United States Patent

[11] **3,596,858**

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[54] **FOURDRINIER SEAM**
3 Claims, 11 Drawing Figs.

[52] **U.S. Cl.** **245/10**
[51] **Int. Cl.** **B21f 15/00**
[50] **Field of Search** 245/10

[56] **References Cited**

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ABSTRACT: A seam for a Fourdrinier belt having interwoven warps and shutes in which the warps that terminate along the seam have their ends arranged on the wear side of the belt and positioned under one or more shutes extending across the seam.

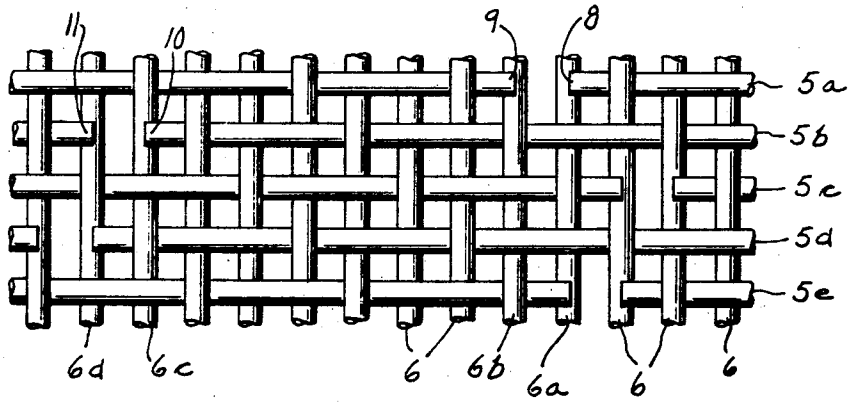


Fig. 1

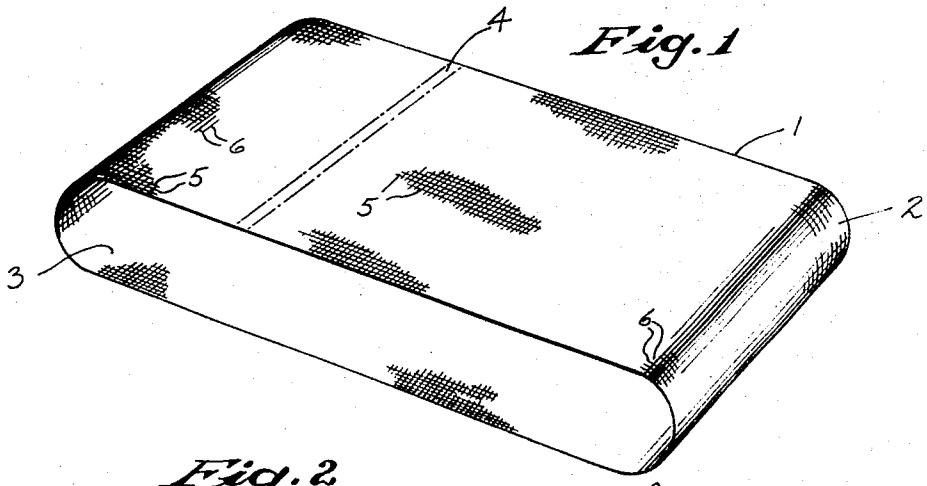


Fig. 2

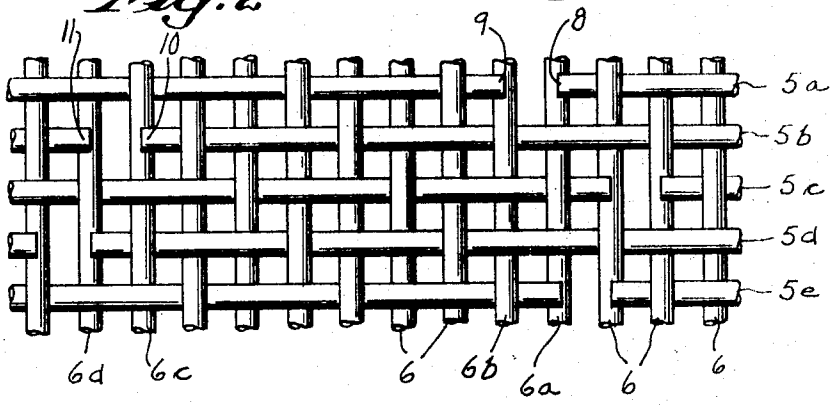


Fig. 3

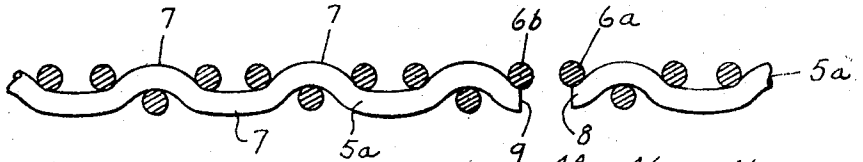


Fig. 4

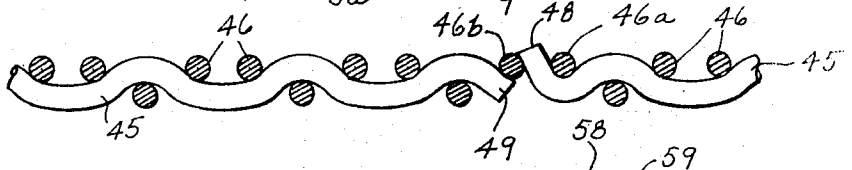


Fig. 5

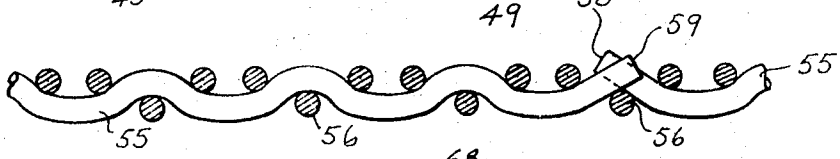
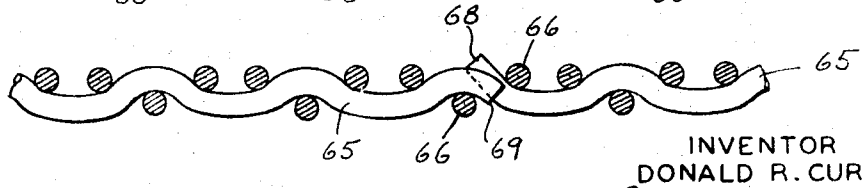


Fig. 6



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Fig. 7

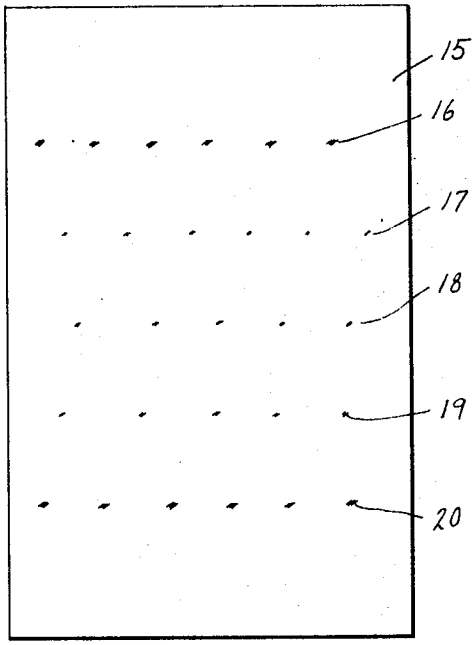


Fig. 8

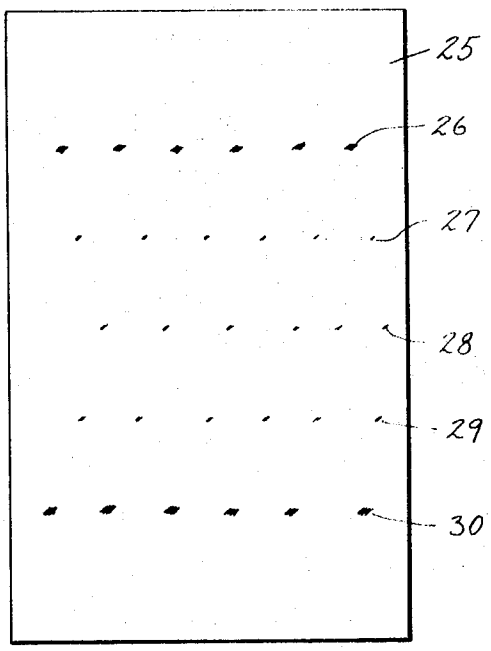


Fig. 9

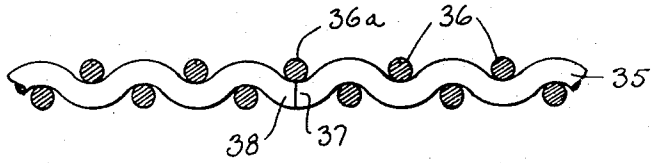


Fig. 10

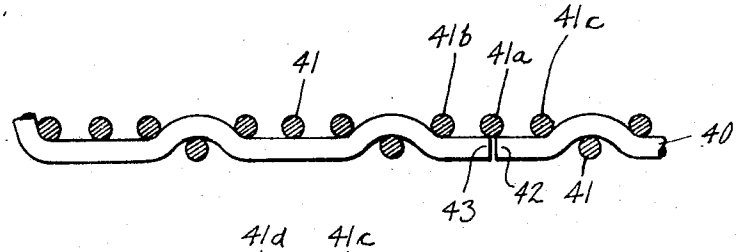
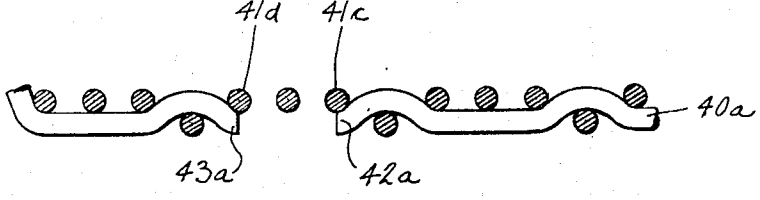


Fig. 10A



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FOURDRINIER SEAM

BACKGROUND OF THE INVENTION

1. Field

This invention relates to the art of seam constructions for Fourdrinier belts for use on papermaking machines.

2. Prior Art

A Fourdrinier belt is made from a length of fabric having interwoven warps and shutes that is seamed together to form an endless belt. Most of the warps terminate along the seam and the manner in which the warp ends are arranged therealong affects the quality of the paper made on the Fourdrinier belt because of its affect on marking of the paper.

The term "marking" of the paper as used herein refers to the production of defective portions of the paper sheet in which the fiber is thinner than in the balance of the sheet and is usually caused by deficient drainage through the Fourdrinier belt along the seam. Seam marking is a common problem and occurs with Fourdrinier belts of various types, either metal or plastic, having different mesh counts and thread diameters. Seam marking is also an important problem with many types of papers, for example: fine papers, printing papers, condenser and electrical papers, quality papers, glassine, cigarette papers, bond papers, filter papers, and other papers that must have a uniform surface without irregularities. Furnishes with short fibers, furnishes with additives such as pigments and mineral fibers, and those with hardwood pulp generally exhibit greater susceptibility to marking.

Many prior art seams for Fourdrinier belts have warp ends projecting from or disposed along the papermaking surface of the belt. Other prior art seams have had the warp ends arranged along the wear or machine side of the belt so that they reduced marking of the paper, but they still present marking problems because of the manner in which the warp ends were positioned on the wear side of the fabric, particularly in the arrangement of the warp ends in relation to each other and to shute wires extending across the seam.

Thus the problem still remains of providing a seam for a Fourdrinier belt that will substantially reduce or eliminate marking of paper made on the belt.

SUMMARY OF THIS INVENTION

I have now discovered a seam construction for a Fourdrinier belt that exhibits greatly reduced marking in all instances and no visible markings at all with some types of paper. The seam of this invention accomplishes this improvement in paper marking by arranging the warp ends terminating at the seam along the wear surface of the belt instead of along the papermaking surface, by arranging the warp ends underneath shute wires extending across the seam, and by providing that the warp ends do not overlap but are either butted against each other or spaced from one another along the seam. Experimental data, as discussed below, have demonstrated that the seam of this invention develops less paper marking in comparison to prior art Fourdrinier seams.

Among the principal objects of this invention are to provide a seam for a Fourdrinier belt which will reduce marking of paper made on the belt; to provide a seam for a Fourdrinier belt in which the warp ends terminating at the seam are arranged on the wear surface of the belt and positioned under shutes along the seam; and to provide a seam of the foregoing type in which the warps ends along the seam are not overlapped. A more specific object is to provide the particular structural details hereinafter described and claimed.

DESCRIPTION OF THE DRAWINGS

The ensuing description sets forth the details of the present invention in terms sufficient to instruct persons skilled in the art as to its practice by reference to several illustrated embodiments together with a discussion of some possible variations, it being understood that the description is intended as illustrative and not limitative inasmuch as other embodiments and variations of those discussed herein are possible that will remain within the scope of this invention. In the drawings:

FIG. 1 is a perspective view of a Fourdrinier belt of the type to which the seam of this invention pertains;

FIG. 2 is an enlarged plan view of a portion of the seam used to form the belt of FIG. 1, and FIG. 3 is a longitudinal sectional view thereof;

FIGS. 4, 5 and 6 are sectional views of some prior art seams used for Fourdrinier belts;

FIGS. 7 and 8 are plan views of papers made on Fourdrinier belts having the prior art seams of FIGS. 4—6 which schematically represent the effects of marking; and

FIGS. 9, 10 and 10A are longitudinal sectional views similar to FIG. 3 illustrating the seam of this invention with Fourdrinier cloths having different weaves.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1—3

FIG. 1 illustrates an endless belt 1 as used for the papermaking surface on a Fourdrinier machine, the exterior surface of the belt designated by the numeral 2 being the papermaking surface on which fibers are formed into a paper sheet, and the interior surface designated by the reference numeral 3 being referred to herein as the machine or wear surface because it contacts the various machine elements utilized to drive the belt. The belt 1 is formed from a length of fabric having its opposite ends joined along a seam 4. The fabric includes warps 5 interwoven with shutes 6, the warps extending longitudinally and the shutes transversely of the fabric. The shutes 6 extending across the seam 4 may be woven concurrently with the warps as the fabric is made or they may constitute additional shutes added to form the seam after a desired length length of the fabric has been woven on a loom. In any event, after the length of fabric has been woven, ends of the warps 5 project beyond the last shute at each end of the fabric and such extending warp ends are joined together along the seam 4 in the manner described below. During the weaving of the fabric, the warps 5 become crimped as shown in FIG. 3 so as to have knuckles 7 and the shutes 6 may be similarly crimped during the weaving process or may remain straight.

The warps 5 and shutes 6 can be woven together in any repeated pattern used in the papermaking field, such as the "plain weave" in which each warp passes successively over one shute and then under the next shute, the so-called "twill" (sometimes referred to as a semitwill) weave in which each warp passes under two shutes and over the next shute, etc. The twill weave is illustrated in FIGS. 1—3.

Fourdrinier belts made with the seams of this invention may have warp and shute threads which are metal or plastic, either in the form of wire, monofilaments or thin threads twisted into cable-form. The terms warp and shute are employed herein in the usual sense in which they are used in the Fourdrinier weaving art in which, when fabric of a specified weave is woven on a loom, the individual warps are strung longitudinally of the loom through a set of heddles and are raised and lowered by movement of the heddles in accordance with the preselected weave pattern to form what are termed triangular sheds. The shute material is carried in a shuttle that is caused to move transversely of the loom to pass through the sheds formed by raising and lowering of the warps, after which a lay is actuated to beat the shutes into the apex of the sheds or the beatline.

The section of the belt 1 shown in FIG. 2 is taken along the seam 4 as viewed from the wear side 3 of the belt. The ends 8 and 9 of warp 5*a* are are arranged to terminate under shutes 6*a* and 6*b* respectively. Furthermore, referring now to FIG. 3, it will be noted that the ends 8 and 9 of warp 5*a* are spaced from one another so that they do not overlap, and it will be further noted that the ends 8 and 9 are arranged underneath a shute so that they are not disposed within an open area bounded by the interwoven warps and shutes. Warp 5*b*, in a

similar fashion, has its ends **10** and **11** arranged to terminate along the wear side of the belt but they are positioned under shutes **6***c* and **6***d*; again the ends **10** and **11** of warp **5***b* are spaced from one another and do not overlap. From FIG. **2**, it can be seen that warps **5***c*, **5***d*, and **5***e* have their respective ends arranged in the same fashion as ends of warps **5***a* and **5***b* except that they terminate under different pairs of adjacent spaced shutes **6**. All warps terminating along the seam **4** have their ends arranged in the same manner as warps **5***a*—**5***e* in order to form the seam of this invention. The ends of the warps **5** may be spaced from each other as shown in FIGS. **2** and **3** or they may be butted against each other under either shute **6***a* or shute **6***b*, but they are not to be overlapped when forming the seam of this invention.

FIGS. 4—6

For comparison purposes, FIGS. **4**—**6** illustrate the manner in which warp ends terminate along a seam according to several typical prior art seam constructions. In FIG. **4**, the fabric includes warps **45** interwoven with shutes **46**. The end **48** of a warp terminates between shutes **46***a* and **46***b* and is arranged along the papermaking surface of the belt whereas the warp end **49** terminates along the wear surface of the belt under the shute **46***b*. In the seam of FIG. **5**, a warp **55** has its ends **58** and **59** both terminating along the papermaking surface of the belt above a shute **56**; as indicated, the ends **58** and **59** of each warp are overlapped with one another. FIG. **6** illustrates a seam construction in which warps **65** have their ends **68** and **69** terminating, respectively, along the papermaking and wear surfaces of the belt and in which the two ends **68** and **69** are overlapped with one another between two adjacent shutes **66**.

EXAMPLE

In order to ascertain the paper marking obtained with the seam of this invention illustrated in FIGS. **1**—**3** as compared to marking obtained with the prior art seams of FIGS. **4**, **5** and **6**, a length of Fourdrinier fabric was woven of plastic warps and shutes in a twill weave. The fabric was woven in a 56 by 52 mesh, i.e. 56 warps per inch and 52 shutes per inch. The warps were monofilament polyester plastic with a diameter of 0.25 mm, and the shutes were monofilament polyester plastic with a diameter of 0.30 mm.

The above length of fabric was formed into an endless belt as illustrated in FIG. **1** using four different seams: one section was joined with the seam of FIGS. **1**—**3**, another section with the prior art seam of FIG. **4**, a third section with the prior art seam of FIG. **5** and the last section with the prior art seam of FIG. **6**. The seam used for joining the fabric into the belt was similar to that illustrated in U.S. Pat. No. 3,366,355 to H. C. Haller, with the ends of the warps arranged to terminate in five spaced rows across the seam in a controlled pattern. Using a beaten bleached kraft pulp made from mixed northern hardwoods, a lightweight paper (somewhat heavier than tissue paper) was made on the belt, which paper had a weight of 19 grams per square meter. The paper sheets after being suitably dried were inspected for marking along the four seams used for the belt and the results are illustrated in FIGS. **7** and **8**.

The seams of FIGS. **4** and **6** produced the seam marking shown by the sheet **15** in FIG. **7**. Marking was exhibited along the rows **16**—**20**, these being the rows of the seam along which the warp ends terminated. There was greater marking along rows **16** and **20** than along rows **17**—**19**. The marking was visible to the naked eye and would have rendered the paper sheet unsatisfactory for many uses. The marking shown by the seam of FIG. **5** is illustrated by the sheet **25** in FIG. **8**. Again, there was marking along rows **26**—**30** along which the ends of the warps terminated across the seam. The marking was more pronounced that that obtained with the seams of FIGS. **4** and **6**, and marking was greater along the outer rows **26** and **30** in comparison to that along the inner rows **27**—**29**.

In contrast, the seam of FIGS. **1**—**3** produced no visible marking in the paper, thereby indicating that it provided more effective drainage along the seam area than the constructions of FIGS. **4**—**6**, particularly in that the seam drainage was substantially equivalent to that of the balance of the fabric.

When the same pulp used in this example was run at heavier weights, it was found that the seam of this invention again developed less marking of the paper than the prior art seams of FIGS. **4**—**6**.

FIGS. 9—10

FIG. **9** illustrates a seam according to this invention as used for joining together a length of Fourdrinier fabric woven in the so-called "plain" weave in which each warp passes alternately under one shute and then over the next shute. A warp **35** when interwoven with shutes **36** according to this pattern has its ends **37** and **38** terminating along a shute **36***a* which extends across the seam joining the fabric together. The ends **37** and **38** are positioned along the wear side of the fabric as is the case of the seam **1**—**3**, and both are positioned underneath shute **36***a*. Further, as indicated in the drawing the ends **37** and **38** of the warp **35** are butted against each other but, as with the seam of FIGS. **1**—**3**, they do not overlap. Other warps **35** in the fabric also will have their ends terminating underneath a shute along the seam and abutted against each other as illustrated by the warp **35**, or slightly spaced from one another.

In FIG. **10** a Fourdrinier fabric is illustrated as having warps **40** interwoven with shutes **41** in a so-called "satin" weave in which each warp first passes over one shute and then passes under the next three shutes, after which it extends over one and under three shutes in a repeated fashion across the length of the fabric. The ends **42** and **43** of the warp **40** are illustrated as terminating under shute **41***a* which extends across the seam joining the fabric in the belt, and the ends may either be spaced from one another as illustrated in the drawings or butted against each other, but they are not to be overlapped. The ends **42** and **43** also could terminate under shute **41***b* or **41***c* in similar fashion. FIG. **10***a* illustrates an alternate arrangement of the warp ends along the seam in a fabric of the satin weave in which a warp **40***a* has one of its ends **42***a* arranged under shute **41***c* and its other end **43***a* arranged under shute **41***d*, the shutes **41***c* and **41***d* each being one of the three shutes under which a long knuckle of the warp passes. Warps on either side of the warp **40***a* will have their ends terminated under a different set of shutes **40** and a fabric of satisfactory structural integrity can be produced even though the warp ends are spaced from each other.

There has thus been described several forms of Fourdrinier belt seams according to this invention in which warp ends are positioned along the seam in a particular arrangement which produces demonstrably lesser marking of the paper than other prior art seams. The warp ends are all on the wear or interior surface of the belt so there are no sharp protuberances along or extending from the papermaking surface; in other words, the seam of this invention eliminates irregularities on the papermaking surface. The small gap between warp ends illustrated with some of the seams of this invention has been found to be inconsequential as far as any adverse affects on the life or durability of the seam are concerned.

I claim:

1. In a seam for joining together a length of fabric into a Fourdrinier belt having a papermaking exterior surface and a wear interior surface, which fabric includes warps interwoven with shutes, the improvement:

characterized in that the ends of warps terminating along the seam are arranged along the wear surface of the belt,

further characterized in that each end of a warp terminating along the seam is arranged under a shute extending across the seam, and

still further characterized in that the ends of a warp terminating along the seam are arranged in one of two con-

ditions, the first condition having the ends of the warp longitudinally aligned with and spaced from each other and the second condition having the ends of the warp longitudinally aligned with and butted against each other.

2. A seam according to claim 1 for joining together a length of Fourdrinier fabric having warps interwoven with shutes in a pattern of the type in which each warp has a first knuckle passing under a plurality of shutes and an adjacent knuckle passing over at least the next shute, which pattern is repeated along the warp, characterized in that

one warp end terminating along the seam is arranged under one of shutes under which said first knuckle of the warp passes, and the other end is arranged under another shute under which said first knuckle of the warp passes.

3. A seam according to clam 1 for joining together a length of Fourdrinier fabric having warps interwoven with shutes in a pattern of the type in which each warp has a first knuckle passing under a plurality of shutes and a adjacent knuckle passing over at least the next shute, which pattern is repeated along the warp, characterized in that

each end of a warp terminating along the seam is arranged under one of shutes under which said first knuckle of the warp passes.