

Nov. 1, 1966

J. R. WAGNER

3,281,905

BELT CONSTRUCTION AND METHOD OF FORMING THE SAME

Filed Oct. 14, 1964

2 Sheets-Sheet 1

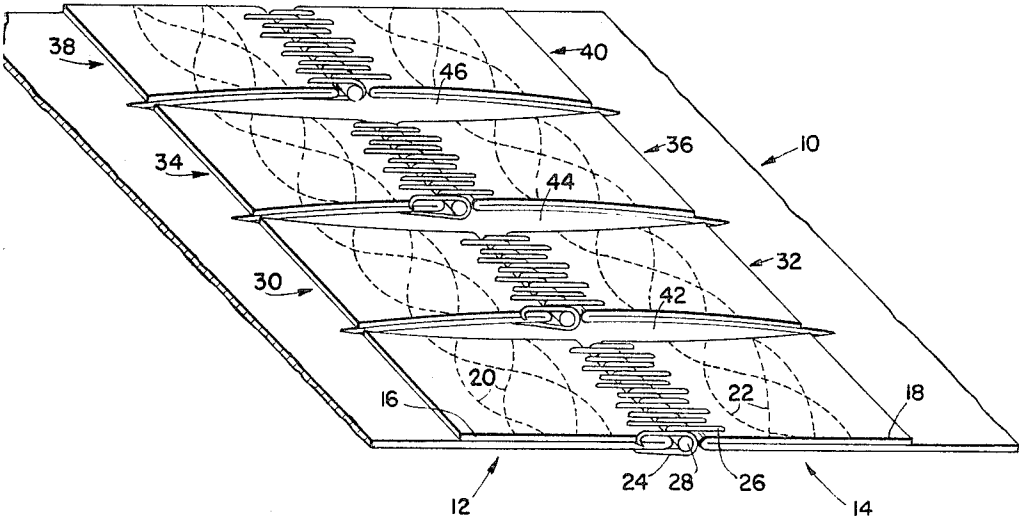


FIG. 1

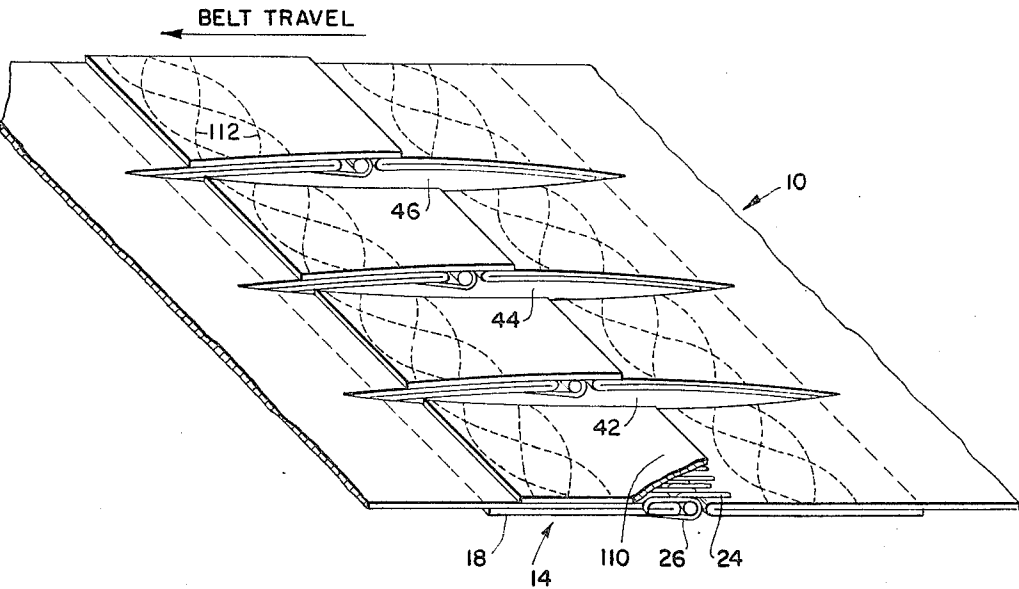


FIG. 5

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FIG. 2

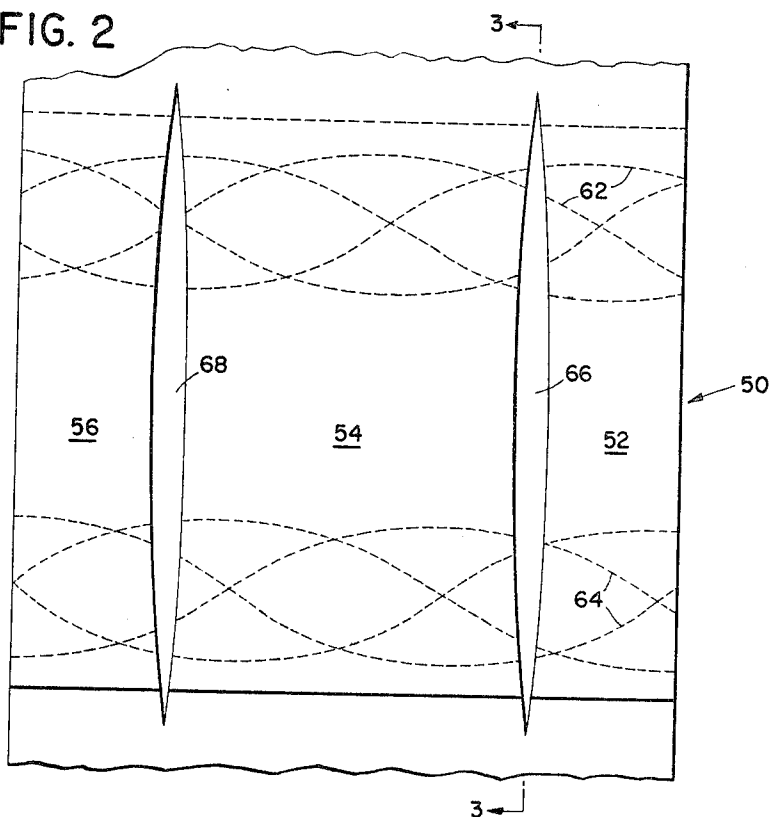
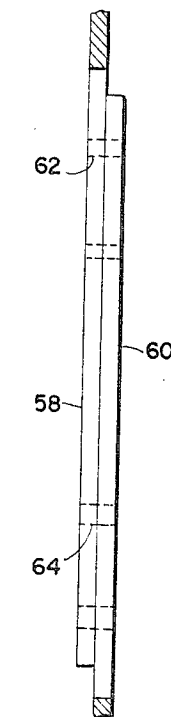


FIG. 3

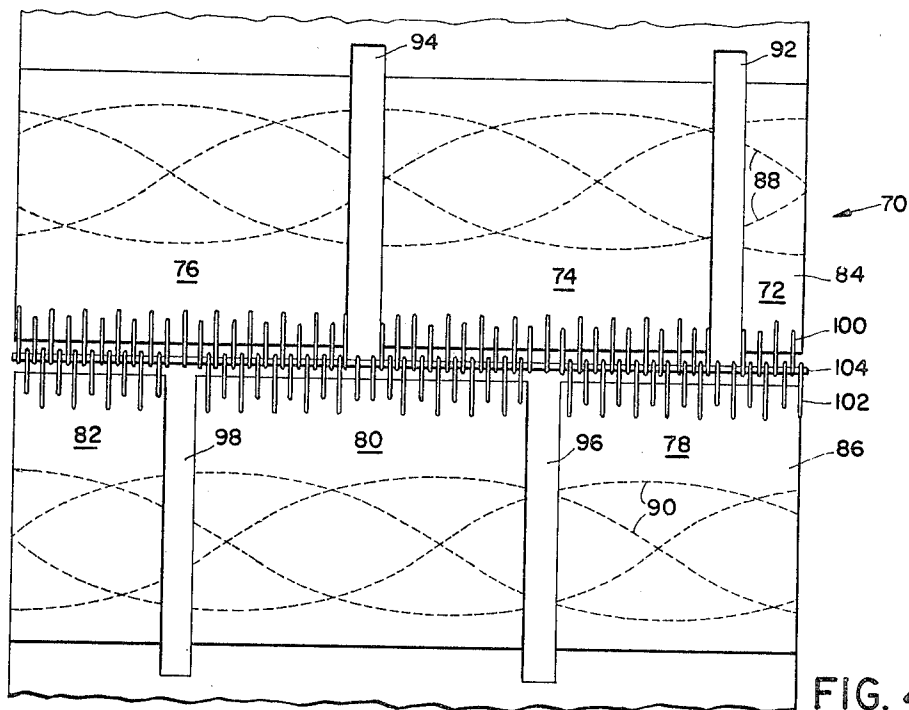


FIG. 4

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**BELT CONSTRUCTION AND METHOD
OF FORMING THE SAME**

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11 Claims. (Cl. 24—33)

This invention relates to belt constructions and more particularly relates to papermakers' drier belts and to methods of forming the same.

Drier belts of the type to which the present invention is directed, while of general application, are particularly well suited for use in connection with the manufacture of non-woven fibrous products such as paper, paperboard, box-board, etc., in a papermaking machine. As is well known, such machines customarily include a "wet" section and one or more drying sections. The paper product is formed from a web of water-saturated pulp which is transported by one or more papermakers' wet felts through opposed press rolls and other dewatering devices in the wet section of the machine until the moisture content of the web is reduced and its fiber structure compacted to such a point that it may become substantially self-supporting. The web is then received by one or more drier belts which are arranged for movement along endless paths to carry the web around a series of rotating drier drums or "cans" in the drying section of the machine. These drums apply heat to the web to remove the remaining moisture.

Numerous arrangements are employed to fasten the ends of flat fabrics to render them useful as drier belts. In some cases the ends are overlapped and sewn, riveted or glued together. In other situations the ends are brought together in a butt joint and secured by a strip of material overlapping the joint. For the most part, however, the ends of present day drier belts are joined by a clipper seam, which is a form of flexible hinge that includes a series of interleaved clipper hooks clenched to the belt ends or to supporting fabrics sewn to the belt. An elongated connector, customarily in the form of a cable, extends through the hooks to hold the ends of the belt in place.

All of the foregoing methods of forming a seam are relatively economical. However, all produce a seam which is substantially different from the remainder, or body, of the belt in regard to thermal expansion or contraction, moisture growth or contraction, residual shrinkage, resiliency (expansion or contraction under stress), permeability, heat transfer and similar qualities. These differences between the seam and the rest of the belt may cause the belt to wrinkle and pucker when placed into service. That is, wrinkles and puckers appear due to the differential effect of temperature, moisture, stress and other factors on the seam as compared with the body of the belt, and this is of special moment under the widely varying conditions encountered in the drying section of a paper machine. For instance, under tension in the machine direction, or longitudinal direction, the belt tends to lengthen and become more narrow. The seam does not narrow to the same extent as the body of the belt, causing wrinkles and puckers to appear. The wrinkles and puckers may undesirably mark the paper web being dried.

It is known that endless belts may be produced wherein the seam is virtually indistinguishable from the body of the belt, for instance, by special weaving processes, or hand interweaving of the ends of a flat belt. However, these processes are expensive and increase the cost of the belt and also the cost of installing it on a paper machine.

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There is at present no known way of joining two ends of flat woven belts by inexpensive means and methods without introducing the aforesaid undesirable properties.

One general object of this invention is to provide a new and improved fastening construction for the ends of a papermakers' drier belt.

It is another object of the present invention to provide an economical method of seaming flat belts by which the seam has substantially the same thermal expansion or contraction, moisture growth or contraction, residual shrinkage and resiliency characteristics as the body of the belt in the transverse direction, as well as good permeability, heat transfer, etc.

It is another object of this invention to provide a belt which has an economical seam construction in which the seam and the body of the belt have substantially uniform characteristics in the cross-machine direction as regard to thermal expansion or contraction, moisture growth or contraction, residual shrinkage, resiliency, permeability, heat transmission and the like.

It is another object of this invention to provide a papermakers' drier belt in which the seam, as well as the remainder of the belt, has substantially the same width during operation, thus substantially eliminating wrinkles, puckers, stresses and the like.

It is a particular object of this invention to provide an improved clipper seam for a papermakers' drier belt which has the same thermal expansion or contraction, moisture growth or contraction, residual shrinkage, resiliency, permeability and heat transmission characteristics as the body of the belt in directions parallel to the seam.

Other objects as well as features of the present invention will be best understood by reading the present specification in conjunction with the drawings, in which:

FIGURE 1 is a perspective view of a seam in a papermakers' drier belt in accordance with one embodiment of the present invention;

FIGURE 2 is a plan view of a seam in a papermakers' drier belt showing another embodiment of the present invention;

FIGURE 3 is a sectional view taken generally along the line 3—3 of FIGURE 2;

FIGURE 4 is a fragmentary plan view of a drier belt utilizing another embodiment of the present invention; and

FIGURE 5 is a perspective view of another embodiment of the present invention showing the use of flaps in conjunction with a seam in the practice of this invention.

The objects of this invention may be achieved by joining the ends of a flat woven fabric or other belt material by means of a plurality of discrete seam segments spaced apart from one another successively across the width of the belt. Desirably, the spacing between successive seam segments is such that apertures between the seam segments substantially disappear during operation. Even where the intersegmental apertures do not close during operation, a paper web is not marked in any objectionable fashion during drying.

While in some cases the cooperating end segments are joined individually, it is highly advantageous to form a single continuous seam extending completely across the belt, in any of the usual manners, as by clipper hooks, stitching, gluing, riveting, etc., and to then divide the seam into segments by removing discrete portions of the seam at predetermined intervals to form apertures between the segments. The intersegmental apertures extend completely through the seam in the longitudinal, or machine, direction and, desirably extend even further into the body of the belt in both directions from the seam, say up to about three inches from the seam. The width of the seam segments depends on the width and construc-

tion of the belt but preferably is between about 2 to 6 inches. The preferred width of each aperture is between about $\frac{1}{16}$ inch and one inch. The apertures are preferably diamond-shaped, but there are several good embodiments in which the apertures are substantially rectangular in configuration. Other intersegmental aperture shapes may be employed, and it is not intended to limit the scope of the broader aspects of the invention to any particular intersegmental aperture shape.

Papermakers' drier belts vary in width from as narrow as four feet in some instances to as broad as thirty feet or more in other instances. The wrinkling and puckering which besets papermakers appears to be of particular significance in connection with wide belts of this type.

The division of the seam into a plurality of relatively narrow segments provides a means by which diagonal stress, such as is generated by fabric non-uniformities, cocked rolls, etc., may be reduced in magnitude. Diagonal stress will not be transmitted by the relatively narrow seam segments to the same extent that it is transmitted by a single large seam. Rather, the multiple seam segments distribute cross-machine stress into the machine direction. In this manner, diagonal stresses are confined to narrow bands which conform to the width of the fabric segments between the apertures.

Wrinkling and puckering of the belt are eliminated by use of the segmented seam. Apparently, the apertures between the segments tend to compensate for differences in thermal expansion or contraction, moisture growth or contraction, residual shrinkage, stresses, resiliency, etc., between the seam and the body of the belt in the cross-machine direction. It is believed that the intersegmental apertures permit the cross-machine dimension of the seam to contract or expand to conform to changes caused by moisture, temperature, tension, etc., to substantially the same extent as the width of the body of the belt.

The intersegmental apertures improve the permeability and heat transfer characteristics of the seams and cause such factors to closely approach those of the body of the belt. The permeability at a seam in a papermakers' drier belt is affected by the number and type of thicknesses of layers of the material of which the belt is composed, and variations in permeability may cause paper marking. The permeability across the seam may be made to substantially equal the permeability in the body of the belt due to the size and arrangement of the apertures associated with the segmented seam. The effect on permeability is particularly evident where the seam in the drier belt is made by folding the ends of the belt over on itself to produce a loop for connection purposes, for instance, in a clipper seam. By employing the intersegmental apertures of the present invention, the net permeability across the length of the seam may be maintained and paper marking due to that problem substantially eliminated. Also, the utilization of the segmented seam provides a means by which the higher insulating qualities of a multiple layered belt seam may be reduced, again probably due to the apertures associated with the seam.

The present invention may be applied to produce an improved clipper seam which is uniquely different from heretofore known clipper seams in that it permits the seam to relieve stresses and to expand and contract, stretch and return, in the cross-machine direction as the body of a drier belt contracts or expands, stretches or returns in the corresponding direction as the result of heat, moisture, tension or other environmental changes during operation. The improved properties enable the clipper seam to maintain approximately the same width as the remainder of the belt and to relieve stresses during operation. Therefore wrinkles, puckers, stresses and other non-uniformities in the seam or belt associated with clipper seams are reduced or eliminated. It is believed that the desired result occurs because the clipper seam cable, being cut and therefore discontinuous or being in the form of short rods or pins, permits the seam to expand and contract, stretch and return and also allows the yarns of the

belt to distort and therefore relieve stresses, whereas the continuous seams of the prior art were restricted in such motion by the continuous-type cables heretofore employed. The segmented seam of the invention permits the stress points in the belt and the seam, such as might be caused by machine misalignment, roll deflection, moisture and thermal conditions, etc., to shift in accordance with the particular operating conditions and thereby avoid the appearance of wrinkles or ripples.

Drier belts in which polyurethane adhesive is used in the seam have a greater probability of causing wrinkling than many of the other known seaming methods. The present invention also is applicable to seams formed with polyurethane resin to reduce wrinkling and puckering.

It is known that, in the case of woven belts where the belt cross direction yarns are formed from nylon, moisture absorption causes growth or linear expansion. By use of the present invention, the growth in the cross direction may act substantially uniformly in both seam and belt, thus preventing wrinkling and puckering due to that cause.

In several embodiments of the invention, the drier belt is of open weave construction and is woven from synthetic yarns. In cases in which additional stability, shove resistance, etc., is desired, the woven yarns preferably are treated with resins in a manner similar to that described, for example, in Holden and Schiff U.S. Patent 2,903,021, granted September 8, 1959, or in Beaumont and Christie U.S. Patent 3,032,441, granted May 1, 1962. One particularly advantageous apparatus for preparing the yarns is disclosed in Christie and Schiff U.S. Patent 3,149,003 granted September 15, 1964.

In other arrangements, the drier belt may be of substantially any construction consistent with good drying action, including conventional drier belts woven from yarns of cotton and asbestos or from synthetic yarns for example, or various perforate or imperforate non-woven belts, such as those of rubber or various synthetic film materials, etc.

Referring to FIGURE 1 of the drawings, there is shown a drier belt 10 having typical seam segments 12 and 14. The terminal portions 16 and 18 of the belt are folded back upon themselves to provide a double thickness of material forming the seam segments 12 and 14. The folded terminal portions are held in place by a suitable stitching 20, 22. A plurality of clipper hooks 24 are clenched to the seam segment 12 and are arranged in interleaving relationship with cooperating clipper hooks 26 similarly affixed to the seam segment 14. The hooks 24 and 26 accommodate a segmented cable 28 which extends in a transverse direction and serves to hold the ends of the segments 12 and 14 in fixed but flexible relationship with each other.

Seam segments 30, 32, 34, 36, 38 and 40 are similarly comprised of terminal portion, stitching, clipper hooks and cable. Seam segment 12 is disposed opposite and cooperates with seam 14; similarly, seam segments 30, 34 and 38 are disposed opposite and cooperate with seam segments 32, 36 and 40, respectively. The adjacent seam segments 12 and 14, 30 and 32, 34 and 36, 38 and 40 are spaced apart from one another by apertures 42, 44 and 46, respectively. The apertures 42, 44 and 46 extend completely through the terminal portions 16 and 18. That is, the apertures extend from the body of the belt on one side of the seam, across the folded over portions 16 and 18 and into the body of the belt on the other side of the seam.

The segmented cable 28 is in the form of a series of flexible spaced-apart rods or pins in axial alignment with each other. Each of these rods is relatively short, when compared with the transverse dimension of the belt, and is of a length not greater than and preferably substantially coextensive with the transverse dimension of the adjacent seam segment. The rods are separated from each other by the apertures 42, 44 and 46 and are free to

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move toward and away from one another as the belt advances through the drying section of a paper machine.

Turning now to FIGURES 2 and 3, there is shown a belt 50 which includes a seam comprising a number of segments 52, 54, 56. Each of these segments is fabricated by overlapping the terminal portions 58 and 60 of the belt and joining them by stitching 62, 64. The terminal portions may be further joined by an adhesive or by rivets, staples, lacing, etc. (not shown). The seam segments 52, 54 and 56 are separated from one another by apertures 66 and 68 which extend completely through the overlapped portion formed by terminal portions 58 and 60 and into the body, or single thickness portion, of the belt.

The apertures are preferably substantially diamond-shaped as shown in FIGURES 1 and 2 but may, if desired, be of generally rectangular configuration and in some cases may be in the form of narrow slits. Also, the cooperating seam segments, at each end of the belt, while preferably disposed opposite one another as shown in FIGURE 1, may be staggered with relation to one another as shown in FIGURE 4.

In FIGURE 4, the belt 70 is formed at its ends into seam segments 72, 74, 76, 78, 80 and 82, formed by folding back terminal portions, such as terminal portion 84 of seam segments 72 and terminal portion 86 of seam segment 78, onto themselves. The terminal portions are stitched in place by stitching 88 and 90.

The seam segments are staggered apart from one another forming slots 92, 94, 96 and 98. The segments contain clipper hooks such as clipper hooks 100 in seam segment 72 and clipper hooks 102 in seam segment 78. The clipper hooks on oppositely disposed seam segments are interleaved and joined by a cable 104. Because the clipper hooks 100 and 102 are of such transverse dimension that a space exists between them, each of the seam segments is free to expand and contract, extend and return, in the transverse direction. The embodiment of FIGURE 4 is particularly useful, because it retains the cable 104 in continuous form and so expedites connection of the belt ends.

Turning now to FIGURE 5, there is shown another embodiment of the present invention in which a flap in the form of a cover tape 110 is joined to the belt 10 as described above with regard to FIGURE 1. The tape 110 is joined by stitching 112 to the seam segment 14 on the side opposite the folded over terminal portion 18 and is arranged to cover the clipper hooks 24 and 26 so as to provide a smooth surface for the paper being transported. The belt and paper move in the direction of the arrow. Ideally, the transverse dimensions of the apertures 42, 44 and 46 are such that the apertures are reduced in size to a disappearing point during operation due to the longitudinal stress applied, thermal conditions, etc.

The terms and expressions which have been employed are used as terms of description and not of limitation, and there is no intention in the use of such terms and expressions of excluding any equivalents of the features shown and described, or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed.

What is claimed is:

1. A drier belt end fastening construction comprising, in combination, a drier belt having a pair of end portions, joining means for interconnecting said end portions to form a seam for said drier belt, and a narrow flap affixed to a surface of said drier belt in position to cover said joining means, said seam including a plurality of apertures extending through said end portions, said joining means and said flap, whereby the seam is free to conform to the cross machine dimension of the body of the belt and wrinkling and puckering are avoided.

2. The method of reducing wrinkling and puckering in a belt formed from a flat woven fabric and having a seam which differs substantially from the body of the belt in ability to conform to dimensional changes resulting from stresses occurring during operation comprising divid-

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ing the seam into a plurality of discrete segments, successive segments being spaced apart from one another at predetermined intervals by removing portions of the seam, whereby the segments are free to move differentially with respect to each other and to conform to the position of the adjacent body of the belt, to thereby substantially eliminate wrinkling and puckering.

3. A method of forming an improved clipper seam in a papermakers' drier belt comprising installing a clipper seam in the drier belt, and thereafter removing predetermined portions of said seam in order to divide said seam into a plurality of seam segments, the seam segments being free to move differentially with respect to each other and to conform to the position of the adjacent body of the belt, to thereby substantially eliminate wrinkling and puckering.

4. In a papermakers' drier belt made from a flat material having a body portion and end portions which are joined together to render said belt endless, said end portions being substantially different in their response to environmental changes than said body portion, the improvement comprising a plurality of discrete seam segments disposed at spaced intervals along each of said end portions in the transverse direction of said belt, said seam segments being defined by apertures disposed between adjacent segments, each of said apertures extending longitudinally with respect to the belt substantially entirely across at least one of said end portions, said apertures tending to compensate for differing responses of said end portions and said body portion to environmental changes.

5. In a papermakers' drier belt made from a flat material having a body portion and end portions which are joined together to render said belt endless, said end portions being reinforced and having a substantially different response to environmental changes than said body portion, the improvement comprising a plurality of discrete seam segments disposed at spaced intervals along each of said end portions in the transverse direction of said belt, said seam segments being defined by apertures disposed between adjacent segments, each of said apertures extending longitudinally with respect to the belt substantially entirely across the reinforcement on at least one of said end portions, said apertures tending to compensate for differing responses of said end portions and said body portion to environmental changes.

6. In a papermakers' drier belt made from a flat material having a body portion and two ends which are joined together to render said belt endless, said ends being turned over to overlap said body portion and thereby form end portions which are substantially different in their response to environmental changes than said body portion, the improvement comprising a plurality of discrete seam segments disposed at spaced intervals along each of said end portions in the transverse direction of said belt, said seam segments being defined by apertures disposed between adjacent segments, each of said apertures extending longitudinally with respect to the belt substantially entirely across at least one of said turned over end portions, said apertures tending to compensate for differing responses of said end portions and said body portion to environmental changes.

7. In a papermakers' drier belt of the character set forth in claim 6, each of said apertures extending longitudinally with respect to said belt completely across at least one of said turned over end portions.

8. In a papermakers' drier belt of the character set forth in claim 6, each of said apertures on one of said end portions being opposite an aperture on the other end portion.

9. In a papermakers' drier belt made from a flat material having a body portion and end portions which are joined together to render said belt endless, said end portions being substantially different in their response to environmental changes than said body portion, the improvement comprising a plurality of discrete seam seg-

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ments disposed at spaced intervals along each of said end portions in the transverse direction of said belt, the individual seam segments being free to move transversely with relation to one another, said seam segments being defined by apertures disposed between adjacent segments, each of said apertures extending longitudinally with respect to the belt substantially entirely across at least one of said end portions, said apertures tending to compensate for differing responses of said end portions and said body portion to environmental changes.

10. In a papermakers' drier belt made from a flat material having a body portion and end portions which are joined together to render said belt endless, said end portions being substantially different in their response to environmental changes than said body portion, the improvement comprising joining means for interconnecting said end portions, a narrow flap affixed to a surface of said drier belt in position to cover said joining means, and a plurality of discrete seam segments disposed at spaced intervals along each of said end portions in the transverse direction of said belt, said seam segments being defined by apertures disposed between adjacent segments and extending through said end portions, said joining means and said flap, each of said apertures extending longitudinally with respect to the belt substantially entirely across at least one of said end portions, said apertures tending to compensate for differing responses of said end portions and said body portion to environmental changes.

11. In a papermakers' drier belt made from a flat material having a body portion and end portions which

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are joined together to render said belt endless, said end portions being substantially different in their response to environmental changes than said body portion, the improvement comprising a plurality of discrete seam segments disposed at spaced intervals along each of said end portions in the transverse direction of said belt, joining means including a series of interleaved clipper hooks affixed to each of said seam segments and a plurality of comparatively short rods extending through said clipper hooks to interconnect said segments, the individual seam segments being free to move transversely with relation to one another, said seam segments being defined by apertures disposed between adjacent segments, each of said apertures extending longitudinally with respect to the belt substantially entirely across at least one of said end portions, said apertures tending to compensate for differing responses of said end portions and said body portion to environmental changes.

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