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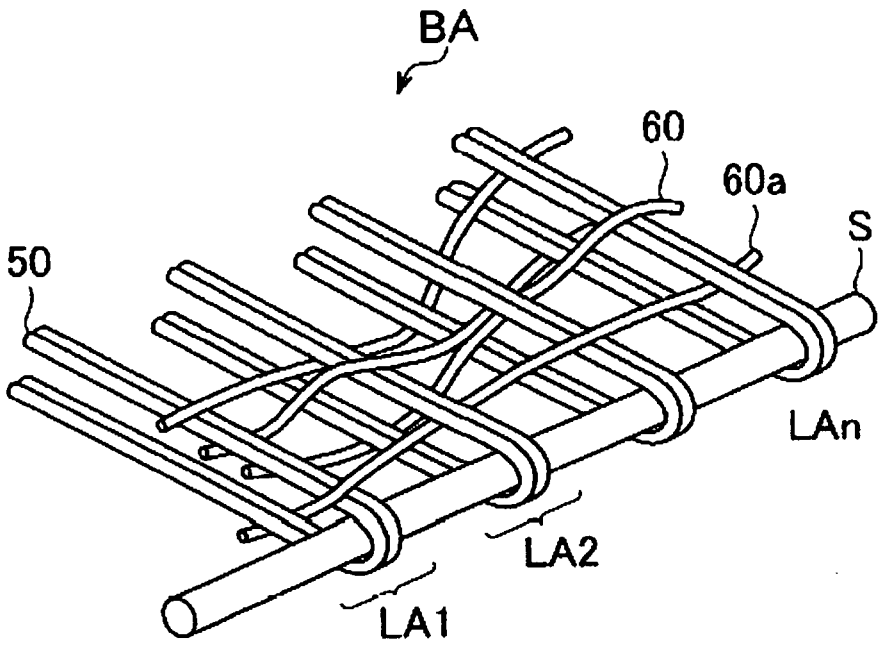
(54) **Felt with seam for paper manufacture**

(57) In a seam felt for paper manufacture, seam loops formed at opposite ends of a length of ground fabric to which layers of batt fiber are integrated by needle punching, are formed as groups of loops composed of machine direction yarns. When the opposite ends of the ground fabric are brought together, the groups of loops are intermeshed in an alternating arrangement to form a common bore for receiving a seam thread by which the intermeshed groups of loops are secured together. The loops of each group can be held together by adhesive bonding, or by heat adhesion if the machine direction yarns are core-in-sheath composite fibers wherein the sheath has a lower melting point than that of the core.

Fig. 5



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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority on the basis of Japanese patent application 232191/2008, filed September 10, 2008. The disclosure of Japanese application 232191/2008 is hereby incorporated by reference.

FIELD OF THE INVENTION

[0002] This invention relates to a felt employed in the press part of a paper manufacture machine, and particularly to a felt having seam loops, hereinafter sometimes be referred to simply as a "seam felt".

BACKGROUND OF THE INVENTION

[0003] In a paper manufacturing process, water is conventionally squeezed out from a wet paper web in the press part of a papermaking machine by means of a needle felt and a pair of press rolls. It is known to utilize a felt formed into an endless belt by connecting both ends of an elongated felt by means of seam loop. As shown in FIG. 1, the elongated felt F is formed into the shape of a belt, so that the loops L at its ends can be brought together and connected.

[0004] As shown in FIG. 2, the felt F comprises a ground fabric B and batt fiber layers W formed on the obverse and reverse sides thereof. The batt layers W are formed by web fibers laminated onto the ground fabric B by intertwining integration utilizing needle punching.

[0005] The ground fabric B is a woven fabric made up of yarns extending along the "machine direction" (MD), i.e., the direction of belt movement, and yarns extending along the "cross-machine direction" (CD). The seam loops L are formed by yarns extending along the MD direction.

[0006] When installed in a papermaking machine, and before its ends are connected together, the felt is hung on the machine and both ends of the felt are brought into abutment with each other. Then, the loops at the respective ends of the felt are intermeshed in an alternating arrangement so that, except at the ends of the rows of seam loops in the CD direction, each loop on one end of the felt is disposed between two adjacent loops on the other end of the felt.

[0007] As shown in FIG. 2(a), when the meshing operation takes place the portions of the felt near its ends are not in parallel, coplanar relationship. Instead, the two ends are arranged to form a peak, and then the loops are brought into intermeshing relationship. In other words, when the loops are brought into intermeshing relationship, loops at one end of the felt are moved upward into spaces between adjacent loops at the other end in a direction transverse to the direction in which the latter loops extend from their end of the felt. In practice, a jig (not described) is usually employed to facilitate the intermeshing of the seam loops.

[0008] After the loops are brought into intermeshing relationship, as shown in FIG. 2 (b), the loops of both ends of the felt form a common bore into which a seam thread S is inserted. Thereafter, the ends of the felt, now connected but still forming a peak, are brought into coplanar relationship to complete the formation of the endless paper manufacturing felt known as a "seam felt."

[0009] Because they can be installed easily in a papermaking machine, the use of seam felts has recently increased as explained in Japanese Laid-Open Patent application No. 2004-232142.

[0010] When the felt F is converted from a configuration having two free ends to an endless configuration, the opposite sides of the belt constitute an outer circumferential side and an inner circumferential side, respectively. The outer circumferential side contacts a wet paper web, and the inner circumferential side comes into contact with a press roll.

[0011] The structure of the ground fabric B is shown schematically in FIG. 3, which illustrates a double woven ground fabric at one end of the belt. The yarns extending in the MD direction are turned back on themselves so that each yarn includes upper side and lower side elements.

[0012] The ground fabric B comprises MD yarns 11A to 14B, and CD yarns 21 to 24. In the group of MD yarns 11A to 14B, yarns 11A and 11B are continuous with each other, as are yarns 12A and 12B, 13A and 13B, and 14A and 14B. Seam loops L are formed at each end of the ground fabric by virtue of the fact that the MD yarns are turned back on themselves.

[0013] To stabilize the forms of the seam loops, heat setting is performed in a next manufacturing step. Thereafter, the seam loops at both ends of the ground fabric B are intermeshed with one another and the ends of the ground fabric are connected by insertion of a seam thread S though the intermeshed loops. Batt fiber layers are then intertwiningly integrated with the ground fabric in a needle punching step. The completed felt is shown in FIG. 4 (see United States Patent No. 4,938,269). In FIG. 4, the seam loops of one end are shown somewhat darker than the seam loops at the other end so that it is more easily seen that the seam loops are meshed in an alternating arrangement.

[0014] When the seam felt is completed, the seam thread S is pulled out, and the seam loops become disengaged so that the felt again has two free ends. The felt can then be packaged for shipment. When the felt is newly installed in

a papermaking machine, the rolls of the machine do not need to be dismounted and their supports do not need to be disengaged. The seam felt which is to be newly installed is brought into the paper machine with the aid of a guiding as described in Japanese Laid-Open Patent Application No. 284092/1996.

[0015] When the new seam felt is in place on the machine rolls, its free ends are brought into abutment with each other, and a seam thread S is inserted into the tubular space formed by the intermeshed seam loops L of the opposing ends of the felt. If the meshing of the seam loops L is poor, the insertion of the seam thread S can require a considerable amount of time and effort. For example, if a loop becomes slanted, or is drawn into the ends of the felt along the MD direction, the inside diameter of the loop can become smaller. When one or more of the loops becomes smaller, the space for receiving the seam thread S, formed by the intermeshing loops, becomes uneven, increasing the difficulty of insertion of the core line member.

[0016] In addition, the engagement of the seam loops L in an alternating arrangement is by its nature complicated and difficult. The difficulty of arranging the loops in proper intermeshing relationship also increases as the diameter of the MD direction yarns decreases, making the assembly of the felt more time-consuming.

SUMMARY OF THE INVENTION

[0017] An object of the invention is to solve the above-mentioned problems, and to provide a seam felt for paper manufacture having ends that can be joined more quickly and easily so that installation of the felt in a papermaking machine can be carried out more quickly and easily.

[0018] I have discovered that forming groups of seam loops, each with two or more yarns in the MD direction arranged in side by side relationship leads to a solution of the above-described problems.

[0019] The seam felt for paper manufacture according to the invention has some features in common with a conventional seam felt. These features include the fact that it comprises a ground fabric having two ends meeting each other so that the felt forms a closed loop, the direction around the loop being a machine direction, and each of the ends being formed with seam loops intermeshed with seam loops formed at the other end and forming a common bore, a seam thread S extending through the common bore formed by the intermeshed seam loops, thereby connecting said ends of the fabric together, and batt fiber layers intertwiningly integrated with the ground fabric by needle punching.

[0020] In the seam felt according to the invention, however, the intermeshed seam loops comprise groups of seam loops formed on each of the ends of the belt. The groups of seam loops formed on the respective ends of the ground fabric are intermeshed with one another in alternating relationship, and each said group is composed of a plurality of seam loops on the same end of the ground fabric arranged in side by side relationship without seam loops formed on the other end of the ground fabric interposed between any of the seam loops of said group.

[0021] Preferably, each group of seam loops is composed of at least two but not more than three seam loops.

[0022] In an embodiment of the invention, the seam loops forming each group are integrated with one another by adhesive bonding.

[0023] In an alternative embodiment, yarns of the seam loops, which are yarns of the ground fabric extending in the machine direction, are each composed of a core-in-sheath composite fiber comprising a sheath surrounding a core. The melting temperature of the sheath is lower than the melting point of the core, and the seam loops in each of the groups are integrated by fusion of their sheaths, that is, by heat adhesion.

[0024] Preferably, the distance between adjacent seam loops in a group is equal to or smaller than the diameter of the MD yarns of the ground fabric. Even more preferably, the seam loops are formed such that adjacent seam loop within a group are in contact with each other or almost in contact

[0025] One of the advantages of the Invention is that, with groups of seam loops each composed of two or more loops of MD yarn arranged side by side, even if the yarns forming the seam loops are thin, the seam loops at the opposite ends of the ground fabric can be brought easily into stable meshing relationship easily when the ends are connected while the felt is being installed in a papermaking machine.

[0026] Another advantage is that if the seam loops in a group are joined together by adhesive bonding or fused together, the group becomes more difficult to displace either in the cross-machine direction or in directions transverse to the faces of the felt. Therefore, the seam loops can be more stably positioned in the desired configuration so that intermeshing of the seam loops can be carried out smoothly.

BRIEF DESCRIPTION OF DRAWINGS

[0027] FIG. 1 is a schematic perspective view of a conventional felt for paper manufacture, in which the ends of the felt are separated from each other;

[0028] FIGs. 2(a) and 2(b) are respectively sectional and perspective views, illustrating the meshing of the ends of the felt of FIG. 1;

[0029] FIG. 3 is a fragmentary perspective view showing details of the seam loop part of the conventional felt;

[0030] FIG. 4 is a schematic perspective view of the conventional felt showing the completion of the connection of its ends;

[0031] FIG. 5 is fragmentary perspective view of the seam loop part of a felt according to the invention;

[0032] FIG. 6 is a sectional view along the CD (cross direction) direction of a felt for paper manufacture according to a different embodiment of the invention; and

[0033] FIG. 7 is a perspective view illustrating the meshing state of the seam loop part of a felt according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0034] FIG. 5 shows one end of a double weave ground fabric BA according to the invention. The ground fabric BA is a woven fabric comprising MD yarns 50 and CD yarns 60. The MD yarns 50 are turned back on themselves at an end, and arranged in groups LA1, LA2...LAn, each group being composed of two seam loops in side-by-side relationship. As shown in FIG. 5, the seam loops in each group are in contact or almost in contact with each other. The seam loops in each group can be disposed either in contact with each other or spaced from each other by an interval equal to or smaller than the fiber diameter of the MD yarns 50.

[0035] The MD yarns 50 are preferably supplied to the weaving machine as monofilament yarns. Preferably, each group of seam loops is composed of two or three monofilament yarns. If a group of adjacent seam loops is composed of four or more yarns, the distance between groups of seam loops, i.e., a distance corresponding to the distance between groups LA1 and LA2 in FIG. 5, will become excessively wide, impairing the strength of the seam and bringing about a risk of seam failure.

[0036] The CD yarns 60 can be either single monofilament yarns or twisted monofilament yarns. Multifilament yarns or spinning yarns are preferably employed as the CD yarns 60a in the vicinity of the seam thread S, so that the intertwining of the batt fibers with the CD yarns by needle punching is strengthened at and near the locations of the seam.

[0037] After the ground fabric BA is prepared by weaving, it is heat set in order to stabilize the forms of the seam loops. With the groups of seam loops at both ends of the ground fabric intermeshed in alternating relationship the ends of the ground fabric are connected by insertion of a seam thread S, batt fiber layers are intertwiningly integrated with the ground fabric by needle punching to complete the felt.

[0038] The seam thread S is pulled out of the seam loops of the completed felt to disengage the ends of the felt. The product can then be packaged for shipment. In the same manner as in the case of a conventional felt, the seam felt according to the invention is mounted on to a papermaking machine. Then, with both ends of the seam felt in abutment with each other and with a plurality of groups of seam loops at both ends in mesh with one other in an alternating arrangement, a seam thread S is inserted into a common bore formed by the meshing of the seam loops to connect the ends of the seam felt together, forming an endless seam felt on the papermaking machine.

[0039] It is desirable to join the seam loops of each group together using an adhesive so that they are integrated with each other. Alternatively, where the MD yarns are core-in-sheath composite fibers in which the sheath has a lower melting point than that of the core, the seam loops of each group can be joined, and thereby stabilized, by heat adhesion, causing the sheaths to fuse to one another. The joining of the seam loops for stabilization of the loops by heat can be carried out in a heat setting process.

[0040] A group of seam loops may consist of more than two seam loops arranged side by side, so that, even if the MD yarns forming the seam loops are thin, the seam loops at the opposite ends of the felt can be meshed easily and stably when seaming is carried out on a papermaking machine. In addition, if the seam loops in a group are bonded together, the group is less easily displaced in the cross machine direction and also less easily displaced in directions transverse to the faces of the felt. When the seam loops of the groups are bonded together, the seam loops can be stably positioned and their configuration maintained so that meshing can be carried out smoothly.

[0041] With the seam loops in groups, and especially when the seam loops in each group are bonded together, it is less likely that loops will becomes slanted, or drawn into the ends of the felt along the MD direction so that their inside diameters become smaller. Therefore the common bore formed by the meshed loops can be more uniform, and the seam thread S can be inserted easily.

[0042] Examples of seam felts in accordance with the invention will now be described by way of illustration but not for the purpose of limiting the scope of the invention. For the examples, the following yarns were prepared for use as MD yarns and CD yarns:

Yarn A: monofilament (single yarn) of nylon 6.
Fineness: 1000dtex (diameter of fiber: 0.33mm)

Yarn B: monofilament (single yarn) of nylon 6.
Fineness: 500dtex (diameter of fiber: 0.23mm)

Yarn C: monofilament (single yarn) of core-in-sheath composite fiber having nylon 6, with a high melting point of 250 degrees Celsius, as the core, and copolymerized nylon, with a lower melting point of 180 degrees Celsius, as the sheath.
Fineness 1000dtex (diameter of fiber: 0.32mm)

EXAMPLE 1

[0043] In this example, yarn A was employed as the MD yarns, and yarn B was used as the CD yarns. The ground fabric BA1 was fabricated by 3/1 1/3 warp double weaving. A cross-sectional view of the weave in the CD direction is shown in FIG. 6. For the MD yarns, two yarns set side by side were supplied to the weaving machine so that the seam loops are formed with two yarns constituting one group. For the ground fabric BA1, the MD yarns were turned back on themselves at the position of the seam thread S as shown in FIG. 7.

[0044] FIG. 7 is a perspective view of the seaming section of the ground fabric BA1 showing groups LB1 and LA2 of seam loops at one end, and a groups LB1 at the other end, joined together by a seam thread S form and endless felt.

[0045] Following weaving, the ground fabric BA1 was drawn out from the weaving machine, and hung on a pair of rolls. Then, the ground fabric was subjected to heat treatment, using a heating device (not shown). The heating device can be installed on one of the rolls or between the rolls. The heat treatment heat sets the ground fabric BA1, stabilizing the forms of the seam loop groups. Afterward heat treatment, a liquid resin was applied to the seam loop groups and dried. The application and drying of the resin bonded the seam loops of each group, integrating them together. Where the seam thread S is constituted by a yarn made of resin having low surface free energy, such as a fluoric resin, the liquid resin may be applied only to a part of the groups of seam loops, making it easier to draw out the seam thread S.

[0046] Following heat treatment and resin application, the ground fabric BA1 was hung onto a needle punching machine, and laminated with batt fibers comprising 15dtex staple fibers. The needle punching operation intertwines the batt fibers with the ground fabric, integrating the layers to complete the seam felt. The batt fiber layers were laminated with a basis weight of 300g/m^2 on the outer circumferential side of the felt, and with a basis weight of 100g/m^2 on the inner circumferential side.

[0047] As a final step, the seam thread S was pulled out of the felt, so that the completed seam felt 1 in accordance with the invention had two free ends.

EXAMPLE 2

[0048] As in the first example, in this example, yarn A was employed as the MD yarn, and yarn B was used as the CD yarn.
The ground fabric was woven in 3/1 1/3 warp double weave.

[0049] In this case, the supply speed of the CD yarn and the supply speed of the MD yarn were adjusted on the weaving machine so that the seam loops of each group were separated by a distance close to the diameter of yarn A. A ground fabric having a 0.2mm seam loop interval in the seam loop groups was obtained. The remaining conditions were the same as in Example 1. Thus, the seam felt 2 of the present invention was completed.

EXAMPLE 3

[0050] In this example, yarn C was used as the MD yarn, and yarn B was employed as the CD yarn, the ground fabric was prepared in he same manner as that in Example 1. The ground fabric was then subjected to heat setting, as in example 1, to stabilize the forms of the groups of seam loops. In this example, the heat set temperature was adjusted to at least 180 degrees Celsius, causing the copolymerized nylon sheath of the yarn C to melt, thereby joining the seam loops of each group.
In other respects, the process was the same as in Example 1. Thus, the seam felt 3 of the present invention was completed.

EXAMPLE 4

[0051] In this example, yarn A was used as the MD yarn, and yarn B was used as the CD yarn. For the MD yarn, three yarns were supplied as one set to the weaving machine, so that each seam loop group was composed of three yarns. In other respects, the example (seam felt 4) was the same as Example 1.

EXAMPLE 5

[0052] In this example, yarn A was used as the MD yarn, and yarn B used as the CD yarn. For the MD yarn, four yarns were supplied to the weaving machine as one set, and consequently each group of seam loops was constituted by four

yarns. In other respects, the conditions were the same as those of Example 1. Thus, the seam felt 5 of the present invention was completed.

COMPARATIVE EXAMPLE 6

[0053] In a comparative example (seam felt 6), yarn A was used as the MD yarn, and yarn B was as the CD yarn. The yarns were woven in a 3/1 1/3 warp double configuration to produce a ground fabric B. The MD yarn was composed of only one continuous yarn and the MD yarns were turned back at one end.
As shown in FIG. 3, each seam loop was composed of only a single yarn having top and bottom elements. The manufacturing process was otherwise the same as that of Example 1.

[0054] The seam strength, the conditions of meshing, and the ease of mounting of the seam felts made according to the six examples were determined. The results are shown in Table 1 below.

[0055] Seam strength was evaluated, in units of kg/5cm, by the cutting strength when the seam thread was interposed in the common bore defined by the meshed seem loops.

[0056] In the evaluation of meshing conditions, the degree of inclination of the seam loops, and the degree to which the seam loops were drawn in their root direction into the felt were examined. When the total number of inclined groups of loops and drawn-in loops in a seam section 1m in length was less than five, the seam was evaluated as "good"; when there were five or more but no more than ten inclined groups and drawn-in loops, the seam was evaluated as "slightly good"; and when there were more than ten inclined groups of loops and drawn-in loops, the seam was evaluated as "poor".

[0057] The ease of mounting was evaluated on the basis of the time in working hours needed for seaming per 1m in the CD direction after the seam felt was mounted onto a papermaking machine.

[TABLE 1]

seam felt	seam strength	meshing condition of seam loop	ease of felt mounting work
seam felt 1	200	slightly good	3
seam felt 2	200	slightly good	3
seam felt 3	200	good	3
seam felt 4	180	good	1 or less
seam felt 5	150	good	1 or less
seam felt 6	200	poor	5 or more

[0058] The numbers assigned to the seam felts in column 1 correspond to the example numbers. When the seam strength of seam felt 1 is compared with that of seam felt 6 (the comparative example) no difference was found to exist. In seam felt 1, there is an interval of two MD yarn widths between the groups of the seam loops, but, with this interval, there is no noticeable influence on the strength of the seam. The meshing condition was evaluated as "slightly good" and the ease of mounting was better than the ease of mounting of seam felt 6. Seam felt 2, in which the seam loops of each group do not come into direct contact but are separated by a small interval achieved an evaluation equivalent to the evaluation of seam felt 1.

[0059] The seam felt 3, in which a core-in-sheath composite fiber was employed as the MD yarn, achieved a better meshing condition evaluation than that achieved by seam felt 1, where a liquid resin was applied to harden the neighborhood of the seam loops.

[0060] Seam felt 4 exhibited a slightly lower seam strength, but good meshing conditions, and superior ease of mounting.

[0061] Finally, in the case of seam felt 5 where each group of seam loops consisted of four yarns, the interval between groups of seam loops was equal to four MD yarn widths. This resulted in a slight drop off of seam strength compared to that of seam felt 4. However, meshing conditions were good, and ease of mounting was very good, as in the case of seam felt 4.

[0062] It should be understood that the examples described herein are not the only possible embodiments of the invention. Other embodiments will be apparent to persons skilled in the art from the foregoing description, and are within the scope of the invention as defined by the following claims.

Claims

1. A seam felt for paper manufacture comprising a ground fabric having two ends meeting each other so that the felt forms a closed loop, the direction around the loop being a machine direction, and each of said ends being formed with seam loops intermeshed with seam loops formed at the other of said ends and forming a common bore, a seam thread extending through said common bore formed by the intermeshed seam loops, thereby connecting said ends of the fabric together, and batt fiber layers intertwiningly integrated with said ground fabric by needle punching, wherein the intermeshed seam loops comprise groups of seam loops formed on each of said ends, said groups formed on the respective ends of the ground fabric being intermeshed with one another in alternating relationship, and wherein each said group is composed of a plurality of seam loops on the same end of the ground fabric arranged in side by side relationship without seam loops formed on the other end of the ground fabric interposed between any of the seam loops of said group.

2. A seam felt for paper manufacture according to claim 1, wherein each said group of seam loops is composed of at least two but not more than three seam loops.

3. A seam felt for paper manufacture according to claim 1 or 2, wherein the seam loops forming each said group are integrated by adhesive bonding.

4. A seam felt for paper manufacture according to claim 1 or 2, wherein the seam loops are formed by yarns of the ground fabric extending in the machine direction, each said yarn being a core-in-sheath composite fiber comprising sheath surrounding a core, wherein the melting temperature of the sheath is lower than the melting point of the core, and wherein the seam loops in each of said groups are integrated by fusion of their sheaths.

Fig. 1

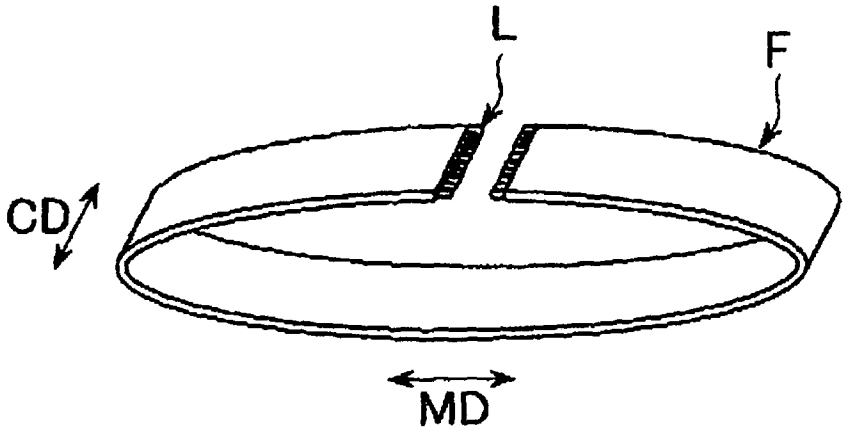


Fig. 2

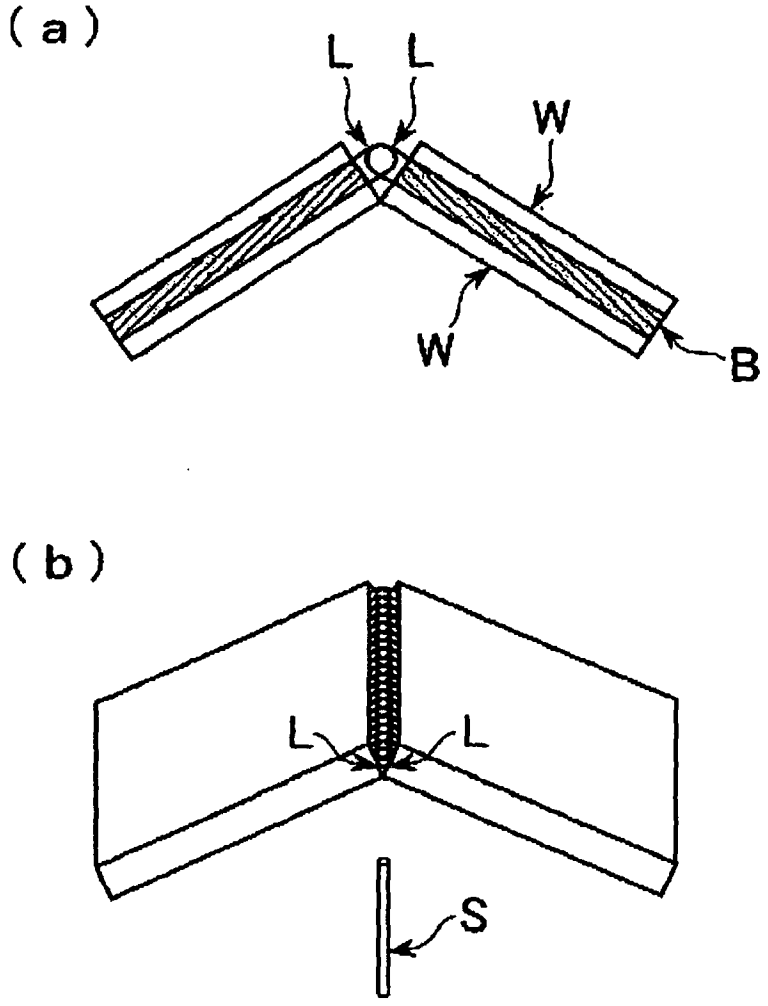


Fig. 3

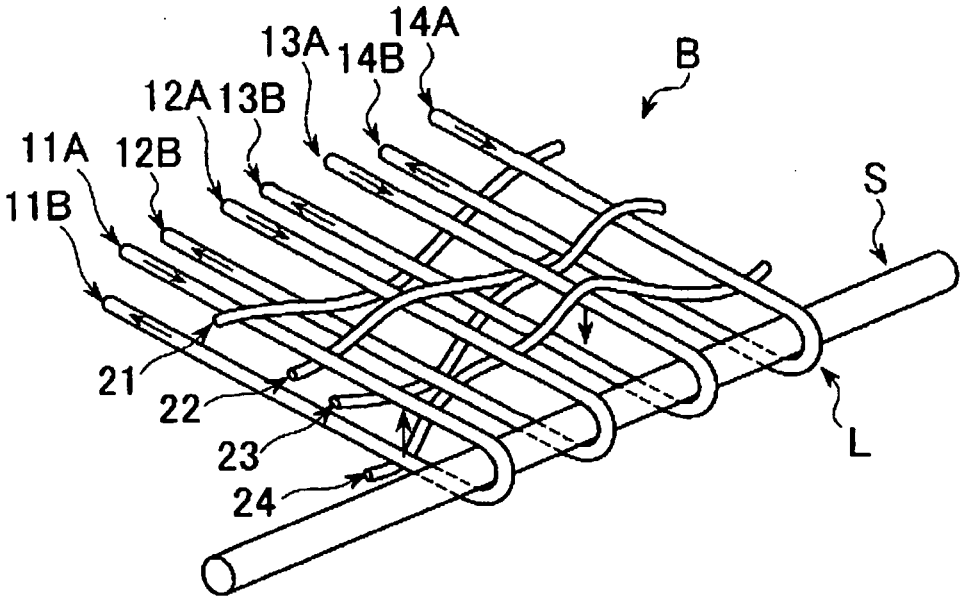


Fig. 4

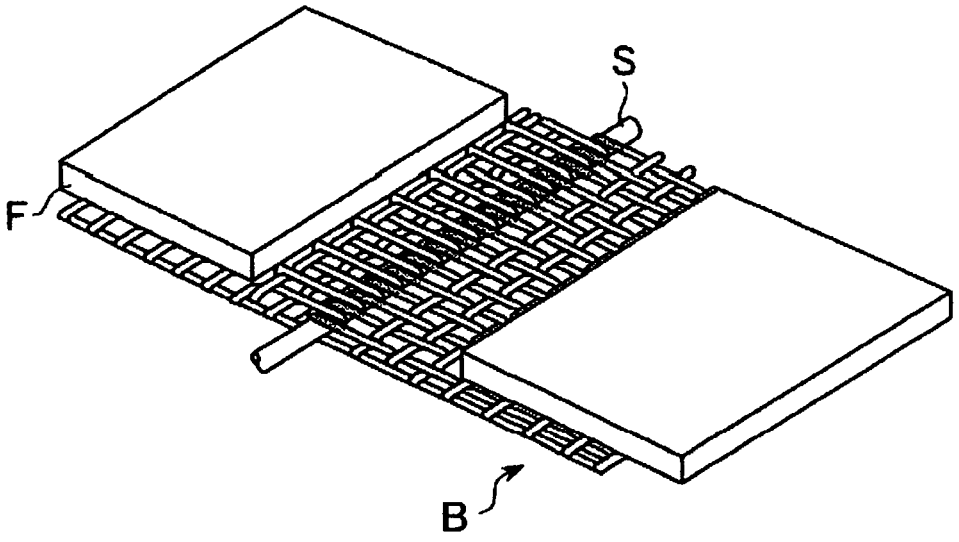


Fig. 5

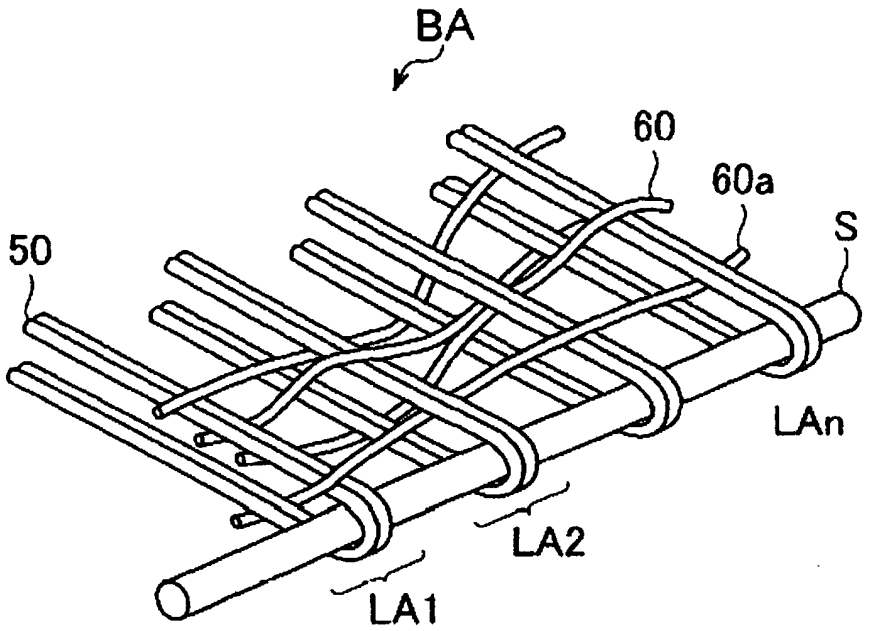


Fig. 6

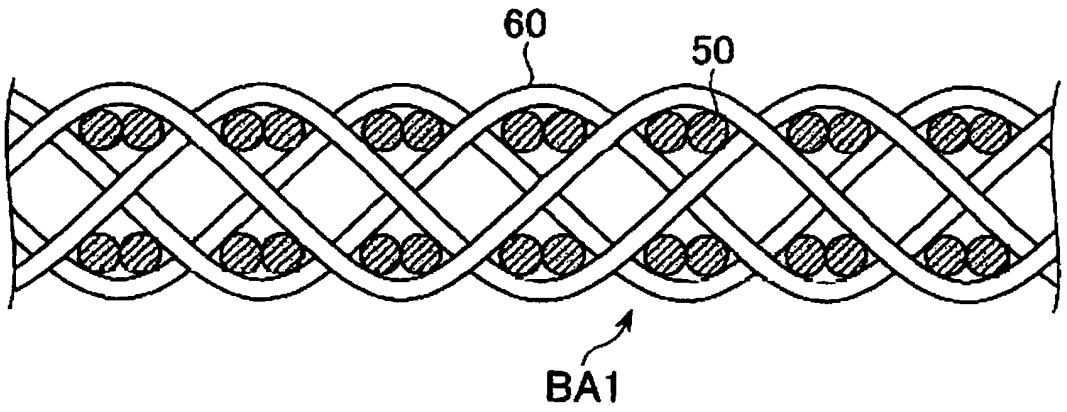
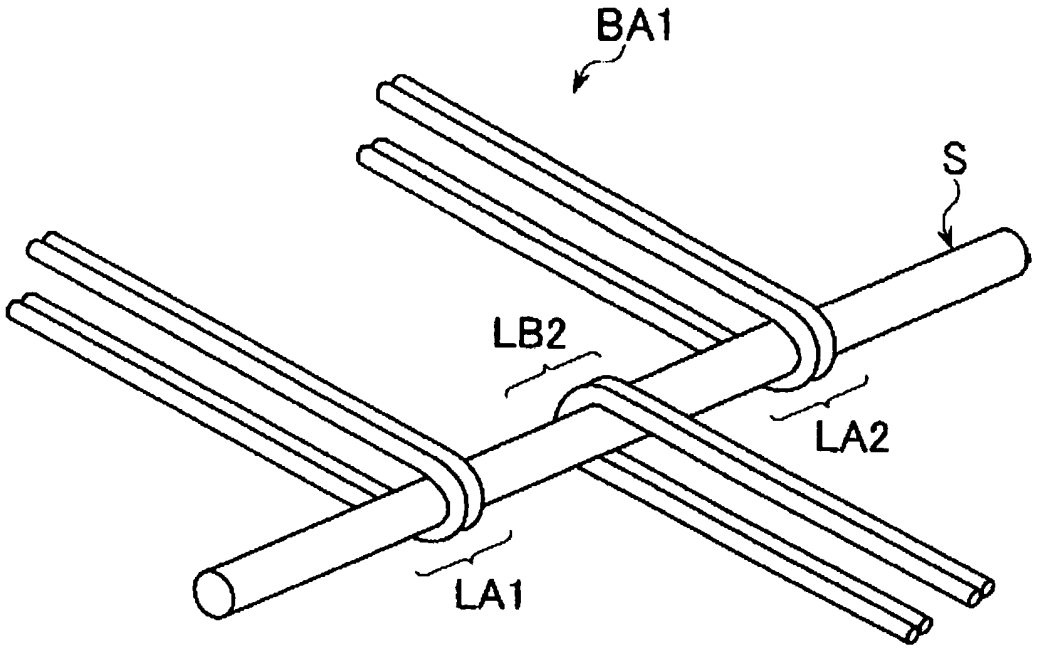


Fig. 7



REFERENCES CITED IN THE DESCRIPTION

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