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(54) **SEAMED INDUSTRIAL FABRICS**

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Description

Background of the Invention

1. Field of the Invention

[0001] The present invention relates to the papermaking and related arts. More specifically, the present invention is an industrial fabric of the on-machine-seamable variety, such as an on-machine-seamable press fabric for the press section of a paper machine.

2. Description of the Prior Art

[0002] During the papermaking process, a cellulosic fibrous web is formed by depositing a fibrous slurry, that is, an aqueous dispersion of cellulose fibers, onto a moving forming fabric in the forming section of a paper machine. A large amount of water is drained from the slurry through the forming fabric, leaving the cellulosic fibrous web on the surface of the forming fabric.

[0003] The newly formed cellulosic fibrous web proceeds from the forming section to a press section, which includes a series of press nips. The cellulosic fibrous web passes through the press nips supported by a press fabric, or, as is often the case, between two such press fabrics. In the press nips, the cellulosic fibrous web is subjected to compressive forces which squeeze water therefrom, and which adhere the cellulosic fibers in the web to one another to turn the cellulosic fibrous web into a paper sheet. The water is accepted by the press fabric or fabrics and, ideally, does not return to the paper sheet.

[0004] The paper sheet finally proceeds to a dryer section, which includes at least one series of rotatable dryer drums or cylinders, which are internally heated by steam. The newly formed paper sheet is directed in a serpentine path sequentially around each in the series of drums by a dryer fabric, which holds the paper sheet closely against the surfaces of the drums. The heated drums reduce the water content of the paper sheet to a desirable level through evaporation.

[0005] It should be appreciated that the forming, press and dryer fabrics all take the form of endless loops on the paper machine and function in the manner of conveyors. It should further be appreciated that paper manufacture is a continuous process which proceeds at considerable speeds. That is to say, the fibrous slurry is continuously deposited onto the forming fabric in the forming section, while a newly manufactured paper sheet is continuously wound onto rolls after it exits from the dryer section.

[0006] Referring, for the moment, specifically to press fabrics, it should be recalled that, at one time, press fabrics were supplied only in endless form. This is because a newly formed cellulosic fibrous web is extremely susceptible to marking in the press nip by any nonuniformity in the press fabric -or fabrics. An endless, seamless fabric, such as one produced by the process known as endless weaving, has a uniform structure in both its longitudinal (machine) and transverse (cross-machine) directions. A seam, such as a seam which may be used to close the press fabric into endless form during installation on a paper machine, represents a discontinuity in the uniform structure of the press fabric. The use of a seam, then, greatly increases the likelihood that the cellulosic fibrous web will be marked in the press nip.

[0007] For this reason, the seam region of any workable on-machine-seamable press fabric must behave under load, that is, under compression in the press nip or nips, like the rest of the press fabric, and must have the same permeability to water and to air as the rest of the press fabric, in order to prevent the periodic marking of the paper product being manufactured by the seam region.

[0008] Despite the considerable technical obstacles presented by these requirements, it remained highly desirable to develop an on-machine-seamable press fabric because of the comparative ease and safety with which such a fabric could be installed on the press section. Ultimately, these obstacles were overcome with the development of press fabrics having seams formed by providing seaming loops on the crosswise edges of the two ends of the fabric. The seaming loops themselves are formed by the machine-direction (MD) yarns of the fabric. The seam is closed by bringing the two ends of the press fabric together, by interdigitating the seaming loops at the two ends of the fabric, and by directing a so-called pin, or pintle, through the passage defined by the interdigitated seaming loops to lock the two ends of the fabric together. Needless to say, it is much easier and far less time-consuming to install an on-machine-seamable press fabric, than it is to install an endless press fabric, on a paper machine.

[0009] One method to produce a press fabric that can be joined on the paper machine with such a seam is to flat-weave the fabric. In this case, the warp yarns are the machine-direction (MD) yarns of the press fabric. To form the seaming loops, the warp yarns at the ends of the fabric are turned back and woven some distance back into the fabric body in a direction parallel to the warp yarns. Another technique, far more preferable, is a modified form of endless weaving, which normally is used to produce an endless loop of fabric. In modified endless weaving, the weft, or filling, yarns are continuously woven back and forth across the loom, in each passage forming a loop on one of the edges of the fabric being woven by passing around a loop-forming pin. As the weft yarn, or filling yarn, which ultimately becomes the MD yarn in the press fabric, is continuous, the seaming loops obtained in this manner are stronger than any that can be produced by weaving the warp ends back into the ends of a flat-woven fabric.

[0010] Originally, single monofilament strands were used in both the machine and cross-machine directions of on-machine-seamable press fabrics. The relative

stiffness of monofilament ensures that it will have the requisite good seaming-loop formation properties. Experience showed, however, that single monofilament strands are difficult to weave and have insufficient elasticity in the machine direction for many kinds of contemporary presses. Tensile failure and seam breakage were frequent occurrences.

[0011] Another difficulty is presented by the very open, rigid, incompressible structure of base fabrics woven from single monofilament. For some papermaking applications, this incompressibility is not a problem, and may even be ideal. However, for positions that have poor auxiliary fabric dewatering capacity, or produce mark-sensitive paper grades, a softer, more compressible base fabric is needed.

[0012] A more compressible base fabric may be obtained by weaving with multifilament or plied monofilament yarns, instead of with single monofilament strands. However, yarns of these types do not have the rigidity necessary for good loop formation or for maintaining the integrity of the seam area during the loop interdigitation required when the seam is to be closed. Moreover, because yarns of these types are twisted, loops formed from them tend to rotate about axes lying in the planes formed by the loop. When this rotation, known as the secondary helix effect, occurs, it causes the loops to rotate from the ideal orientation needed for interdigitation. Such departure makes it difficult, if not impossible, to properly interdigitate the loops at each end of the press fabric during closure, as well as to direct the pintle through the passage defined by the interdigitated loops.

[0013] Various attempts have been made in the prior art to overcome these difficulties by making non-monofilament loop-forming MD yarns act like monofilament. In U.S. Patent No. 5,005,610, the MD yarns in an on-machine-seamable papermakers' fabric have a composite structure including braided monofilament strands. The braided yarn forms seaming loops which resist deformation and, because they are balanced with regard to twist, form seaming loops which are not susceptible to "secondary helix effect" rotation from the ideal plane geometry of the seam.

[0014] In U.S. Patent No. 5,204,150, the MD yarns in an on-machine-seamable papermakers' fabric are plied/twisted yarns extruded from a resin which partially melts during the heat-setting of the fabric, giving the MD yarns a monofilament-like character. Even though not balanced due to the twisting and plying, the fusion caused by the partial melting of the individual ends prevents loop rotation from the ideal seam geometry.

[0015] In U.S. Patent No. 5,391,419, the MD yarns of an on-machine-seamable papermakers' fabric are plied/twisted yarns having a coating which gives the yarn a monofilament-like structure. The coating may be either permanent, semi permanent or soluble. Even though the yarns may not be balanced, the coating prevents loop rotation.

[0016] In U.S. Patent No. 5,514,438, the MD yarns of an on-machine-seamable papermakers' fabric have a core of cabled monofilaments surrounded by a sheath of multifilaments. The multifilament sheath binds the cabled monofilaments together, and prevents any of the monofilaments in the core from blocking the passage defined by the interdigitated loops formed by the MD yarns during seaming.

[0017] Finally, in U.S. Patent No. 5,875,822, the MD yarns of an on-machine-seamable papermakers' fabric are plied/twisted yarns and form seaming loops along the widthwise edges at the two ends of the fabric. A monofilament seaming spiral is attached to the seaming loops at each end. The seaming spirals are used to join the fabric into endless form, thereby providing a fabric having plied/twisted MD yarns with monofilament joining means.

[0018] The present invention represents a different approach for providing an on-machine-seamable industrial fabric having plied/twisted MD yarns with seaming loops which maintain their integrity and proper orientation during seaming.

Summary of the Invention

[0019] Accordingly, the objective of the present invention is to provide an on-machine-seamable industrial fabric having multicomponent MD yarns with seaming loops which maintain the proper orientation and the required integrity for seaming.

[0020] This objective is met according to claim 1 by using, as the machine-direction (MD) yarns, multicomponent yarns comprising a plurality of individual yarn strands and at least one, thermofusible strand of a thermoplastic material, wherein the thermoplastic material of the at least one thermofusible strand has a melting point lower than that of the individual yarn strands in the multicomponent yarn. As a result, upon application of a heat treatment to any given length of the multicomponent yarn at a temperature higher than the melting point of the thermofusible strand but below that of the individual yarn strands, the thermoplastic material melts and flows into the spaces between the individual yarn strands, and, at the conclusion of the heat treatment, resolidifies and stiffens the multicomponent yarn and holds the individual yarn strands thereof together along that given length. This ensures that the seaming loops formed by the multicomponent yarns will maintain the proper orientation and the required integrity for seaming.

[0021] In addition, the inclusion of one or more thermofusible strands in the multicomponent yarn enables the stiffness of the yarn to be controlled based upon the number and/or sizes of the thermofusible strands included. In turn, this enables fabric compressibility and resiliency to be controlled to a greater degree than is possible in fabrics manufactured with yarns not having thermofusible strands.

[0022] The multicomponent yarns may be plied

monofilament, plied multifilament, multifilament or plied/twisted yarns or combinations thereof. By a plied/twisted yarn is meant any variety of yarn used in the production of paper machine clothing having multiple ends or filaments, which are twisted together to a desired degree, and, in many cases, then combined or plied with other filaments of the same type or of a different type. During the plying operation, the yarn components are combined together by twisting them in the opposite direction from that of the individual components. The plied/twisted yarns may accordingly be considered to be multicomponent yarns. The multicomponent yarns may alternatively be braided or knitted yarns. In any event, the multicomponent yarn includes at least one thermofusible strand.

[0023] The individual yarn strands included in the multicomponent yarn are typically of circular cross section, although it should be understood that they may be of any of a variety of other cross-sectional shapes, such as rectangular, oval or multilobed. The multicomponent yarn, produced by ply/twisting, braiding or knitting its components, may have a cross section which is not circular in shape.

[0024] The present on-machine-seamable industrial fabric may be woven in a modified endless weaving technique from a system of MD yarns and a system of cross-machine-direction (CD) yarns, wherein the MD yarns are the multicomponent yarns described above. Alternatively, the industrial fabric may be flat-woven, wherein the MD yarns, the warp yarns during the weaving process, are again the multicomponent yarns. In each case, the industrial fabric has a rectangular shape with a length, a width, two lengthwise edges and two widthwise edges.

[0025] In the modified endless weaving technique, the MD yarns (multicomponent yarns) extend back-and-forth continuously for the length of the industrial fabric between the two widthwise edges and form a first plurality of seaming loops along one of the two widthwise edges and a second plurality of seaming loops along the other of the two widthwise edges. Upon application of the heat treatment described above, which could be carried out any time during the manufacturing process, even at the yarn-forming stage, the multicomponent yarns, and seaming loops formed therefrom, are stiffened and the plurality of individual yarn strands thereof held together by the thermoplastic material of the at least one thermofusible strand in the multicomponent yarn.

[0026] On the other hand, when the industrial fabric is flat-woven, warp yarns extending from the two widthwise edges thereof are turned back and woven some distance back into the fabric body to form the seaming loops.

[0027] The industrial fabric is joined into endless form by interdigitating the seaming loops of the first plurality with the seaming loops of the second plurality and by directing a pintle through the passage defined by the interdigitated seaming loops to close the loop seam, locking the two widthwise edges of the fabric together.

[0028] It should be understood that the multicomponent yarns may also be used in the cross-machine direction (CD) to enhance the CD stability of the fabric. In an endless woven structure, with or wirthout a seam, the stiffness of the CD yarn has a direct bearing on the number of MD and CD yarns that may be included in a fabric. The use in weaving of a yarn of lower stiffness allows a broader range of, and especially higher, end counts. When the present multicomponent yarn is used in the cross-machine direction, the number of MD and CD yarns in the fabric may be increased, and the multicomponent yarn may be stiffened appropriately after weaving by the application of heat.

[0029] The present multicomponent yarn may also be used as the machine-direction (MD) yarn in a flat-woven fabric which is to be joined into endless form with a woven seam because they can be designed to take the crimp required to form such a seam.

[0030] The present invention will now be described in more complete detail with frequent reference being made to the figures identified below.

Brief Description of the Drawings

[0031]

Figure 1 is a schematic perspective view of an on-machine-seamable industrial fabric;

Figure 2 is a schematic perspective view of the two ends of the on-machine-seamable industrial fabric prior to their being joined to one another;

Figure 3 is a cross-sectional view, taken in the warpwise direction, of the industrial fabric;

Figure 4 is a cross-sectional view, taken in the weftwise direction, of the seam region of the industrial fabric; and

Figure 5 is a cross-sectional view, analogous to that provided in Figure 4, of the seam region of an alternate embodiment of the industrial fabric.

Detailed Description of the Preferred Embodiment

[0032] Turning now specifically to the figures, Figure 1 is a schematic perspective view of an on machine-seamable industrial fabric 10. The fabric 10 takes the form of an endless loop once its two ends 12,14 have been joined to one another at seam 16.

[0033] Figure 2 is a schematic perspective view of the two ends 12,14 of the on-machine-seamable industrial fabric 10 prior to their attachment to one another. Widthwise across the edges of each of the two ends 12,14 are a plurality of seaming loops 18. To attach the two ends 12,14 to one another, they are brought together, in so doing alternating and intermeshing, or interdigitating, the seaming loops 18 at each end with one another. The interdigitated seaming loops 18 define a passage

through which a pin, or pintle, a yarn-like strand or member, may be directed to secure the ends 12,14 to one another.

[0034] Figure 3 shows a cross section, taken in the warpwise direction, of an industrial fabric 20 on which the present invention may be practiced. Fabric 20 is shown to be woven in a duplex weave, although it should be understood that such a weave is shown as an example only, and that the invention could be practiced with fabrics 20 that are woven in other weaves, such as single-, two-, three- or higher layer weaves, or which are laminated and include several fabric layers. Fabric 20 may be a base fabric for a press fabric, and, accordingly, may be needled with one or more layers of staple fiber batt material on one or both sides, or may be coated in some manner. Alternatively, fabric 20 may be used on one of the other sections of the paper machine, that is, on the forming or drying sections, or as a base for a polymeric-resin-coated, paper-industry process belt (PIPB). Moreover, fabric 20 may be used as a corrugator belt or as a base thereof; as a pulp-forming fabric, such as a double-nip-thickener belt; or as other industrial process belts.

[0035] Fabric 20 is woven using a modified endless weaving technique. In such a situation, warp yarns 22 ultimately become the cross-machine-direction (CD) yarns, and the weft yarns 24 ultimately become the machine-direction (MD) yarns, when reference is made to the orientations of the yarns relative to the machine on which fabric 20 is installed.

[0036] Warp yarns 22, the CD yarns in the on-machine-seamable fabric 20, may be of any of the yarn types used to weave bases for paper machine fabrics or PIPB's, or for the other fabrics and belts mentioned above. That is to say, monofilament yarns, which are monofilament strands used singly, or multicomponent yarns, as described above, may be used as warp yarns 22.

[0037] Weft yarns 24, the MD yarns in the on-machine-seamable fabric 20, on the other hand, are multicomponent yarns. As described above, multicomponent yarns may be plied monofilament, plied multifilament, multifilament or plied/twisted yarns or combinations thereof. The multicomponent yarns may also be braided or knitted yarns.

[0038] In any event, the individual yarn strands comprising warp yarns 22 (CD yarns) and weft yarns 24 (MD yarns) are extruded from synthetic polymeric resin materials, such as polyamide, polyester, polyetherketone, polypropylene, polyaramid, polyolefin, polyphenylene sulfide (PPS) and polyethylene terephthalate (PET) resins, and copolymers thereof, and incorporated into yarns according to techniques well-known in the textile industry and particularly in the paper machine clothing industry.

[0039] The weft yarns 24 (MD yarns), in addition to having a plurality of individual yarn strands, also include at least one thermofusible strand of a thermoplastic material, wherein the thermoplastic material has a melting point lower than that of the individual yarn strands making up the multicomponent yarn. As a consequence, upon application of a heat treatment at a temperature higher than the melting point of the thermofusible strand but below that of the individual yarn strands of the multicomponent yarn, the thermoplastic material stiffens the multicomponent yarn, and seaming loops 18 formed therefrom, and holds the individual yarn strands of the multicomponent yarn together. This ensures that the seaming loops formed by the multicomponent yarns will maintain the proper orientation and the required integrity for seaming. The thermoplastic material may, for example, be polyamide 66, low-melt polyamide 6 or polyurethane.

[0040] As noted above, the multicomponent yarn includes at least one thermofusible strand of the thermoplastic material. That is, it may include one, two, three or more thermofusible strands. The thermofusible strand may be monofilament or multifilament, either of which may be of non-circular cross section. It may be an extruded yarn or a strand cut from a film of the thermoplastic material. It may also be of a strand or strands obtained or cut from a nonwoven material web of polyamide or polyurethane of a low melting temperature. Nonwoven material webs of this type are available from Sharnet.

[0041] In the weaving of fabric 20 by modified endless weaving, the weft yarns 24 are continuously woven back and forth across the loom, in each passage thereacross forming a seaming loop on one of the two widthwise edges of the fabric 20 being woven by passing around a loop-forming pin. Several schemes, disclosed and claimed in U.S. Patent No. 3,815,645 to Codorniu for weaving on-machine-seamable papermakers' fabrics by modified endless weaving are available and may be used in the practice of the present invention.

[0042] Figure 4 is a cross section, taken in the weftwise direction, of the seam region of the fabric 20 taken at the conclusion of the modified endless weaving process. Weft yarns 24, ultimately the MD yarns in fabric 20, weave around loop-forming pin 26 in a continuous manner to provide seaming loops 18.

[0043] It will be appreciated that loop-forming pin 26 must be removed to place fabric 20 into a form in which it may readily be installed on a particular machine. It will also be appreciated that, because weft yarns 24 (MD yarns) are multicomponent yarns, seaming loops 18 may rotate from the ideal seaming-loop geometry, illustrating the secondary helix effect, and deform as soon as the loop-forming pin 26 is removed, rendering subsequent seaming difficult or impossible.

[0044] For this reason, the heat treatment which stiffens and consolidates the multicomponent yarns is carried out before the loop-forming pin 26 is removed. It should be appreciated, however, that the heat treatment can be carried out either before or after the fabric 20 is woven, even at the yarn-forming stage. Further, where staple fiber batt material is to be needled into the fabric

20, the heat treatment can be carried out either before or after the needling process, although heat treatment following needling is preferred because the thermoplastic material of the at least one thermofusible strand improves the anchoring of the staple fiber batt material to the base fabric 20.

[0045] The industrial fabric is joined into endless form by interdigitating the seaming loops 18 at one end of the fabric with those at the other end and by directing a pintle through the passage defined by the interdigitated seaming loops 18. Alternatively, as shown in Figure 5, another cross section of the seam region of the fabric 20 taken in the machine direction, seaming spirals 28 may be attached to the seaming loops 18 and used to join the fabric 20 into the form of an endless loop.

[0046] Specifically, seaming spirals 28 may be interdigitated with seaming loops 18 and joined thereto by connecting yarns 30. In this manner, fabric 20, having multicomponent yarns in the machine direction, may be provided with monofilament seaming loops in the form of the individual coils of the seaming spirals 28.

[0047] Seaming spirals 28 may be monofilament spirals, preferably of extruded polyamide resin. The monofilament diameter may be, for example, 0.40 mm or 0.50 mm. During the installation of fabric 20 on a paper machine, for example, the individual coils of seaming spirals 28, being of monofilament, may be readily interdigitated with one another and joined to one another by directing pintle 32 through the passage defined by the interdigitated coils. Stuffer yarns 34 may be inserted within the seaming spirals 28 to ensure that the seam region has characteristics similar to the rest of the fabric 20. Connecting yarns 30 and stuffer yarns 34 may be yarns of the same types used as the warp yarns 22 (CD yarns) of the fabric 20. Pintle 32 may be a single strand of monofilament, multiple strands of monofilament untwisted about one another, or plied, twisted, braided or knitted together, or one or more strands of any of the multicomponent yarns described above for use as the MD yarns (weft yarns 24) of fabric 20.

[0048] Modifications to the above would be obvious to those of ordinary skill in the art, but would not bring the invention so modified beyond the scope of the appended claims.

Claims

1. An industrial fabric comprising:

a system of machine-direction (MD) yarns and a system of cross-machine-direction (CD) yarns, said yarns of said system of MD yarns being interwoven with said yarns of said system of CD yarns to form said industrial fabric in a rectangular shape having a length, a width, two surfaces, two lengthwise edges, and two widthwise edges, **characterized in that** said MD yarns are multicomponent yarns comprising a plurality of individual yarn strands and at least one thermofusible strand of a thermoplastic material, said at least one thermofusible strand having a melting point lower than that of said individual yarn strands, so that, upon application of a heat treatment, said multicomponent yarns are stiffened and said plurality of individual yarn strands thereof are held together by said thermoplastic material of said at least one thermofusible strand.

2. An industrial fabric as claimed in claim 1, said industrial fabric being closable into endless form with a loop seam during installation on a machine,

wherein said yarns of said system of MD yarns are interwoven with said yarns of said system of CD yarns by a modified endless weaving technique, said MD yarns extending back-and-forth continuously-for said length of said industrial fabric between said two widthwise edges and forming a first plurality of seaming loops along one of said two widthwise edges and a second plurality of seaming loops along the other of said two widthwise edges,

whereby said industrial fabric is joined into endless form by interdigitating said first plurality of seaming loops with said second plurality of seaming loops and by directing a pintle through the passage defined by the interdigitated seaming loops to close said loop seam.

3. An industrial fabric as claimed in claim 1, said industrial fabric being closable into endless form with a pin seam during installation on a machine,

wherein said yarns of said system of MD yarns are interwoven with said yarns of said system of CD yarns by a flat weaving technique, said MD yarns along said two widthwise edges being turned back and woven back into said industrial fabric to form a first plurality of seaming loops along one of said two widthwise edges and a second plurality of seaming loops along the other of said two widthwise edges,

whereby said industrial fabric is joined into endless form by interdigitating said first plurality of seaming loops with said second plurality of seaming loops and by directing a pintle through the passage defined by the interdigitated seaming loops to close said pin seam.

4. An industrial fabric as claimed in claim 1 wherein said yarns of said system of MD yarns are interwoven with said yarns of said system of CD yarns by a flat weaving technique, said two widthwise edges of said industrial fabric being joined to one another with a woven seam to place said industrial fabric into endless form.

5. An industrial fabric as claimed in claim 1 wherein said multicomponent yarns are plied monofilament yarns.

6. An industrial fabric as claimed in claim 1 wherein said multicomponent yarns are plied multifilament yarns.

7. An industrial fabric as claimed in claim 1 wherein said multicomponent yarns are multifilament yarns.

8. An industrial fabric as claimed in claim 1 wherein said multicomponent yarns are plied/twisted yarns.

9. An industrial fabric as claimed in claim 1 wherein said multicomponent yarns are yarns selected from the group consisting of plied monofilament yarns, plied multifilament yarns, multifilament yarns, plied/twisted yarns and combinations thereof.

10. An industrial fabric as claimed in claim 1 wherein said multicomponent yarns are knitted yarns.

11. An industrial fabric as claimed in claim 1 wherein said multicomponent yarns are braided yarns.

12. An industrial fabric as claimed in claim 1 wherein said individual yarn strands of said multicomponent yarns are extruded from a polymeric resin material.

13. An industrial fabric as claimed in claim 12 wherein said polymeric resin material is selected from the group consisting of polyamide, polyester, polyetherketone, polypropylene, polyaramid, polyolefin, polyphenylene sulfide (PPS) and polyethylene terephthalate (PET) resins, and copolymers thereof.

14. An industrial fabric as claimed in claim 1 wherein said thermoplastic material of said at least one thermofusible strand is selected from the group consisting of polyamide 66, low-melt polyamide 6 and polyurethane.

15. An industrial fabric as claimed in claim 1 wherein said at least one thermofusible strand is a monofilament.

16. An industrial fabric as claimed in claim 1 wherein said at least one thermofusible strand is a multifilament.

17. An industrial fabric as claimed in claim 1 wherein said at least one thermofusible strand is a strand cut from a film of said thermoplastic material.

18. An industrial fabric as claimed in claim 1 wherein said at least one thermofusible strand is a strand of a nonwoven material.

19. An industrial fabric as claimed in claim 1 wherein said CD yarns are also said multicomponent yarns.

20. An industrial fabric as claimed in claim 1 further comprising at least one layer of staple fiber batt attached to one of said two surfaces thereof.

21. An industrial fabric as claimed in claims 2 or 3 further comprising:

a first seaming spiral having a plurality of coils interdigitated with said seaming loops of said first plurality at one of said two widthwise edges of said industrial fabric and attached thereto by at least one connecting yarn extending in a cross-machine direction; and
a second seaming spiral having a plurality of coils interdigitated with said seaming loops of said second plurality at the other of said two widthwise edges of said industrial fabric and attached thereto by at least one connecting yarn extending in a cross-machine direction,
whereby said industrial fabric is joined into endless form by interdigitating said coils of said first seaming spiral with said coils of said second seaming spiral and by directing a pintle through the passage defined by the interdigitated coils to close said loop seam.

22. An industrial fabric as claimed in claim 21 wherein said first and second seaming spirals are monofilament spirals.

23. An industrial fabric as claimed in claim 22 wherein said monofilament spirals are extruded from a polyamide resin.

24. An industrial fabric as claimed in claim 21 further comprising at least one stuffer yarn within said first seaming spiral.

25. An industrial fabric as claimed in claim 21 further comprising at least one stuffer yarn within said second seaming spiral.

Patentansprüche

1. Technisches Gewebe mit:

einem Gefüge von Maschinenrichtungs- (MD) -Garnen und einem Gefüge von Quermaschinenrichtungs- (CD)-Garnen, wobei die Garne des Gefüges der MD-Garne mit den Garnen des Gefüges der CD-Garne verwoben sind, um das technische Gewebe in einer rechteckigen

Form zu bilden, die eine Länge, eine Breite, zwei Oberflächen, zwei Längskanten und zwei Breitenkanten aufweist, **dadurch gekennzeichnet, daß** die MD- Garne Mehrkomponentengarne sind, die eine Mehrzahl von einzelnen Garnsträngen und mindestens einen warmverschweißbaren Strang eines thermoplastischen Materials aufweisen, wobei der mindestens eine warmverschweißbare Strang einen Schmelzpunkt aufweist, der niedriger als der der einzelnen Garnstränge ist, so daß bei der Anwendung einer Wärmebehandlung die Mehrkomponentengarne gesteift werden und die Mehrzahl der einzelnen Garnstränge derselben durch das thermoplastische Material des mindestens einen warmverschweißbaren Strangs zusammengehalten werden.

2. Technisches Gewebe nach Anspruch 1, wobei das technische Gewebe während der Installation auf einer Maschine mit einer Schlingenaht zu einer Endlosform verschließbar ist,
wobei die Garne des Gefüges der MD-Garne mit den Garnen des Gefüges der CD-Garne durch eine modifizierte Endloswebetechnik verwoben sind, wobei sich die MD-Garne durchgehend über die Länge des technischen Gewebes zwischen den beiden Breitenkanten hin und her erstrecken und eine erste Mehrzahl von Saumschlingen längs einer der beiden Breitenkanten und eine zweite Mehrzahl von Saumschlingen längs der anderen der beiden Breitenkanten bilden,
wodurch das technische Gewebe zu einer Endlosform zusammengefügt wird, indem die erste Mehrzahl der Saumschlingen mit der zweiten Mehrzahl der Saumschlingen verflochten wird und ein Bolzen durch den Durchgang geführt wird, der durch die verflochtenen Saumschlingen definiert wird, um die Schlingenaht zu schließen.

3. Technisches Gewebe nach Anspruch 1, wobei das technische Gewebe während der Installation auf einer Maschine mit einer Stecknaht zu einer Endlosform schließbar ist,
wobei die Garne des Gefüges der MD-Garne mit den Garnen des Gefüges der CD-Garne durch eine Flachwebetechnik verwoben sind, wobei die MD-Garne längs der beiden Breitenkanten gewendet und in das technische Gewebe zurückgewoben sind, um eine erste Mehrzahl von Saumschlingen längs einer der beiden Breitenkanten und eine zweite Mehrzahl von Saumschlingen längs der anderen der beiden Breitenkanten zu bilden,
wodurch das technische Gewebe zu einer Endlosform zusammengefügt wird, indem die erste Mehrzahl der Saumschlingen mit der zweiten Mehrzahl der Saumschlingen verflochten wird und ein Bolzen durch den Durchgang geführt wird, der durch die verflochten Saumschlingen definiert wird, um die Stecknaht zu schließen.

4. Technisches Gewebe nach Anspruch 1, wobei die Garne des Gefüges der MD-Garne mit den Garnen des Gefüges der CD-Garne durch eine Flachwebetechnik verwoben sind, wobei zwei Breitenkanten des technischen Gewebes mit einer Webnaht miteinander zusammengefügt sind, um das technische Gewebe in eine Endlosform zu versetzen.

5. Technisches Gewebe nach Anspruch 1, wobei die Mehrkomponentengarne einstufige Monofilamentgarne sind.

6. Technisches Gewebe nach Anspruch 1, wobei die Mehrkomponentengarne einstufige Multifilamentgarne sind.

7. Technisches Gewebe nach Anspruch 1, wobei die Mehrkomponentengarne Multifilamentgarne sind.

8. Technisches Gewebe nach Anspruch 1, wobei die Mehrkomponentengarne einstufige/gezwirnte Garne sind.

9. Technisches Gewebe nach Anspruch 1, wobei die Mehrkomponentengarne Garne sind, die aus der Gruppe ausgewählt werden, die aus einstufigen Monofilamentgarnen, einstufigen Multifilamentgarnen, Multifilamentgarnen, einstufigen/gezwirnten Garnen und deren Kombinationen besteht.

10. Technisches Gewebe nach Anspruch 1, wobei die Mehrkomponentengarne gewirkte Garne sind.

11. Technisches Gewebe nach Anspruch 1, wobei die Mehrkomponentengarne Flechtgarne sind.

12. Technisches Gewebe nach Anspruch 1, wobei die einzelnen Garnstränge der Mehrkomponentengarne aus einem Polymerharzmaterial extrudiert sind.

13. Technisches Gewebe nach Anspruch 12, wobei das Polymerharzmaterial aus der Gruppe ausgewählt wird, die aus Polyamid, Polyester, Polyetherketon, Polypropylen, Polyaramid, Polyolefin, Polyphenylensulfid (PPS) und Polyethylenterephthalat-(PET) -Harzen, und deren Copolymeren ausgewählt wird.

14. Technisches Gewebe nach Anspruch 1, wobei das thermoplastische Material des mindestens einen warmverschweißbaren Strangs aus der Gruppe ausgewählt wird, die aus Polyamid 66, niedrigschmelzendem Polyamid 6 und Polyurethan besteht.

15. Technisches Gewebe nach Anspruch 1, wobei der

mindestens eine warmverschweißbare Strang ein Monofilament ist.

16. Technisches Gewebe nach Anspruch 1, wobei der mindestens eine warmverschweißbare Strang ein Multifilament ist.

17. Technisches Gewebe nach Anspruch 1, wobei der mindestens eine warmverschweißbare Strang ein Strang ist, der aus einem Film des thermoplastischen Materials geschnitten ist.

18. Technisches Gewebe nach Anspruch 1, wobei der mindestens eine warmverschweißbare Strang ein Strang aus einem nichtgewebten Material ist.

19. Technisches Gewebe nach Anspruch 1, wobei die CD-Garne ebenfalls die Mehrkomponentengarne sind.

20. Technisches Gewebe nach Anspruch 1, das ferner mindestens eine Lage Stapelfaserwatte aufweist, die an einer seiner beiden Oberflächen befestigt ist.

21. Technisches Gewebe nach Anspruch 2 oder 3, das ferner aufweist:

eine erste Saumspirale mit einer Mehrzahl von Windungen, die mit den Saumschlingen der ersten Mehrzahl an einer der beiden Breitenkanten des technischen Gewebes verflochten sind und daran durch mindestens ein Verbindungsgarn befestigt sind, das sich in Quermaschinenrichtung erstreckt; und
eine zweite Saumspirale mit einer Mehrzahl von Windungen, die mit den Saumschlingen der zweiten Mehrzahl an der anderen der beiden Breitenkanten des technischen Gewebes verflochten sind und daran durch mindestens ein Verbindungsgarn befestigt sind, das sich in Quermaschinenrichtung erstreckt,
wodurch das technische Gewebe durch Verflechtung der Windungen der ersten Saumspirale mit den Windungen der zweiten Saumspirale und durch Führung eines Bolzens durch den Durchgang, der durch die verflochten Windungen definiert wird, so daß Schlingenaht geschlossen wird, zu einer Endlosform zusammengefügt ist.

22. Technisches Gewebe nach Anspruch 21 wobei die ersten und zweiten Saumspiralen Monofilamentspiralen sind.

23. Technisches Gewebe nach Anspruch 22, wobei die Monofilamentspiralen aus einem Polyamidharz extrudiert sind.

24. Technisches Gewebe nach Anspruch 21, das ferner mindestens ein Ausfüllungsgarn in der ersten Saumspirale aufweist.

25. Technisches Gewebe nach Anspruch 21, das ferner mindestens ein Ausfüllungsgarn in der zweiten Saumspirale aufweist.

Revendications

1. Tissu industriel comprenant :

un système de fils dans le sens machine (MD) et un système de fils dans le sens travers (CD), lesdits fils dudit système de fils MD étant entrelacés avec lesdits fils dudit système de fils CD pour former ledit tissu industriel dans une forme rectangulaire ayant une longueur, une largeur, deux surfaces, deux bords dans le sens de la longueur, et deux bords dans le sens de la largeur, **caractérisé en ce que** lesdits fils MD sont des fils à plusieurs composants comprenant une pluralité de torons de fils individuels et au moins un toron thermofusible d'un matériau thermoplastique, ledit au moins un toron thermofusible ayant un point de fusion inférieur à celui desdits torons de fils individuels, de sorte qu'après l'application d'un traitement thermique, lesdits fils à plusieurs composants sont rigidifiés et ladite pluralité de ses torons de fils individuels sont maintenus ensemble par ledit matériau thermoplastique dudit au moins un toron thermofusible.

2. Tissu industriel selon la revendication 1, ledit tissu industriel pouvant être fermé dans une forme sans fin avec une zone de raccordement pendant l'installation sur une machine,

dans lequel lesdits fils dudit système de fils MD sont entrelacés avec lesdits fils dudit système de fils CD par une technique de tissage sans fin modifiée, lesdits fils MD s'étendant selon un mouvement de va et vient de manière continue sur ladite longueur dudit tissu industriel entre lesdits deux bords dans le sens de la largeur et formant une première pluralité de boucles de zone de raccordement le long de l'un desdits deux bords dans le sens de la largeur et une seconde pluralité de boucles à zone de raccordement le long de l'autre desdits deux bords dans le sens de la largeur,

moyennant quoi ledit tissu industriel est raccordé dans une forme sans fin en interdigitant ladite première pluralité de boucles à zone de raccordement avec ladite seconde pluralité de boucles à zone de raccordement et en dirigeant un axe à travers le passage défini par les boucles à zone de raccordement interdigitées pour fermer ladite zone de rac-

cordement de boucle.

3. Tissu industriel selon la revendication 1, ledit tissu industriel pouvant être fermé dans une forme sans fin avec une zone de raccordement à broche pendant l'installation sur une machine,

dans lequel lesdits fils dudit système de fils MD sont entrelacés avec lesdits fils dudit système de fils CD par une technique de tissage plat, lesdits fils MD le long desdits deux bords dans le sens de la largeur étant retournés et tissés vers l'arrière dans ledit tissu industriel pour former une première pluralité de boucles à zone de raccordement le long de l'un desdits bords dans le sens de la largeur et une seconde pluralité de boucles à zone de raccordement le long de l'autre desdits deux bords dans le sens de la largeur,

moyennant quoi ledit tissu industriel est raccordé dans une forme sans fin en interdigitant ladite première pluralité de boucles à zone de raccordement avec ladite seconde pluralité de boucles à zone de raccordement et en dirigeant un axe par le passage défini par les boucles à zone de raccordement interdigitées pour fermer ladite zone de raccordement à broche.

4. Tissu industriel selon la revendication 1, dans lequel lesdits fils dudit système de fils MD sont entrelacés avec lesdits fils dudit système de fils CD par une technique de tissage plat, lesdits deux bords dans le sens de la largeur dudit tissu industriel étant raccordés entre eux avec une zone de raccordement tissée pour placer ledit tissu industriel dans une forme sans fin.

5. Tissu industriel selon la revendication 1, dans lequel lesdits fils à plusieurs composants sont des fils retors monofilament.

6. Tissu industriel selon la revendication 1, dans lequel lesdits fils à plusieurs composants sont des fils retors multifilaments.

7. Tissu industriel selon la revendication 1, dans lequel lesdits fils à plusieurs composants sont des fils multifilaments.

8. Tissu industriel selon la revendication 1, dans lequel lesdits fils à plusieurs composants sont des fils retors/retors simple.

9. Tissu industriel selon la revendication 1, dans lequel lesdits fils à plusieurs composants sont des fils choisis dans le groupe comprenant des fils retors monofilament, des fils retors multifilaments, des fils multifilaments, des fils retors/retors simple et leurs combinaisons.

10. Tissu industriel selon la revendication 1, dans lequel lesdits fils à plusieurs composants sont des fils tricotés.

11. Tissu industriel selon la revendication 1, dans lequel lesdits fils à plusieurs composants sont des fils tressés.

12. Tissu industriel selon la revendication 1, dans lequel lesdits torons de fils individuels desdits fils à plusieurs composants sont extrudés à partir d'un matériau de résine polymère.

13. Tissu industriel selon la revendication 12, dans lequel ledit matériau de résine polymère est choisi dans le groupe comprenant la polyamide, le polyester, le polyéthercétone, le polypropylène, la polyaramide, la polyoléfine, le polyphénylène sulfide (PPS) et les résines de polyéthylène téréphthalate (PET), et leurs copolymères.

14. Tissu industriel selon la revendication 1, dans lequel ledit matériau thermoplastique dudit au moins un toron thermofusible est choisi dans le groupe comprenant la polyamide 66, la polyamide 6 à faible point de fusion et le polyuréthane.

15. Tissu industriel selon la revendication 1, dans lequel ledit au moins un toron thermofusible est un monofilament.

16. Tissu industriel selon la revendication 1, dans lequel ledit au moins un toron thermofusible est un multifilament.

17. Tissu industriel selon la revendication 1, dans lequel ledit au moins un toron thermofusible est un toron coupé à partir d'un film dudit matériau thermoplastique.

18. Tissu industriel selon la revendication 1, dans lequel ledit au moins un toron thermofusible est un toron d'un matériau non tissé.

19. Tissu industriel selon la revendication 1, dans lequel lesdits fils CD sont également desdits fils à plusieurs composants.

20. Tissu industriel selon la revendication 1 comprenant en outre au moins une couche de nappage de fibres courtes fixée à l'une desdites deux surfaces de celle-ci.

21. Tissu industriel selon les revendications 2 ou 3 comprenant en outre :

une première spirale à zone de raccordement ayant une pluralité de bobines interdigitées

avec lesdites boucles à zone de raccordement de ladite première pluralité au niveau de l'un desdits deux bords dans le sens de la largeur dudit tissu industriel et fixée à celle-ci au moins par un fil de raccordement s'étendant dans un sens travers ; et

une seconde spirale à zone de raccordement ayant une pluralité de bobines interdigitées avec lesdites boucles à zone de raccordement de ladite seconde pluralité à l'autre desdits deux bords dans le sens de la largeur dudit tissu industriel et fixée à celle-ci au moins par un fil de raccordement s'étendant dans un sens travers,

moyennant quoi ledit tissu industriel est raccordé dans une forme sans fin en interdigitant lesdites bobines de ladite première spirale avec lesdites bobines de ladite seconde spirale à zone de raccordement et en dirigeant un axe par le passage défini par les bobines interdigitées pour fermer ladite zone de raccordement de boucle.

22. Tissu industriel selon la revendication 21, dans lequel lesdites première et seconde spirales à zone de raccordement sont des spirales monofilament.

23. Tissu industriel selon la revendication 22, dans lequel lesdites spirales monofilament sont extrudées à partir d'une résine de polyamide.

24. Tissu industriel selon la revendication 21 comprenant en outre au moins une chaîne de force à l'intérieur de ladite première spirale à zone de raccordement.

25. Tissu industriel selon la revendication 21 comprenant en outre au moins une chaîne de force à l'intérieur de ladite seconde spirale à zone de raccordement.

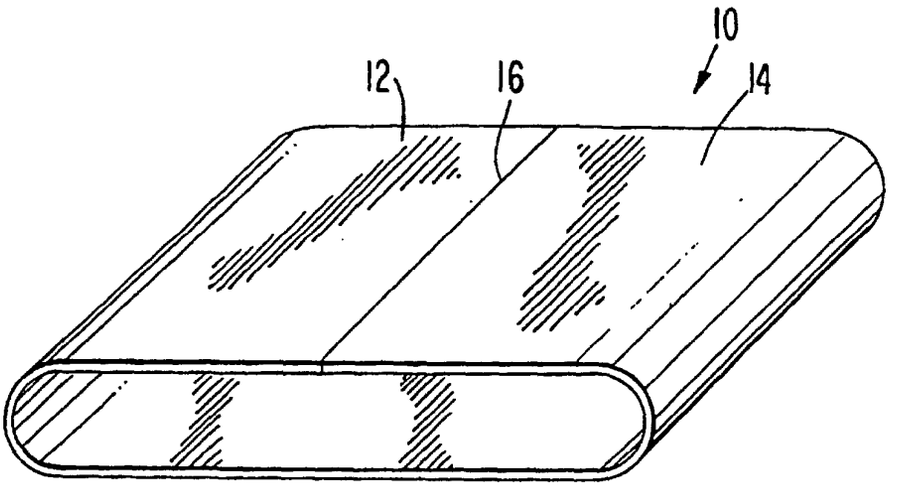

FIG. 1

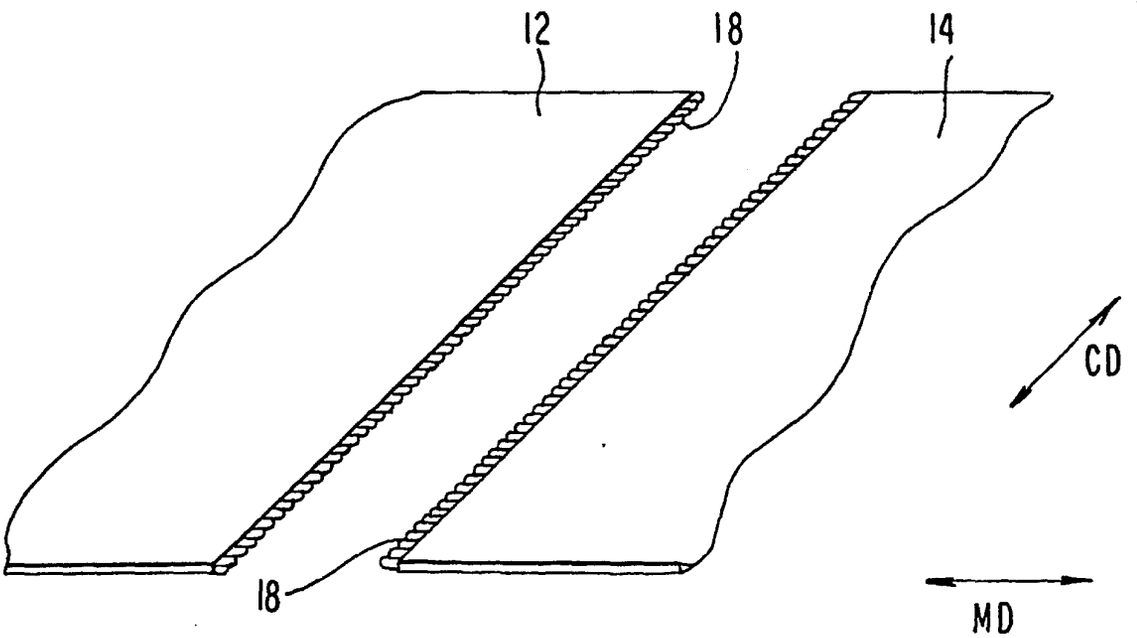

FIG. 2

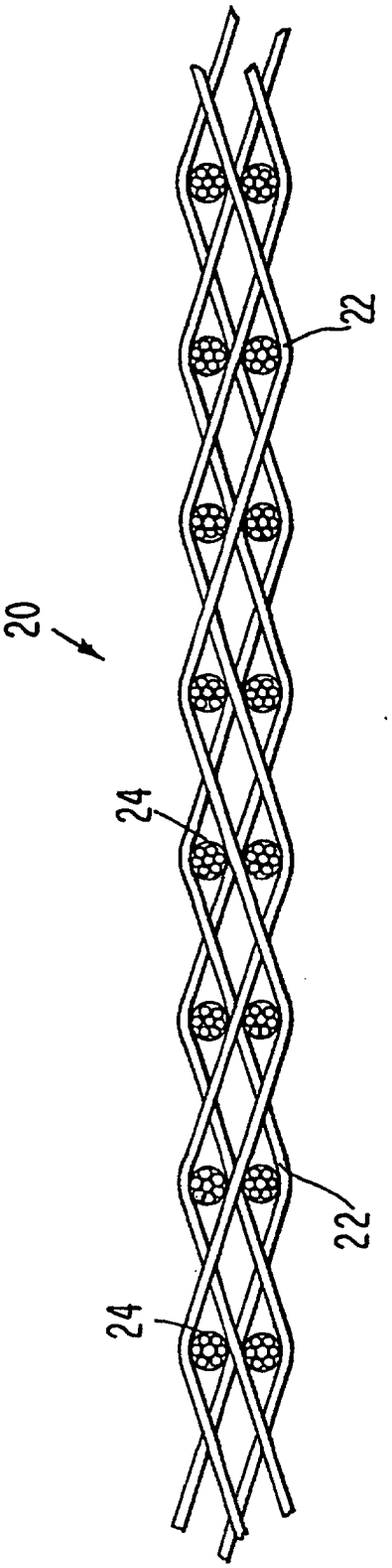

FIG.3

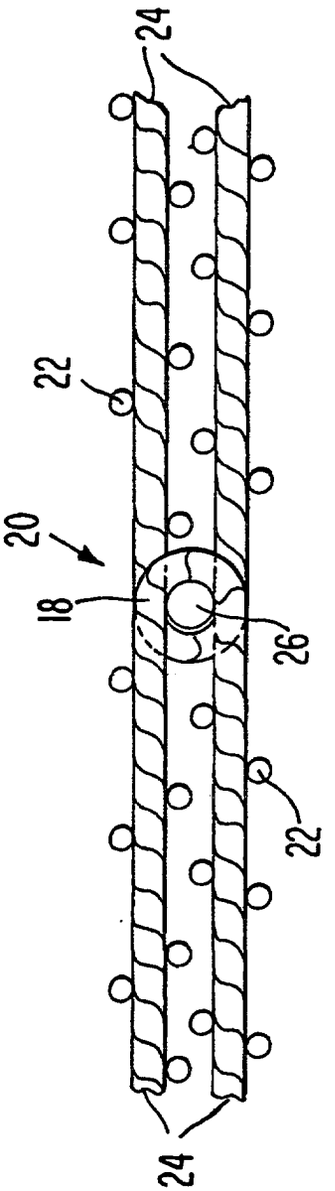

FIG.4

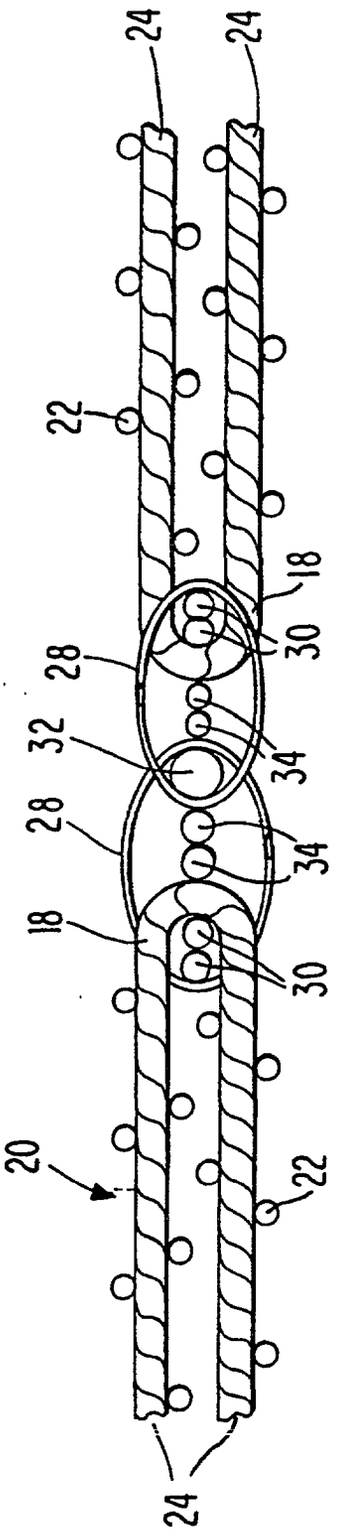

FIG.5