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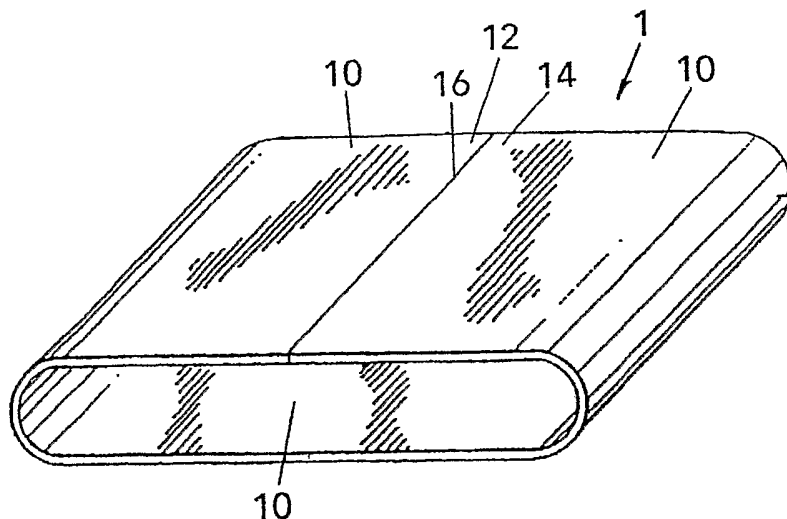
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(54) Title: IN-LINE SANDWICH SEAMS



(57) Abstract: The present invention is both a method for manufacturing a papermaker's dryer fabric and other seamed industrial fabrics, and the fabric made in accordance with the method. The industrial fabric has a main portion and first and second ends, and may be woven so as to have a first weave pattern at the main portion and a second weave pattern different from the first weave pattern at the first and second ends. The second weave pattern forms an upper layer and a lower layer with a pocket therebetween at the first and second ends. The industrial fabric further has a seaming member at least partially disposed in the pocket and attached to the respective upper layer

and lower layer.

IN-LINE SANDWICH SEAMS

BACKGROUND OF THE INVENTION

Field of the Invention

5 The present invention relates primarily to the papermaking arts. Specifically, the present invention relates to seamed woven fabrics for use on papermaking machines.

Description of the Prior Art

10 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
15 forming fabric.

 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
20 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.

25 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
30 drums reduce the water content of the paper sheet to a desirable level through evaporation.

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.

Contemporary fabrics are produced in a wide variety of styles designed to meet the requirements of the paper machines on which they are installed for the paper grades being manufactured. Generally, they comprise a woven base fabric which, depending upon the application may include needled batt of fine, non-woven fibrous material. The base fabrics may be woven from monofilament, plied monofilament, multifilament or plied multifilament yarns, and may be single-layered, multi-layered or laminated. The yarns are typically extruded from any one of the synthetic polymeric resins, such as polyamide and polyester resins, used for this purpose by those of ordinary skill in the paper machine clothing arts.

Woven fabrics take many different forms. For example, they may be woven endless, or flat woven and subsequently rendered into endless form with a seam. Alternatively, they may be produced by a process commonly known as modified endless weaving, wherein the widthwise ends of the base fabric are provided with seaming loops using the machine-direction (MD) yarns thereof. In this process, the MD yarns weave continuously back-and-forth between the widthwise ends of the fabric, at each end turning back and forming a seaming loop. A base fabric produced in this fashion is placed into endless form during installation on a paper machine, and for this reason is referred to as an on-machine-seamable (OMS®) fabric. To place such a fabric into endless form, the two widthwise ends are brought together, the seaming loops at the two ends are interdigitated with one another, and a seaming pin or pintle is directed through the passage formed by the interdigitated seaming loops.

In any event, woven fabrics are typically in the form of endless loops, or are seamable into such forms, having a specific length, measured longitudinally therearound, and a specific width, measured transversely thereacross. Because paper machine configurations vary widely, paper machine clothing manufacturers are required to produce fabrics, and other paper machine clothing, to the dimensions required to fit particular positions in the paper machines of their customers. Needless to say, this requirement makes it difficult to streamline the manufacturing process, as each fabric must typically be made to order.

Fabrics in modern papermaking machines may have a width of from 5 to over 33 feet, a length of from 40 to over 400 feet and weigh from approximately 100 to over 3,000 pounds. These fabrics wear out and require replacement. Replacement of fabrics often involves taking the machine out of service, removing the worn fabric, setting up to install a fabric and installing the new fabric.

In the case of dryer fabrics, in particular, such fabrics were produced by flat weaving and then joined together. Dryer fabrics that are used today are long and require a seam for installation, since dryer section frames are solid without cantilever components and thus prevent the use of endless woven fabrics. Accordingly, the fabrics must be installed with a seam, since they cannot be put on endless.

The seam region of any workable fabric must behave in use as close to the body of the fabric in order to prevent the periodic marking by the seam region of the paper product being manufactured.

Seams may be sewn on which involves a woven web or spiral lace sewn onto both cross-machine direction ("CD") ends of the dryer fabric. The woven web contains connecting loops which are meshed together to form the seam. The woven web, since it is out of plane and thicker than the fabric body, also tends to bump around fabric support rolls, marks the sheet, and has zero permeability, which further exacerbates the sheet marking problem. The woven web are attached to the surface areas of the fabric, for example,

the top side, or the top side and the bottom side. Since the webbing is sewn on the fabric, the webbing and the stitching are exposed to the sheet resulting in sheet marking.

5 The market today is dominated by dryer fabrics having pin or coil “woven in” seams. These seams may require MD yarns to be woven back into the fabric body by hand or machine assisted. Further, CD yarns must be raveled out. These seams are expensive to make, since they are labor intensive.

10 Obviously, there are other ways to provide seamable fabrics for use in papermaking and other industrial applications, with the foregoing being set forth merely as examples. However, as with anything, there is always a desire to improve on or provide an alternative to what has been done previously. Seamable fabrics are no exception. In this regard, heretofore providing a seam on a fabric has been relatively time consuming and labor
15 intensive. If these are aspects that can be improved upon, this would obviously be a desirable result.

SUMMARY OF THE INVENTION

Accordingly, the present invention is both a method for
20 manufacturing a papermaker’s dryer fabric or other seamed industrial fabrics, and the fabric made in accordance with the method.

The present invention provides an industrial fabric for use in a papermaking machine. The industrial fabric has a main portion and first and second ends, and may be woven so as to have a first weave pattern at the
25 main portion and a second weave pattern different from the first weave pattern at the first and second ends. The second weave pattern forms an upper layer and a lower layer with a pocket therebetween at the first and second ends. The industrial fabric further has a seaming member at least partially disposed in the pocket and attached to the respective upper layer
30 and lower layer.

The present invention also provides a method of forming an industrial fabric for use in a papermaking machine. The method includes the steps of forming a main portion of the fabric with a first weave pattern, forming first and second ends with a second weave pattern different from the first weave pattern in which the second weave pattern forms an upper layer and a lower layer with a pocket therebetween, disposing a seaming member at least partially in the pocket; and attaching the seaming member to the respective upper layer and lower layer.

The present invention will now be described in more complete detail with reference being made to the figures identified as follows.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic perspective view of a seamed fabric;

Figure 2 is a schematic perspective view of first and second ends of the fabric prior to their being joined to one another;

Figure 3 is a schematic cross-sectional view of an end of the fabric; and

Figure 4 is a top plan view of the seam, incorporating the teachings of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now specifically to the figures, Figure 1 is a schematic perspective view of the seamed dryer fabric 1 for use in the dryer section of a papermaking machine. However, it should be noted that the invention is applicable to other seamed industrial fabric applications, such as coarse pulp forming fabrics and other industrial fabrics used for the dewatering of recycled deinked pulp and industrial sludge. Also included but not limited to, are fabrics that are used in the production of nonwoven structures such as by processes including melt blowing, air laying, or spunbonding.

Fabric 1 includes main portion 10 taking the form of an endless loop after a first end 12 and a second end 14 have been joined to one another at seam 16.

5 Figure 2 is a schematic perspective view of main portion 10, and the first end 12 and the second end 14 of fabric 1 prior to their attachments to one another. Widthwise across each of the first and second ends 12, 14 are a plurality of seaming members 18 having insertion elements 20 and connecting elements 22. To attach the first end 12 and second end 14 to one another, they are brought together by intermeshing, or interdigitating,
10 connecting elements 22 at each end with one another. The interdigitated connecting elements 22 define a passage through which a pin, a pintle, a yarn-like strand or member, may be directed to secure the first end 12 and second end 14 to one another by way of the "pin seam" so formed.

Figure 3 is a cross-sectional view of the first end 12 of fabric 1.
15 Fabric 1 has main portion 10 formed from a first weave pattern. The first weave pattern is such that a plurality of interwoven layers are formed, *i.e.*, a multi-layer weave. For example, the multi-layer weave may be a two-layer weave having at least one warp system, and at least one weft system. Alternatively, the multi-layer weave may be three-layer fabrics having at
20 least two different warp systems, and at least two different weft systems. Note that the terms "weft", and "CD yarns" are interchangeable in this context. Similarly, the terms "warp" and "MD yarns" are interchangeable. As shown, main portion 10 is a double layer fabric, however, other types of weave patterns suitable for the purpose may be used as will be known to
25 those so skilled in the art.

The first end 12 is formed from a second weave pattern different from the first weave pattern. The second weave pattern is such that two separate layers are formed at the first end 12 and the second end 14 forming a pocket 28 therebetween. That is, two separate layers may be created as
30 extensions of main portion 10 by changing the weave pattern. Thus, as is shown in Figure 3, upper layer 24 and a lower layer 26 are formed from a

second weave pattern having a pocket 28 therebetween. Here, each of upper layer 24 and lower layer 26 is a single layer having interwoven MD yarns 30 and CD yarns 32. However, upper layer 24 and lower layer 26 may be formed from other types of weaves suitable for the purpose as will be known to those so skilled in the art, with the proviso that upper layer 24 and lower layer 26 form a pocket 28. The CD yarns in these two separate layers can also be of a smaller diameter than the CD yarns in the main section of the fabric. Or the CD yarns in the top layer or the bottom layer can be of a smaller diameter. This is to minimize the fabric thickness difference in between the seam area and the main fabric body.

Fabric 1 further includes seaming member 18 at least partially disposed in pocket 28 and attached to upper layer 24 and lower layer 26. The seaming member 18 may be formed of a single piece that is the full width of the fabric, or formed from smaller segments each less than the full width of the fabric. Seaming member 18 includes an insertion element 20 and a connecting element 22. Insertion element 20 may be formed from a woven web or fabric, a nonwoven web, or the like. However, other types of material suitable for the purpose may be used as will be known to those so skilled in the art. Further, insertion element 20 may be made from a material that is different from the material making up main portion 10 and/or upper and lower layers 24, 26.

Connecting element 22 may be a seaming loop, a spiral or the like. Note while loops or spirals are being referred to other types of seaming or coupling elements suitable for the purpose may be used as will be known to those so skilled in the art. Connecting elements 22 may be made of any material suitable for the purpose (e.g. polyester, polyamide, polyethelyne, Ryton, PEEK, metal, etc.).

Insertion element 20 carries connecting element 22. That is, connecting element 22 may be affixed to insertion element 20 by any means known to those so skilled in the art, such as sewing and/or bonding.

Insertion element 20 may be partially or fully disposed in pocket 28. For example, as shown in Figure 3, insertion element 20 may be disposed and sandwiched by upper layer 24 and lower layer 26. Insertion element 20 may be used to attached or secure seaming member 18 to upper layer 24 and
5 lower layer 26, for example, by sewing, bonding or the like. However, other securing methods may be used suitable for the purpose as will be known to those so skilled in the art.

For example, as shown in Figure 3, insertion element 20 may be sewn in-line with thread 38 to upper layer 24 and lower layer 26. One method of
10 sewing a thread in-line is to remove at least one CD yarns from upper layer 24 and lower layer 26 at predetermined locations 34, 36. The predetermined locations 34 in upper layer 24 may align vertically with predetermined locations 36 in lower layer 26. The CD yarns may be removed by hand or purposefully left out by skipping picks (not weaving in a CD yarn) during
15 weaving of upper layer 24 and lower layer 26 by skipping picks at predetermined locations 34, 36. The spaces created by the CD yarn removal provides sewing guides and seats for sewing thread. Furthermore, a solvent soluble yarn could be used as the "removable pick" and of course removed prior to sewing in the element 18. Solvron could be the yarn used, and water
20 can be the solvent. A thread 38 may then be sewn through predetermined locations 34 and 36 to attach insertion element 20 of seaming member 18 to upper layer 24 and lower layer 26.

The pattern of the stitching used to attach seaming member 18 may take on various forms. In addition, the depth of the stitch in the fabric may
25 also vary. Also, it may be desired to have a preliminary stitch to generally affix or align the seaming member 18 on first end 12 and second end 14 and once aligned, implement a main stitching. The amount of stitching necessary should, however, be within the plane of the fabric thickness. The amount, depth and pattern of the stitching used for this purpose would be readily
30 apparent to those of ordinary skill in the art.

The yarn or thread 38 may be made of any material suitable for the purpose (e.g. industrial polyester, nylon, Nomex®, Kevlar® (aramids), Spectran® (HMPE), Vectran® (LCP) and Tenara® and other polymers). The size of the thread 38 will depend upon the application and strength requirements. The yarns or thread used may be of a diameter of less than or equal to the diameter of the MD or CD yarns at first end 12 and second end 14.

Second end 14 may be formed in a manner similar to first end 12 which is described in Figure 3.

Figure 4 is a top plan view of seam 16, incorporating the teachings of the present invention. After seaming members 18 are attached to each of the first end 12 and the second end 14, the first end 12 and the second end 14 are brought together and the connecting elements 22 are intermeshed or interdigitated with each other so as to define a passage. A pin or pintle 40 is then inserted into the passage securing the ends 12, 14 to each other.

First end 12 and second end 14 are preferably even, so that when they are joined together the fabric appears as a typical prior art dryer fabric but with a simpler to produce seam. Also, in a normal pin seam or woven in spiral seam, the MD yarn counts and position at each fabric edge must match. This is a time consuming process step and can add cost or reduce fabric yield (sellable square meters). An advantage of the sewn in seam is that the MD ends don't directly form the seam loops or are used for the connection of a seam spiral, so they do not have to match perfectly, although such matching is preferred.

The present invention may provide a more even caliper profile along the seam area than seams that are attached to the fabric surface. Further, the present invention may reduce manufacturing time and cost because the sandwich seam does not require the use of machine joining or weaving yarns back into the structure body.

Although a preferred embodiment has been disclosed and described in detail herein, its scope should not be limited thereby; rather its scope should be determined by that of the appended claims.

What is claimed is:

1. An industrial fabric for use in a papermaking machine, said fabric having a main portion and first and second ends and being woven so as to have a first weave pattern at said main portion and a second weave
5 pattern different from said first weave pattern at said first and second ends, said second weave pattern forming an upper layer and a lower layer with a pocket therebetween at said first and second ends, said fabric further having a seaming member at least partially disposed in said pocket and attached to said respective upper layer and lower layer.
10
- 2 The industrial fabric according to claim 1, wherein said seaming member includes an insertion element and a connecting element.
3. The industrial fabric according to claim 2, wherein said
15 insertion element is disposed in said pocket.
4. The industrial fabric according to claim 2, wherein said insertion element is a woven web.
- 20 5. The industrial fabric according to claim 2, wherein said connecting element is a seaming loop or a spiral.
6. The industrial fabric according to claim 1, wherein said main portion is formed from a plurality of interwoven layers.
25
7. The industrial fabric according to claim 1, wherein each of said upper and lower layers is a single layer having interwoven machine direction (MD) yarns and cross-machine direction (CD) yarns.

8. The industrial fabric according to claim 7, wherein at least one CD yarn is removed from each of said upper and lower layers at predetermined locations.

5 9. The industrial fabric according to claim 8, wherein said predeter-mined locations in said upper layer align vertically with said predetermined locations in said lower layer.

10 10. The industrial fabric according to claim 9, wherein a thread is sewn through said predetermined locations to attach said seaming member to said upper and lower layers.

15 11. The industrial fabric according to claim 1, wherein said seaming member is sewn to said upper and lower layers.

12. The industrial fabric according to claim 11, wherein said seaming member is sewn in-line.

20 13. The industrial fabric according to claim 1, wherein said seaming member is a single piece having the same width of the fabric.

25 14. The industrial fabric according to claim 1, wherein said seaming member is formed from smaller segments each having less than the width of the fabric.

15. The industrial fabric according to claim 1, wherein the industrial fabric is a dryer fabric for use in a drying section of a papermaking machine.

30 16. A method of forming an industrial fabric for use in a papermaking machine, said method comprising the steps of:

forming a main portion of said fabric with a first weave pattern;
forming first and second ends with a second weave pattern different
from said first weave pattern, said second weave pattern forming an upper
layer and a lower layer with a pocket therebetween,
5 disposing a seaming member in said pocket; and
attaching said seaming member to said respective upper layer and
lower layer.

17. The method according to claim 16, wherein said seaming
10 member includes an insertion element and a connecting element.

18. The method according to claim 17, wherein said insertion
element is disposed in said pocket.

19. The method according to claim 17, wherein said insertion
15 element is a woven web.

20. The method according to claim 17, wherein said connecting
20 element is a seaming loop or a spiral.

21. The method according to claim 16, wherein said main portion
is formed from a plurality of interwoven layers.

22. The method according to claim 16, wherein each of said upper
25 and lower layers is a single layer having a plurality of interwoven machine
direction (MD) yarns and cross-machine direction (CD) yarns.

23. The method according to claim 22, wherein CD yarns are
absent from said upper and lower layers at predetermined locations.
30

24. The method according to claim 23, wherein said predetermined locations in said upper layer align vertically with said predetermined locations in said lower layer.

5 25. The method according to claim 24, wherein a thread is sewn through said predetermined locations to attach said seaming member to said upper and lower layers.

26. The method according to claim 16, wherein said seaming
10 member is sewn to said upper and lower layers.

27. The method according to claim 16, wherein said seaming member is sewn in-line.

15 28. The method according to claim 16, wherein said seaming member is a single piece having the same width of the fabric.

29. The method according to claim 16, wherein said seaming member is formed from smaller segments each having less than the width of
20 the fabric.

30. The method according to claim 16, wherein the industrial fabric is a dryer fabric for use in a drying section of a papermaking machine.

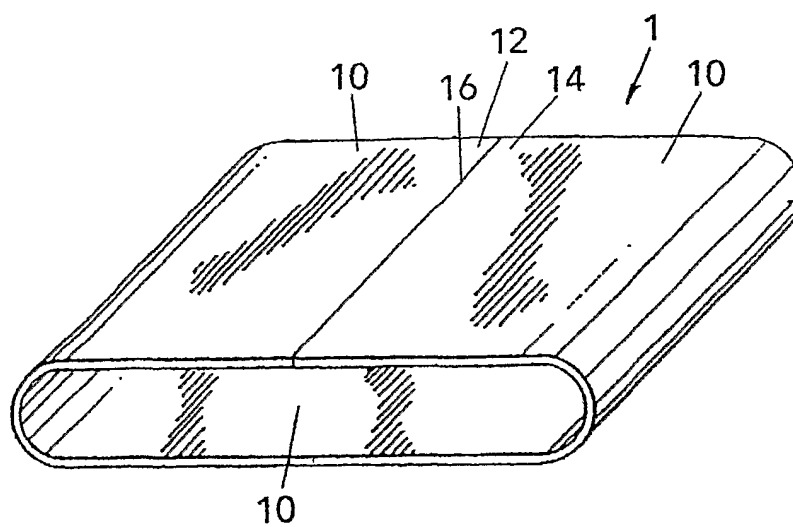


FIG. 1

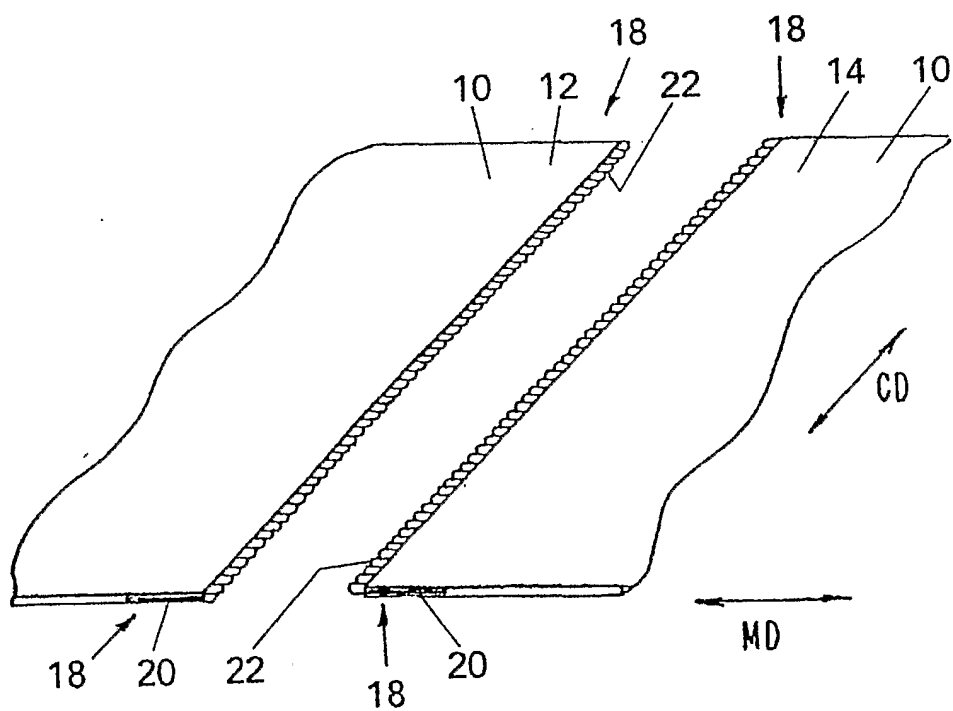


FIG. 2

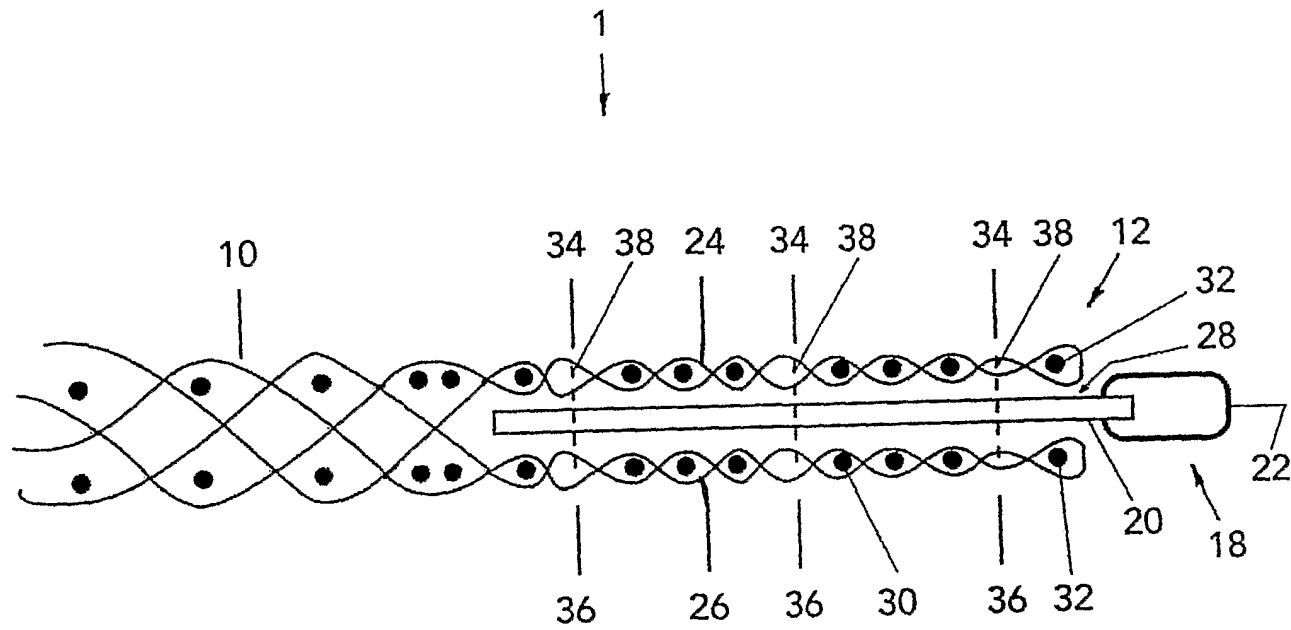


FIG. 3

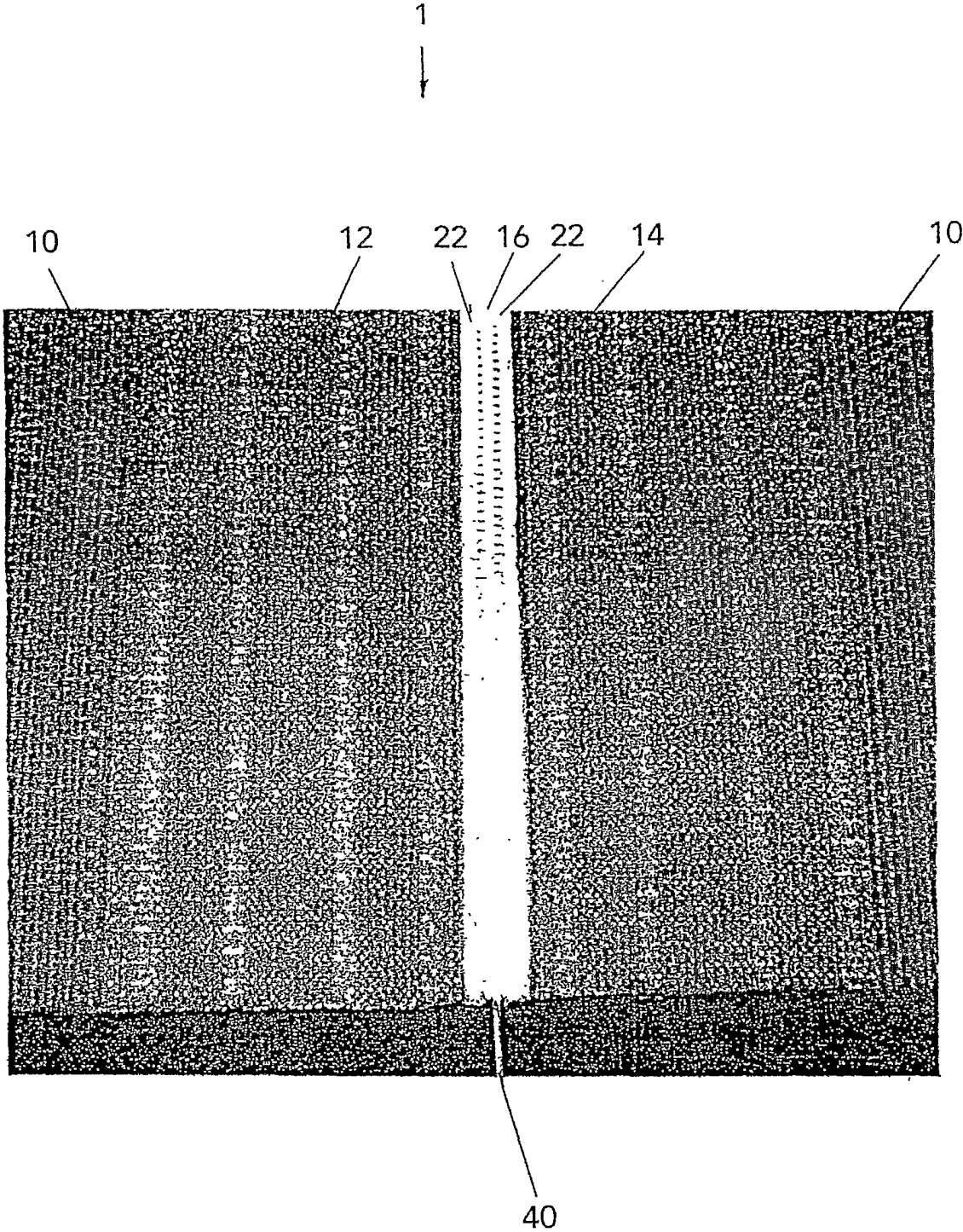


FIG. 4