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(54) Pin seamed papermaker's press felt with laminated base fabric having low melt material machine directions yarns

(57) A press felt (14) that can have a reduced tendency to fray at the seam cut (48) includes: a paper side batt layer (52); a machine side batt layer (50); and a base fabric layer (22) sandwiched between the paper side batt layer (52) and the machine side batt layer (50). The base fabric layer comprises a first fabric (24) and a second fabric (36). The first fabric (24) includes machine direction yarns (26) and cross machine direction yarns (28) interwoven with the machine direction yarns (26). The first fabric (24) has first and second ends (29a,29b) with loops (30), wherein the loops (30) of the first end (29a) are interdigitated with the loops (30) of the second end (29b), and the loops (30) of said first and second ends (29a,29b) receive a pin (34) to form the first fabric (24) into an endless belt having a seam. The second fabric (36) is formed into an endless belt overlying the first fabric (24) and includes machine direction yarns and cross machine direction yarns (40) interwoven with the machine direction yarns (38), wherein the machine direction yarns (38) are formed of a low melt material. In this configuration, the low melt machine direction yarns (40) of the second fabric (36) may have a reduced tendency to fray at the seam cut (48) during prolonged operation.

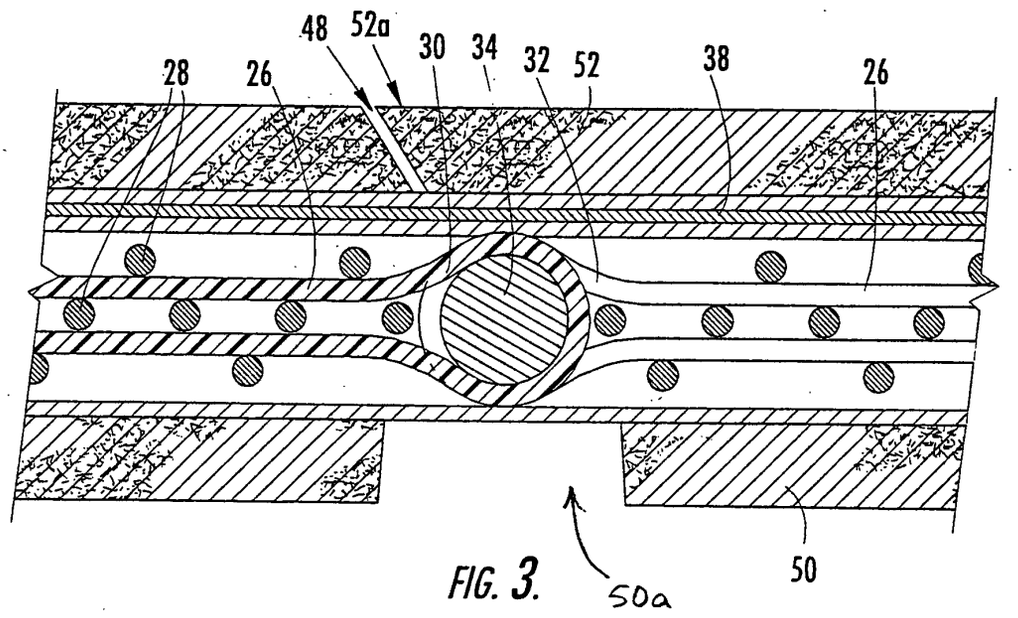

FIG. 3.

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Description

Field of the Invention

[0001] The present invention relates generally to papermaking, and more particularly to fabrics used in papermaking.

Background of the Invention

[0002] In the conventional fourdrinier papermaking process, a water slurry, or suspension, of cellulosic fibers (known as the paper "stock") is fed onto the top of the upper run of an endless belt of woven wire and/or synthetic material that travels between two or more rollers. The belt, often referred to as a "forming fabric," provides a papermaking surface on the upper surface of its upper run which operates as a filter to separate the cellulosic fibers of the paper stock from the aqueous medium, thereby forming a wet paper web. The aqueous medium drains through mesh openings of the forming fabric, known as drainage holes, by gravity alone or with assistance from one or more suction boxes located on the lower surface (i.e., the "machine side") of the upper run of the fabric.

[0003] After leaving the forming section, the paper web is transferred to a press section of the paper machine, in which it is passed through the nips of one or more pairs of pressure rollers covered with another fabric, typically referred to as a "press felt." Pressure from the rollers removes additional moisture from the web; the moisture removal is often enhanced by the presence of a "batt" layer on the press felt. The paper is then conveyed to a drier section for further moisture removal. After drying, the paper is ready for secondary processing and packaging.

[0004] Press felts typically include one or more base fabric layers; these can be "flat-woven" and formed after weaving into an endless belt, or can be woven in endless form. Generally, the flat-woven process is preferred, as it is typically less expensive and more versatile than the endless weaving process. Also, in many instances the felt is cut widthwise and reattached to simplify installation on a paper machine, in which case some of the advantages of endless weaving (such as the absence of a seam in the fabric) are lost.

[0005] Of course, flat weaving a fabric of a base layer requires that provision be made for joining it into endless belts. Such joints should be constructed in such a manner that they are sufficiently strong to withstand the extreme load, temperature, and wear conditions the press felt experiences, yet do not cause the surface of the press felt above the seam to unduly mark the paper. One popular method of joining the base fabric of a press felt is to form loops with machine direction yarns on each end of the base fabric. To form the flat-woven base fabric into an endless belt, the ends of the fabric are placed adjacent to each other, with each of the loops on one end positioned between two loops on the other end in interdigitating fashion. A "pin" (usually formed of mutilfilament polymeric fiber strands) is then inserted into all of the loops to join the ends. After the batt layer(s) are needled or otherwise attached to the base layer, the batt layer(s) are cut at the seam location, the pin is removed, and the finished press felt is shipped to a paper mill. Once at the paper mill, the press felt can be installed by placing it onto a paper machine, then inserting another (usually more flexible) multifilament pin into the loops. Examples of this type of seam are described in U.S. Patent Nos. 4, 764,417 and 4,737,241 to Gulya, 4,601,785 to Lilja et al., and 5,476,123 to Rydin the disclosures of which are hereby incorporated herein by reference in their entireties.

[0006] In some press felts, the base fabric layer itself contains multiple fabric layers (i.e., is a "laminated" base layer). For example, a felt may contain a "duplex" fabric (i.e., a fabric having upper and lower sets of machine direction yarns interwoven with at least one set of cross machine direction yarns - also known as a "double layer" fabric) as well as a finer mesh single layer fabric (i.e., a fabric having only one set each of machine direction yarns and cross machine direction yarns). This combination provides a good balance of strength and durability to the felt with relatively little marking. Typically, the felt is constructed by flat weaving the duplex fabric, endless weaving the single layer fabric, joining the duplex fabric with a pin as described above, overlaying the single layer fabric over the duplex fabric, needling both fabric layers with batt to form machine side and paper side batt layers, removing the pin from the double layer fabric and cutting the batt layers and the single layer fabric at the seam to form a flat structure. Once at the paper mill, the felt is installed on the papermaking machine by inserting a new, typically thinner and more flexible pin into the duplex fabric layer.

[0007] This press felt construction has at least one significant shortcoming. When the single layer fabric is cut, its yarns tend to fray somewhat at the cut. Thus, when the felt is installed and operated on the paper machine, the frayed ends of the finer mesh single layer fabric can interfere with the manner in which the cut portion of the batt layer (which is often a flap of batt layer material) overlays the base fabric. As such, paper formed with such a felt can have an inconsistent appearance and be more susceptible to breaking on the paper machine due to the presence of the seam of the felt. One approach to this problem is offered in International Application No. PCT/US98/19850, which discusses a press felt in which a band of cross machine direction yarns formed of a "low melt" material is included at the seam of the single layer fabric. The low melt material can soften somewhat during heat-setting of the fabric, which can induce the cross machine direction yarns to agglomerate somewhat and reduce fraying.

Summary of the Invention

[0008] In view of the foregoing, it is an object of the present invention to provide a press felt having a laminated base fabric with a reduced tendency for the fraying of yarns at the base fabric seam.

[0009] It is also an object of the present invention to provide such a press felt at a relatively low cost.

[0010] It is a further object of the present invention to provide a method for constructing such a press felt.

[0011] These and other objects are satisfied by the present invention, which is directed to a press felt that can have a reduced tendency to fray at the seam cut. The press felt comprises: a paper side batt layer; a machine side batt layer; and a base fabric layer sandwiched between the paper side batt layer and the machine side batt layer. The base fabric layer comprises a first fabric and a second fabric. The first fabric includes machine direction yarns and cross machine direction yarns interwoven with the machine direction yarns. The first fabric has first and second ends with loops, wherein the loops of the first end are interdigitated with the loops of the second end, and the loops of said first and second ends receive a pin to form the first fabric into an endless belt having a seam. The second fabric is formed into an endless belt overlying the first fabric and includes machine direction yarns and cross machine direction yarns interwoven with the machine direction yarns, wherein the machine direction yarns are formed of a low melt material. In this configuration, the low melt machine direction yarns of the second fabric may have a reduced tendency to fray at the seam cut during prolonged operation.

[0012] Another aspect of the present invention is a papermaker's press felt comprising the paper side batt layer, machine side batt layer, and base fabric layer described above, wherein the second fabric includes a band overlying the pin seam that has no CMD yarns. This configuration can also assist in reducing fraying at the seam cut.

Brief Description of the Drawings

[0013]

Figure 1 is a schematic illustration of the press section of a paper machine employing a press felt of the present invention.

Figure 2 is an enlarged partial cutaway perspective view of the press felt of **Figure 1.**

Figure 3 is a greatly enlarged side section view of the press felt of **Figure 1**.

Figure 4A is a greatly enlarged partial perspective view of the pin seam of the press felt of **Figure 1** in a joined condition.

Figure 4B is an enlarged partial perspective view of the pin seam of **Figure 4A** in an unjoined position.

Figure 5 is a schematic representation of a process for constructing the press felt of **Figure 1**.

Detailed Description of the Invention

[0014] The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown and described. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like components throughout. Components and layers may be exaggerated for clarity.

[0015] As used herein, the terms "machine direction" (MD) and "cross machine direction" (CMD) refer, respectively, to a direction aligned with the direction of travel of the papermakers' fabric on a papermaking machine, and a direction parallel to the fabric surface and transverse to the direction of travel. Also, both the flat weaving and endless weaving methods described hereinabove are well known in the art, and the term "endless belt" as used herein refers to belts made by either method.

[0016] Referring now to the drawings, a papermaking machine press section, designated broadly at **10**, is illustrated in **Figure 1**. The press section **10** includes a press felt **14** that is installed upon and conveyed by a set of rollers **12**. In its travel, the felt **14** travels over a press roll **15**. An opposed press roll **17** is positioned to, in conjunction with the felt **14** and press roll **15,** form a nip **N** between the press rolls **15**.

[0017] In operation, a paper web **P** is conveyed from a forming section **16** through the nip **N** formed by the press rollers **15, 17,** wherein pressure is applied to the paper web **P** by the press rolls **15, 17.** The pressure forces moisture from the paper web **P** that is absorbed by the felt **14.** As the felt **14** is conveyed around its roller set **12**, moisture is removed therefrom, and the felt **14** is conditioned by one or more suction boxes **20.**

[0018] **Figures 2** and **3** illustrate an enlarged section of the felt **14**. As can be seen in Figure **2**, the felt **14** includes a laminated base fabric layer **22** which comprises two separate fabrics: namely, a lower fabric layer comprising a duplex fabric **24** and an upper fabric layer comprising a single layer fabric **36**. The duplex fabric **24** includes two sets of machine

direction yarns **26** and one set of cross machine direction yarns **28** interwoven with the machine direction yarns **26.** The duplex fabric **24** is woven in a flat weave process; thus, in a flat condition, the duplex fabric **24** has two free ends **29a**, **29b**, one of which (**29a**) includes loops **30** (formed by machine direction yarns **26**), and the other of which (**29b**) includes loops **32** formed by machine direction yarns **26.** When the duplex fabric **24** is in an endless condition such as that illustrated in **Figures 2** and **3,** the loops **30, 32** are positioned in interdigitated fashion, and a pin **34** is inserted through the loops **30**, **32** to join the ends **29a, 29b** of the duplex fabric **24** (see **Figures 4A** and **4B**). This fabric can be flat woven in a process such as that disclosed in U.S. Patent No. 5,476,123 to Rydin.

[0019] Those skilled in this art will recognize that other types of fabrics can be employed as the lower fabric layer of the base fabric layer **22** in the manner of the duplex fabric **24**, including single layer fabrics, other duplex fabrics, and triplex fabrics (i.e., those having two sets of machine direction yarns and two sets of cross machine direction yarns). Virtually any weave pattern known to those skilled in this art, such as the illustrated plain weave, twills, satins, and the like, can be used for this fabric layer. The lower fabric layer will typically, but not always, have a mesh that is somewhat more coarse than that of the upper fabric layer; it is preferred that the mesh of the lower fabric layer be between about 30 to 50 machine direction yarns and 50 to 100 cross machine direction yarns per inch. The lower fabric layer should have the aforementioned loops **30, 32** at its ends **29a, 29b** to enable it to be joined into an endless belt with the pin **34**. The construction of the loops **30**, **32** and pin **34** are known to those skilled in this art and need not be described in detail herein; exemplary loop and pin constructions are described in U.S. Patent Nos. 4,737,241 and 4,764,417 to Gulya.

[0020] Referring again to **Figures 2** and **3,** the single layer fabric **36** comprises machine direction yarns **38** interwoven with cross machine direction yarns **40** in a plain weave pattern. The machine direction yams **38** are formed of a low melt material that differs in composition from the material employed with the cross machine direction yarns **40** and the yarns of the duplex fabric **24.** As used herein, the term "low melt" means that the yarns have a lower melting point than at least the cross machine direction yarns **40** of the upper fabric **36,** and in many instances than the other yarns of both the upper and lower fabric layers. The melting point of the low melt yarns is preferably at least 25°C lower than that of the machine direction yarns **26** of the lower fabric layer **24.** Exemplary low melt materials to be employed as machine direction yarns **38** include nylons (including nylon 6, nylon 6-6, nylon 6-10, nylon 6-12 and nylon 12, and blends and copolymers thereof), polyesters and copolymers thereof and polypropylene and copolymers thereof. It is preferred that the low melt material have a melting point of between about 130 and 200°C.

[0021] Those skilled in this art will recognize that other types of fabrics can be employed as the upper fabric layer of the base fabric layer **22** in the manner of the single layer fabric **36**, including other single layer fabrics, duplex fabrics, and triplex fabrics. Virtually any weave pattern known to those skilled in this art, such as the illustrated plain weave, twills, satins, and the like, can be used for this fabric layer. The mesh of the upper fabric layer may vary from between about 16 to 100 machine direction yarns and 16 to 100 cross machine direction yarns per inch, but typically the mesh will be somewhat finer than that of the lower fabric layer. Those skilled in this art will also recognize that, although it may be preferred for cost reasons to employ low melt yarns as machine direction yarns **38** only, low melt yarns can also be used as the cross machine direction yarns **40** of for some or all of the single layer fabric **36,** or even as the machine direction yarns **26** or cross machine direction yarns of the duplex fabric **24.**

[0022] Illustratively and preferably, the single layer fabric 36 includes a band **42** that includes no cross machine direction yarns **40.** The band **42** should overlie the pin **34** of the duplex fabric **24.** The band **42** is approximately 2 to 12 inches with 8 inches being preferred in length (i.e., the band **42** extends approximately 4 inches on either side of the pin **34**). The presence of the band **42** eliminates CMD yarns that might otherwise fray in the seam area.

[0023] Preferably, the single layer fabric **36** is woven in a flat weaving process that produces a fabric with two free ends. The single layer fabric **36** is formed into an endless belt through a joining process such as heat welding, which forms a weld line **46**, although other methods of joining known in the art may also be employed. Alternatively, the single layer fabric **36** can be woven in an endless process so that the band **42** is formed during weaving.

[0024] The form of the yarns employed in the lower and upper fabric layers of the base fabric layer **24** can vary, depending upon the desired properties of the final press felt. For example, the yarns may be multifilament yarns, monofilament yarns, twisted or cabled multifilament or monofilament yarns, spun yarns, or any combination thereof. Also, the materials from which the "non-low melt" yarns employed in the fabric layers are formed may be those commonly used in press felts, such as nylon, cotton, wool, polypropylene, polyester, aramid, polyamide, or the like, and blends and combinations thereof.

[0025] Referring again to **Figures 2** and **3,** the felt **14** also includes scrim sheets **44a**, **44b**, **44c**. The scrim sheet **44a** is positioned between the double layer fabric **24** and the single layer fabric **36**. The scrim sheet **44b** is positioned directly beneath the double layer fabric **24**. The scrim layer **44c** is positioned directly above the single layer fabric **36**. The scrim sheets **44a**, **44b**, **44c** overlie the seam area of the felt **14**, typically extending between about 4 to 10 inches on either side of the seam formed by the pin **34.** Typically, the scrim sheets **44a, 44b, 44c** comprise a non-woven, porous low melt nylon fabric.

[0026] Still referring to **Figures 2** and **3,** the felt **14** also includes two batt layers: a machine side batt layer **50** and

a paper side batt layer **52.** Illustratively and preferably, these batt layers **50, 52** are attached to the base fabric layer **22** through a needling process, although other attachment techniques, such as heat bonding and adhesives, can also be used with the present invention. An exemplary needling process is illustrated and described in co-assigned and co-pending U.S. Patent Application No. 09/359,213, the disclosure of which is hereby incorporated herein by reference in its entirety.

[0027] The machine side and paper side batt layers **50, 52** should be formed of material, such as a synthetic fiber like acrylic, aramid, polyester, or nylon, or a natural fiber such as wool, that assists in wicking water away from the base fabric layer **22.** Preferred materials for the batt layers **50, 52** include polyamide, polyester and blends thereof. The weight and thickness of the batt layers **50**, **52** can vary, although it is preferably that the ratio of batt weight to fabric weight is about between about 0.5 and 2.0, with 1.0 being more preferred. Also, in some embodiments, it may be desirable to have additional batt layers or to omit either or both of the batt layers **50**, **52**. Notably, the machine side belt layer **50** has an open area **50** below the pin **34** in which batt has been removed (**Figure 3**).

[0028] The felt **14** also includes a seam cut **48**. The seam cut **48** extends through the paper side batt layer **52,** the single layer fabric **36,** and the machine side batt layer **50**. Illustratively and preferably, the seam cut **48** is made at an angle of between about **30** and **80** degrees to the plane of the base fabric layer **22**, and a flap **52a** is formed by loosening the portion of the paper side batt layer **52** adjacent the seam cut **48.** This process is described in detail in the aforementioned U.S. Patents to Gulya and Lilja. Of course, no cut is necessary for the duplex fabric **24,** as the pin **34** can simply be removed to enable the ends **29a, 29b** of the duplex fabric **24** to be separated.

[0029] **Figure 5** illustrates an exemplary manufacturing process for the felt **14**. Initially, the duplex fabric **24** is flat woven such that machine direction loops **30, 32** are created on the ends **29a, 29b.** A pin **60** (which is typically larger and less flexible than the pin **34** described above) is inserted through the loops **30, 32** (as they are interdigitated) to join them and thereby form the duplex fabric **24** into an endless belt. Separately, the single layer fabric **36** is woven in a flat weaving or endless weaving process. If flat woven, the single layer fabric **36** is formed into an endless belt with a heat welding process, such as one that employs heat or ultrasonic radiation. The single layer fabric **36** is then positioned to overlie the duplex fabric **24** such that the band **42** that lacks cross machine direction yarns overlies the pin **34**, the scrim sheets **44a**, **44b**, **44c** are positioned over the seam area, and the machine side and paper side batt layers 50, 52 are needled to the base fabric layer **22** (the open area **50a** is typically created by removing fiber with a brush and tweezers).

[0030] Once the batt layers **50, 52** have been added, the entire felt **14** is then heat treated at a temperature sufficient to cause softening of the machine direction yams **38** formed of low melt material without unduly softening the other yarns of the base fabric **22.** Typically, the heat treatment is carried out at a temperature of between about 130° to 200° C. The pin **60** is then removed, and the seam cut **48** is formed with blades or other cutting devices through the paper side batt layer **52** and the single layer fabric **36**. The felt **14** can then be shipped in its flat form to a paper mill, where the pin **34** can be inserted into the machine direction loops **30, 32** as the felt **14** is installed on the upper rolls **12.**

[0031] Importantly, when the seam cut **48** is made, the yarns of the single layer fabric **36,** and in particular the machine direction yarns **38,** can have a far lower tendency to fray than the fabrics of prior art felts. This reduced fraying is the result of the inclusion of the low melt machine direction yarns **38.** As described, during the heat treatment of the felt **14**, the softening of the low melt machine direction yarns **38** causes the agglomeration of the machine direction yarns **38** and the fibers of the paper side batt layer **52.** As a result, the flap **52a** adjacent to the seam cut **48** can lay uniformly, even during operation, which has not always been the case for prior art fabrics.

[0032] The invention will now be more particularly described in the following non-limiting example.

EXAMPLE

[0033] A press felt was constructed according to the following parameters

	MD yarns		**CMD yarns**		**Mesh** Count
Base Fabric Layer	**Size (inches)**	**Material**	**Size (inches)**	**Materials**	
Duplex Layer	0.015	Nylon	0.015	Nylon	40x48
Single Layer*	0.014	Nylon	0.008	Nylon	40x24

* The single layer fabric was woven without CMD yarns in a 8 inch wide band that was positioned directly over the pin seam of the duplex fabric.

Batt Layers	**Material**	**Weight (g/m^2)**
Machine Side	Nylon staple	150

(continued)

Batt Layers	Material	Weight (g/m^2)
Paper Side	Nylon staple	780

Heat Treatment: 3 minutes at 175°C.

[0034] The resulting press felt successfully produced linerboard paper.

[0035] The foregoing is illustrative of the present invention and is not to be construed as limiting thereof. Although exemplary embodiments of this invention have been described, those skilled in the art will readily appreciate that many modifications are possible in the exemplary embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the claims. The invention is defined by the following claims, with equivalents of the claims to be included therein. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures.

Claims

1. A papermaker's press felt, comprising:

a paper side batt layer;
a machine side batt layer; and
a base fabric layer sandwiched between said paper side batt layer and said machine side batt layer, said base fabric layer comprising a first fabric and a second fabric;
said first fabric including machine direction yarns and cross machine direction yarns interwoven with said machine direction yarns, said first fabric having first and second ends with loops, said loops of said first end being interdigitated with said loops of said second end, said loops of said first and second ends receiving a pin to form said first fabric into an endless belt having a seam;
said second fabric formed into an endless belt overlying said first fabric and including machine direction yarns and cross machine direction yarns interwoven with said machine direction yarns, wherein said machine direction yarns are formed of a low melt material.

2. The papermaker's press felt defined in Claim 1, wherein said second fabric includes a band overlying said seam of said first fabric that has no cross machine direction yarns.

3. The papermaker's press felt defined in Claim 1, said paper side batt layer and said machine side batt layer are needled to said base fabric layer.

4. The papermaker's press felt defined in Claim 1, wherein said first fabric comprises a duplex fabric.

5. The papermaker's press felt defined in Claim 1, wherein said second fabric comprises a single layer fabric.

6. The papermaker's press felt defined in Claim 1, wherein said low melt material is selected from the group consisting of: nylon and nylon copolymer.

7. The papermaker's press felt defined in Claim 1, wherein said first fabric layer forms a coarser mesh than said second fabric.

8. The papermaker's press felt defined in Claim 1, wherein each of said paper side batt layer, said machine side batt layer, and said second fabric includes a cut corresponding to said first fabric seam to enable said press felt to take a flat condition upon removal of said pin.

9. The papermaker's press felt defined in Claim 8, wherein said cut is oriented at an angle of between about 30 and 80 degrees relative to the plane of the base fabric layer.

10. A papermaker's press felt, comprising:

a paper side batt layer;
a machine side batt layer; and
a base fabric layer sandwiched between said paper side batt layer and said machine side batt layer, said base fabric layer comprising a first fabric and a second fabric;
said first fabric including machine direction yarns and cross machine direction yarns interwoven with said machine direction yarns, said first fabric having first and second ends with loops, said loops of said first end being interdigitated with said loops of said second end, said loops of said first and second ends receiving a pin to form said first fabric into an endless belt having a seam;
said second fabric formed into an endless belt overlying said first fabric and including machine direction yarns and cross machine direction yarns interwoven with said machine direction yams, said second fabric including a band overlying said seam that has no CMD yarns.

11. The papermaker's press felt defined in Claim 10, said paper side batt layer and said machine side batt layer are needled to said base fabric layer.

12. The papermaker's press felt defined in Claim 10, wherein said first fabric comprises a duplex fabric.

13. The papermaker's press felt defined in Claim 10, wherein said second fabric comprises a single layer fabric.

14. The papermaker's press felt defined in Claim 10, wherein said low melt material is selected from the group consisting of: nylon and nylon copolymer.

15. The papermaker's press felt defined in Claim 10, wherein said first fabric layer forms a coarser mesh than said second fabric.

16. The papermaker's press felt defined in Claim 10, wherein each of said paper side batt layer, said machine side batt layer, and said second fabric includes a cut corresponding to said first fabric seam to enable said press felt to take a flat condition upon removal of said pin.

17. The papermaker's press felt defined in Claim 16, wherein said cut is oriented at an angle of between about 30 and 80 degrees relative to the plane of the base fabric layer.

18. A method of constructing a papermaker's press felt having a laminated base fabric layer, said method comprising the steps of:

interweaving machine direction yarns and cross machine direction yarns to form a first fabric, said first fabric having first and second ends with loops;
positioning the loops of said first and second ends of said first fabric in interdigitated relationship;
inserting a pin into said loops to form a seam that joins the first and second ends of said first fabric, thereby forming said first fabric into an endless belt;
interweaving machine direction yarns and cross machine direction yarns to form a second fabric, wherein said machine direction yarns are formed of a low melt material;
attaching said second fabric to said first fabric;
heating said low melt band to cause said low melt material to soften; and
cutting a seam through said low melt band that corresponds to said seam of said first fabric.

19. The method defined in Claim 18, further comprising the step of attaching a first batt layer to overlie said second fabric layer.

20. The method defined in Claim 19, wherein said cutting step further comprises cutting said first batt layer to form a seam therein.

21. The method defined in Claim 19, further comprising the step of attaching a second batt layer to underlie said first fabric layer.

22. The method defined in Claim 21, wherein said cutting step further comprises cutting said second batt layer to form a seam therein.

23. The method defined in Claim 18, further comprising the step of removing the pin from said first fabric after said heating step and prior to said cutting step.

24. The method defined in Claim 18, wherein said heating step comprises heating the low melt material at a temperature of between about 130°C and 200°.

25. The method defined in Claim 18, wherein said step of interweaving said second fabric comprises flat-weaving said second fabric.

26. The method defined in Claim 18, further comprising the step of heat welding said second fabric to join ends thereof and thereby form said second fabric into an endless belt.

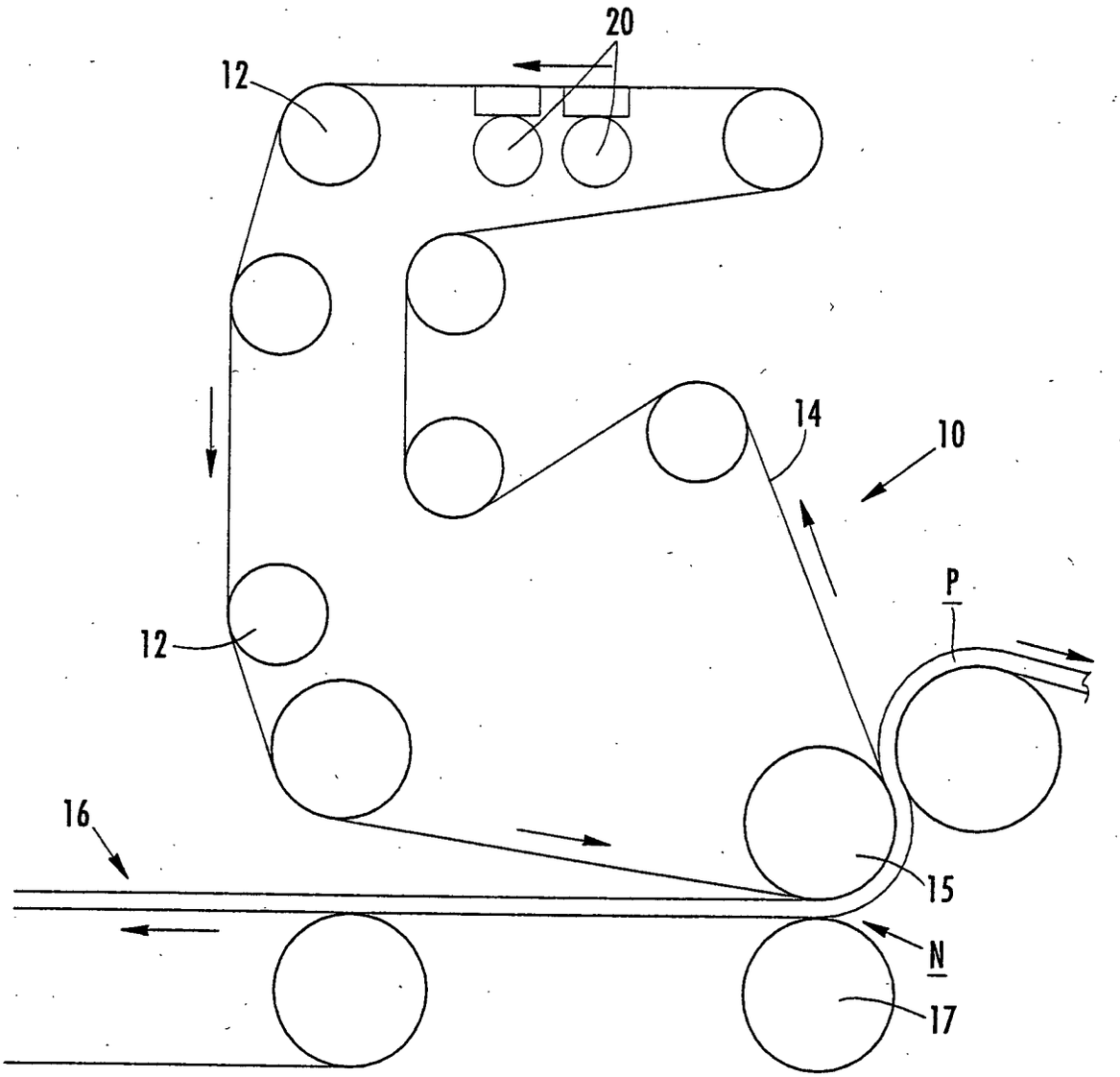

FIG. 1.

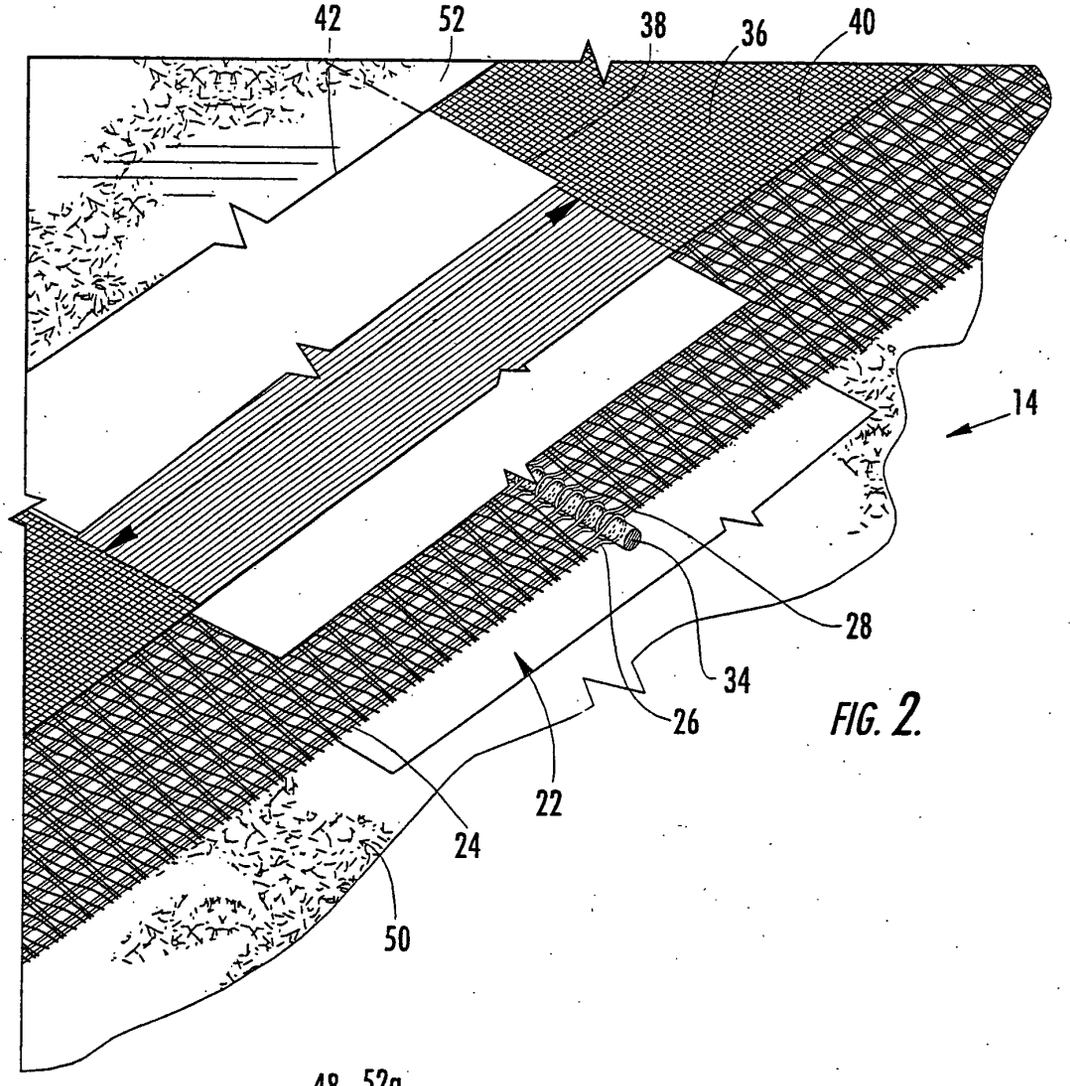
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FIG. 2.

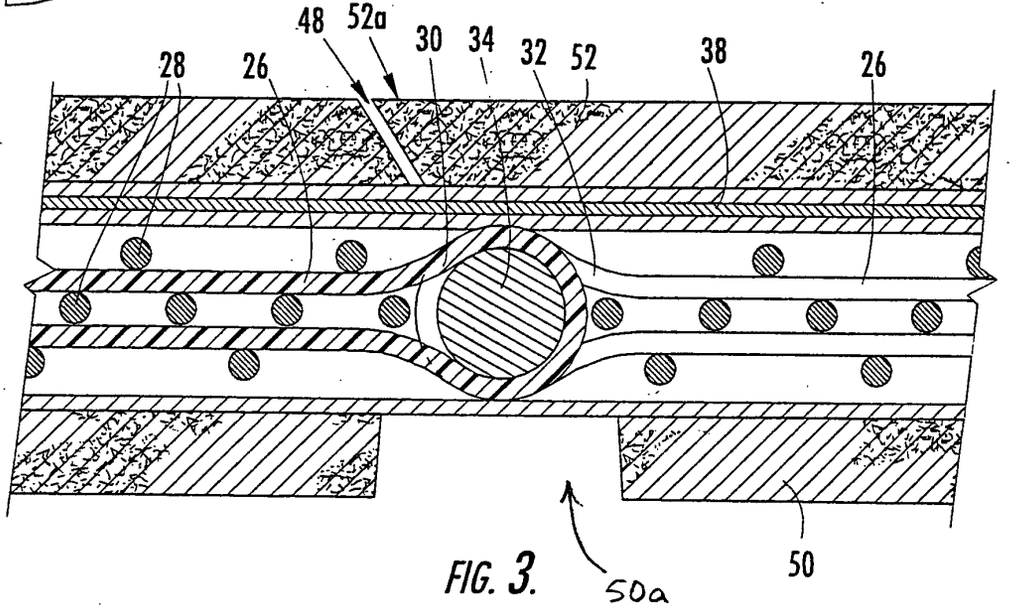
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FIG. 3.

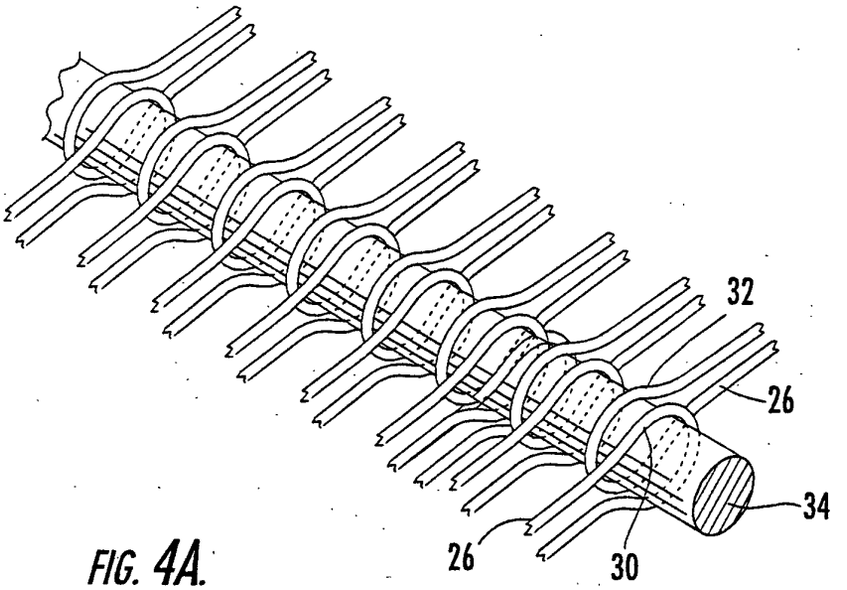

FIG. 4A.

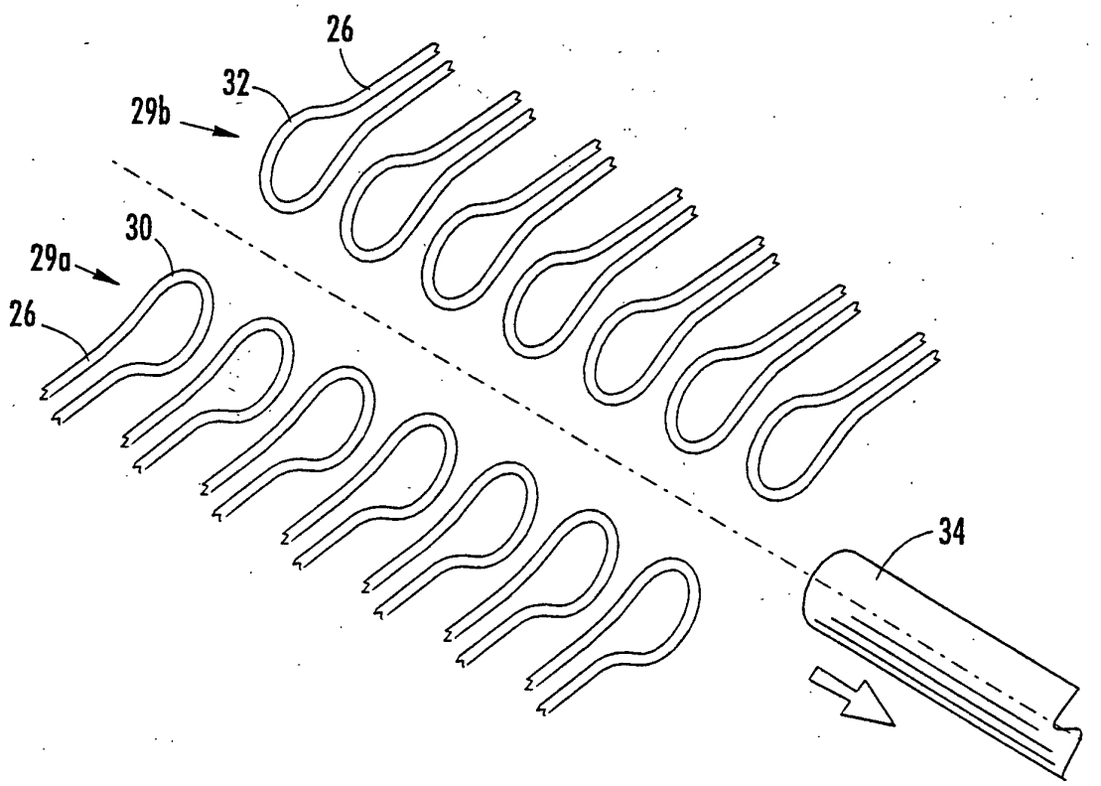

FIG. 4B.

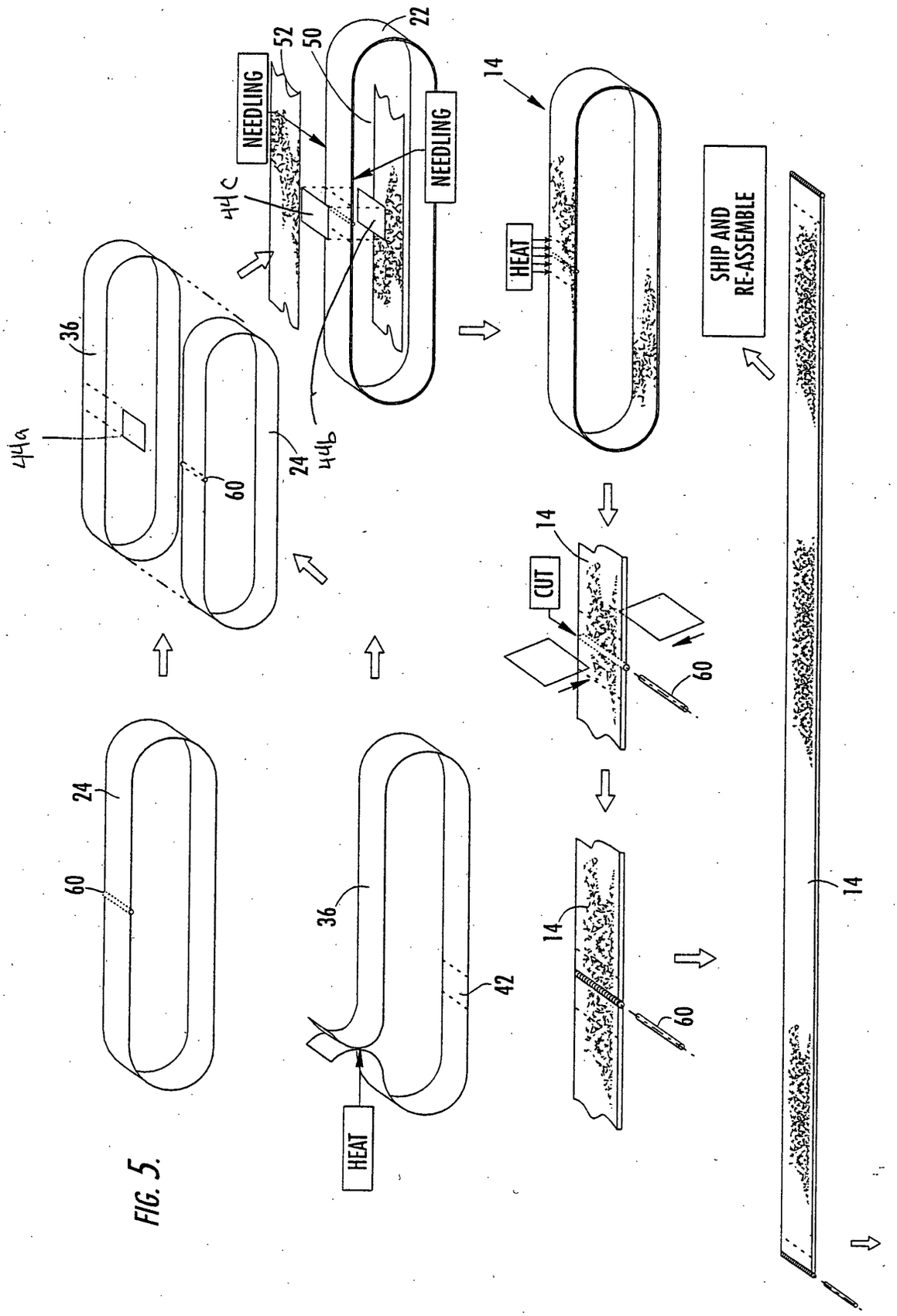
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FIG. 5.

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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

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MUNICH	5 September 2002	Gast, D

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