111 on which a second warp yarns 117 are placed, i.e., from the outside of the reinforcing fibrous substrate 111 that are currently being hung over, a resin material for forming a second resin layer 15 is discharged onto the surface of the reinforcing fibrous substrate 111 from a resin discharge opening 25 of a coater, and the resin material is applied using a coater bar 23. Next, the applied resin material is cured by heating to form the second resin layer 15.

[0124] Next, as shown in FIG. 10, the reinforcing fibrous substrate 111 is turned and hung over such that the formed second resin layer 15 is in contact with the rolls 21. Subsequently, a resin material that forms a resin 113 of a reinforcing fibrous substrate layer 11 and a resin that constitutes the first resin layer 13 is discharged from the resin discharge opening 25 of the coater onto the surface of the reinforcing fibrous substrate 111 and the resin material is applied using the coater bar 23. By this, the reinforcing fibrous substrate 111 is impregnated with the resin material to constitute the resin 113, and at the same time, a precursor of the first resin layer 13 is formed on the reinforcing fibrous substrate 111. Then, the resulting laminated body of the resin comprising the reinforcing fibrous substrate 111 is cured by heating to yield the wet paper transfer belt 1 in which the first resin layer 13, the reinforcing fibrous substrate layer 11 and the second resin layer 15 have been laminated in this order. Furthermore, the first plane 131 of the first resin layer 13 and/or the second plane 151 of the second resin layer 15 may be polished, using a polishing apparatus as necessary.

[0125] Next, with reference to FIGs. 11 and 12, Front Surface Coating Penetration Method is to be explained. FIGs. 11 and 12 are schematic diagrams for illustrating a preferred embodiment of a method of producing a papermaking belt according to the present disclosure. First, as shown in FIG. 11, an endless reinforcing fibrous substrate 111 is hung over two parallelly placed rolls 21 such that the substrate is in contact with the rolls. At this time, the reinforcing fibrous substrate 111 is placed such that the second warp yarns 117 of the reinforcing fibrous substrate 111 is in contact with the rolls 21. Next, while rotating the rolls, from the side of the reinforcing fibrous substrate 111 on which the first warp yarns 115 are placed, i.e., from the outside of the reinforcing fibrous substrate 111 that are currently being hung over, a resin material is discharged onto the surface of the reinforcing fibrous substrate 111 from resin discharge opening 25 of a coater, and the resin material is applied using a coater bar 23. The resin material applied at this time can penetrate into the reinforcing fibrous substrate 111. Therefore, in the present embodiment, it is possible to form not only the resin 113 contained in the reinforcing fibrous substrate 111, but also the resin that constitutes the second resin layer 15, and

the reinforcing fibrous substrate layer 11 and the second resin layer 15 can be formed at the same time.

[0126] Next, as shown in FIG. 12, a resin material for a first resin layer 13 is given onto the outer surface of the formed reinforcing fibrous substrate layer 11. Specifically, this is carried out by discharging the resin material from the resin discharge opening 25 and giving the resin material onto the outer surface of the reinforcing fibrous substrate layer 11, while the formed reinforcing fibrous substrate layer 11 and the second resin layer 15 are rotated by the rolls 21. Furthermore, at the same time, the given resin material is uniformly applied using the coater bar 23. Moreover, the resin material that constitutes each layer may be given as a mixture with the aforementioned inorganic filler(s).

[0127] Next, the applied resin material is to be dried and cured. This yields the wet paper transfer belt 1 in which the first resin layer 13, the reinforcing fibrous substrate layer 11 and the second resin layer 15 have been laminated in this order from the outer surface. Furthermore, the first plane 131 of the first resin layer 13 and/or the second plane 151 of the second resin layer 15 may be polished, using a polishing apparatus as necessary.

[0128] As above, the present invention has been explained in detail based on its preferred embodiments, though the present invention is not limited thereto, and each constituent can be substituted with any constituent that is capable of performing a similar function, or alternatively, any constituent can be added.

[0129] Moreover, in the aforementioned description, a wet paper transfer belt has been described as an example of a papermaking belt, though the present invention is not limited to it. For example, a papermaking belt of the present invention may be a shoe press belt, or may be a different papermaking belt.

[Examples]

[0130] Hereinbelow, the present invention will more specifically be described with examples, though the present invention is not to be limited to these examples.

1. Production of Wet Paper Transfer Belt

(Example 1)

[0131] A wet paper transfer belt according to Example 1 was produced by Front Surface Coating Penetration Method as follows:

(i) Preparation of Reinforcing Fibrous Substrate

[0132] First, as a reinforcing fibrous substrate, a woven fabric of a warp backed weave pattern having the following constitution was prepared:

- First Warp Yarns: Monofilament twist yarns of 3810 dtex consisting of polyamide 6.
  (Two polyamide 6 monofilaments of 370 dtex were twisted together, and five sets of this were further twisted together. The primary twist was set at 2.1 twists/cm, and the final twist was set at 1.2 twists/cm.)
- Second Warp Yarn: Multifilament twist yarns of 3333 dtex consisting of polyamide 6.
  (68 polyamide 6 filaments of 22.1 dtex were parallelly arranged and twisted together, and two sets of this were further twisted together. The primary twist was set at 0.7 twists/cm, and the final twist was set at 0.7 twists/cm.)
- Weft Yarns: Monofilament twist yarns of 1582 dtex consisting of polyamide 610.
  (Two polyamide 610 monofilaments of 370 dtex were twisted together, and two sets of this were further twisted together. The primary twist was set at 3.1 twists/cm, and the final twist was set at 2.2 twists/cm.)
- Weave Pattern: Top and bottom warp yarns, 35 warp yarns/5 cm; Weft yarns, 40 yarns/5 cm; a warp backed weave pattern (3/1 117, corresponding to the weave pattern in FIGs. 2 to 4)

(ii) Formation of Laminated Body

[0133] First, the prepared endless reinforcing fibrous substrate was hung over two parallelly placed rolls. At this time, the reinforcing fibrous substrate was hung over the rolls such that second warp yarns of the reinforcing fibrous substrate were in contact with the rolls. While rotating the rolls, a urethane composition was given onto a surface on which the first warp yarns of the reinforcing fibrous substrate were exposed. As the urethane composition, a mixture of a urethane prepolymer obtained by reacting a mixture of 2,4-tolylene-diisocyanate (2,4-TDI) and 2,6-tolylene-diisocyanate (2,6-TDI) with polytetramethylene ether glycol (PTMG) and dimethylthiotoluene diamine (DMTDA) as a curing agent were used.

[0134] When this urethane composition was given, the urethane composition was impregnated in the reinforcing fibrous substrate, and at the same time, it penetrated into the reinforcing fibrous substrate, forming the reinforcing fibrous substrate layer and the roll-side second resin layer at the same time. Next, a urethane composition of a first resin layer

on each wet paper web carrying-side was given onto the outer surface of the formed reinforcing fibrous substrate layer to laminate the first resin layer. From this the outermost layer in order, a laminated body which would become the first resin layer, the reinforcing fibrous substrate layer and the second resin layer was heated and dried, yielding a semifinished product of a wet paper transfer belt.

(iii) Polishing and Buffing

[0135] A polishing paper cloth from #80 to #600 was set on a polishing apparatus as appropriate, and a wet paper web carrying-side surface of the wet paper transfer belt (semifinished product) was polished. Moreover, buffing was performed as appropriate in order to adjust the surface roughness of a wet paper-contact surface, an arithmetic average roughness of a wet paper carrying surface of the wet paper transfer belt of each example was set at from 0.3 to 20 μm. As above, the wet paper transfer belt according to Example 1 was completed.

[0136] The product dimension of the wet paper transfer belt was set at 20 m in length and 700 mm in width.

(Example 2)

[0137] A wet paper transfer belt according to Example 2 was produced in a similar manner to Example 1 except that the reinforcing fibrous substrate was changed as follows:
In the reinforcing fibrous substrate used in Example 2, first warp yarns, second warp yarns and weft yarns similar to those in the reinforcing fibrous substrate used in Example 1 were used. On the other hand, it had a warp backed weave pattern (3/1 1/3, corresponding to the weave pattern in FIGs. 5 to 7) as its fabric weave pattern.

(Example 3)

[0138] A wet paper transfer belt according to Example 3 was produced in a similar manner to Example 1 except that the reinforcing fibrous substrate was changed as follows:
In the reinforcing fibrous substrate used in Example 3, first warp yarns, second warp yarns and a fabric weave pattern similar to those in the reinforcing fibrous substrate used in Example 1 were used. On the other hand, weft yarns used were as follows:

- Weft Yarns: Monofilament single yarns of 1059 dtex consisting of polyamide 610.

(Example 4)

[0139] A wet paper transfer belt according to Example 4 was produced in a similar manner to Example 2, except that batt fibers were needled into both sides of the reinforcing fibrous substrate to form batt fiber layers.

[0140] In Example 4, short fibers of 22 dtex, cut length = 76 mm, consisting of polyamide 66 were used as batt fibers. Batt fiber layers were formed such that the basis weight would be 100 g/m^2 on a side on which the first resin layer is to be formed (the wet paper web carrying-side), and 100 g/m^2 on a side on which the second resin layer is to be formed (roll-side).

(Comparative Example 1)

[0141] A wet paper transfer belt according to Comparative Example 1 was produced in a similar manner to Example 4 except that the reinforcing fibrous substrate was changed as follows:

- First and Second Warp Yarns: Monofilament twist yarns of 2271 dtex consisting of polyamide 6.
  (Two polyamide 6 monofilaments of 370 dtex were twisted together, and three sets of this were further twisted together. The primary twist was set at 2.7 twists/cm, and the final twist was set at 2.1 twists/cm.)
- Weft Yarns: Monofilament twist yarns of 1582 dtex consisting of polyamide 610.
  (Two polyamide 610 monofilaments of 370 dtex were twisted together, and two sets of this were further twisted together. The primary twist was set at 3.1 twists/cm, and the final twist was set at 2.2 twists/cm.)
- Weave Pattern: Top and bottom warp yarns, 35 warp yarns/5 cm; Weft yarns, 40 yarns/5 cm; a warp backed weave pattern (3/1 1/3, corresponding to the weave pattern in FIGs. 5 to 7).

2. Evaluation

[0142] The produced wet paper transfer belts of Examples 1 to 4 and Comparative Example 1 were evaluated for the

status of development of warping at the end part according to the following procedures.

[0143] First, from each of the wet paper transfer belts of Examples 1 to 4 and Comparative Example 1, a test piece S of 3.2 m in length and 22 cm in width was cut out. Next, in the room at the room temperature of 20 ± 2 °C and humidity of 50 ± 10 %, each test piece S of Examples 1 to 4 and Comparative Example 1 were immersed in water for 24 hours.

[0144] Next, the longitudinal end parts of each test piece S of Examples 1 to 4 and Comparative Example 1 were sutured to form an anulus. Then, as shown in FIG. 13, each test piece S was hung over two parallelly placed rolls 30. Next, the rolls 30 were rotated, and the test piece S was run for two rounds at a speed of 4 m cloth/min, while spraying water 41 onto the surface of test piece by a spraying apparatus 40.

[0145] After spraying, a tensile force acting on the test piece S was adjusted to 5 kN/m, and thereafter the rolls 30 were stopped. Then, as shown in FIG. 14, the second resin layer-side of the test piece S was brought into contact with a carpenter's square 50, and the carpenter's square 50 was adjusted to be made horizontal, and the distance between the carpenter's square 50 and a part of the test piece S that is at the farthest from the carpenter's square 50 was measured as selvage curl distance d_1 and d_2. Note that, the end part of the test piece S might warp towards the roll-side, i.e., the carpenter's square 50-side. In this case, the distance between the highest part of the test piece S near the center in the width direction and the carpenter's square 50 was measured as the selvage curl distance. The selvage curl distance was measured for four parts, their average was taken as the selvage curl distance of the test piece S.

[0146] The results of the evaluation above are shown in Table 1 with the constitution of each of the reinforcing fibrous substrates of Examples 1 to 4 and Comparative Example 1.

Table 1

			Example 1	Example 2	Example 3	Example 4	Comparative Example 1
Reinforcing Fibrous Substrate	1st Warp Yarns	Type	Monofilament twist yarns	Monofilament twist yarns	Monofilament twist yarns	Monofilament twist yarns	Monofilament twist yarns
		Fineness (dtex)	3810	3810	3810	3810	2271
	2nd Warp Yarns	Type	Multifilament twist yarns	Multifilament twist yarns	Multifilament twist yarns	Multifilament twist yarns	Multifilament twist yarns
		Fineness (dtex)	3333	3333	3333	3333	2271
	Weft Yarns	Type	Monofilament twist yarns	Monofilament twist yarns	Monofilament single yarns	Monofilament twist yarns	Monofilament twist yarns
		Fineness (dtex)	1582	1582	1059	1582	1582
	Fabric Weave Pattern		3/1 1/7	3/1 1/3	3/1 1/7	3/1 1/3	3/1 1/3
	Number of Crossing Points of 1st Warp Yarn and Weft Yarn		16	4	16	4	4
	Number of Crossing Points of 2nd Warp Yarn and Weft Yarn		8	4	8	4	4
Batt Fiber Layer	Wet paper web Carrying (1st Resin)-Side		Non	Non	Non	Present	Present
	Roll (2nd Resin)-Side		Non	Non	Non	Present	Present
Evaluation	Selvage Curl Distance (mm)		3.6	6.1	10.0	12.5	18.5

[0147] As shown in Table 1, the wet paper transfer belts according to Examples 1 to 4 had smaller selvage curl distance as compared to the wet paper transfer belt according to Comparative Example 1, meaning that the warping at the end part was suppressed. In the evaluation mentioned above, a test piece S of 22 cm in width was used, though a wet paper transfer belt to be hung into the actual papermaking machine would have a width of several meters, and the warping at its end part would become greater almost in proportion thereto.

[0148] Comparing Examples 1 and 2 to Example 3, the wet paper transfer belts according to Examples 1 and 2 in which the monofilament twist yarns were used as the weft yarns had a smaller selvage curl distance as compared to Example 3 in which the monofilament single yarns were used.

[0149] Comparing Example 1 to Example 2, the wet paper transfer belt according to Example 1 in which the reinforcing fibrous substrate having a 3/1 1/7 fabric weave pattern was used had a smaller selvage curl distance as compared to Example 2 in which the reinforcing fibrous substrate having a 3/1 1/3 fabric weave pattern was used.

[Reference signs list]

[0150]

1, 1A, 1B	wet paper transfer belt (papermaking belt)
11, 11B	reinforcing fibrous substrate layer
111, 111A, 111B	reinforcing fibrous substrate
113	resin
115, 115A	first warp yarn
117, 117A	second warp yarn
119, 119A	weft yarn
13, 13B	first resin layer
131, 131B	first plane (wet paper web-contact surface)
15, 15B	second resin layer
151, 151B	second plane (roll contact surface)

Claims

1. A papermaking belt that is used in a papermaking machine and that comprises a first plane on which a wet paper web is placed and a second plane on the opposite side to the first plane, wherein:

   the papermaking belt comprises a reinforcing fibrous substrate layer comprising at least one layer of a woven fabric;
   at least one layer of said woven fabric comprises a double or more combination weave pattern;
   said combination weave pattern comprises first yarns and second yarns that are placed in parallel;
   said first yarns are placed closer to the first plane-side than said second yarns, and said second yarns are placed closer to the second plane-side than said first yarns; and
   the fineness of said first yarns are greater than the fineness of said second yarns.

2. The papermaking belt according to Claim 1, wherein said second yarns are crimped yarns.

3. The papermaking belt according to Claim 1 or 2, wherein said second yarns are multifilament twist yarns.

4. The papermaking belt according to any one of Claims 1-3, wherein said first yarns and said second yarns are placed in the machine direction of the papermaking belt.

5. The papermaking belt according to any one of Claims 1-4, comprising no batt fiber layer.

6. The papermaking belt according to any one of Claims 1-5, wherein:

   said woven fabric comprising said combination weave pattern further comprises third yarns that are woven into said first yarns and said second yarns; and
   said third yarns are monofilament twist yarns.

7. The papermaking belt according to any one of Claims 1-6, wherein:

said woven fabric comprising said combination weave pattern further comprises third yarns that are woven into said first yarns and said second yarns; and
said combination weave pattern is a weave pattern that comprises a repeat unit that is capable of concurrent formation of a repeat in which each said third yarn passes through K said first yarns on the side of said first plane while it passes through L said first yarns on the side of said second plane and a repeat in which each said third yarn passes through *M* said second yarns on the side of said first plane while it passes through *N* said second yarns on the side of said second plane;
wherein the relation $K/L \geq N/M$ is satisfied.

8. The papermaking belt according to any one of Claims 1-7, wherein:

said woven fabric comprising said combination weave pattern further comprises third yarns that are woven into said first yarns and said second yarns; and
the number of crossing points of said first yarns and said third yarns in a weave repeat is greater than the number of crossing points of said second yarns and said third yarns in the weave repeat.

9. The papermaking belt according to any one of Claims 1-8, wherein the papermaking belt is a wet paper transfer belt.

10. The papermaking belt according to any one of Claims 1-8, wherein the papermaking belt is a shoe press belt.

FIG. 1

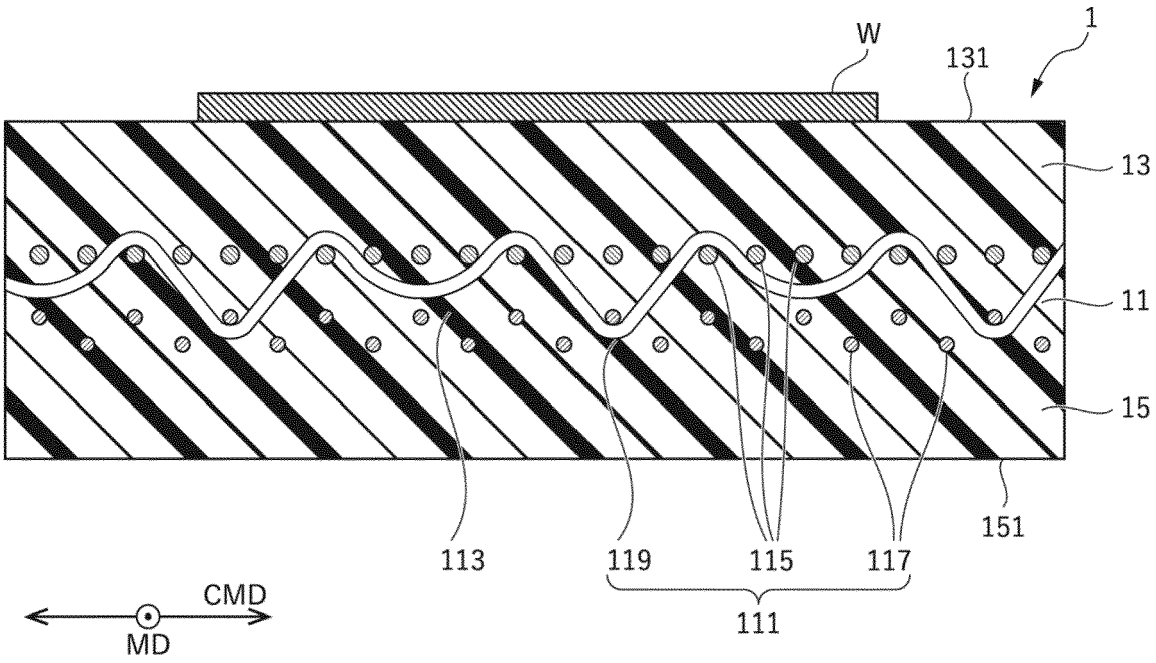

W
131
1
13
11
15
151
113
119
115
117
111
CMD
MD

FIG. 2

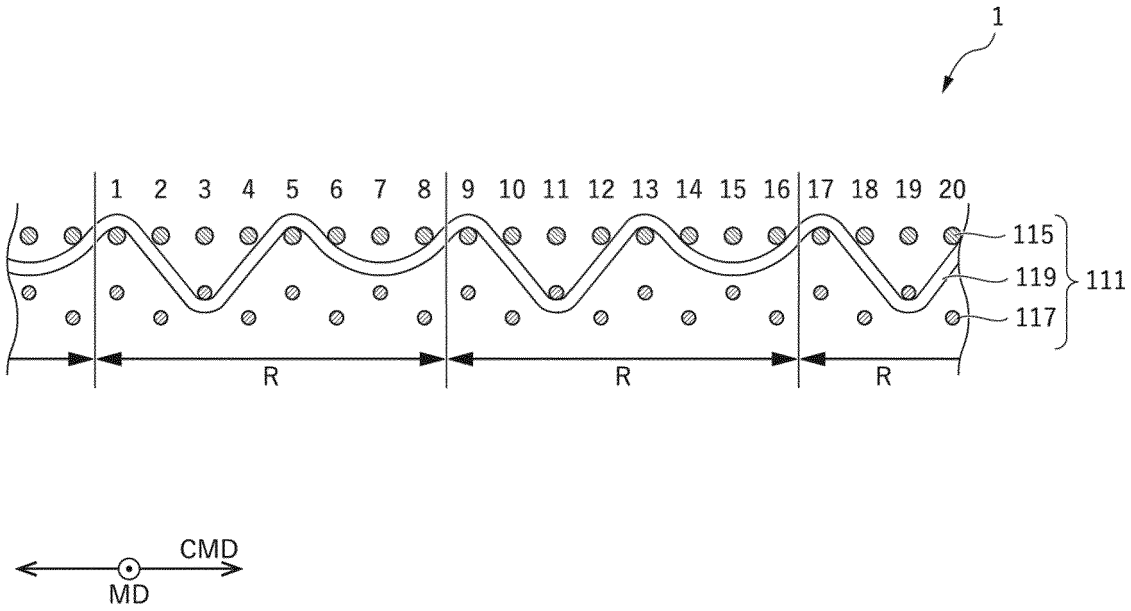

1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
115
119
117
111
R
R
R
CMD
MD

FIG. 3

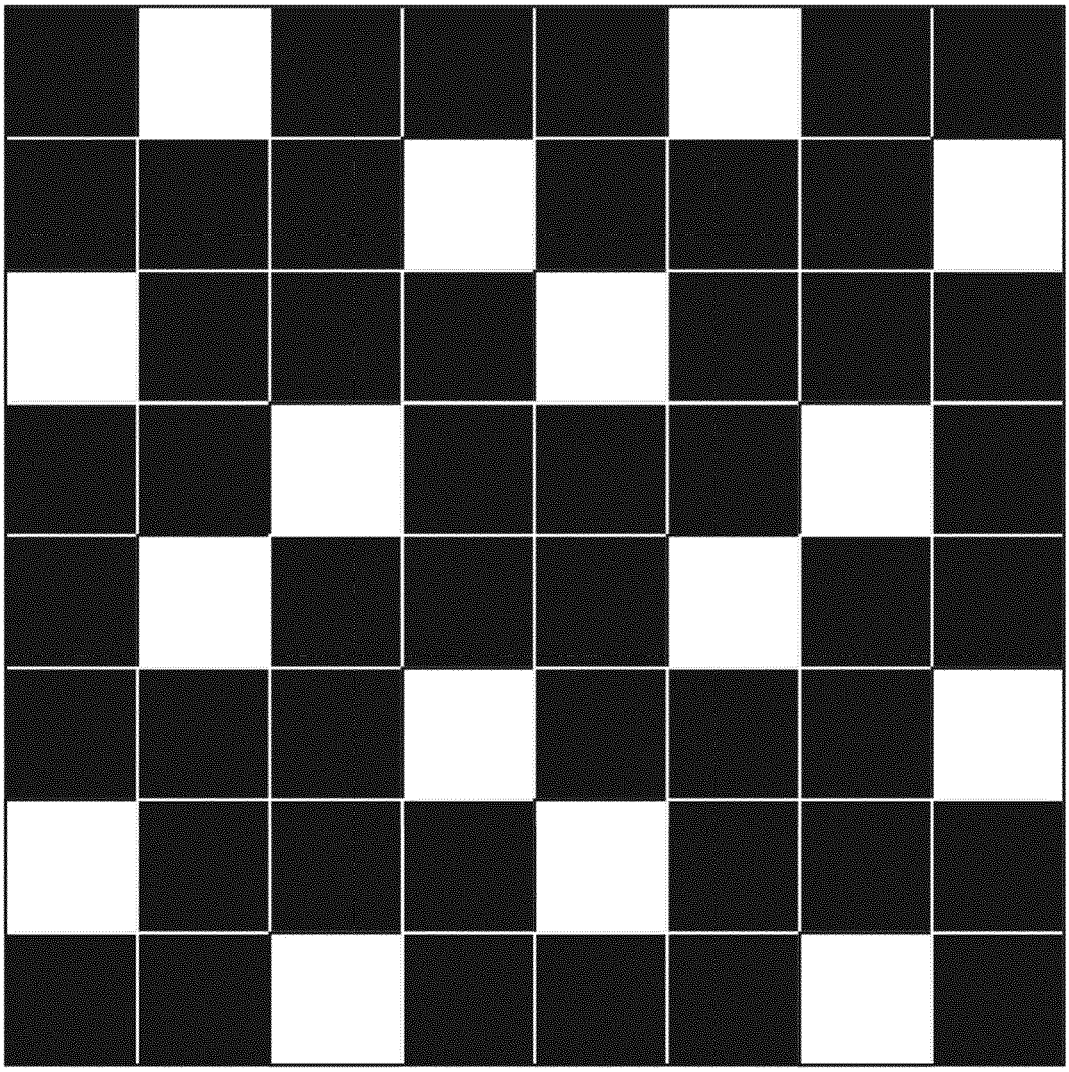


FIG. 4

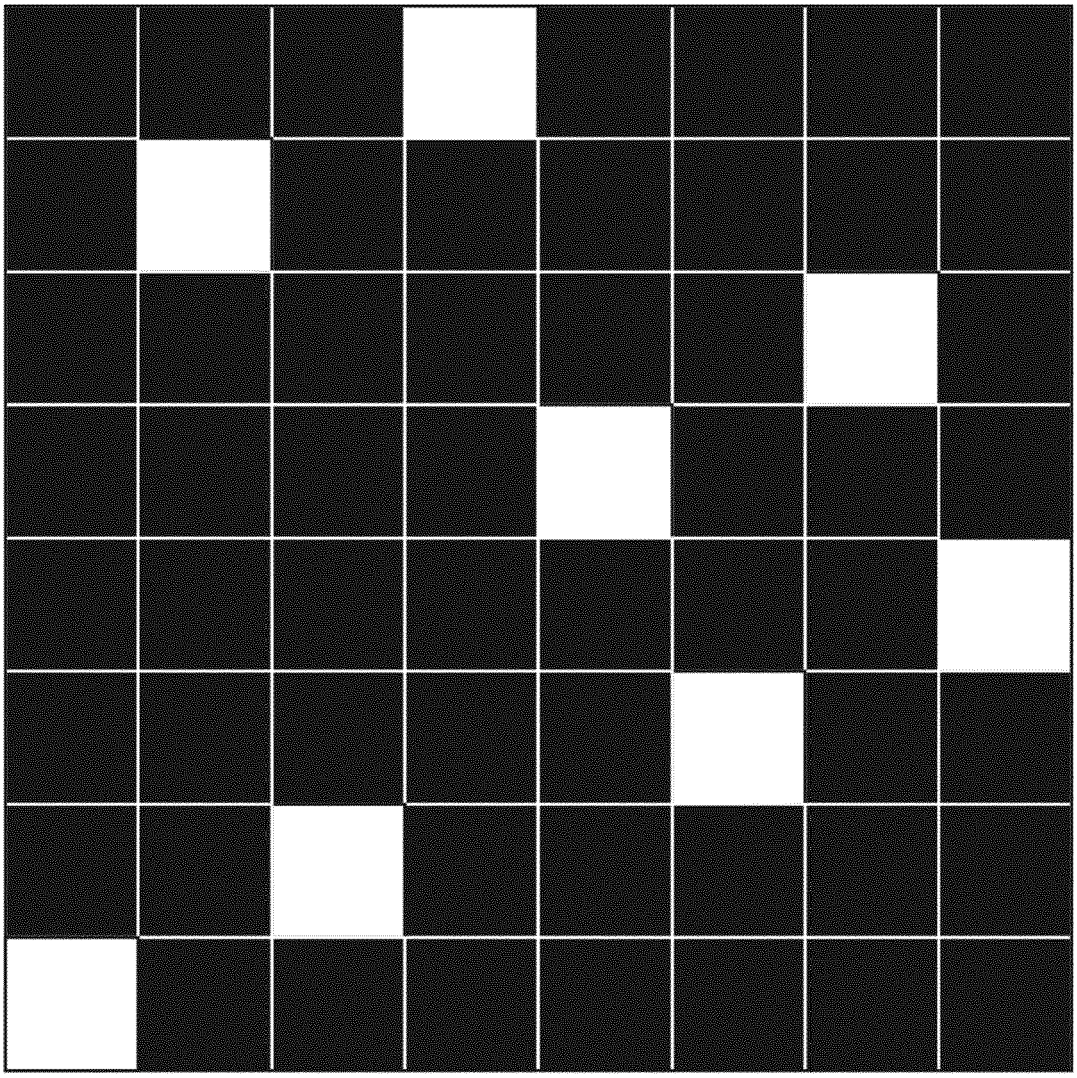


FIG. 5

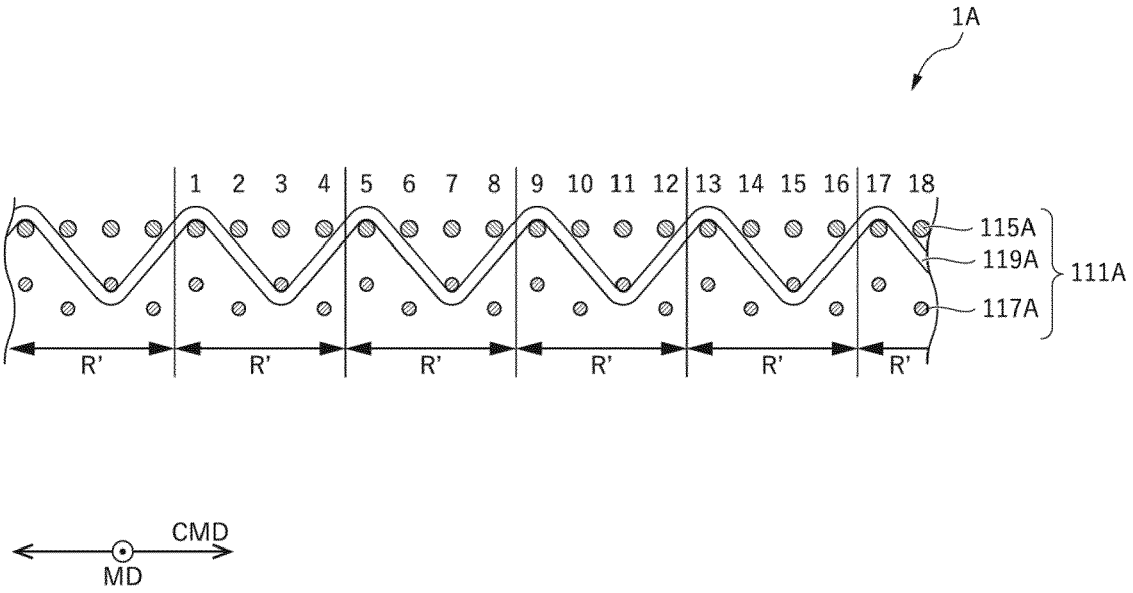

1A
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
115A
119A
111A
117A
R' R' R' R' R' R'
CMD
MD

FIG. 6

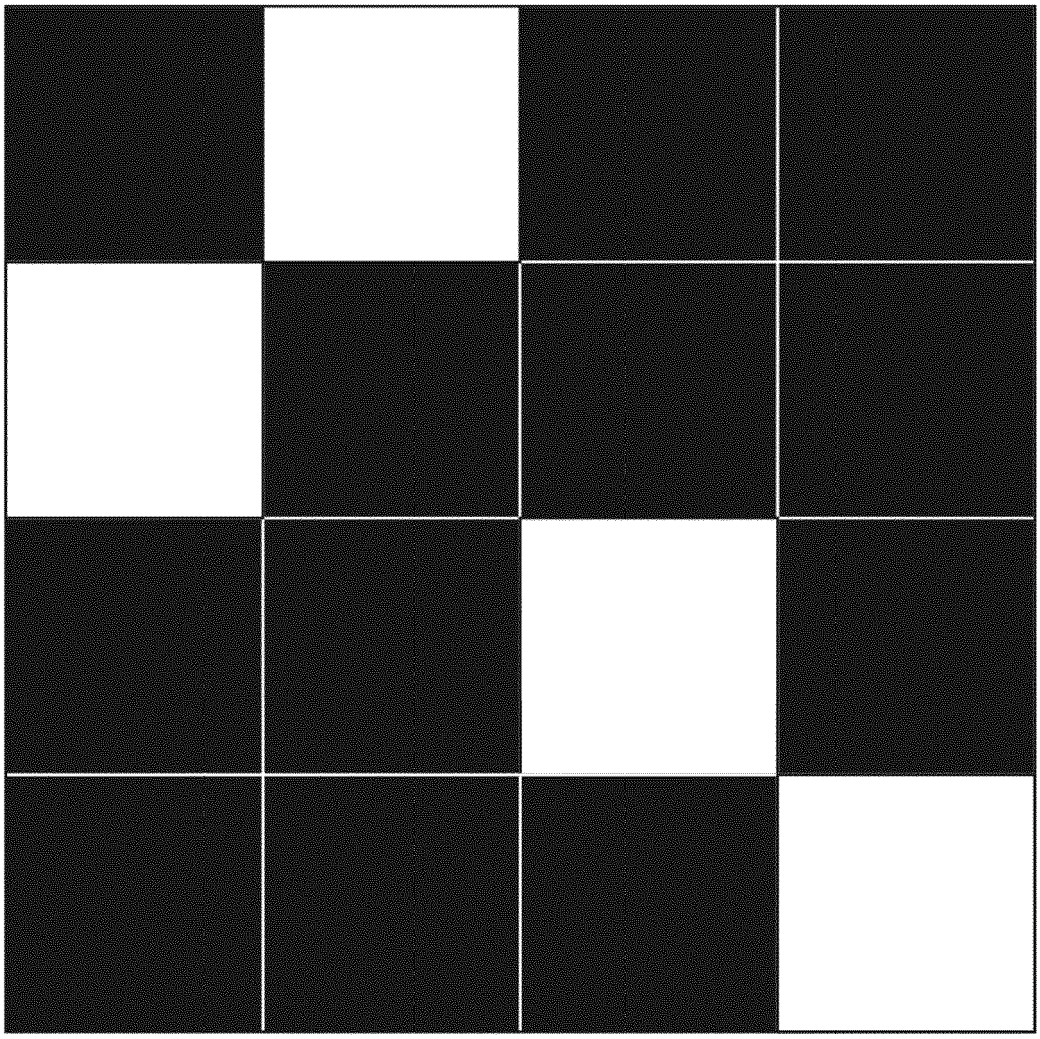


FIG. 7

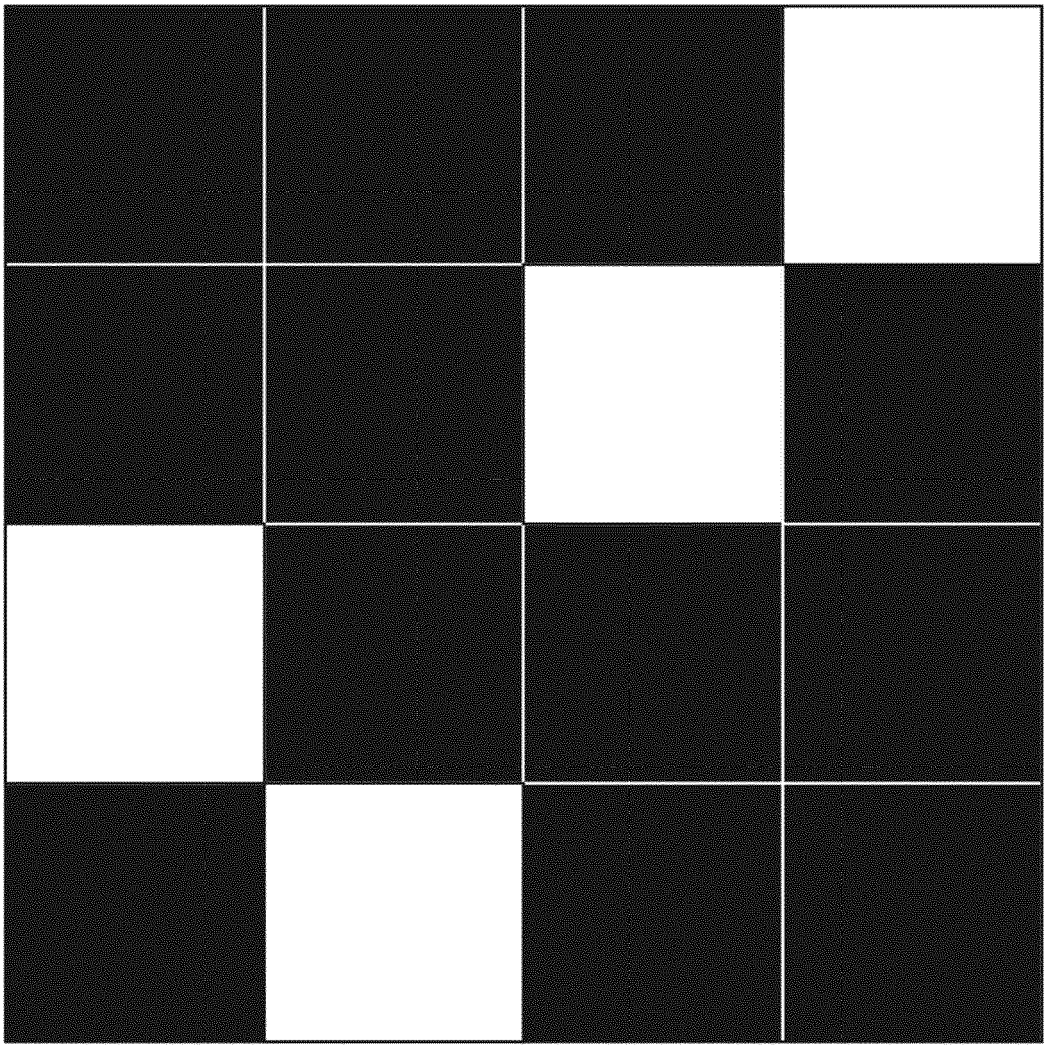


FIG. 8

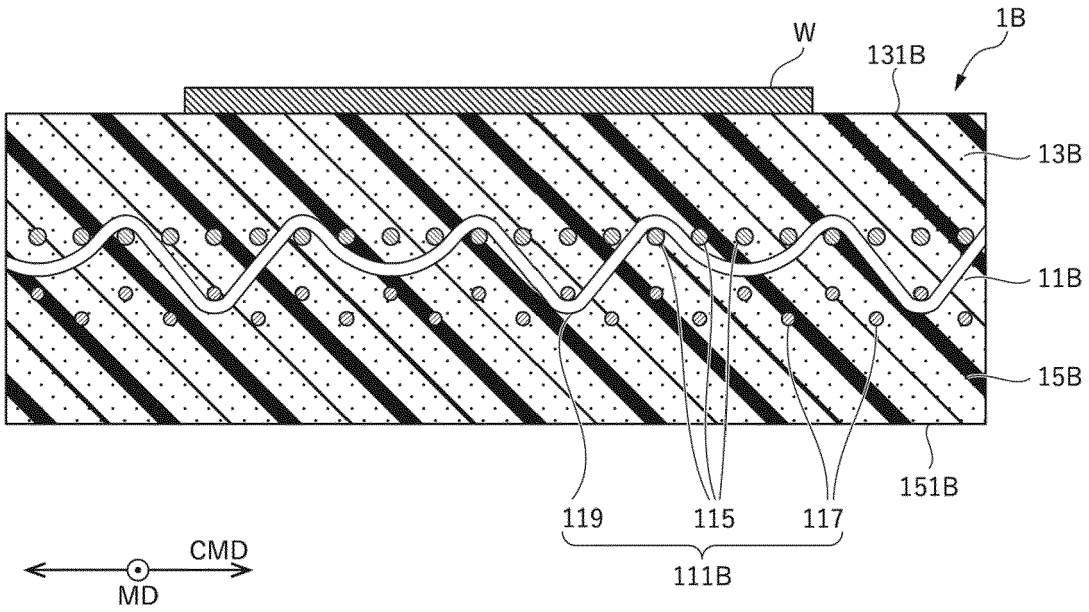

W
131B
1B
13B
11B
15B
151B
119
115
117
111B
CMD
MD

FIG. 9

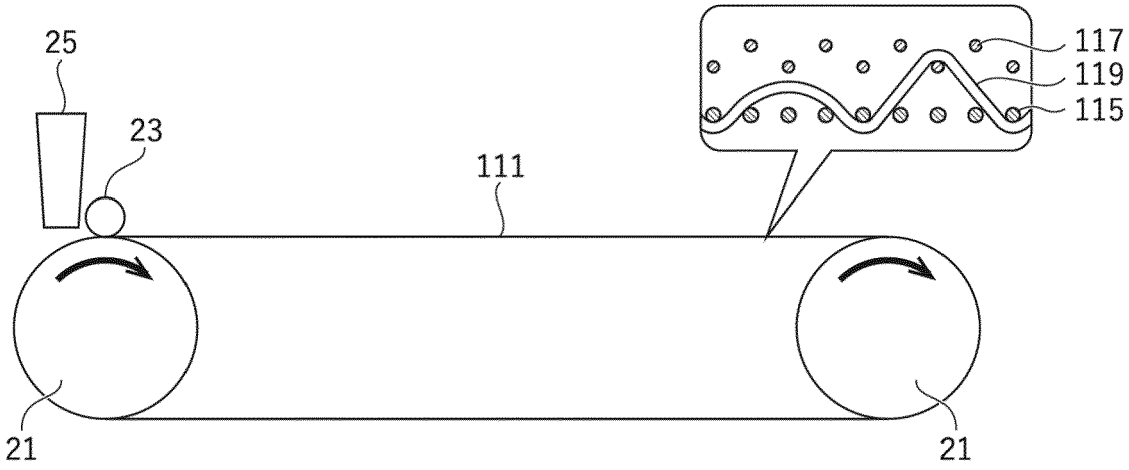

25
23
111
117
119
115
21
21

FIG. 10

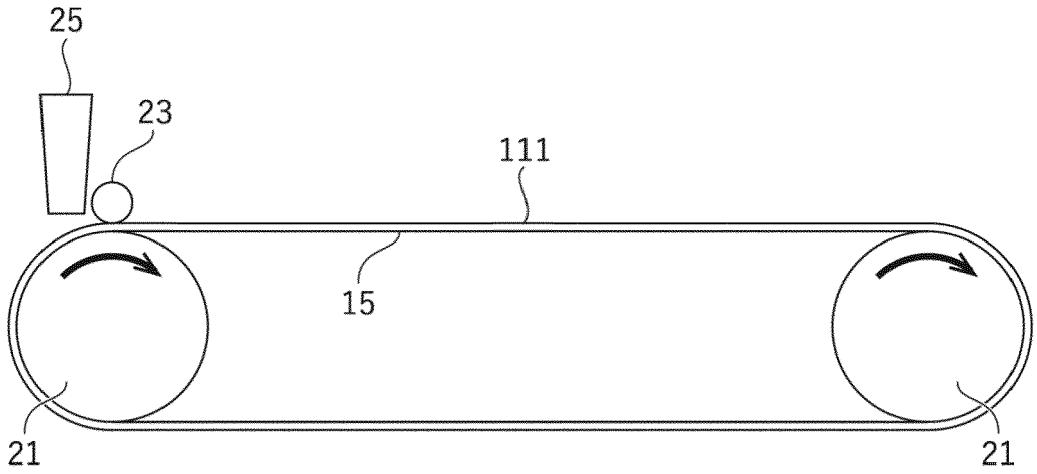


FIG. 11

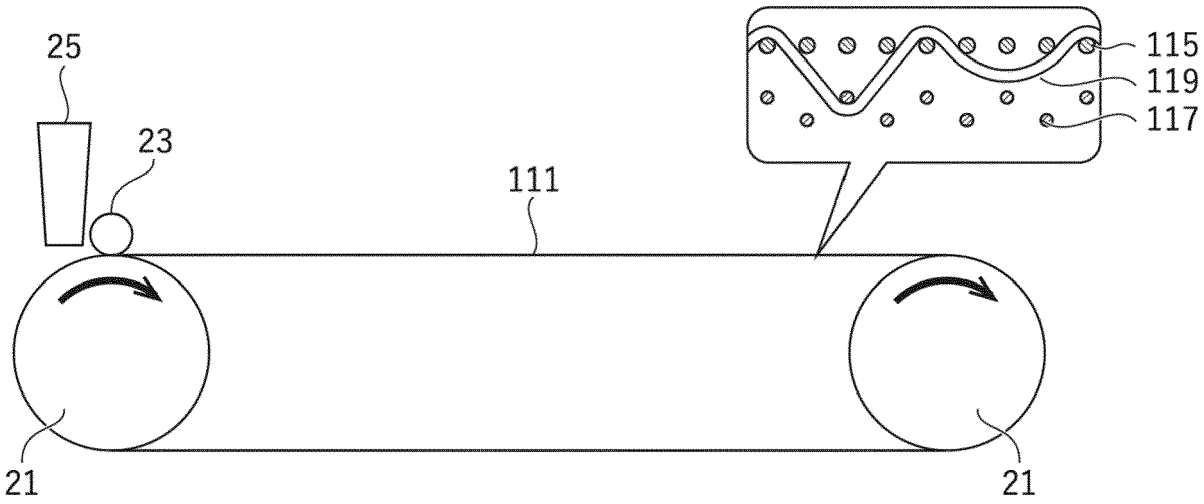


FIG. 12

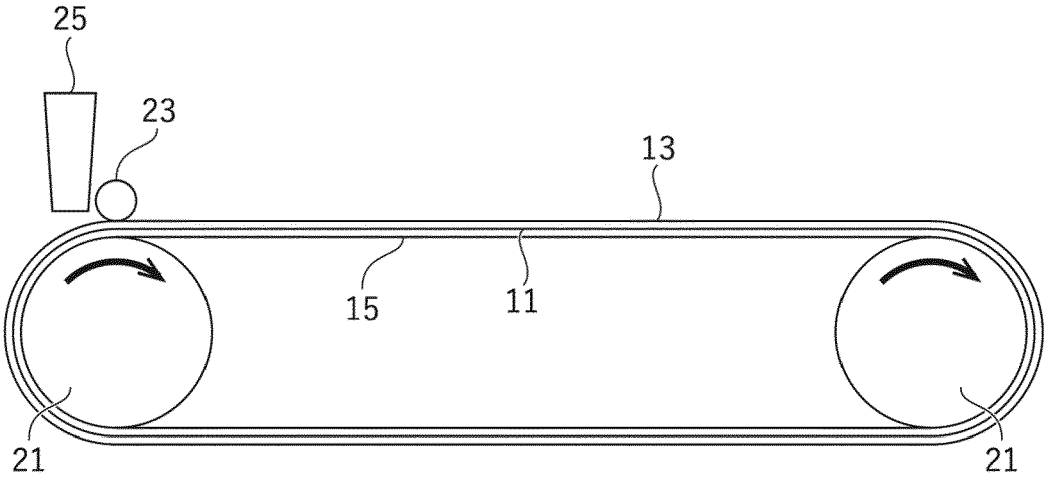


FIG. 13

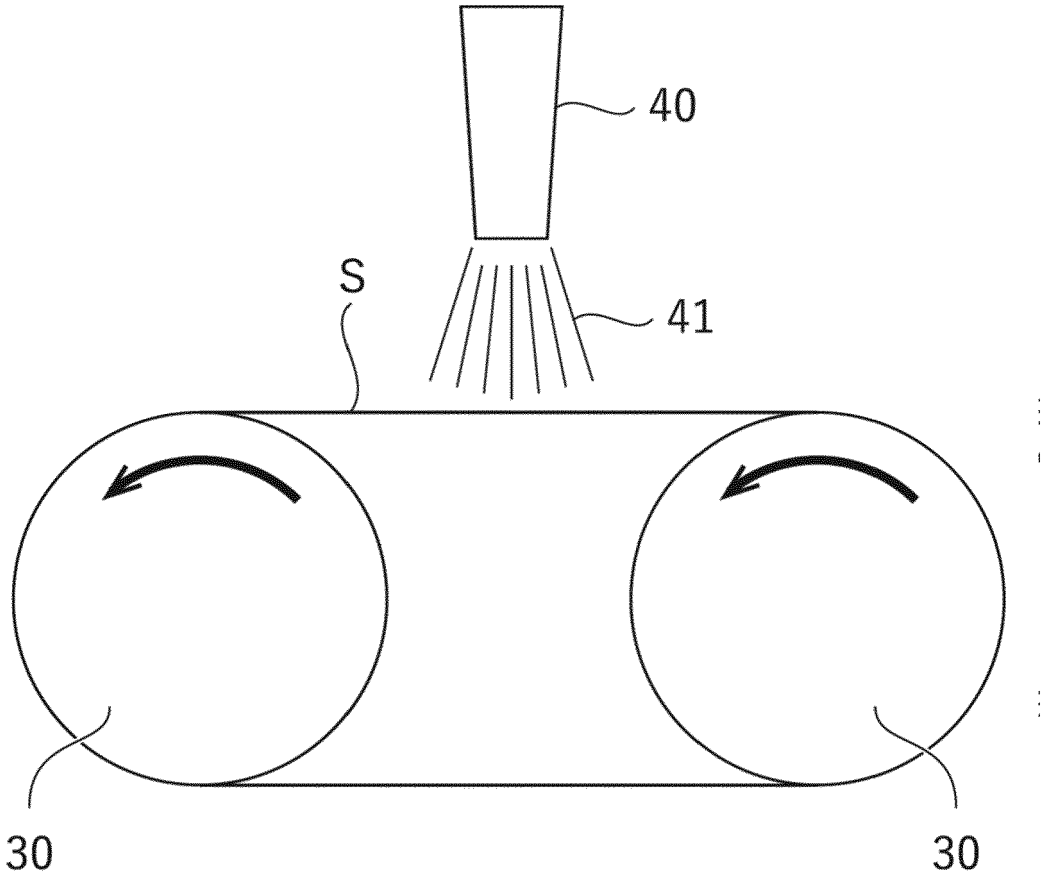


FIG. 14

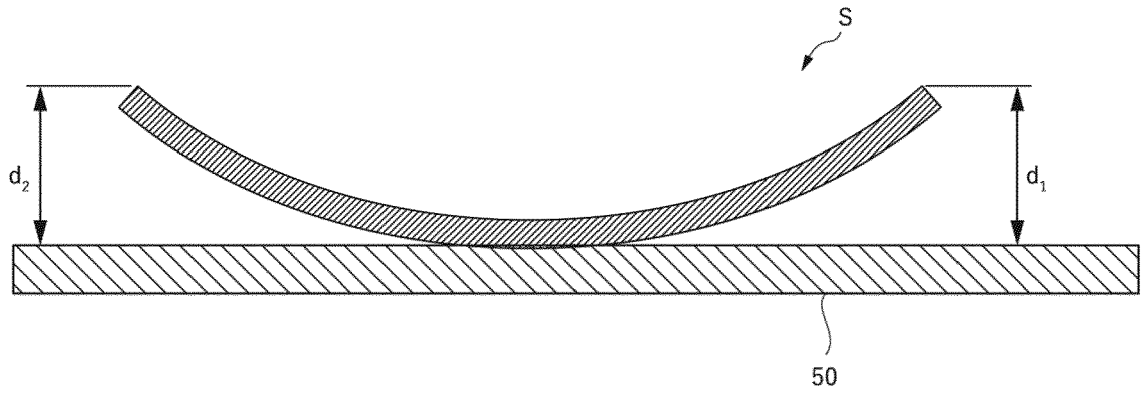


FIG. 15

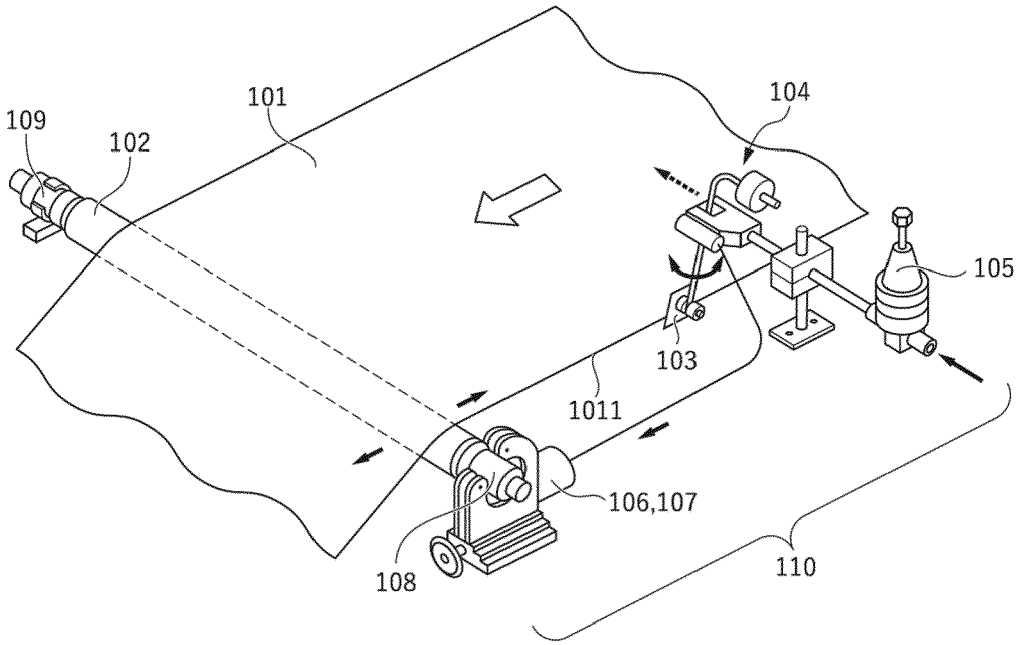
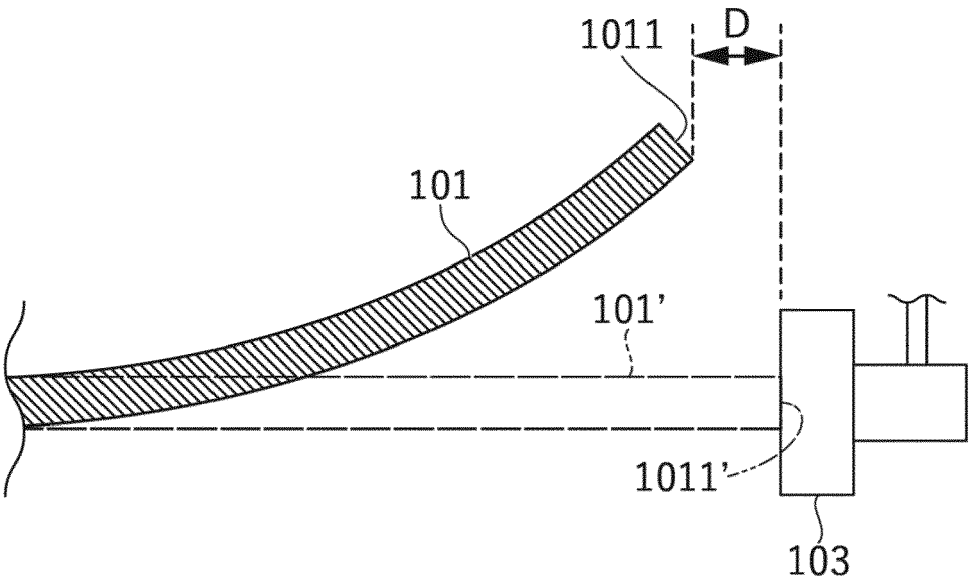


FIG. 16



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2022138602 A **[0001]**
- WO 03071030 A1 **[0006] [0008]**