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(54) **PAPERMAKING FELT BASE MEMBER AND PAPERMAKING FELT**

(57) [Technical Problem]

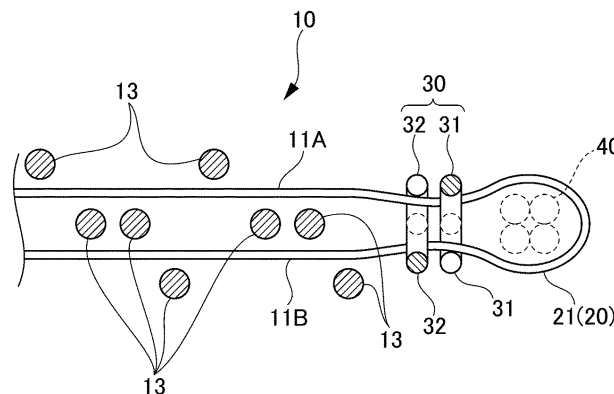
Provided are a base member for a seamed papermaking felt and a papermaking felt, which do not impair the work efficiency of joining seam loops and which suppress the occurrence of seam marks in a seam part.

[Solution to Problem]

The papermaking felt base member comprises: an ended woven fabric comprising machine direction yarns reciprocating in a machine direction, and cross machine direction yarns arranged along a cross machine direction and interwoven with the machine direction yarns; a plurality of pintle wire insertion loops formed by folding back

the machine direction yarns at both ends of the woven fabric in the machine direction, through which a pintle wire is able to be inserted; and a plurality of filling yarns arranged along the cross machine direction at least one end of the woven fabric between the cross machine direction yarns disposed at the outermost end of the woven fabric and the pintle wire insertion loops, wherein, among the plurality of filling yarns, the fineness of a first filling yarn that is disposed closest to the pintle wire insertion loops is smaller than the fineness of a second filling yarn that is disposed on the cross machine direction yarn side of the first filling yarn.

**FIG. 2**



## Description

### CROSS REFERENCE TO RELATED APPLICATIONS

**[0001]** This application is based upon and claims benefit of priority from Japanese Patent Applications No. 2023-189834, filed on November 7, 2023 and No. 2024-165655, filed on September 24, 2024, the entire contents of which are incorporated herein by reference.

### BACKGROUND

[Technical Field]

**[0002]** The present invention relates to a papermaking felt base member and a papermaking felt.

[Background Art]

**[0003]** In a press part of the papermaking process, water is squeezed out of wet paper web mainly by means of a papermaking felt and a pair of press rolls. Since the press part is generally a continuous device, this papermaking felt also needs to operate continuously, and therefore the papermaking felt is used as an annular, endless felt within the press part.

**[0004]** Papermaking felts that are generally used are an annular, endless papermaking felt and an ended papermaking felt. Since the endless papermaking felt is annular, there is no joint part in the felt, and thus the shape of the joint part will not be transferred to the wet paper web. On the other hand, when the endless papermaking felt is installed onto a papermaking machine, the rolls and roll support members, etc. are removed using a crane or the like before the installation. Therefore, in the case of a large papermaking machine, the machine needs to be stopped for long time to perform the installing operation.

**[0005]** In contrast, a papermaking felt with ends is generally a seamed papermaking felt with seam loops at both ends for joining, facilitating its installation onto a papermaking machine. After the papermaking machine is stopped, the seamed papermaking felt is connected to a used papermaking felt or a rope or sling belt passed through the papermaking machine via a seamed-felt guide belt attached in advance to the newly installed seamed papermaking felt, without removing the rolls or the roll support members, and is pulled into the papermaking machine.

**[0006]** Then, both ends of the installed papermaking felt are butted together, and a pintle wire is inserted into the space created by alternating interlocking of the seam loops to form an endless papermaking felt, completing the installing operation onto the machine.

**[0007]** In this type of a seamed papermaking felt, the work efficiency of inserting a pintle wire into the space created by alternating interlocking of the seam loops, i.e., the work efficiency of joining the seam loops, is greatly affected by the form of the seam loops. Moreover, the part

where the seam loops joined (seam part) comes into contact with the wet paper web during water-squeezing, and imparts irregularities, known as seam marks, to the wet paper web. The shape of this seam mark is also greatly influenced by the form of the seam loops. Furthermore, the short fibers layered on the felt tend to fall off easily near the seam loops.

**[0008]** Various techniques have been proposed that add improvements in the seam loop and its vicinity in order to improve the work efficiency of joining operations by optimizing the form of the seam loops, also to reduce seam marks in the seam part, and further to prevent falling-off of short fibers from the seam part.

**[0009]** JP 2008-297637 A proposes a seamed felt in which a twisted yarn made of two yarn materials being twisted together is arranged as a weft yarn in the vicinity of the seam loop, for the purpose of avoiding occurrence of flaws such as seam marks by preventing the part where the weft yarn in the vicinity of the seam loop is woven from generating irregularities which causes uneven pressure at the time of pressing, and further for the purpose of suppressing twisting of the loops and at the same time preventing the flaps from falling off.

**[0010]** JP 2003-247191 A proposes a seamed felt in which adjustment yarns are woven into the end edges of the CD yarn material in a weaving pattern different from that of the CD yarn material in the base member, and are arranged independently in each layer of the MD yarn material, for the purpose of preventing that the operation of joining seam loops becomes difficult due to a structure in which the root position of the loop is not constant relative to the entire base member.

**[0011]** JP 2003-166189 A proposes a seamed felt in which the fineness, density, and weave pattern of the CD yarn material in the seam loop region are changed for the purpose of improving the uniformity of the permeability, compressibility, etc., of the seamed felt in the seam loop region.

### SUMMARY

[Technical Problem]

**[0012]** The typical manufacturing process for a seamed papermaking felt includes the following steps.

**[0013]** Step 1: A step of preparing an endless base member by alternately interlocking the seam loops at both ends of an ended base member having seam loops at both ends in the machine direction and inserting a pintle wire into the cylindrical space formed by the seam loops.

**[0014]** Step 2: A step of heat setting the endless base member under tension.

**[0015]** Step 3: A step of replacing the pintle wire of the endless base member before needling.

**[0016]** Step 4: A step of laminating a film of short fibers formed by carding or the like onto the endless base member, and intertwining and integrating them by need-

ling to prepare a seamed papermaking felt precursor.

**[0017]** Step 5: A step of replacing the pintle wire of the seamed papermaking felt precursor.

**[0018]** Step 6: A step of subjecting the seamed papermaking felt precursor to chemical treatment and heat setting under tension to prepare a seamed felt for papermaking.

**[0019]** Step 7: A step of removing the pintle wire of the seamed papermaking felt, cutting the short fibers on both the wet paper web side and the roll side of the seam loop part to form a flap on the wet paper web side of the short fiber layer.

**[0020]** Step 8: A step of winding the seamed papermaking felt into a roll, packaging and storing it.

**[0021]** Here, the ended base member for seamed papermaking felt and the seamed papermaking felt are subjected to heat setting under tension as shown in Steps 2 and 6 above, so that the dimensional stability of the base member itself and the form of the seam loop are maintained. However, the completed seamed papermaking felt is generally stored as being wound-up in a rolled form, with the seam loops at both ends not alternately interlocked, i.e., in a state with ends, until its use is started at the papermaking company. During storage at the papermaking company, the forces inherent in the warp yarns that make up the seam loops and the weft yarns in the vicinity of the seam loops gradually disrupt the arrangement of the seam loops over time.

**[0022]** Once the arrangement of the seam loops are disrupted, it becomes difficult to introduce and insert the pintle wire through them, which impairs the work efficiency of joining the seam loops. Moreover, the disruption of the arrangement of the seam loops also increases the unevenness in the seam part, and as a result, more seam marks likely to occur in the wet paper web that comes into contact with the papermaking felt when it is pressed during use. The seamed papermaking felts described in the prior art documents leave room for further improvement in terms of the above problems.

**[0023]** Therefore, an object of the present invention is to provide a base member for a seamed papermaking felt and a papermaking felt, for which the work efficiency of joining seam loops is not impaired and the occurrence of seam marks in the seam part is suppressed.

[Solution to Problem]

**[0024]** The present inventors have made an intensive research to achieve the object described above, and as a result found that the filling yarns arranged along the cross machine direction yarn material arranged at the end edge of the base member for the seamed papermaking felt have a relatively large influence on the shape-retaining property of the seam loops. Furthermore, the present inventors have focused on the fineness, type and weaving method of the filling yarn, and proceeded with the investigation into their influence during needling in particular, and as a result reached the present invention.

**[0025]** A gist of the present invention is as follows:

[1] A papermaking felt base member comprising:

an ended woven fabric comprising machine direction yarns reciprocating in a machine direction, and cross machine direction yarns arranged along a cross machine direction and interwoven with the machine direction yarns; a plurality of pintle wire insertion loops formed by folding back the machine direction yarns at both ends of the woven fabric in the machine direction, through which a pintle wire is able to be inserted; and

a plurality of filling yarns arranged along the cross machine direction at at least one end of the woven fabric between the cross machine direction yarns arranged at the outermost end of the woven fabric and the pintle wire insertion loops,

wherein, among the plurality of filling yarns, the fineness of a first filling yarn that is arranged closest to the pintle wire insertion loops is smaller than the fineness of a second filling yarn that is arranged on the cross machine direction yarn side of the first filling yarn.

[2] The papermaking felt base member according to [1], wherein the second filling yarn is adjacent to the first filling yarn.

[3] The papermaking felt base member according to [1] or [2], wherein the fineness of the first filling yarn is equal to or higher than 240 dtex and equal to or less than 2,000 dtex.

[4] The papermaking felt base member according to any one of [1] to [3], wherein the fineness of the second filling yarn is equal to or higher than 330 dtex and equal to or less than 2,090 dtex.

[5] The papermaking felt base member according to any one of [1] to [4], wherein the fineness of the first filling yarn is smaller than the fineness of the second filling yarn by 90 dtex or more and 1,850 dtex or less.

[6] The papermaking felt base member according to any one of [1] to [5], wherein the ratio of the fineness of the second filling yarn to the fineness of the first filling yarn is equal to or higher than 105% and equal to or less than 195%.

[7] A papermaking felt base member according to any one of [1] to [6], wherein, at the at least one end of the woven fabric, the plurality of filling yarns consist of the first filling yarn and the second filling yarn.

[8] The papermaking felt base member according to any one of [1] to [7], wherein the second filling yarn comprises a spun yarn and/or a multifilament yarn.

[9] The papermaking felt base member according to any one of [1] to [8], wherein the first filling yarn comprises a spun yarn and/or a multifilament yarn.

[10] The papermaking felt base member according to

any one of [1] to [9], wherein the plurality of filling yarns are interwoven with the machine direction yarns so as to form a double warp backed weave pattern.

[11] The papermaking felt base member according to [10], wherein the machine direction yarns comprises upper yarns and lower yarns that make up the pintle wire insertion loops, and

the double warp backed weave pattern comprises a repeating unit in which the plurality of filling yarns each pass through one of the upper yarns of the machine direction yarns on the opposite side to the lower yarn side and pass through one of the adjacent lower yarns on the opposite side to the upper yarn, provided that the adjacent filling yarns do not pass through the opposite side to the lower yarn side of the same upper yarn.

[12] The papermaking felt base member according to any one of [1] to [11], wherein the woven fabric comprises a double warp-and-weft backed weave pattern or a multiple warp-and-weft backed weave pattern.

[13] The papermaking felt base member according to any one of [1] to [11], wherein the woven fabric comprises an n-ply warp backed weave pattern, and

comprises a repeat that comprises a pattern in which the cross machine direction yarn passes between an a-th machine direction yarn and an a+1-th machine direction yarn from a first surface, which is one surface of the woven fabric, then passes through the first surface side of the first machine direction yarn from the first surface, and then passes between a b-th machine direction yarn and a b+1-th machine direction yarn from the first surface; or

comprises a repeat that comprises a pattern in which the cross machine direction yarn passes between the a-th machine direction yarn and the a+1-th machine direction yarn from the first surface, then passes through the first surface side of the first machine direction yarn from the first surface, and then passes through the side of a second surface, which is the other surface of the woven fabric, of an n-th machine direction yarn from the first surface; or

comprises a repeat that comprises a pattern in which the cross machine direction yarn passes through the second surface side of the n-th machine direction yarn from the first surface, then passes through the first surface side of the first machine direction yarn from the first surface, and then passes between the b-th machine direction yarn and the b+1-th machine direction yarn from the first surface;

wherein n is an integer equal to or greater than 2, a and b are any integers equal to or greater than 1 and equal to or smaller than n-1, and  $a \neq b$ .

[14] A papermaking felt comprising the papermaking felt base member according to any one of [1] to [13], and

a short fiber layer laminated onto the papermaking felt base member.

#### [Advantageous Effects of Invention]

**[0026]** According to the configuration above, a base member for a seamed papermaking felt and a papermaking felt for which the work efficiency of joining seam loops is not impaired and the occurrence of seam marks in the seam part is suppressed can be provided.

#### BRIEF DESCRIPTION OF DRAWINGS

##### [0027]

FIG. 1 is a schematic diagram of a papermaking felt base member according to the present embodiment. FIG. 2 is a cross-sectional view in a machine direction showing a seam loop part of the papermaking felt base member shown in FIG. 1.

FIG. 3 is a cross-sectional view in a machine direction showing that seam loop parts of the papermaking felt base member shown in FIG. 1 being joined to each other.

Fig. 4 is a cross-sectional view in a cross machine direction for illustrating a weave pattern formed by filling yarns and machine direction yarns of the papermaking felt base member shown in FIG. 1.

FIG. 5 is a cross-sectional view in the machine direction of the vicinity of a seam part of a papermaking felt according to the present embodiment.

FIG. 6 is a cross-sectional view in a machine direction showing a part of a papermaking felt base member according to a modified example of the present invention.

FIG. 7 is a cross-sectional view in a cross machine direction for illustrating a weave pattern of a woven fabric of a papermaking felt base member according to a modified example of the present invention.

FIG. 8 is a cross-sectional view in a cross machine direction for illustrating a weave pattern of a woven fabric of a papermaking felt base member according to a modified example of the present invention.

FIG. 9 is a cross-sectional view in a cross machine direction for illustrating a weave pattern of a woven fabric of a papermaking felt base member according to a modified example of the present invention.

FIG. 10 is a schematic diagram for illustrating the relationship between the arrangement of seam loops and the insertion of a pintle wire.

FIG. 11 is a schematic diagram for illustrating the relationship between the arrangement of seam loops and the insertion of a pintle wire.

FIG. 12 is a schematic diagram for illustrating the relationship between the arrangement of seam loops

and the insertion of a pintle wire.

FIG. 13 is a schematic diagram for illustrating the relationship between the arrangement of seam loops and the insertion of a pintle wire.

FIG. 14 is an enlarged photographic image of a seam loop part of a papermaking felt according to an example.

FIG. 15 is an enlarged photographic image of a seam loop part of a papermaking felt according to a comparative example.

FIG. 16 is a schematic diagram for illustrating a test for evaluating marking property of a papermaking felt.

FIG. 17 is an enlarged photographic image of a seam mark transferred to a paper pressed using a papermaking felt according to the example.

FIG. 18 is an enlarged photographic image of a seam mark transferred to a paper pressed using a papermaking felt according to the comparative example.

## DESCRIPTION OF THE EMBODIMENTS

**[0028]** Hereinbelow, referring to the appended drawings, preferred embodiments of a papermaking felt base member and a papermaking felt according to the present invention will be described in detail.

### <1. Papermaking felt base member>

**[0029]** First, a papermaking felt base member according to the present embodiment will be described. FIG. 1 is a schematic diagram of a papermaking felt base member according to the present embodiment, FIG. 2 is a cross-sectional view in a machine direction showing a seam loop part of the papermaking felt base member shown in FIG. 1, FIG. 3 is a cross-sectional view in a machine direction showing that seam loop parts of the papermaking felt base member shown in FIG. 1 being joined to each other, and FIG. 4 is a cross-sectional view in a cross machine direction for illustrating a weave pattern formed by filling yarns and machine direction yarns of the papermaking felt base member shown in FIG. 1.

**[0030]** Note that, in the drawings, 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. In addition, in the drawings, the illustration of some members has been omitted as appropriate in order to make the explanation easier. Here, the cross machine direction may be referred to as "CMD", and the machine direction may be referred to as "MD".

**[0031]** The papermaking felt base member 1 according to the present embodiment shown in FIG. 1 is a base member for a seamed papermaking felt 100 described later, and the seamed papermaking felt 100 can be constructed by carrying a short fiber layer 60 on the papermaking felt base member 1 as shown in FIG. 5. The papermaking felt base member 1 shown in FIG. 1 has

a woven fabric 10, seam loop parts 20, and filling yarns 30.

**[0032]** The woven fabric 10 is a band-shaped member having ends, and as shown in FIG. 2, includes machine direction yarns (MD yarns) 11A and 11B that reciprocate in the machine direction (MD), and cross machine direction yarns (CD yarns) 13 that are arranged along the cross machine direction (CD) and are woven into the MD yarns 11A and 11B. The weave pattern of the woven fabric 10 and the configurations of the MD yarns 11A, 11B, and CD yarns 13 will be described later.

**[0033]** The seam loop parts 20 are provided at both ends of the woven fabric 10 in the machine direction, and include a plurality of pintle wire insertion loops (seam loops) 21. Each seam loop 21 is a loop formed by the folding back of the MD yarns 11A and 11B of the woven fabric 10. Specifically, the MD yarn 11A extends from the woven fabric 10, folds back along the thickness direction of the woven fabric 10, i.e., perpendicular to the thickness direction of the woven fabric 10 or being inclined at a predetermined angle from the thickness direction with respect to the cross machine direction, and returns to the woven fabric 10 as the MD yarn 11B, thereby forming the seam loop 21. Each pair of the MD yarns 11A and 11B forms a seam loop 21, so that a seam loop part 20 is formed as a row of a plurality of seam loops 21 along the cross machine direction at each of both ends of the woven fabric 10 in the machine direction.

**[0034]** The average minimum diameter of seam loops 21 is not particularly limited, but is, for example, equal to or more than 0.50 mm and equal to or less than 4.00 mm.

**[0035]** Since each seam loop 21 basically forms a loop along the thickness direction of the woven fabric 10, it is possible to insert a pintle wire 40 in the cross machine direction through each formed seam loop 21. Therefore, in the seam loop part 20, the pintle wire 40 can be inserted through a plurality of seam loops 21 arranged along the cross machine direction.

**[0036]** Then, as shown in FIG. 3, the seam loops 21 of the seam loop parts 20 at both ends in the machine direction of the papermaking felt base member 1 are interlocked with each other and a pintle wire 40 is inserted through the seam loops 21 to form a seam part 50, joining both ends in the machine direction of the papermaking felt base member 1, resulting in an annular papermaking felt base member 1.

**[0037]** Here, generally speaking, ideally, as shown in FIG. 10, each seam loop 221 is arranged in a line along the cross machine direction and such that each seam loop 221 itself is parallel to the thickness direction TD. In this case, the pintle wire 240 can easily be inserted through each seam loop 221.

**[0038]** The papermaking felt base member and the papermaking felt are subjected to heat setting under tension as shown in their manufacturing steps, so that the dimensional stability of the base member itself and the form of the seam loop are maintained. However, the completed papermaking felt is stored as being wound-up

in a rolled form, with the seam loops at both ends not alternately interlocked, i.e., in a state with ends, until its use is started at the papermaking company. During storage at the papermaking company, the forces inherent in the MD yarns that make up the seam loops and the CD yarns in the vicinity of the seam loops gradually disrupt the arrangement of the seam loops over time.

**[0039]** For example, as shown in FIGs. 11 and 12, each of the seam loops 221A and 221B might incline with respect to the thickness direction TD. Furthermore, as shown in FIG. 13, each seam loop 221C might not be aligned along the cross machine direction but might shift in the thickness direction. In many cases, these events occur simultaneously. Furthermore, when an inclination such as that of seam loops 221A and 221B or a positional shift such as that of seam loops 221C occurs, it becomes difficult to insert a pintle wire 240 into the space created by the interlocking of seam loops 221A, 221B or 221C, for the reason that it becomes difficult to alternately interlock seam loops 221A, 221B or 221C at both ends, and that the insertion resistance of the pintle wire 240 increases, or the like.

**[0040]** Once the arrangement of the seam loops are disrupted in this manner, it becomes difficult to introduce and insert the pintle wire through them, which impairs the work efficiency of joining the seam loops. Moreover, the disruption of the arrangement of the seam loops also increases the unevenness in the seam part, and as a result, more seam marks likely to occur in the wet paper web that comes into contact with the papermaking felt when it is pressed during use.

**[0041]** However, in the papermaking felt base member 1 according to the present embodiment, the arrangement of the seam loops 21 in the seam loop part 20 is prevented from being disrupted by the filling yarns 30 described next.

**[0042]** As shown in FIG. 1, the filling yarns 30 are arranged along the cross machine direction at both ends in the machine direction of the woven fabric 10 between the CD yarns 13 disposed at the extreme ends of the woven fabric 10 and the seam loops 21. As shown in FIGs. 1 and 2, in this embodiment, the filling yarns 30 comprise two filling yarns, including a filling yarn (first filling yarn) 31 disposed on the seam loop 21 side and a filling yarn (second filling yarn) 32 disposed on the CD yarn side. The filling yarns 31 and 32 are each woven into the MD yarns 11A and 11B, which form the seam loops 21.

**[0043]** By disposing the filling yarns 30 in the vicinity of the seam loop part 20 in this manner, the positions of the MD yarns 11A and 11B, particularly in the thickness direction, can be fixed, and thus the positions of each seam loop 21 can be fixed. This prevents the arrangement of the seam loops 21 from being disrupted.

**[0044]** Moreover, in the papermaking felt 100 described later, the seam loop parts 20 are joined to each other to form a seam part 50, making the papermaking felt 100 annular. Since there are no CD yarns in the vicinity of

the seam part 50, short fibers in the short fiber layer 60 are difficult to be fixed, and the short fibers tend to easily come off when the papermaking felt 100 is in use. However, the filling yarns 30 disposed in the vicinity of the seam part 50 can suitably fix the short fibers and prevent the short fibers from coming off the short fiber layer 60.

**[0045]** Furthermore, the papermaking felt 100 is repeatedly pressed together with the wet paper web by press rolls or a press shoe in the press part. The filling yarn 30 can fix the position of each seam loop 21, and can keep the unevenness that inevitably occurs in the seam part 50 relatively small. As a result, it is possible to suppress the occurrence of pressure marks, so-called seam marks, corresponding to the seam part 50 on the wet paper web that comes into contact with the papermaking felt when it is pressed during use.

**[0046]** In the present embodiment, the fineness of the filling yarn 31 disposed on the seam loop 21 side is smaller than the fineness of the filling yarn 32 disposed on the CD yarn 13 side. This allows the filling yarn 30 to fully exhibit each of the functions of the filling yarn 30 mentioned above. This results in a papermaking felt base member 1 which does not impair the work efficiency of joining seam loop parts 20 and which suppresses the occurrence of seam marks in the seam part 50.

**[0047]** In detail, the filling yarn 31 arranged on the seam loop 21 side has only the filling yarn 32 arranged on the CD yarn 13 side, so that the degree of fixation is small and the degree of freedom is high. On the other hand, the filling yarn 32 arranged on the CD yarn 13 side is sandwiched between the filling yarn 31 and the CD yarn 13, and thus the degree of fixation is high and the degree of freedom is low.

**[0048]** When the papermaking felt 100 is manufactured, a film of short fibers formed by carding or the like is laminated onto the papermaking felt base member 1, which are intertwined and integrated by needling to form a short fiber layer (felt layer) 60.

**[0049]** Here, the inventors have found that, if the fineness of the filling yarn 31 and the filling yarn 32 are approximately the same, the needling effect by needling on the seam part 50 is greater for the filling yarn 31 arranged on the seam loop 21 side than that for the filling yarn 32 arranged on the CD yarn 13 side. This is thought to be due to that the filling yarn 31 arranged on the seam loop 21 side is not fixed by other yarns, such as the CD yarn 13, as opposed to the filling yarn 32 arranged on the CD yarn 13 side. As a result, during needling, the shrinkage of the filling yarn 31 arranged on the seam loop 21 side due to needling becomes larger than the shrinkage of the filling yarn 32 arranged on the CD yarn 13 side.

**[0050]** In this case, the balance of forces that the MD yarns 11A and 11B woven into the filling yarn 31 and the MD yarns 11A and 11B woven into the filling yarn 32 each receive from the filling yarns 31 and 32 is disrupted and become different, which causes a disturbance of the arrangement of the seam loops 21. As a result, the effect of the filling yarns 30 mentioned above is not fully exerted.

**[0051]** In contrast, in the present embodiment, the fineness of the filling yarn 31 arranged on the seam loop 21 side is smaller than the fineness of the filling yarn 32 arranged on the CD yarn 13 side. This allows the needling effect by needling to be approximately the same for the filling yarns 31 and 32, making it possible to appropriately adjust the balance of the forces that the MD yarns 11A and 11B receive from the filling yarns 31 and 32. As a result, the filling yarn 30 is able to fully exhibit each of the functions of the filling yarn 30 mentioned above.

**[0052]** The fineness of the filling yarn (first filling yarn) 31 arranged on the seam loop 21 side is not particularly limited, though it is, for example, equal to or higher than 240 dtex and equal to or less than 2,000 dtex, preferably equal to or higher than 900 dtex and equal to or less than 1,400 dtex, more preferably equal to or higher than 1,000 dtex and equal to or less than 1,300 dtex. This allows needling to give an appropriate degree of the needling effect as necessary.

**[0053]** The fineness of the filling yarn (second filling yarn) 32 arranged on the CD yarn 13 side is not particularly limited, though it is, for example, equal to or higher than 330 dtex and equal to or less than 2,090 dtex, preferably equal to or higher than 1,400 dtex and equal to or less than 1,900 dtex, more preferably equal to or higher than 1,500 dtex and equal to or less than 1,800 dtex. This allows needling to give a sufficient needling effect.

**[0054]** Moreover, the fineness of the filling yarn (first filling yarn) 31 is smaller than the fineness of the filling yarn (second filling yarn) 32, and it is smaller, for example, by 90 dtex or more and 1,850 dtex or less, preferably by 250 dtex or more and 1,000 dtex or less, more preferably by 400 dtex or more and 700 dtex or less. This allows the needling effect and shrinkage due to needling to be approximately the same for the filling yarn (first filling yarn) 31 and the filling yarn (second filling yarn) 32, making it possible to more appropriately adjust the balance of the forces that the MD yarns 11A and 11B receive from the filling yarns 31 and 32.

**[0055]** Moreover, the ratio of the fineness of the filling yarn (first filling yarn) 31 and the fineness of the filling yarn (second filling yarn) 32 (fineness of second filling yarn/fineness of first filling yarn) is, for example, equal to or higher than 105% and equal to or less than 195%, preferably equal to or higher than 120% and equal to or less than 180%, and more preferably equal to or higher than 130% and equal to or less than 170%. This allows the needling effect and shrinkage due to needling to be approximately the same for the filling yarn (first filling yarn) 31 and the filling yarn (second filling yarn) 32, making it possible to more appropriately adjust the balance of the forces that the MD yarns 11A and 11B receive from the filling yarns 31 and 32.

**[0056]** In the present embodiment, the filling yarns 30 comprise two filling yarns, the filling yarn 31 and the filling yarn 32. By reducing the number of yarns in the filling yarns 30 in this manner, the occurrence of seam marks

can be further suppressed. Moreover, the arrangement of the seam loops 21 can be made more appropriate.

**[0057]** Moreover, each yarn constituting the filling yarns 30 (in the present embodiment, the filling yarn 31 and filling yarn 32) is woven into the MD yarns 11A and 11B. FIG. 4 is a cross-sectional view in a cross machine direction for illustrating a weave pattern formed by filling yarns 31 and 32 and MD yarns 11A and 11B of the base member 1 for a papermaking felt shown in FIG.

1. As shown in FIG. 4, in the present embodiment, the filling yarns 31 and 32 are used as weft yarns, the MD yarns 11A are used as upper warp yarns, and the MD yarns 11B are used as lower warp yarns to form a double warp backed weave pattern. By forming a double warp backed weave pattern in this manner with the filling yarn 30 and the MD yarns 11A and 11B, the MD yarns 11A and 11B can be more fixed by the filling yarns 30, making it easier to fix the arrangement of the seam loops 21.

**[0058]** Moreover, the filling yarn 31 and the filling yarn 32 each have a repeating unit in which they each pass over the upper side of one MD yarn 11A in the figure (the opposite side to the MD yarn 11B) and at the same time passes under the lower side of an adjacent MD yarn 11B in the figure (the opposite side to the MD yarn 11A). The filling yarns 31 and filling yarns 32 that are adjacent to each other do not pass over the upper side of the same MD yarn 11A in the figure (the opposite side to the MD yarn 11B). That is, the adjacent filling yarns 31 and 32 of the filling yarns 30 are in different phases and alternately pass over the upper side of the MD yarns 11A in the figure. The woven fabric weave pattern formed by the filling yarns 30 and the MD yarns 11A and 11B can be expressed as a 1/1 1/1 double warp backed weave pattern according to the definition mentioned later. This allows the MD yarns 11A and 11B to be more firmly fixed to the filling yarns 30, and the arrangement of the seam loops 21 to be more firmly fixed.

**[0059]** Each yarn that constitutes filling yarns 30 (the filling yarn 31 and filling yarn 32) may be any form of yarn, and may be a spun yarn, a filament yarn, a composite twist yarn containing two or more of spun yarn, or a composite twist yarn containing one or more of spun yarn and one or more of filament yarn. The yarns constituting the filling yarns 30 may be of the same form or different forms.

**[0060]** Spun yarn is a yarn obtained by spinning short fibers. The spun yarn is easy to be intertwined with the short fibers constituting the short fiber layer 60 and other yarns, such as the MD yarns 11A and 11B, by needling in the process of forming the short fiber layer 60, and is likely to contribute to preventing the short fibers from falling off the short fiber layer 60 and to fixing the arrangement of the seam loops 21.

**[0061]** The short fibers constituting the spun yarn may have an average fiber length that is, for example, equal to or longer than 20 mm and equal to or less than 300 mm, and preferably equal to or longer than 50 mm and equal to or less than 200 mm. Moreover, the average fineness of

the short fibers constituting the spun yarn is not particularly limited, though it can be, for example, equal to or higher than 1.0 dtex and equal to or less than 20 dtex, preferably equal to or higher than 2.0 dtex and equal to or less than 15 dtex.

**[0062]** The fineness of the spun yarn is not particularly limited when it is used as such, as a yarn that constitutes the filling yarns 30 (the filling yarn 31 and the filling yarn 32), though it is, for example, equal to or higher than 240 dtex and equal to or less than 2,090 dtex, preferably equal to or higher than 1,000 dtex and equal to or less than 2,000 dtex.

**[0063]** Moreover, when the spun yarn is used as a material of the composite twist yarn, the fineness of the spun yarn is not particularly limited, though it is, for example, equal to or higher than 200 dtex and equal to or less than 1,850 dtex, preferably equal to or higher than 800 dtex and equal to or less than 1,850 dtex.

**[0064]** 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.

**[0065]** 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 papermaking felt base member 1. 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.

**[0066]** Herein, 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 papermaking felt base member 1. The fineness of a monofilament is, for example, equal to or higher than 100 dtex and equal to or less than 2,250 dtex, preferably equal to or higher than 200 dtex and equal to or less than 2,250 dtex.

**[0067]** A "multifilament or monofilament twist yarn" refers to a twist yarn in which a multifilament or monofilament is used as an original yarn. A "paralleled multifilament or monofilament yarn" refers to a yarn in which a plurality of the above-described single yarns that constitute a multifilament or monofilament are arranged in parallel as original yarns.

**[0068]** 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 multifilament yarn has the intended fineness, for example. In this case, 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 100 dtex and equal to or less than 1,000 dtex, more preferably equal to or higher than 100 dtex and equal to or less than 500 dtex.

**[0069]** When a multifilament or monofilament twist yarn is used, a plied or single twist yarn may be used. In a case of a plied yarn, for example, a plurality of original yarns are placed in parallel such that the fineness will be equal to or higher than 240 dtex and equal to or less than 2,090 dtex, preferably equal to or higher than 400 dtex and equal to or less than 1,000 dtex, and these parallelly placed original yarns are twisted. Then, several, for example, from 2 to 10 of the twisted, paralleled 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, and it is, for example, equal to or more than 0.05 twists/cm and equal to or less than 10.0 twists/cm, preferably equal to or more than 0.1 twists/cm and equal to or less than 5.0 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 10.0 twists/cm, preferably equal to or more than 0.1 twists/cm and equal to or less than 5.0 twists/cm.

**[0070]** In a case of single twist, a plurality of original yarns are arranged in parallel to achieve an intended fineness, and these parallelly arranged original yarns are twisted together to yield a multifilament or monofilament single twist yarn. In this case, the number of twists is not particularly limited, and it is, 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.

**[0071]** 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 150 dtex and equal to or less than 1500 dtex, more preferably equal to or higher than 200 dtex and equal to or less than 1000 dtex.

**[0072]** Moreover, each yarn constituting the filling yarns 30 (the first filling yarn 31 and the second filling yarn 32) may appropriately be processed. Such processing includes stretching process, crimping process, etc.

**[0073]** The composite twist yarn includes two or more of spun yarn and/or filament yarn, and its specific examples include a composite twist yarn of two or more of spun yarn, a composite twist yarn of one or more of multifilament yarn and one or more of monofilament yarn, a composite twist yarn of one or more of spun yarn and one or more of monofilament yarn, a composite twist yarn of one or more of spun yarn and one or more of multifilament yarn, and a composite twist yarn of one or more of spun yarn, one or more of monofilament yarn, and one or more of multifilament yarn. When multiple spun yarns are used in a composite twist yarn, they may be the same or different. Similarly, when multiple filament yarns are used in a composite twist yarn, they may be the same or different.

**[0074]** In this case, a plurality of original yarns (spun

yarns, multifilament yarns and monofilament yarns) can be arranged in parallel to achieve an intended fineness, and these parallelly arranged original yarns are twisted together to yield a composite twist yarn. In this case, the number of twists is not particularly limited, and it is, 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.

**[0075]** Among those mentioned above, each of the yarns that constitute the filling yarns 30 is preferably a yarn containing a spun yarn and/or a multifilament yarn, and more preferably a composite twist yarn of one or more of spun yarn and one or more of multifilament yarn, a composite twist yarn in which two or more of spun yarn are twisted, or a spun yarn. This allows the arrangement of the seam loops 21 of the base member 1 for the papermaking felt to be more appropriately aligned, contributing to the improvement in work efficiency of joining the seam loop parts 20, and at the same time more reliably preventing the short fibers in the vicinity of the seam part 50 from falling off.

**[0076]** In particular, the first filling yarn is preferably a yarn containing a spun yarn and/or a multifilament yarn, and more preferably a spun yarn, a composite twist yarn in which two or more of spun yarns are twisted or a composite twist yarn of one or more of spun yarn and one or more of multifilament yarn, further preferably a spun yarn or a composite twist yarn in which two or more of spun yarns are twisted. This allows the arrangement of the seam loops 21 of the base member 1 for the papermaking felt to be more appropriately aligned, contributing to the improvement in work efficiency of joining the seam loop parts 20, and at the same time more reliably preventing the short fibers in the vicinity of the seam part 50 from falling off.

**[0077]** In particular, the second filling yarn is preferably a yarn containing a spun yarn and/or a multifilament yarn, and more preferably a spun yarn, a composite twist yarn in which two or more of spun yarns are twisted or a composite twist yarn of one or more of spun yarn and one or more of multifilament yarn, further preferably a composite twist yarn of one or more of spun yarn and one or more of multifilament yarn. This allows the arrangement of the seam loops 21 of the base member 1 for the papermaking felt to be more appropriately aligned, contributing to the improvement in work efficiency of joining the seam loop parts 20, and at the same time more reliably preventing the short fibers in the vicinity of the seam part 50 from falling off.

**[0078]** The materials which constitute the filling yarns 30 are not particularly limited, and, for example, 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., can be used either alone or in combination of two or more types.

**[0079]** Moreover, each of the yarns that constitute the filling yarns 30 (the first filling yarn 31 and the second filling yarn 32) may comprise identical materials or may comprise different materials to each other.

**[0080]** Among those mentioned above, each of the yarns that constitute the filling yarns 30 (the first filling yarn 31 and the second filling yarn 32) preferably comprise one or more type(s) selected from a group consisting of a polyester, an aliphatic polyamide and an aromatic polyamide (aramid), more preferably comprise one or more type(s) 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 easier for the seam loops 21 to align. Moreover, the strength of the vicinity of the seam part 50 is sufficiently maintained, and its dimensional stability is improved.

**[0081]** Next, the configuration of the woven fabric 10 will be described. In the present embodiment, the weave pattern of the woven fabric 10 is a so-called 3/1 1/3 double warp backed weave pattern. In such a weave pattern, an equal force is applied to the MD yarns 11A and the MD yarns 11B in the cross machine direction, so that the MD yarns 11A and 11B are less prone to shift in the cross machine direction. As a result, seam loops 21 formed by the MD yarns 11A and the MD yarns 11B are less likely to incline, and the arrangement of seam loops 21 can be fixed more reliably.

**[0082]** In this specification, when a woven fabric is viewed from one side, a/b represents a repeat in which, at points where an MD yarn intersects with CD yarns in a machine direction from the seam loop side toward the woven fabric, the MD yarn is observed continuously a times and then the CD yarns are observed continuously b times. In this case, the MD yarn repeats ups and downs in which it passes over a CD yarns and then passes under b CD yarns. Moreover, in the repeat of the weave pattern, after CD yarns being observed continuously b times, if the MD yarn is observed c times and the CD yarns are observed d times thereafter, the repeat is expressed as a/b/c/d. In this case, the MD yarn repeats ups and downs in which it passes over a CD yarns, passes under b CD yarns, passes over c CD yarns, and finally passes under d CD yarns.

**[0083]** Furthermore, when multiple layers of warp yarns are present, the above notation is written from the surface layer side, with a space between, as being viewed from one side of the woven fabric. For example, for the woven fabric 10 shown in FIG. 2, the MD yarn 11A has a repeat in which the MD yarn 11A is observed three times and then the CD yarn 13 is observed once, and this repeat is represented as 3/1. On the other hand, the MD yarn 11B has a repeat in which the MD yarn 11B is observed once and then the CD yarns 13 are observed

three times, and this repeat is expressed as 1/3. Therefore, the weave pattern of the woven fabric 10 is expressed as 3/1 1/3. Moreover, when the same notation appears consecutively in a multiple weave pattern, the redundant notations can be omitted. For example, a warp backed weave pattern expressed as 1/1 1/1 can be expressed as 1/1 warp backed weave pattern.

**[0084]** The MD yarns 11A, 11B, and the CD yarn 13 may each be a yarn of any form, and includes, for example, a multifilament or monofilament twist yarn, a multifilament and/or monofilament paralleled yarn and a monofilament single yarn, etc. Moreover, in a similar manner as the filling yarn 30, it may be, for example, a spun yarn and/or a filament yarn, or a composite twist yarn containing two or more types of spun yarn and/or filament yarn.

**[0085]** From the viewpoint of ensuring the strength of the papermaking felt 100 and the papermaking felt base member 1 and the strength of the loops, it is preferable that the MD yarns 11A, 11B and the CD yarns 13 all contain filament yarns. Note that the MD yarns 11A, 11B and the CD yarns 13 may be yarns of different forms to each other, or they may be yarns of an identical form. Moreover, the MD yarn 11A may comprise yarns of an identical form or multiple forms, the MD yarns 11B may comprise yarns of an identical form or multiple forms, and the CD yarns 13 may comprise yarns of an identical form or multiple forms.

**[0086]** Among those mentioned above, the MD yarns 11A and 11B preferably contain a monofilament for the purpose of improving the strength of the seam loop 21, and preferably contain a monofilament twist yarn for the purpose of preventing short fibers from falling off the seam loop part 20 and the seam part 50.

**[0087]** Among those mentioned above, the CD yarns 13 preferably contain a monofilament for the purpose of ensuring the water permeability of the papermaking felt 100, and preferably contain a monofilament twist yarn for the purpose of preventing short fibers from falling off the papermaking felt 100.

**[0088]** The fineness of the MD yarns 11A, 11B and the CD yarns 13 is not particularly limited, though it is, for example, equal to or higher than 500 dtex and equal to or less than 3,000 dtex, preferably equal to or higher than 700 dtex and equal to or less than 2,000 dtex, more preferably equal to or higher than 800 dtex and equal to or less than 1,500 dtex. This allows the papermaking felt base member 1 to have sufficient rigidity.

**[0089]** In addition, the materials constituting the MD yarns 11A, 11B and the CD yarns 13 are not particularly limited, and, for example, the above-mentioned materials listed for the filling yarn 30 can be used alone or in combination of two or more. Two or more of the MD yarns 11A, 11B and the CD yarns 13 may comprise identical materials or may comprise different materials to each other.

**[0090]** Among those mentioned above, the MD yarns 11A, 11B and the CD yarns 13 preferably comprise one or

more type(s) selected from a group consisting of a polyester, an aliphatic polyamide and an aromatic polyamide (aramid), more preferably comprise one or more type(s) 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 allows the papermaking felt base member 1 to have sufficient rigidity.

**[0091]** The yarn densities of the MD yarns 11A, 11B and the CD yarns 13 are not particularly limited and can be set as appropriate. The yarn density of the MD yarns 11A and 11B is, for example, 30 yarns/5 cm to 200 yarns/5 cm, preferably 60 yarns/5 cm to 120 yarns/5 cm in total. The yarn density of the CD yarns 13 is, for example, 20 yarns/5 cm to 200 yarns/5 cm, preferably 30 yarns/5 cm to 120 yarns/5 cm.

**[0092]** The thickness of the above-mentioned papermaking felt base member 1 is not particularly limited, and can be, for example, equal to or more than 0.2 mm and equal to or less than 3.5 mm, preferably equal to or more than 0.5 mm and equal to or less than 3.0 mm. The weight of 1 m<sup>2</sup> of the papermaking felt base member 1 is not particularly limited, and can be, for example, equal to or more than 150 g/m<sup>2</sup> and equal to or less than 1,200 g/m<sup>2</sup>, and preferably equal to or more than 300 g/m<sup>2</sup> and equal to or less than 1,000 g/m<sup>2</sup>.

**[0093]** The weave pattern, thickness and weight of 1 m<sup>2</sup> of the papermaking felt base member 1 are appropriately set depending on the intended properties such as the strength, porosity and breathability of the papermaking felt 100, and the marking property of the papermaking felt base member 1.

**[0094]** The dimensions of the papermaking felt base member 1 as mentioned above are not particularly limited, and are set, for example, in accordance with the dimensions of a papermaking machine.

**[0095]** As described above, the papermaking felt base member 1 comprises an ended woven fabric 10 comprising MD yarns 11A, 11B and CD yarns 13, seam loops 21 formed by folding back the MD yarns 11A and 11B at both ends of the woven fabric 10 in the machine direction, and a plurality of filling yarns 30 (filling yarns 31 and 32) arranged between the CD yarn 13 disposed at the extreme end of the woven fabric 10 and the seam loops 21 at both ends of the woven fabric 10 in the machine direction. The fineness of the filling yarn 31 arranged on the seam loop 21 side is smaller than the fineness of the filling yarn 32 arranged on the CD yarn 13 side of the filling yarn 31.

**[0096]** This allows the needling effect that the filling yarns 31 and 32 receive during needling at the time of laminating the short fiber layer 60 to be approximately the same, making it possible to appropriately adjust the balance of the forces that the MD yarns 11A and 11B receive from the filling yarns 31 and 32. By means of this, it becomes possible to suppress the occurrence of a disruption of the arrangement of the seam loops 21. As

a result, the filling yarns 31 and 32 is able to fully exert its intended effect, and the work efficiency of joining seam loop parts 20 will not be impaired while the occurrence of seam marks derived from the seam part 50 will be suppressed in the papermaking felt base member 1.

## <2. Papermaking felt>

**[0097]** Next, a papermaking felt according to the present embodiment will be described. FIG. 5 is a cross-sectional view in a machine direction of the vicinity of a seam part of the papermaking felt according to the present embodiment.

**[0098]** As shown in FIG. 5, the papermaking felt 100 according to the present embodiment comprises a papermaking felt base member 1 and a short fiber layer 60 laminated onto the papermaking felt base member 1.

**[0099]** The short fiber layer 60 comprises a wet paper web side surface layer 61 laminated on the wet paper web contact side of the papermaking felt 100 of the papermaking felt base member 1, a wet paper web side inner layer 62 arranged within the woven fabric 10 of the papermaking felt base member 1, and a roll side layer 63 laminated onto the roll contact side of the papermaking felt 100 of the papermaking felt base member 1.

**[0100]** In the vicinity of a seam part 50 of the short fiber layer 60, a flap 64 is formed as a cut along the cross machine direction so that the short fiber layer 60 is discontinuous at the flap 64. Accordingly, when a pintle wire 40 is removed from the seam part 50, the short fiber layer 60 as well as the papermaking felt base member 1 comes to have ends, and as a result, the papermaking felt 100 comes to have ends. On the other hand, when the papermaking felt 100 is installed into a papermaking machine, the seam loop parts 20 of the ended papermaking felt 100 are interlocked to each other and the pintle wire 40 is inserted through, thereby forming a seam part 50 to make the papermaking felt 100 annular.

**[0101]** The materials which constitute each layer of the short fiber layer 60 are not particularly limited, and 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., can be used either alone or in combination of two or more types. Among those mentioned above, polyamide is preferred as the material for the short fibers from the viewpoints of abrasion resistance, compression recoverability, impact resistance, hydrophilicity, hydrolysis resistance, chemical resistance, etc.

**[0102]** The fineness of the short fibers constituting the wet paper web side surface layer 61 is not particularly limited, but is, for example, equal to or higher than 0.1 dtex and equal to or less than 200 dtex. The fineness of

the short fibers constituting the wet paper web side inner layer 62 is not particularly limited, but is, for example, equal to or higher than 3 dtex and equal to or less than 200 dtex. The fineness of the short fibers constituting the wet paper web side surface layer 61 may be the same as or different from the fineness of the short fibers constituting the wet paper web side inner layer 62. Furthermore, without being limited to the embodiments shown in the drawings, the wet paper web side surface layer 61 and the wet paper web side inner layer 62 may be integrated into a single layer.

**[0103]** The total weight of 1 m<sup>2</sup> of the wet paper web side surface layer 61 and the wet paper web side inner layer 62 can be, in entirety, equal to or more than 100 g/m<sup>2</sup> and equal to or less than 1,500 g/m<sup>2</sup>, preferably equal to or more than 300 g/m<sup>2</sup> and equal to or less than 1,200 g/m<sup>2</sup>, and more preferably 400 g/m<sup>2</sup> and equal to or less than 1,000 g/m<sup>2</sup>. The fineness and the weight of 1 m<sup>2</sup> of the short fibers in the wet paper web side surface layer 61 and the wet paper web side inner layer 62 are appropriately set depending on the intended characteristics such as the strength, porosity, and breathability of the papermaking felt 100, and the surface properties of the short fiber layer in the wet paper web side surface layer 61.

**[0104]** The fineness of the short fibers constituting the roll side layer 63 is not particularly limited, but is, for example, equal to or higher than 3 dtex and equal to or less than 150 dtex. The weight of 1 m<sup>2</sup> of the short fibers on the roll side surface is not particularly limited, but can be, for example, equal to or more than 50 g/m<sup>2</sup> and equal to or less than 500 g/m<sup>2</sup>.

**[0105]** The weight of 1 m<sup>2</sup> of the papermaking felt 100 is not particularly limited, but is, for example, in entirety, equal to or more than 250 g/m<sup>2</sup> and equal to or less than 3,000 g/m<sup>2</sup>, and preferably equal to or more than 400 g/m<sup>2</sup> and equal to or less than 2,000 g/m<sup>2</sup>. The thickness of the papermaking felt 100 is not particularly limited, but is, for example, equal to or more than 1 mm and equal to or less than 6 mm, and preferably equal to or more than 2 mm and equal to or less than 4 mm.

**[0106]** The papermaking felt 100 described above can be obtained by laminating a film of short fibers formed by carding or the like onto both sides of the papermaking felt base member 1, on the wet paper web side.

**[0107]** Specifically, first, a film of short fibers formed by carding or the like is laminated onto the papermaking felt base member 1, which are intertwined and integrated by needling, and thereby laminating a short fiber layer 60 onto the papermaking felt base member 1. This completes the precursor of the papermaking felt 1. Next, the precursor of the papermaking felt 1 is appropriately chemically treated, heat-set and pressed, the pintle wire is removed, and the short fibers in the seam loop parts 20 are cut to create flaps 64, resulting in the papermaking felt 1. Before use, the papermaking felt 100 is, for example, wound in a roll, packaged, and stored.

**[0108]** The papermaking felt 100 described above

comprises a papermaking felt base member 1. Therefore, in the papermaking felt 100, the seam loops 21 are an arrangement that is less likely to be disrupted. For example, even in a situation where the papermaking felt 100 is stored in package for a prolonged period in a papermaking company, the arrangement of the seam loops 21 is less likely to be disrupted. Therefore, it provides an efficient operation of joining the seam loops 21.

**[0109]** Furthermore, since the disruption of the arrangement of the seam loops 21 is suppressed, the occurrence of pressure marks, so-called seam marks, on the wet paper web that comes into contact with the papermaking felt 100 when it is pressed during use is suppressed. Moreover, since the disruption of the arrangement of the seam loops 21 is suppressed, the falling-off of the short fibers from the short fiber layer 60 is suitably suppressed.

### <3. Modified Examples>

**[0110]** Next, some modified examples of the papermaking felt base member and the papermaking felt 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. The First Modified Example)

**[0111]** The above-mentioned embodiment described examples in which two filling yarns 31 and 32 are disposed at each end of the papermaking felt base member 1. However, the present invention is not limited thereto, and the base member for papermaking felt can have three or more filling yarns at each end. FIG. 6 shows one example.

**[0112]** FIG. 6 is a cross-sectional view in a machine direction showing a part of a papermaking felt base member according to a modified example of the present invention. A papermaking felt base member 1A shown in FIG. 6 is different from the papermaking felt base member 1 mentioned above in the number of filling yarns 30A, but otherwise they are similar. Hereinbelow, the filling yarn 30A will be described in detail, and description of similar points will be omitted.

**[0113]** As shown in FIG. 6, the papermaking felt base member 1A has three filling yarns 30A (filling yarns 31A, 32A, and 33A) arranged along the cross machine direction between the seam loop part 20 and the CD yarn 13 at the machine direction end. The fineness of the filling yarn 31A arranged on the seam loop 21 side is smaller than the fineness of the filling yarn 32A and/or the filling yarn 33A arranged on the CD yarn 13 side. In this case, the filling yarn 31A is the first filling yarn, and the filling yarn 32A

and/or the filling yarn 33A is/are the second filling yarn.

**[0114]** This results in a uniform needling effect by needling among the filling yarns 30A, making it possible to appropriately adjust the balance of the forces that the MD yarns 11A and 11B receive from the filling yarns 31A, 32A and 33A. By means of this, it becomes possible to suppress the occurrence of a disruption of the arrangement of the seam loops 21. As a result, the filling yarns 31A, 32A and 33A are able to fully exert their intended effect, and the work efficiency of joining seam loop parts 20 will not be impaired and the occurrence of seam marks due to the seam part will be suppressed in the papermaking felt base member 1A.

**[0115]** Either the filling yarn 32A or 33A may have a larger fineness than the fineness of the filling yarn 31A, but it is preferable that the filling yarn 31A has a smaller fineness than the fineness of the filling yarn 32A that is adjacent to the filling yarn 31A. Thus, the aforementioned effect can be ensured with more certainty by that the fineness of the filling yarn 32A adjacent to the filling yarn 31A, which is the first filling yarn, is larger.

**[0116]** Moreover, within the filling yarns 30A, the fineness of each of the filling yarns 31A and 32A is preferably smaller than the fineness of adjacent filling yarns 32A and 33A on the CD yarn 13 side.

**[0117]** The number of filling yarns is not limited to the above-mentioned embodiments and the modified example shown in FIG. 6, and can be any number. For example, at one end of the base member for papermaking felt, 2 to 10 filling yarns, preferably 2 to 5 filling yarns, may be disposed.

**[0118]** Moreover, in the above-mentioned embodiments and the modified example shown in FIG. 6, it has been described that multiple filling yarns 30 and 30A are disposed at both ends of the woven fabric 10 such that they satisfy the relationship between the first filling yarn and the second filling yarn, though the present invention is not limited to this. For example, the relationship between the first filling yarn and the second filling yarn may be met only at one end of the woven fabric, or there may be only one filling yarn at one end of the woven fabric.

#### (3.2. Weave Pattern of Woven Fabric)

**[0119]** In the above-mentioned embodiments, the woven fabric 10 of the papermaking felt base member 1 has been described as having a 3/1 1/3 double warp backed weave pattern, but the present invention is not limited to this, and the woven fabric may have any weave pattern.

**[0120]** As mentioned above, the weave pattern of the woven fabric of the base member for the papermaking felt is not particularly limited, though it includes double weave patterns represented by double warp backed weave patterns (e.g., a 3/1 1/3 double warp backed weave, a 5/1 1/1 double warp backed weave, a 2/1 1/2 double warp backed weave (a 2/1 1/2 warp backed 1.5-ply weave), a 5/1 1/1 1/5/1/1 double warp backed weave), double weft

backed weave patterns (e.g., a 3/1 1/3 double weft backed weave, a 5/1 1/1 double weft backed weave, a 2/1 1/2 double weft backed weave), and double warp-and-weft backed weave pattern (e.g., a 1/1 double warp-and-weft backed weave), and triple- or higher multilayer weave patterns.

**[0121]** As mentioned above, any weave pattern may be used as the weave pattern of the woven fabric of the base member for the papermaking felt. The relationship between the weave pattern and the arrangement of the seam loops will be described below. FIGs. 7 to 9 are cross-sectional views in a cross machine direction for illustrating weave patterns of a woven fabric of the base member for papermaking felt according to modified examples of the present invention. Each of the woven fabrics 10B to 10H in FIGs. 7 to 9 has an n-ply, double- or multiple-layered weave pattern, and the woven fabrics 10B to 10H form a first surface 15 and a second surface 17. Here, n is an integer equal to or more than 2.

**[0122]** The woven fabric 10B shown in FIG. 7 has a repeat that includes a pattern in which the CD yarn 13 passes between the a-th and a+1-th MD yarns 11 from the first surface 15 of the woven fabric 10B, then passes through the first surface 15 side of the first MD yarn from the first surface 15, and then passes between the b-th and b+1-th MD yarns 11 from the first surface 15 (pattern 1-1). In FIG. 7, a and b are any integers equal to or more than 1 and equal to or less than n-1, and  $a \neq b$ .

**[0123]** The woven fabric 10C shown in FIG. 7 has a repeat that includes a pattern in which the CD yarn 13 passes between the a-th and a+1-th MD yarns 11 from the first surface 15 of the woven fabric 10C, then passes through the first surface 15 side of the first MD yarn from the first surface 15, and then passes through the second surface 17 side of the n-th MD yarns 11 from the first surface 15 (pattern I-2).

**[0124]** The woven fabric 10D shown in FIG. 7 has a repeat that includes a pattern in which the CD yarn 13 passes through the second surface 17 side of the n-th MD yarns 11 from the first surface 15 of the woven fabric 10D, then passes through the first surface 15 side of the first MD yarn from the first surface 15, and then passes between the b-th and b+1-th MD yarns 11 from the first surface 15 (pattern I-3).

**[0125]** In each of the woven fabrics 10B to 10D of patterns I-1 to I-3 shown in FIG. 7, the CD yarn 13 turns around the MD yarn 11 located in the center at the top of the figure, but the angle of the CD yarn 13 with respect to the thickness direction is different before and after turning around the MD yarn 11. In such a case, a force in the cross-machine direction is inevitably applied from the CD yarn 13 to the MD yarn 11 that has a central turn, and as a result, the MD yarn 11 becomes prone to shift in the cross machine direction and the seam loop 21 on the extension of the MD yarn 11 becomes prone to incline.

**[0126]** However, in the present invention, by employing specific filling yarns, the arrangement of the seam loops 21 is fixed, which prevents the inclination of the seam

loops 21. That is, when a woven fabric having a weave pattern including a repeat of the above-mentioned patterns I-1 to I-3 is used, the effect of the present invention will be exerted more remarkably.

**[0127]** Next, the woven fabric 10E shown in FIG. 8 has a repeat that includes a pattern in which the CD yarn 13 passes between the a-th and a+1-th MD yarns 11 from the first surface 15 of the woven fabric 10E, or passes through the second surface 17 side of the n-th MD yarns 11 from the first surface 15 (dashed line), then passes several times through the first surface 15 side of the first MD yarn from the first surface 15 (pattern II-1).

**[0128]** The woven fabric 10F shown in FIG. 8 has a repeat that includes a pattern in which the CD yarn 13 passes several times through the first surface 15 side of the first MD yarn from the first surface 15, then passes between the a-th and a+1-th MD yarns 11 from the first surface 15, or passes through the second surface 17 side of the n-th MD yarns 11 from the first surface 15 (dashed line) (pattern II-2).

**[0129]** In the woven fabrics 10E and 10F of the patterns II-1 and II-2 shown in FIG. 8, too, a force in the cross-machine direction is likely to be applied to the MD yarn 11 during the process in which the CD yarn 13 turns around the MD yarn 11 located in the center at the top of the figure, and as a result, the MD yarn 11 becomes prone to shift in the cross-machine direction, and the seam loop 21 on the extension of the MD yarn 11 becomes prone to incline. However, in the present invention, by employing a specific filling yarns, the arrangement of the seam loops 21 is fixed, which prevents the inclination of the seam loops 21 even where the woven fabric contain the pattern II-1 or II-2 shown in FIG. 8.

**[0130]** The woven fabric 10G shown in FIG. 9 has a repeat that includes a pattern in which the CD yarn 13 passes between the a-th and a+1-th MD yarns 11 from the first surface 15 of the woven fabric 10G, then passes through the first surface 15 side of the first MD yarn from the first surface 15, and then passes between the a-th and a+1-th MD yarns 11 from the first surface 15 (pattern III-1).

**[0131]** Moreover, the woven fabric 10H shown in FIG. 9 has a repeat that includes a pattern in which the CD yarn 13 passes through the second surface 17 side of the n-th MD yarns 11 from the first surface 15 of the woven fabric 10H, then passes through the first surface 15 side of the first MD yarn from the first surface 15, and then passes through the second surface 17 side of the n-th MD yarns 11 from the first surface 15 (pattern III-2).

**[0132]** In each of the woven fabrics 10G and 10H of the patterns III-1 and III-2 shown in FIG. 9, the CD yarn 13 turns around the MD yarn 11 located in the center at the top of the figure, and the angle of the CD yarn 13 with respect to the thickness direction is identical before and after turning around the MD yarn 11. Therefore, in these configurations it is less likely that a force in the cross machine direction is applied to the MD yarn 11 during the process in which the CD yarn 13 turns around the MD

yarn 11 located in the center at the top of the figure, and as a result, the seam loop 21 on an extension of the MD yarn 11 is less likely to incline. However, even in such woven fabrics 10G and 10H, in which the inclination of the seam loops 21 due to the weave pattern is unlikely to occur, the inclination of the seam loops 21 may still occur by needling or the action of external forces during storage. Even in such a case, in the present invention, by employing specific filling yarns, the arrangement of the seam loops 21 is fixed, which prevents the inclination of the seam loops 21.

**[0133]** Furthermore, in the double warp-and-weft backed weave pattern and multiple warp-and-weft backed weave pattern, there is an interlayer part in which the weave pattern of its upper layer and that of its lower layer are not fixed, and the upper and lower layers of this interlayer part are prone to misalign due to the structure of the weave pattern. This causes the MD yarns of the upper and lower layers to easily misalign relative to each other, and the seam loops on the extension of the MD yarns to easily incline. However, in the present invention, by employing specific filling yarns, the arrangement of the seam loops is fixed, which prevents the inclination of the seam loops even where a woven fabric of warp-and-weft backed weave pattern is used.

**[0134]** In addition, among the double warp backed weave patterns, a configuration in which the upper MD yarns and the lower MD yarns are not located at the same positions in the thickness direction, and the lower MD yarns are arranged between the upper MD yarns when the woven fabric is viewed in a plane, is referred to as a "1.5-ply warp backed weave pattern." In addition, among the double weft backed weave patterns, a configuration in which the upper CD yarns and the lower CD yarns are not located at the same positions in the thickness direction, and the lower CD yarns are arranged between the upper CD yarns when the woven fabric is viewed in a plane, is referred to as a "1.5-ply weft backed weave pattern." An example of the 1.5-fold warp structure includes a 2/1 1/2 1.5-ply warp backed weave pattern.

**[0135]** Among those mentioned above, in the 1.5-ply warp backed weave pattern, due to the structure of the weave pattern of the woven fabric, an upper MD yarn and a lower MD yarns are located in different positions in the cross machine direction, and as a result, the seam loop formed by the upper MD yarn and the lower MD yarn is prone to incline with respect to the thickness direction. However, in the present invention, by employing specific filling yarns, the arrangement of the seam loops is fixed, which prevents the inclination of the seam loops even where a woven fabric of 1.5-ply warp backed weave pattern is used.

**[0136]** The woven fabric of the felt base member may contain MD yarns that do not contribute to the formation of seam loops.

### (3.3. The Third Modified Example)

**[0137]** In the above-described embodiment, it has been described that, as shown in FIG. 4, a weave pattern is formed in which two filling yarns 31 and 32 are woven into the MD yarns 11A and 11B at the end of the paper-making felt base member 1. However, the present invention is not limited to this, and the filling yarns can be woven into the MD yarns in any weave pattern.

**[0138]** As a weave pattern of a woven fabric formed by filling yarns and MD yarns, for example, a weave pattern having a repeat including the pattern III-1 or III-2 shown in FIG. 9 mentioned above in which the CD yarn is replaced with a filling yarn is preferable. Such a weave pattern can sufficiently fix the CD yarns forming the seam loops, and can more reliably fix the arrangement of the seam loops.

**[0139]** An example of such a weave includes a 1/1 double warp backed weave pattern shown in FIG. 4.

### (3.4. The Fourth Modified Example)

**[0140]** In the above-mentioned embodiment, it has been described that the short fiber layer 60 of the paper-making felt 100 has the roll-side layer 63, though the present invention is not limited to this, and the roll-side layer 63 may be omitted.

**[0141]** As above, the present invention has been described in detail based on preferred embodiments, though the present invention is not limited thereto, and each component can be substituted with any one that is capable of performing an equal function, or an optional component can be added.

### [EXAMPLES]

**[0142]** Hereinbelow, the present invention will more specifically be described with examples, though the present invention is not to be limited to these examples.

#### <1. Manufacture of Papermaking felt>

##### (Example)

**[0143]** First, a base member for a papermaking felt according to this example was prepared as follows.

**[0144]** The configuration of the woven fabric was as follows: Note that seam loops were formed at both ends of the woven fabric.

**[0145]** MD yarns: Monofilament single yarns of 1,000 dtex consisting of polyamide 6; 90 yarns/5 cm.

**[0146]** CD yarns: Three monofilament single yarns of 330 dtex twisted together, consisting of polyamide 6; 80 yarns/5 cm.

**[0147]** Weave pattern of the woven fabric of MD yarns and CD yarns: 2/1 1/2 double warp backed weave pattern (1.5-ply warp backed weave pattern).

**[0148]** Weight of 1 m<sup>2</sup>: 450 g/ m<sup>2</sup>.

**[0149]** Next, the following filling yarns were prepared

and woven into the MD yarns between the seam loops and the woven fabric to form a 1/1 double warp backed weave pattern. Note that, when the filling yarns are woven into the MD yarns, the first filling yarn was placed on the seam loop side and the second filling yarn was placed on the CD yarn side.

**[0150]** Filling yarns: Two yarns (a first filling yarn and a second filling yarn)

First filling yarn: Two polyamide 6 spun yarns (588 dtex) Z-twisted at 0.5 twists/cm were S-twisted together at 3.2 twists/cm to give a first filling yarn (1,150 dtex).

Second filling yarn: Two polyamide 6 spun yarns (588 dtex) Z-twisted at 0.5 twists/cm were S-twisted together at 3.2 twists/cm to generate a twisted spun yarn (1,150 dtex). Then, one of the twisted spun yarn and two polyamide 6 multifilament yarns (7d x 30 filaments, 210 dtex) were S-twisted together at 3.0 twists/cm to give a second filling yarn (1,695 dtex).

**[0151]** Next, short fibers were intertwined and integrated with the papermaking felt base member described above by needling to complete a precursor of the papermaking felt. As the short fiber layers formed on the papermaking felt, a wet paper web-side surface layer, a wet paper web side inner layer, and a roll side layer were formed. The short fiber layers were formed by laminating the following number of layers of cards for each of which short fiber composition (e.g., fineness) and weight of 1 m<sup>2</sup> have been set in advance as follows onto the papermaking felt base member and intertwining the cards with base member.

**[0152]** Wet paper web side surface layer card: 15 dtex polyamide 66 short fiber, weight of 1 m<sup>2</sup>: 100 g/m<sup>2</sup>, 2 layers.

**[0153]** Wet paper web side inner layer card: 22 dtex polyamide 66 short fiber, weight of 1 m<sup>2</sup>: 100 g/m<sup>2</sup>, 3 layers.

**[0154]** Roll side card: 22 dtex polyamide 66 short fiber, weight of 1 m<sup>2</sup>: 100 g/m<sup>2</sup>, 2 layers.

**[0155]** The above-described precursor of the papermaking felt was chemically treated, heat-set and pressed, the pintle wire was removed, and the short fibers in the seam loop parts were cut to create flaps, thereby completing the papermaking felt according to the example. The weight of 1 m<sup>2</sup> of the papermaking felt was 1,100 g/m<sup>2</sup>, its thickness was 2.65 mm, and its air permeability was 27.5 cc/m<sup>2</sup>/sec.

(Comparative Example)

**[0156]** A base member for papermaking felt and a papermaking felt according to the comparative example were obtained in the same manner as in the examples, except that the composition of the filling yarns were changed as follows.

**[0157]** Two polyamide 6 spun yarns (588 dtex) Z-

twisted at 0.5 twists/cm were S-twisted together at 3.2 twists/cm to generate a twisted spun yarn (1,150 dtex). Then, one of the twisted spun yarn and two polyamide 6 multifilament yarns (7d x 30 filaments, 210 dtex) were S-twisted together at 3.0 twists/cm to give a first filling yarn and a second filling yarn (1,695 dtex). That is, the first filling yarn and the second filling yarn used were the same yarn.

<2. Evaluation>

**[0158]** The example and comparative example were evaluated by the following evaluation methods.

(1) Degree of alignment of seam loop arrangement

**[0159]** The papermaking felts according to the example and the comparative example were observed under an optical microscope without inserting a pintle wire through the seam loop part, and the degree of alignment of the seam loop arrangement was evaluated. The results are shown in FIGs. 14 and 15. FIG. 14 is an enlarged photographic image of the seam loop part of the papermaking felt according to the example, and FIG. 15 is an enlarged photographic image of the seam loop part of the papermaking felt according to the comparative example.

**[0160]** As shown in FIGs. 14 and 15, the seam loops were aligned better in the papermaking felt according to the example as compared to the papermaking felt according to the comparative example. Therefore, it can be understood that the papermaking felt according to the example provides a better work efficiency of joining the seam loops during the formation of a seam part as compared to the papermaking felt according to the comparative example.

(2) Evaluation of pintle wire insertion resistance

**[0161]** For each of the papermaking felt according to the example and the comparative example, a pintle wire ( $\phi$ 0.4 mm x 4 wires) was inserted through the seam loop part, and the force with which the pintle wire could move through (the pintle wire insertion resistance) was evaluated for each papermaking felt with a width of 70 cm. The pintle wire insertion resistance value for the example was 0.81 kgf/70 cm, whereas that for the comparative example was 7.50 kgf/70 cm. The papermaking felt according to the example has the seam loops aligned better and has significantly smaller pintle wire insertion resistance value as compared to the papermaking felt according to the comparative example. Therefore, it can be understood that the papermaking felt according to the example provides a better work efficiency of joining the seam loops during the formation of a seam part as compared to the papermaking felt according to the comparative example.

## (3) Evaluation of marking property

**[0162]** The marking property was evaluated for each of the papermaking felts according to the example and the comparative example. First, as shown in FIG. 16(a), a carbon paper 301, a paper 302 and a short fiber batt 303 (100 g/m<sup>2</sup>) were placed on papermaking felt 1 in this order. Here, the carbon paper 301 and the paper 302 were laminated so as to be placed onto the seam part 50 of the papermaking felt 1.

**[0163]** Next, as shown in FIG. 16(b), the papermaking felt 1 on which the carbon paper 301, the paper 302 and the batt 303 were arranged was pressed using two press rolls 400 having a diameter of 100 mm under conditions of a press speed of 5 cm/sec and a linear pressure of 50 kgf/cm, so that the shape of the seam part of the papermaking felt 1 was transferred to the paper to form a seam mark.

**[0164]** Note that, in this seam mark formation, the pressing is performed at a slower press speed as compared to general pressing process using a papermaking machine so that the seam mark is clearly formed.

**[0165]** The results are shown in FIGs. 17 and 18. FIG. 17 is an enlarged photographic image of a seam mark transferred to a paper pressed using a papermaking felt according to an example, and FIG. 18 is an enlarged photographic image of a seam mark transferred to a paper pressed using a papermaking felt according to a comparative example. As shown in FIGs. 17 and 18, the seam mark transferred from the papermaking felt according to the example were smaller as compared to the papermaking felt according to the comparative example. Therefore, it can be understood that the formation of a seam mark is suppressed in the papermaking felt according to the example as compared to the papermaking felt according to the comparative example.

[Reference signs list]

**[0166]**

- 1, 1A Papermaking felt base member
- 10, 10A, 10B, 10C, 10D, 10E, 10F, 10G, 10H Woven fabric
- 11, 11A, 11B Machine direction yarn (MD yarn)
- 13 Cross machine direction yarn (CD Yarn)
- 20 Seam loop part
- 21 Seam loop
- 30, 30A, 31, 31A, 32, 32A, 33A Filling yarn
- 40 Pintle wire
- 50 Seam part
- 60 Short fiber layer
- 61 Wet paper web side surface layer
- 62 Wet paper web side inner layer
- 63 Roll side layer
- 100 Papermaking felt

## Claims

1. A papermaking felt base member comprising:

an ended woven fabric comprising machine direction yarns reciprocating in a machine direction, and cross machine direction yarns arranged along a cross machine direction and interwoven with the machine direction yarns; a plurality of pintle wire insertion loops formed by folding back the machine direction yarns at both ends of the woven fabric in the machine direction, through which a pintle wire is able to be inserted; and a plurality of filling yarns arranged along the cross machine direction at at least one end of the woven fabric between the cross machine direction yarns arranged at the outermost end of the woven fabric and the pintle wire insertion loops, wherein, among the plurality of filling yarns, the fineness of a first filling yarn that is arranged closest to the pintle wire insertion loops is smaller than the fineness of a second filling yarn that is arranged on the cross machine direction yarn side of the first filling yarn.

2. The papermaking felt base member according to claim 1, wherein the second filling yarn is adjacent to the first filling yarn.

3. The papermaking felt base member according to claim 1 or 2, wherein the fineness of the first filling yarn is equal to or higher than 240 dtex and equal to or less than 2,000 dtex.

4. The papermaking felt base member according to any one of claims 1 to 3, wherein the fineness of the second filling yarn is equal to or higher than 330 dtex and equal to or less than 2,090 dtex.

5. The papermaking felt base member according to any one of claims 1 to 4, wherein the fineness of the first filling yarn is smaller than the fineness of the second filling yarn by 90 dtex or more and 1,850 dtex or less.

6. The papermaking felt base member according to any one of claims 1 to 5, wherein the ratio of the fineness of the second filling yarn to the fineness of the first filling yarn is equal to or higher than 105% and equal to or less than 195%.

7. A papermaking felt base member according to any one of claims 1 to 6, wherein, at the at least one end of the woven fabric, the plurality of filling yarns consist of the first filling yarn and the second filling yarn.

8. The papermaking felt base member according to any

one of claims 1 to 7, wherein the second filling yarn comprises a spun yarn and/or a multifilament yarn.

9. The papermaking felt base member according to any one of claims 1 to 8, wherein the first filling yarn comprises a spun yarn and/or a multifilament yarn. 5
10. The papermaking felt base member according to any one of claims 1 to 9, wherein the plurality of filling yarns are interwoven with the machine direction yarns so as to form a double warp backed weave pattern. 10
11. The papermaking felt base member according to claim 10, wherein the machine direction yarns comprises upper yarns and lower yarns that make up the pintle wire insertion loops, and the double warp backed weave pattern comprises a repeating unit in which the plurality of filling yarns each pass through one of the upper yarns of the machine direction yarns on the opposite side to the lower yarn side and pass through one of the adjacent lower yarns on the opposite side to the upper yarn, provided that the adjacent filling yarns do not pass through the opposite side to the lower yarn side of the same upper yarn. 20 25
12. The papermaking felt base member according to any one of claims 1 to 11, wherein the woven fabric comprises a double warp-and-weft backed weave pattern or a multiple warp-and-weft backed weave pattern. 30
13. The papermaking felt base member according to any one of claims 1 to 11, wherein the woven fabric comprises an n-ply warp backed weave pattern, and comprises a repeat that comprises a pattern in which the cross machine direction yarn passes between an a-th machine direction yarn and an a+1-th machine direction yarn from a first surface, which is one surface of the woven fabric, then passes through the first surface side of the first machine direction yarn from the first surface, and then passes between a b-th machine direction yarn and a b+1-th machine direction yarn from the first surface; or comprises a repeat that comprises a pattern in which the cross machine direction yarn passes between the a-th machine direction yarn and the a+1-th machine direction yarn from the first surface, then passes through the first surface side of the first machine direction yarn from the first surface, and then passes through the side of a second surface, which is the other surface of the woven fabric, of an n-th machine direction yarn from the first surface; or comprises a repeat that comprises a pattern in 40 45 50 55

which the cross machine direction yarn passes through the second surface side of the n-th machine direction yarn from the first surface, then passes through the first surface side of the first machine direction yarn from the first surface, and then passes between the b-th machine direction yarn and the b+1-th machine direction yarn from the first surface; wherein n is an integer equal to or greater than 2, a and b are any integers equal to or greater than 1 and equal to or smaller than n-1, and  $a \neq b$ .

14. A papermaking felt comprising the papermaking felt base member according to any one of claims 1 to 13, and a short fiber layer laminated onto the papermaking felt base member.

FIG. 1

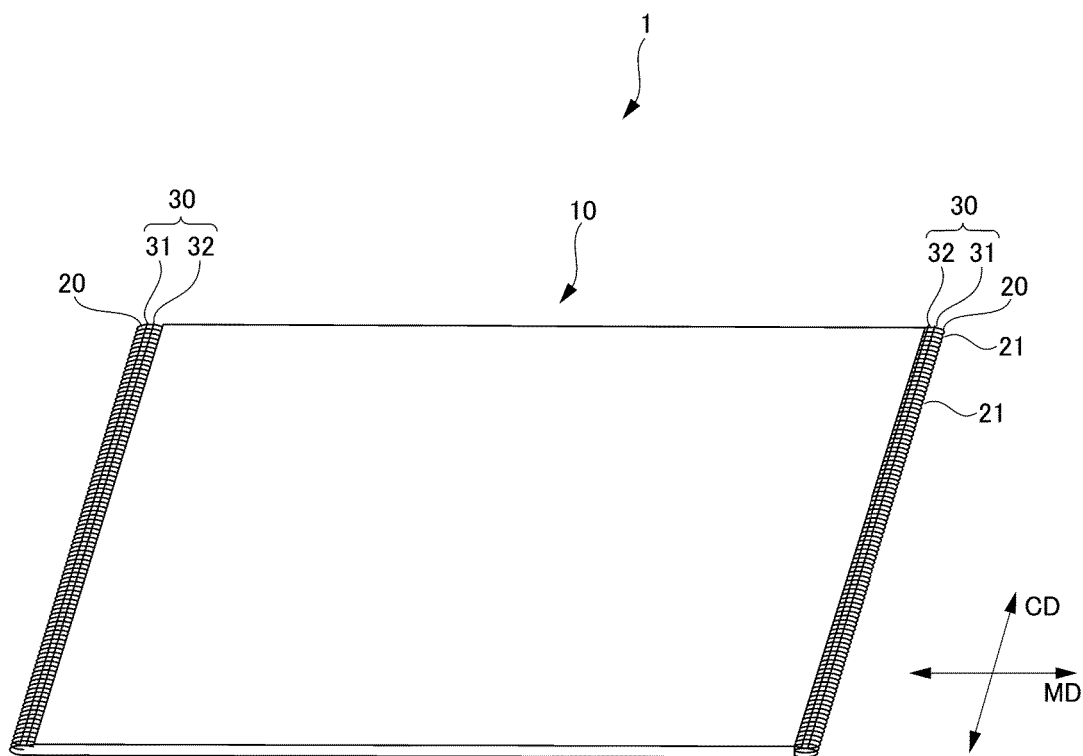


FIG. 2

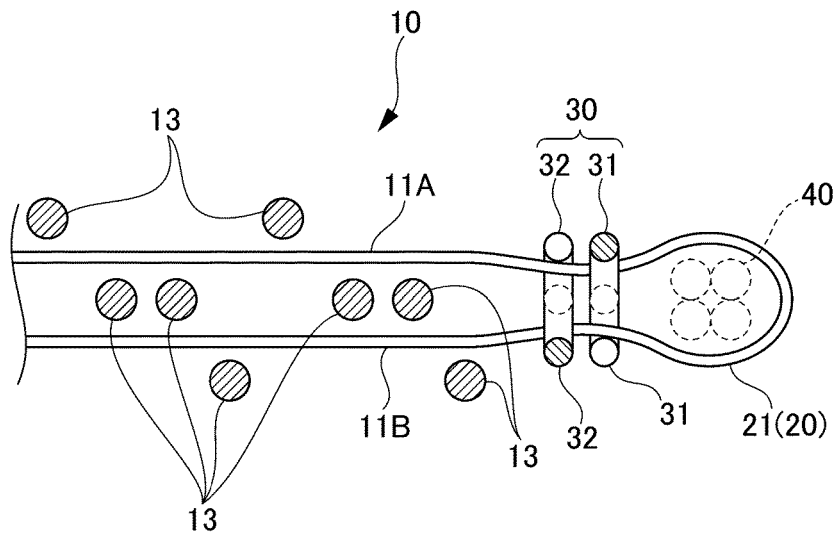


FIG. 3

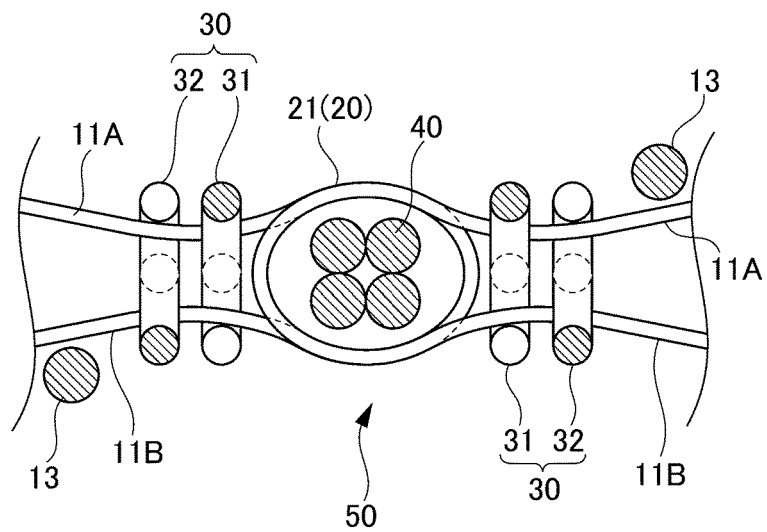


FIG. 4

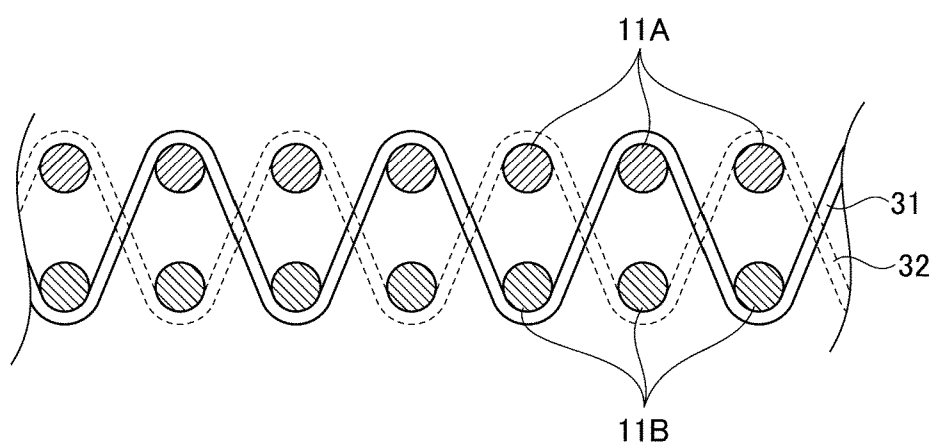


FIG. 5

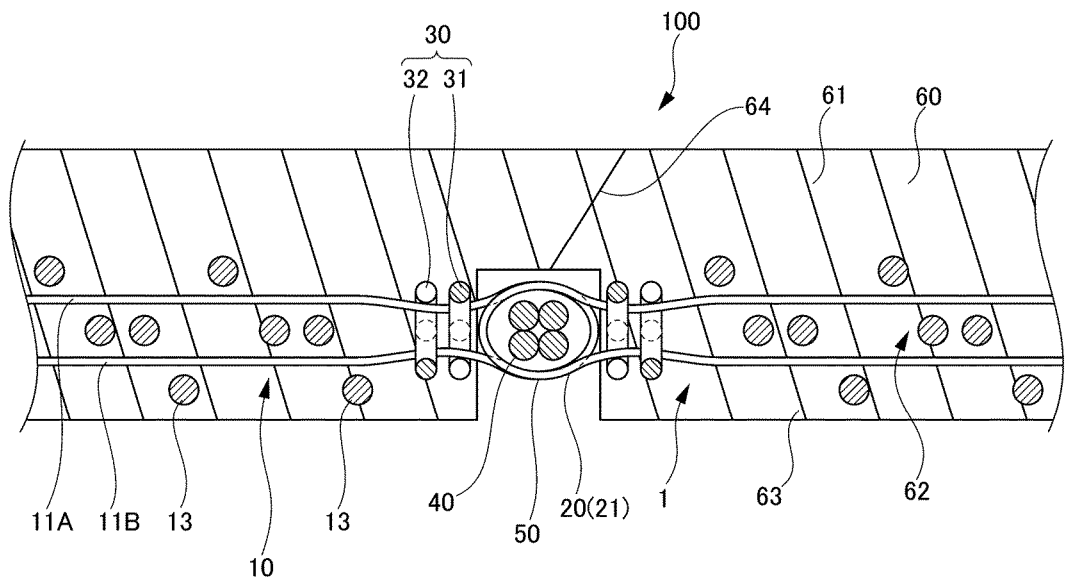


FIG. 6

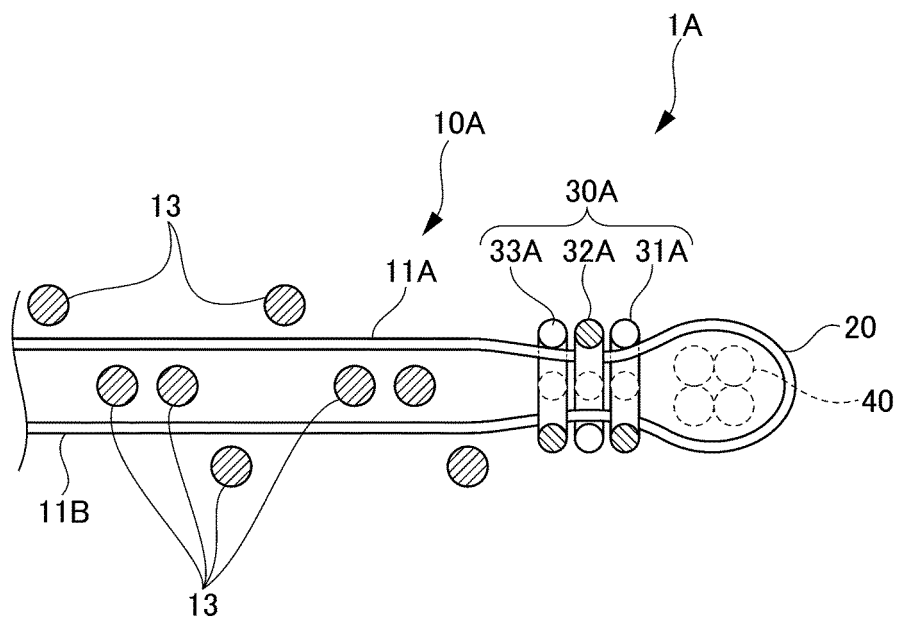


FIG. 7

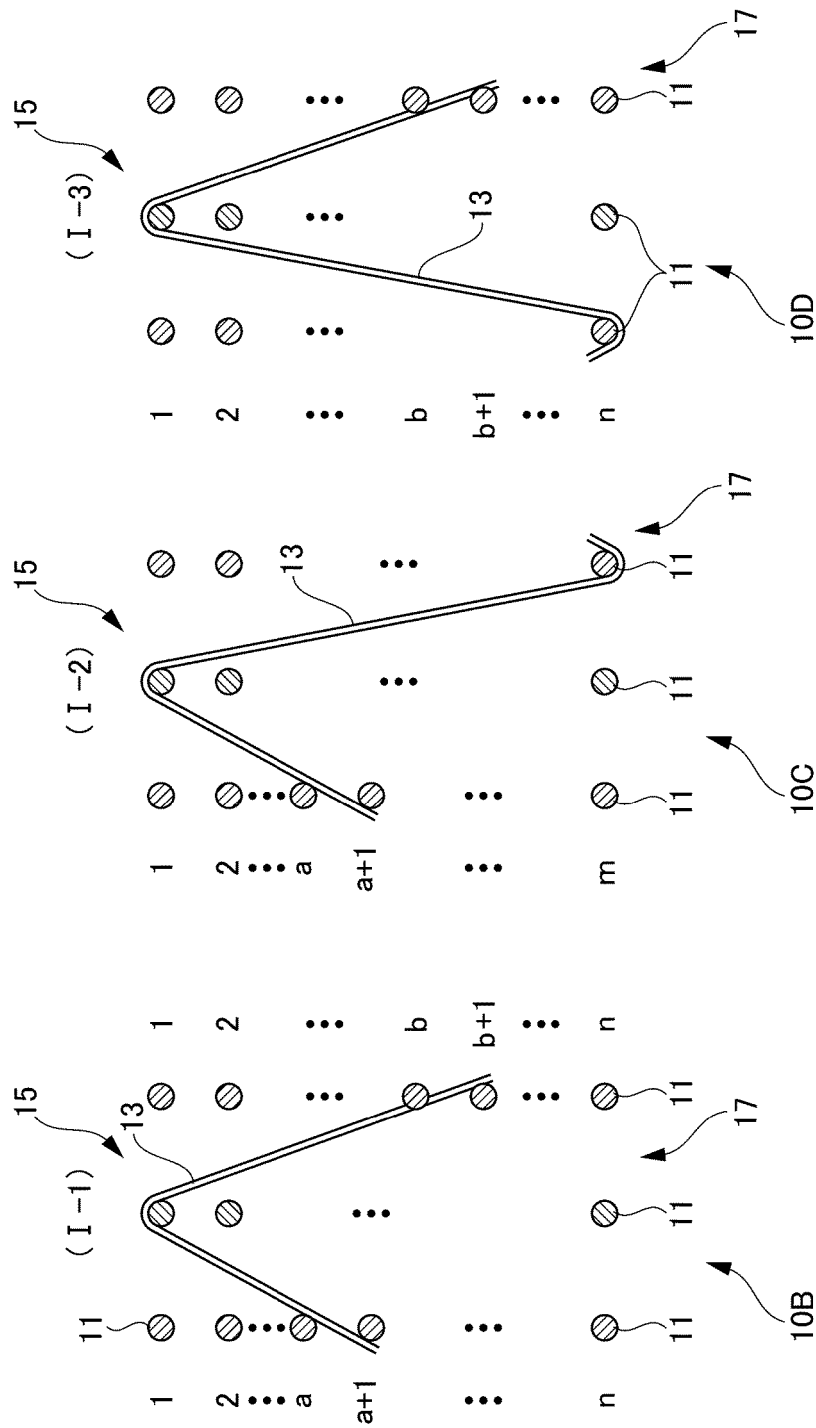


FIG. 8

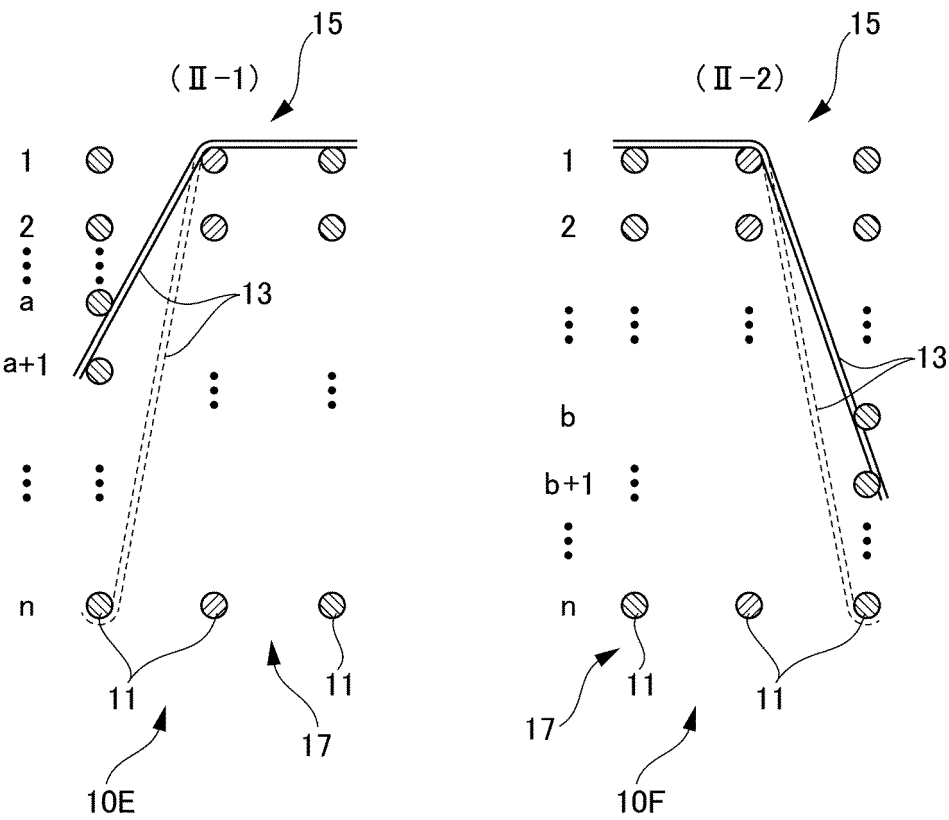


FIG. 9

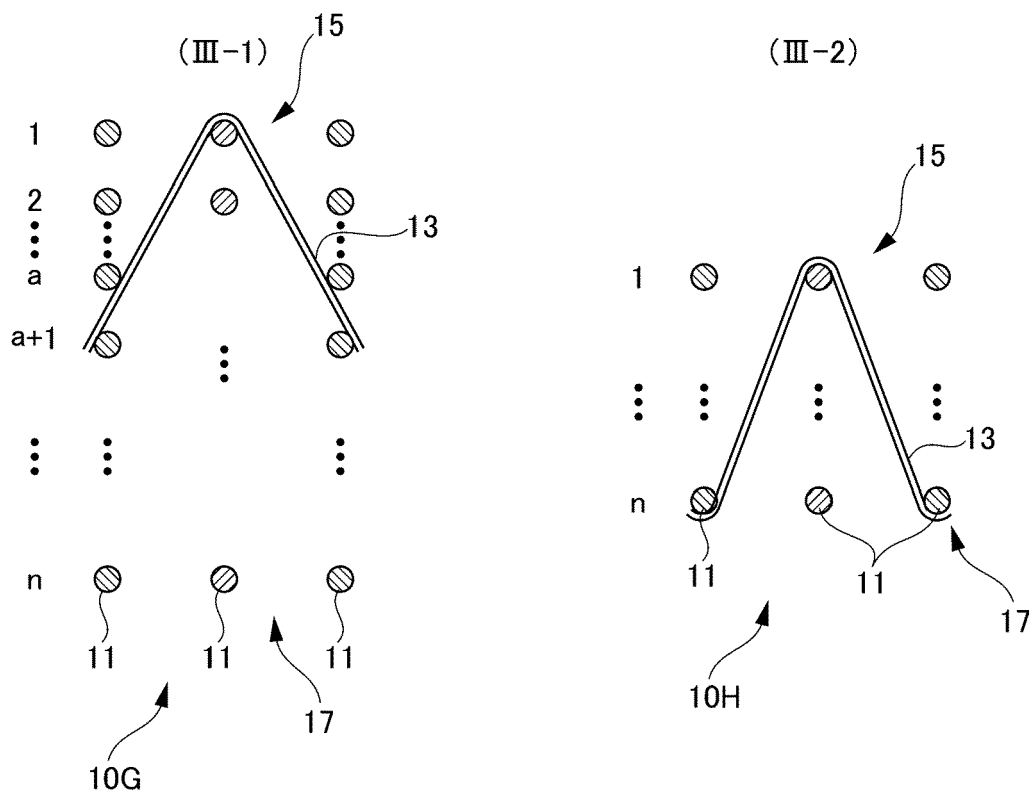


FIG. 10

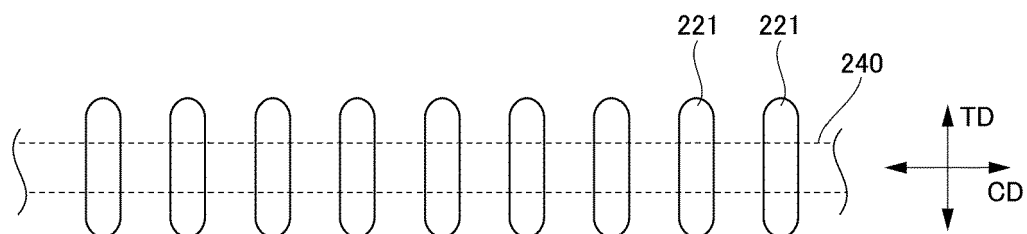


FIG. 11

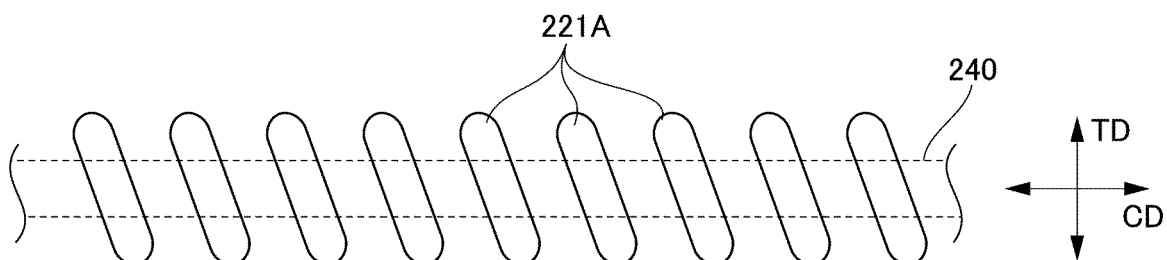


FIG. 12

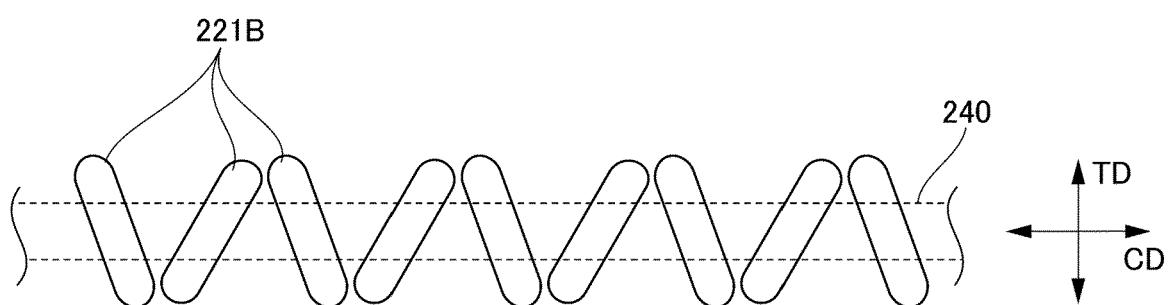


FIG. 13

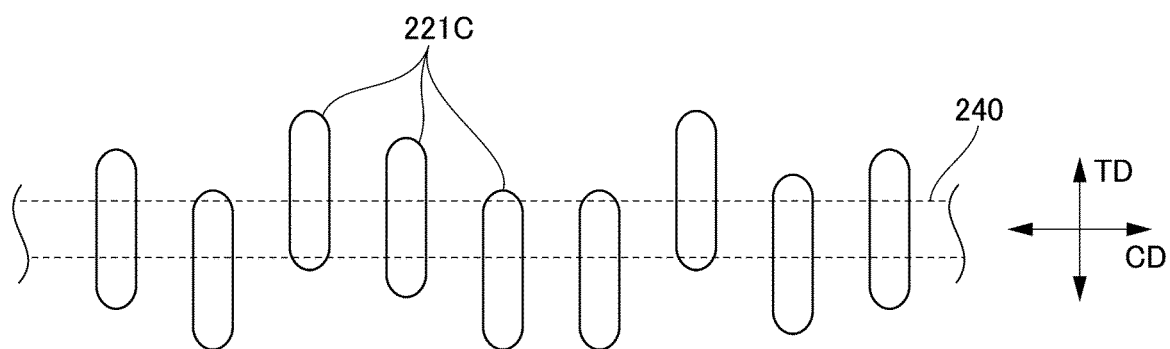


FIG. 14

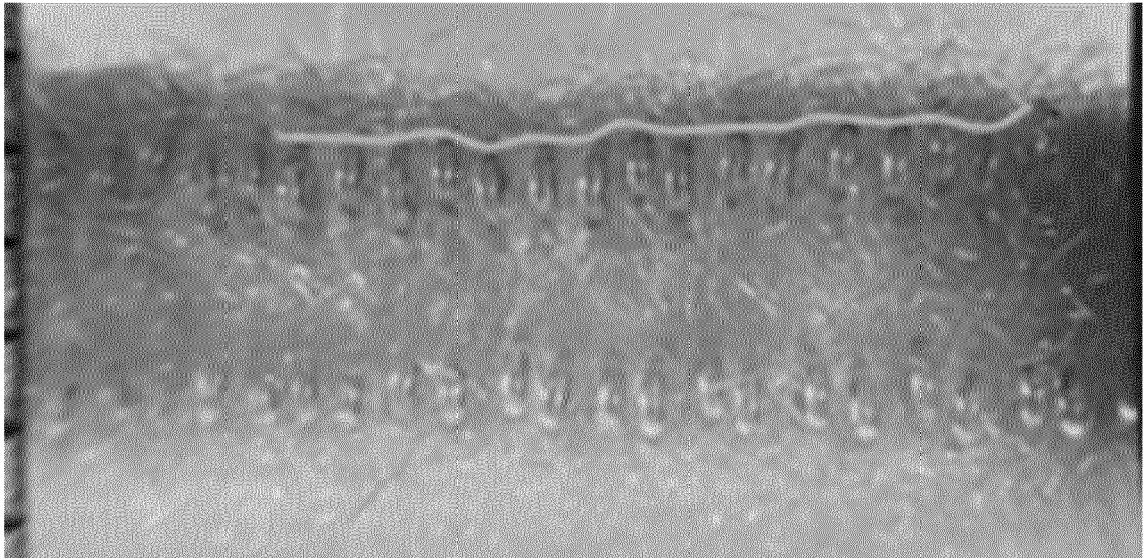


FIG. 15



FIG. 16

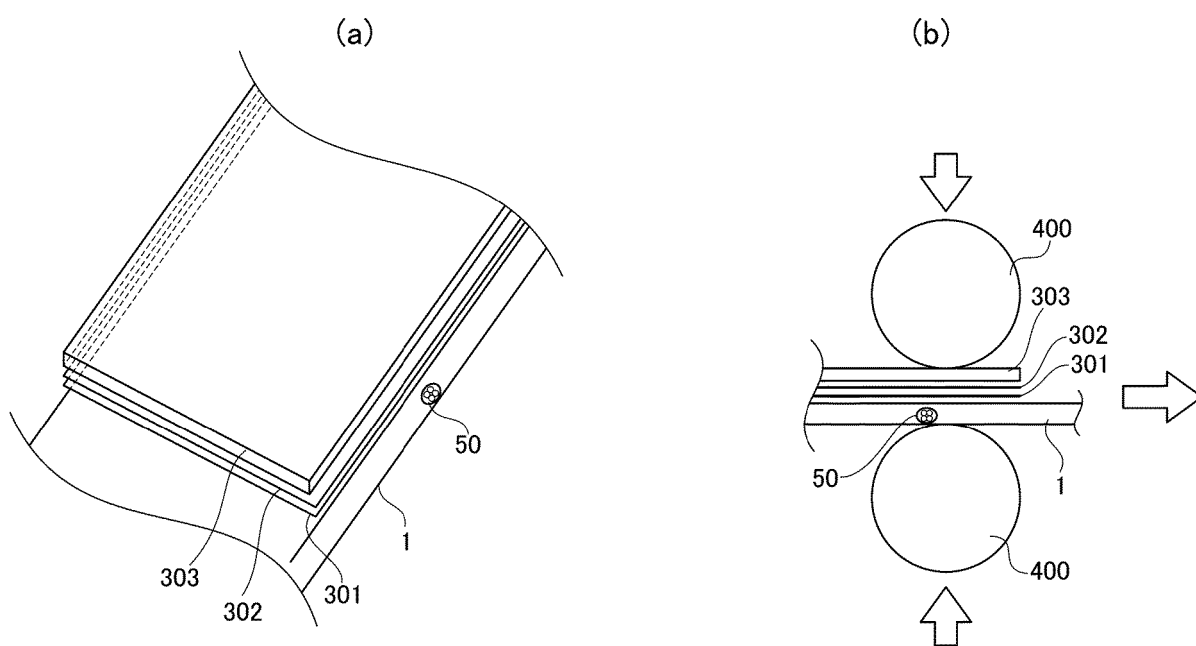


FIG. 17

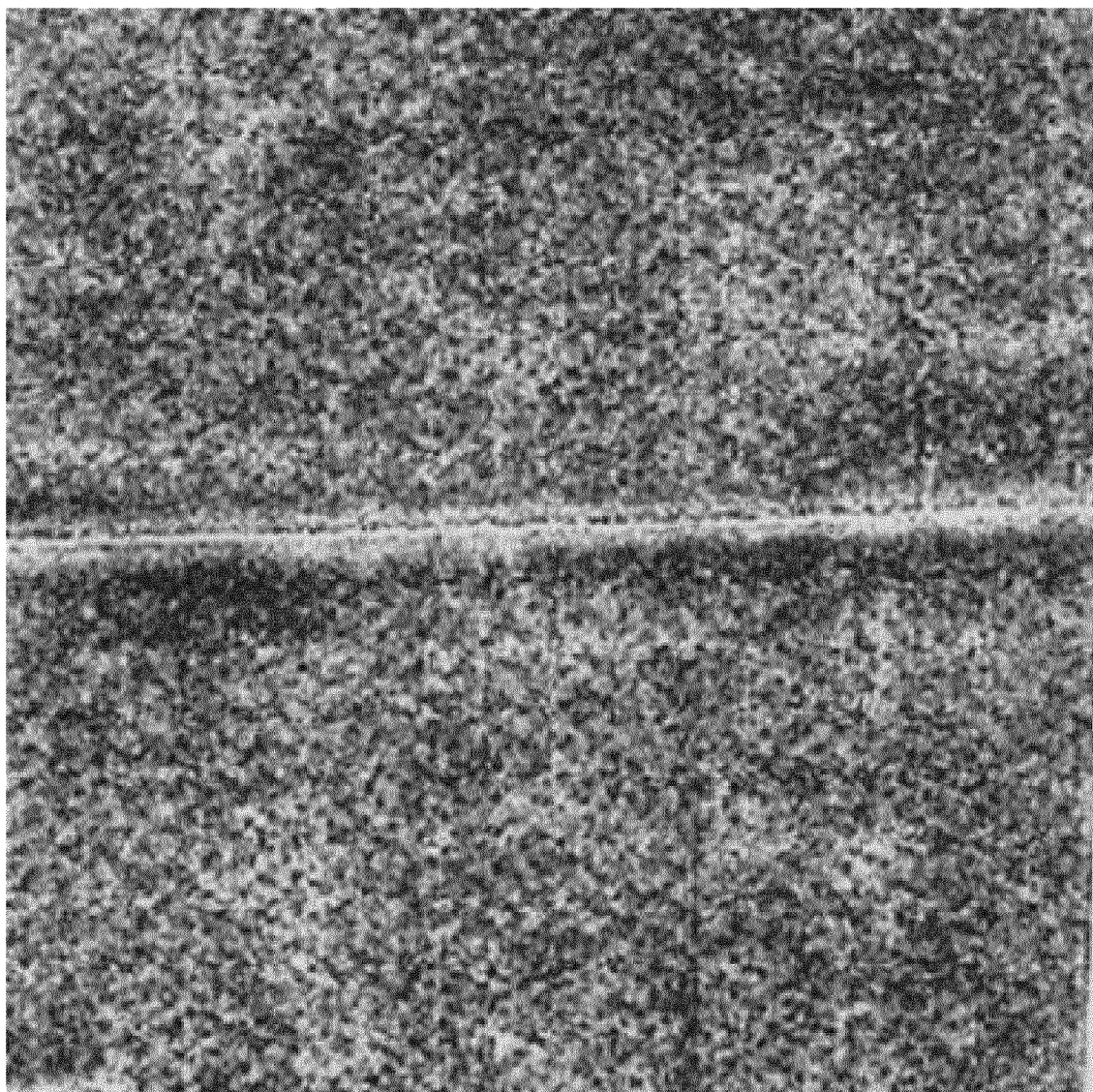
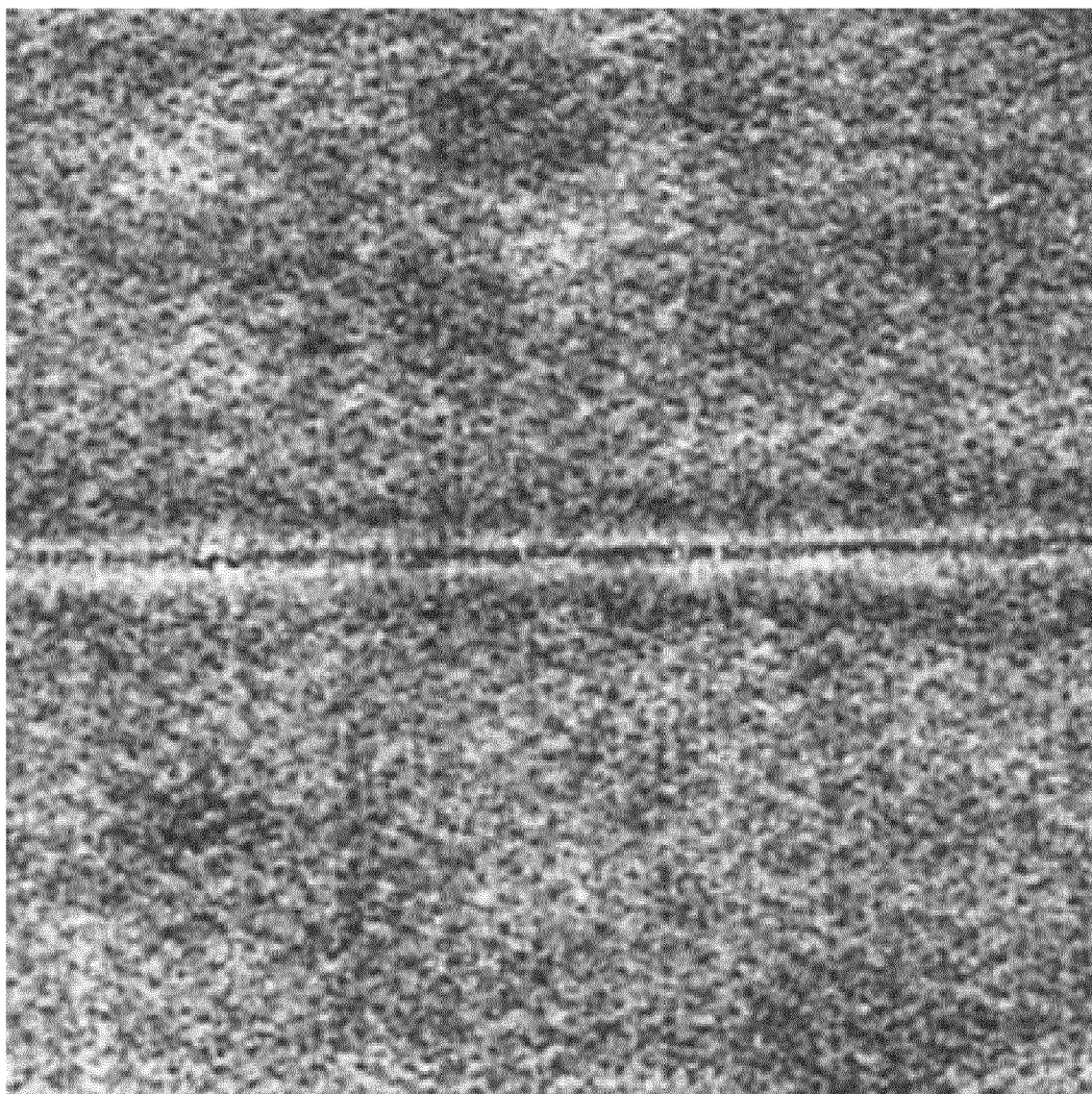


FIG. 18





## EUROPEAN SEARCH REPORT

Application Number

EP 24 21 0585

## DOCUMENTS CONSIDERED TO BE RELEVANT

| Category                                                                                                                                                                                                                                                                     | Citation of document with indication, where appropriate, of relevant passages                                                                 | Relevant to claim                | CLASSIFICATION OF THE APPLICATION (IPC) |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------------------------|
| A                                                                                                                                                                                                                                                                            | EP 2 157 235 A1 (VOITH PATENT GMBH [DE])<br>24 February 2010 (2010-02-24)<br>* column 5, last paragraph - column 6,<br>paragraph 2; figures * | 1-14                             | INV.<br>D21F1/00<br>D21F7/10            |
| A                                                                                                                                                                                                                                                                            | US 2012/145349 A1 (OGIWARA YASUYUKI [JP])<br>14 June 2012 (2012-06-14)<br>* paragraphs [0056] - [0059]; figures 3,4<br>*                      | 1-14                             |                                         |
| A                                                                                                                                                                                                                                                                            | US 7 135 093 B2 (WEAVEXX CORP [US])<br>14 November 2006 (2006-11-14)<br>* paragraphs [0027] - [0029]; figure *                                | 1-14                             |                                         |
|                                                                                                                                                                                                                                                                              |                                                                                                                                               |                                  | TECHNICAL FIELDS SEARCHED (IPC)         |
|                                                                                                                                                                                                                                                                              |                                                                                                                                               |                                  | D21F<br>D21J                            |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                   |                                                                                                                                               |                                  |                                         |
| Place of search                                                                                                                                                                                                                                                              |                                                                                                                                               | Date of completion of the search | Examiner                                |
| Munich                                                                                                                                                                                                                                                                       |                                                                                                                                               | 28 February 2025                 | von Mittelstaedt, A                     |
| CATEGORY OF CITED DOCUMENTS                                                                                                                                                                                                                                                  |                                                                                                                                               |                                  |                                         |
| X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document                                                      |                                                                                                                                               |                                  |                                         |
| T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                               |                                  |                                         |

EPO FORM 1503 03.82 (P04C01)

# **ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.**

EP 24 21 0585

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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20

25

30

35

40

45

50

55

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| EP 2157235 A1                             | 24-02-2010          | NONE                       |                     |
| -----                                     |                     |                            |                     |
| US 2012145349 A1                          | 14-06-2012          | CA 2761223 A1              | 08-06-2012          |
|                                           |                     | CN 102535229 A             | 04-07-2012          |
|                                           |                     | EP 2463437 A1              | 13-06-2012          |
|                                           |                     | EP 2749695 A1              | 02-07-2014          |
|                                           |                     | JP 2012122177 A            | 28-06-2012          |
|                                           |                     | US 2012145349 A1           | 14-06-2012          |
|                                           |                     | US 2013233503 A1           | 12-09-2013          |
| -----                                     |                     |                            |                     |
| US 7135093 B2                             | 14-11-2006          | AR 043665 A1               | 03-08-2005          |
|                                           |                     | AT E395461 T1              | 15-05-2008          |
|                                           |                     | AU 2004200988 A1           | 07-10-2004          |
|                                           |                     | BR PI0400259 A             | 28-12-2004          |
|                                           |                     | CA 2459832 A1              | 20-09-2004          |
|                                           |                     | CN 1532332 A               | 29-09-2004          |
|                                           |                     | EP 1460173 A2              | 22-09-2004          |
|                                           |                     | ES 2306931 T3              | 16-11-2008          |
|                                           |                     | JP 4178120 B2              | 12-11-2008          |
|                                           |                     | JP 2004285554 A            | 14-10-2004          |
|                                           |                     | KR 20040082960 A           | 30-09-2004          |
|                                           |                     | MX PA04002666 A            | 02-12-2004          |
|                                           |                     | US 2004182467 A1           | 23-09-2004          |
| -----                                     |                     |                            |                     |

EPO FORM P0459

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

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- JP 2023189834 A [0001]
- JP 2024165655 A [0001]
- JP 2008297637 A [0009]
- JP 2003247191 A [0010]
- JP 2003166189 A [0011]