Nov. 5, 1963 J. M. DE BELL ETAL 3,109,219

SEAM STRUCTURE FOR FOURDRINIER TYPE SCREEN FABRIC AND METHOD OF MAKING SAME

Filed June 21, 1961

Fig. 1.

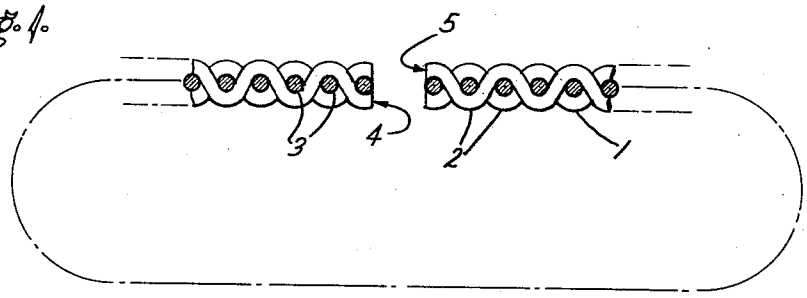


Fig. 2.

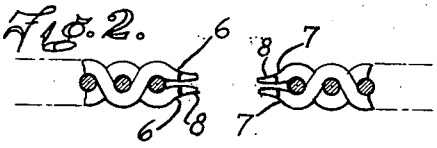


Fig. 3.

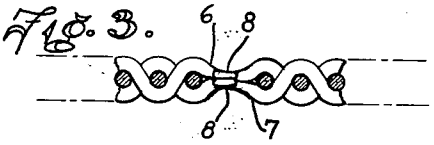


Fig. 4.

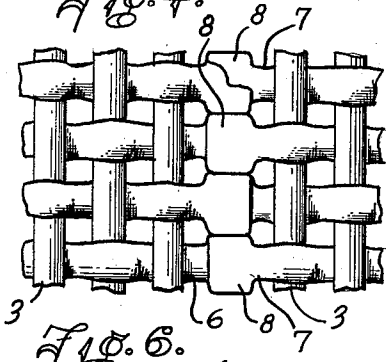


Fig. 5.

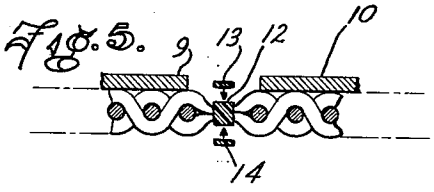


Fig. 6.

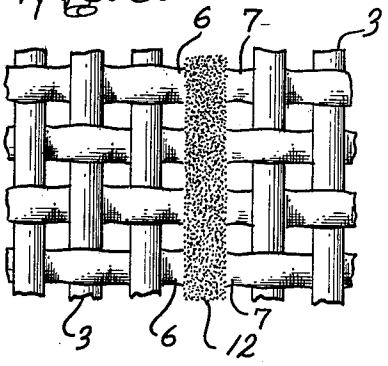


Fig. 7.

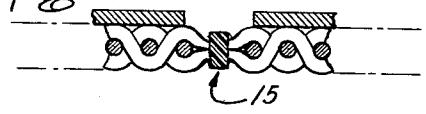


Fig. 8.

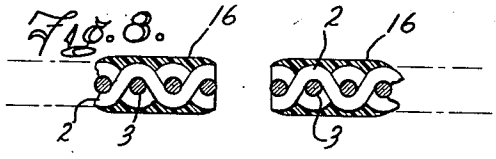
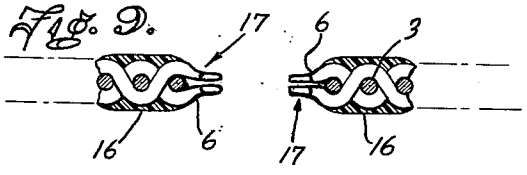


Fig. 9.



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3,109,219

SEAM STRUCTURE FOR FOURDRINIER TYPE SCREEN FABRIC AND METHOD OF MAKING SAME

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22 Claims. (Cl. 28—74)

This invention relates to seam or joint structures, and method of making them, in fourdrinier type screen fabrics, in which the warp elements, at least, are formed of synthetic organic yarns or filaments, or of yarns or filaments containing synthetic organic material such as glass yarns or filaments coated with a synthetic organic material.

Fourdrinier type screen fabric, as the term is here used, is the type of fabric commonly used in paper making machines and is characterized by a relatively fine mesh, an ability to sustain constant movement under tension and flexure in the presence of water and to withstand frictional abrasion.

Fourdrinier type fabric has utility for many commercial purposes but finds its principal use in paper making machines, for which, and for other uses, the ends of a length of the screen fabric are seamed or joined together to form an endless belt. It is important that the seam be not only strong enough to sustain the tensile strain imposed thereon in the operation of the machine, but also, in the case of paper making machines, that it sufficiently conform to the adjacent surfaces of the screen as not to materially affect or objectionably mar the appearance of the surface of the paper product made thereon. If correct drainage is lacking the paper cannot be stripped from the belt in an endless sheet.

While presently known splicing techniques are adequate for splicing all-metal fourdrinier screen fabrics, such techniques are not applicable to a fourdrinier screen fabric having a warp of non-metallic yarns or filaments.

It is the broad object of the present invention to provide seam structures and methods of making them, applicable to fourdrinier type screen fabric, at least the warp elements of which are non-metallic and which contain a synthetic organic plastic.

Stated in another way it is an object of the invention to provide a seam geometry broadly applicable to the above stated fourdrinier type screen fabrics.

A further object is to provide a seam, the transverse width of which may be controlled, and if found desirable or necessary, restricted to a width equal to or not substantially greater than, the transverse width of a weft element of the fabric being spliced, the thickness of the seam being similarly subject to control and restriction to a thickness not substantially greater than the overall thickness of the fabric.

Other and further objects and advantages of the invention will be made apparent in the following specification and claims.

Broadly the above objectives of the invention are attained by forming a relatively narrow transversely extending body of a synthetic organic material of which lapped free end portions of the warp elements, extending from the edges of the fabric to be joined, are at least an incorporate part, adhesively and/or cohesively bonded together into a strain resisting unit, having a per-inch tensile strength in the direction of the warp adequately proportional to that of the per-inch strength of the warp assembly, for the use to which the seamed fabric is to be put.

The most exacting structural limitations are perhaps imposed in the seaming of fourdrinier screen fabric to meet the requirements of its use in the manufacture of fine quality paper, and in the following illustrative disclosures it is assumed that the seamed fabric is to be used for that purpose, the warp being of a synthetic organic material in the form of a monofilament, or a staple or multifilament yarn, and the weft, by way of illustration and not limitation, being metal wire.

In the accompanying drawings which diagrammatically disclose such an illustrative embodiment of the invention:

FIG. 1 is a longitudinal sectional view, on a greatly enlarged non-exact scale, of the end portions of a length of fourdrinier type fabric, illustrating an initial step in the seaming procedure;

FIG. 2 is a view of the end portions, similar to FIG. 1 but showing the end portions prepared for the second step in the seaming procedure;

FIG. 3 is a similar view showing the third step;

FIG. 4 is a fragmentary plan view on a greatly enlarged non-exact scale showing the relative position of the fabric elements in correspondence to that of FIG. 3;

FIGS. 5 to 7 are views showing succeeding steps in the seaming operation; and

FIGS. 8 and 9 illustrate a modification in the procedure.

Referring to FIG. 1 a length of the fourdrinier fabric of the type previously described is generally indicated at 1, the non-metallic warp filaments being indicated at 2 and the metal shoots or wefts elements at 3. As the initial step in the seaming procedure the end portions of the strip which are to be seamed together are annealed or heat treated to remove internal strains from and stabilize the warp material as found necessary. The fabric ends are then trimmed to provide the needed end extension of the warp elements. For the assumed use of the fabric this is conveniently done by trimming along the terminal shoot wire as indicated at 4 and 5. The terminal weft or shoot wires are then removed from each end of the strip leaving end portions 6 and 7 of the warp extending from the strip ends. As shown in FIG. 2 the extending end portions are brought into the general plane of the weft and, as indicated at 8 in FIGS. 2 and 4, are flattened or otherwise shaped at their extreme end portions by swaging or pressure, under heat if found desirable, and cleaned to remove any processing oils, dirt, or other foreign matter. The end portions are then brought into lapped relation as shown in FIG. 4, the extent of overlap not materially exceeding the width of a shoot or weft element of the fabric. Ideally and as shown the opposed warp elements are substantially aligned and the side edges of the flattened ends of adjacent warp elements are in substantial contact, but alignment of the opposed warp elements is not essential and the sides of the flattened end portions of the adjacent warp elements may lap each other, the opposed warp ends in effect interdigitating. The end portions of the strip are held in the position of FIGS. 3 and 4, in any suitable manner as by bars 9 and 10 which clamp the end portions against a supporting surface, not shown.

With the end portions so confined a suitable solvent or a plastic solution is applied to the ends 6—7. The solute embedding material will depend on the material of which the warp filaments are formed and is either an effective adhesive therefor or is effectively compatible and miscible therewith to, respectively, effect either a bonding adhesion between the surfaces of the lapped warp ends, or such superficial intermixing, by the solvent of the solution, as to create a union between the material of the warp ends and also a union of the warp ends and the solute material.

Nylon is one of the various synthetic organic materials commonly used for the warp filaments, and is below

referred to for one exemplary disclosure of the seaming structure and method of the invention.

Assuming therefore that the warp filaments **2** are formed of nylon, such as nylon 6, a nylon solvent such as phenol, preferably in the form of a solution of nylon in phenol (later more specifically described) is applied in a single or in successive coats to both sides of the fabric at the lapped area of the filament ends by use of a dip pen, or equivalent applicator, as indicated at **12**, by stippling in FIG. 6 and in section in FIG. 5. By way of example for a fourdrinier fabric of the order of 50 to 55 mesh, the warp filaments being .011 of an inch, and the shoot wires .011 of an inch, in diameter, five coatings of a 5% solution of nylon in phenol has been found satisfactory. The solution is preferably brought to a temperature of 350° F. and applied as above described. After each application the temperature of the seam area is raised to a temperature sufficient to drive off the solvent, preferably in the range of 350° F. to 375° F. After each of the first two applications pressure (about 5 pounds per lineal inch) may be applied over the seam area, in order to assure that the free end portions **6** and **7** are properly positioned and held in place to assure an adequate flow of the initial coating solution between and around the lapped filament end portions **6** and **7** which define the width of the seam.

Phenol softens the nylon of the filaments sufficiently to render it superficially miscible with the nylon of the adjacent coatings, so that the coatings bond to the filaments and to each other without a perceptible or effective interface between them. The increase of the temperature following each application of the coating solution dries that coating to leave it in condition to similarly miscibly accept the succeeding coatings. Thus the warp ends **6** and **7** are integrally bonded together into a unitary body **12** with the resin cast from the coatings. Following the last coating operation, without drying the latter coatings, lengths of nylon ribbon **13** and **14**, each about 4 to 7 mils thick and 15 mils wide, are placed longitudinally over and along the outer surfaces of the bonding body **12**, as indicated in FIG. 5. The ribbons **13** and **14** are softened with hot phenol (350° F.), before being put in place, and the temperature of the seam area again raised to 350° F. to 375° F. Thus the resin of the end portions **6** and **7**, the resin of the coating body **12** and of the ribbons **13—14** is formed into a substantially homogeneous seam structure as indicated at **15** in FIG. 7. It will be understood that the ribbons **13** and and **14** may be applied and heated in successive operations or may be simultaneously integrated into the seam structure by a single heating step following their application. Pressure may be employed in the integration of the ribbons if found desirable.

In seaming the nylon-metal fabric of the above illustration the 5% nylon content of the coating solution in the above example was nylon 6/10, that is the polymerization product of hexamethylenediamine containing 6 carbon atoms, and sebacic acid containing 10 carbon atoms, and the nylon ribbons used were formed of 6/6 nylon, that is it is the polymerization product of hexamethylenediamine containing 6 carbon atoms and adipic acid containing 6 carbon atoms. Nylon 6 or nylon 11 may be used in place of the 6/6 and 6/10. Alcohol soluble nylon copolymers may also be used. It will be understood that the percentage of solute material in the solution is not critical and while solutions of the order of 5% facilitate application in the manner above described, percentages up to saturation may be used as found feasible.

The above procedure and materials provide a seam which conforms closely to the screen texture of the fabric. The cross-sectional dimensions of the seam and its position with respect to the adjacent fabric elements closely approximate those of the weft elements so that no objectionable marking or marring of the paper made thereon results, and drainage through the screen is not materially impeded.

As will be apparent, where desired and where the use of the spliced screen permits, the transverse width of the seam may be increased by increasing the length of the free warp ends **6—7** and increasing the extent to which they are lapped, the transverse width of application of the embedding material and the width of the ribbon being correspondingly increased.

As above pointed out the embedding material may be such as makes a strong adhesive bond with the warp ends rather than a miscible bond. For example, if the warp comprises nylon, the embedding material may be a cyanoacrylate monomer polymerizing, preferably, at room temperature, with approximately 10% plasticizer, thickening agent and stabilizer; the material available under the trade name Eastman 910 being an example. Such material may be applied in successive coats in the manner above described, the coats being allowed to cure under pressure as found necessary (about 5 pounds per lineal inch). The monomer may be aluminum-filled (up to 10% by weight) with some increase in the strength of the bond, but aluminum powder accelerates the cure of the resin. Strips **13** and **14** of nylon may be pressed into bonding adherence to the final coating of the embedding adhesive. Any of the various commercially available adhesives which make a strong bond with nylon, such as the phenolic butyral adhesives, exemplified by that available from Interchemical Corporation under the trade name SRP 1614 may be employed in practicing the invention.

The above described seam geometry of the invention is not limited to the seaming of screen fabrics in which the warp elements are of a specific synthetic organic material, it only being necessary to use solvents, and bonding agents which are appropriate for the resin of which the warp elements are formed. For a further example, assuming the warp elements are formed of polyester resin such as polyethylene terephthalate, the warp ends, having been suitably shaped or flattened as in FIG. 2 and cleaned, may be lapped to the desired extent. In this example the bonding **12** may comprise one or more coatings of a suitable solvent such as m-chloro-aniline or phenol, preferably with about 5% polyethylene terephthalate in the solvent, successively applied at a temperature of 350–420° F. to opposite sides of the lapped warp ends with the latter at approximately the same temperature and with pressure applied at that temperature for about three minutes, and the coatings cooled to room temperature under pressure. Ribbons **13** of polyethylene terephthalate film may then be incorporated at opposite sides of the coating body **12**. Such ribbons may be coated with a polyester adhesive. For example a 3 mil polyethylene terephthalate ribbon with 2 mil coating of 46971 Mylar adhesive by Du Pont may be employed.

In seaming heavier fabrics than that of the example above given or where for manufacturing conditions or other reasons difficulty is encountered in maintaining the width of the seam within the desired width, additional steps shown in FIGS. 8 and 9 may be employed. Prior to or after trimming the fabric as described but before removal of the end shoot, the mesh of the fabric for a short distance back of the fabric ends may be filled with a solid barrier material, as indicated at **16** in FIG. 8, which is soluble, in water for example, but insoluble in such solvents as may be used in making the bond. One, or more, end shoots are then removed and the barrier material between the filament end portions **6** and **7** broken away as indicated at **17** to permit flattening of the ends (FIG. 9) and lapping of the filament ends **6** and **7** in the manner shown in FIGS. 3 and 4. The forming of the seam structure may then be proceeded with as above described, or the space between the barriers **16** may be bridged with mold plates, not shown, and the cavity formed by the barriers **15** and the plates filled with the bonding com-

position by injection or otherwise. In any event after the seaming structure has been formed the barriers 16 are dissolved away by a suitable solvent or removed by manual stripping, air blasting, or other suitable procedure.

What is claimed is:

1. In a fourdrinier screen fabric having a non-metallic warp containing synthetic organic material, a seam comprising lapped end portions of the warp elements embedded in a body of synthetic organic material, said body extending transversely of the fabric between and parallel to weft elements of the fabric and bonding the embedded warp ends to each other and to said body, said body including a preformed strip of the warp material extending longitudinally thereof and incorporated therein.

2. In a fourdrinier screen fabric having a non-metallic warp containing synthetic organic material, a seam comprising flattened end portions of the warp positioned in lapping relation substantially in the plane of the weft and embedded in a body of synthetic organic material extending transversely of the fabric between, spaced from and parallel to the adjacent weft elements of the fabric and bonding the embedded warp ends to each other and to said body.

3. A seam as in claim 2, the warp elements being nylon and said body comprising nylon.

4. A seam as in claim 2, the warp elements being nylon and said body comprising one or more integrated coatings of nylon and preformed strips of nylon superposed on opposite sides of said body.

5. A seam as in claim 2, the warp elements being nylon and the body comprising one or more superposed coatings of polycyanoacrylate.

6. A seam as in claim 2, the warp elements being nylon and the body comprising one or more superposed coatings of polycyanoacrylate and preformed strips of nylon superposed on opposite sides of said body.

7. A seam as in claim 2 the warp elements and said body comprising a polyester resin.

8. A seam as in claim 2, the warp elements being polyethylene terephathale and the body comprising superposed coatings of up to 5% polyethylene terephthalate in m-chloro-aniline.

9. A seam as in claim 2, the warp elements being polyethylene terephthalate and the body comprising superposed coatings of up to 5% polyethylene terephthalate in m-chloro-aniline, and preformed strips of polyethylene terephthalate superposed on opposite sides of said body.

10. The method of seaming together warp edges of a fourdrinier screen fabric having a warp containing synthetic organic material which comprises, clearing the said edges of weft elements as needed to provide extending warp end portions, at each edge, cleaning the extending warp end portions, bringing the extending warp end portions at said edges into lapped relation and applying a synthetic organic material to said lapped end portions to form an embedding body around the lapped end portions to bend said portions together and to said body.

11. The method of claim 10 in which said embedding body is formed by the application of successive coatings of a solution of embedding material to the lapped warp end portions at opposite sides of the fabric.

12. The method of seaming together warp edges of a fourdrinier screen fabric having a warp containing synthetic organic material which comprises clearing the said edges of weft elements as needed to provide extending warp end portions, at each edge, flattening the ends of said portions, cleaning the ends, bringing the opposed extending warp end portions into substantial alignment at said edges and into lapped relation and applying a synthetic organic material to said lapped end portions to form an embedding body around the lapped end portions to bond said portions together and to said body.

13. The method of seaming together warp edges of a fourdrinier screen fabric having a warp containing synthetic organic material which comprises, clearing the said edges of weft elements as needed to provide extending warp end portions, at each edge, cleaning the ends, bringing the extending warp end portions at said edges into lapped relation, applying successive coatings of a synthetic organic material to said lapped end portions at opposite sides of the fabric, and applying preformed solvent-softened strips of the warp material over said coatings at opposite sides of the fabric.

14. The method of seaming together warp edges of a fourdrinier screen fabric, having a warp of nylon which comprises clearing the said edges of weft elements as needed to provide extending warp end portions at each edge, cleaning the ends, bringing the extending warp end portions at said edges into lapped relation, and applying to said lapped end portions at both sides of the fabric, successive coatings of a viscous solution of nylon, raising the temperature of the seam area following each coating operation to substantially drive off the solvent, applying slight pressure to at least the initial coating prior to the application of the successive coatings.

15. The method of seaming warp edges of a fourdrinier screen fabric, having a warp of nylon, which comprises clearing the said edges of weft elements as needed to provide extending warp end portions at each edge, cleaning the ends, positioning the extending warp end portions in lapping relation substantially in the plane of the weft members, applying to the so-positioned extending warp end portions, at both sides of the fabric, successive coatings of a 5% solution of nylon in phenol at a temperature of substantially 350° F., raising the temperature of the seam area, following each coating operation, to a temperature in the range 350° F. to 375° F. to drive off the solvent, applying a pressure of approximately 5 pounds per lineal inch to at least the initial coating prior to the application of the successive coatings, and applying a strip, 4 to 7 mils thick and approximately 15 mils wide, of nylon softened with phenol at a temperature of 350° F., longitudinally over the coatings at each side of the fabric, and again raising the temperature of the seam area to a temperature in the range 350° F. to 375° F.

16. The method of seaming warp edges of a fourdrinier screen wabric, having a warp of nylon, which comprises clearing the said edges of weft elements as needed to provide extending warp end portions at each edge, cleaning the ends, positioning the extending warp end portions in lapping relation substantially in the plane of the weft members, applying to the so-positioned extending warp end portions, at both sides of the fabric, successive coatings of a cyanoacrylate monomer, and curing the successive coats to form an embedding body around the lapped portions of the extending warp ends.

17. The method of claim 16 in which the cyanoacrylate monomer is filled, up to 10% by weight with finely divided aluminum.

18. The method of seaming warp edges of a fourdrinier screen fabric, having a warp of nylon, which comprises clearing the said edges of weft elements as needed to provide extending warp end portions at each edge, cleaning the ends, positioning the extending warp end portions in lapping relation substantially in the plane of the weft members, applying to the so-positioned extending warp end portions, at both sides of the fabric, successive coatings of a cyanoacrylate monomer polymerizing at room temperature, allowing the successive coats to cure under contact pressure, to form an embedding body around the lapped portions of the extending warp ends and pressing a strip of nylon into bonding adherence with the embedding body.

19. The method of seaming warp edges of a fourdrinier screen fabric, having a warp of polyethylene terephthalate, which comprises clearing the said edges of weft elements as needed to provide extending warp end portions at each edge, cleaning said portions, positioning the extending warp end portions in lapping relation substantially

in the plane of the weft members, heating the so-positioned extending warp end portions to a temperature of approximately 350° F. to 420° F., applying successive coats of approximately 5% polyethylene terephthalate in m-chloro-aniline heated to a temperature of approximately 350° F. to 420° F. to the so-positioned extending warp end portions.

20. The method of seaming warp edges of a fourdrinier screen fabric, having a warp of polyethylene terephthalate, which comprises heat treating the fabric at, and for a substantial distance rearwardly from, the edges to be joined to stabilize the material of the warp, clearing said edges of weft elements as needed to provide warp end portions at each edge, flattening the ends of said portions, cleaning the said end portions, bringing the flattened end portions into lapped relation, heating the so-positioned warp end portions to a temperature of approximately 250° F., applying successive coats of hot phenol thereto, raising the temperature of said warp end portions to approximately 420° F. under pressure, permitting evaporation of the phenol, applying hot phenol to ribbons of polyethylene terephthalate and to the now cool warp end portions, at each side of the fabric, and applying the said ribbons, successively one to each side of the fabric, over the warp end portions, under pressure and at a temperature approximating 420° F.

21. The method of seaming together warp edges of a fourdrinier screen fabric having a warp containing synthetic organic material which comprises trimming the edges along a weft element, filling the mesh of the fabric rearwardly of said weft element with a barrier material,

clearing the said edges of weft elements and barrier material as needed to provide extending warp end portions extending from the remaining barrier material, bringing the so-extending wrap end portions into lapped relation, forming an embedding body of a synthetic organic material around the said lapped end portions between the adjacent edges of the barrier material to bond said warp end portions together and thereafter cleaning the fabric of said barrier material.

22. The method of seaming together warp edges of a fourdrinier screen fabric having a warp containing synthetic organic material which comprises trimming the edges along a weft element, filling the mesh of the fabric rearwardly of said weft element with a barrier material, clearing the said edges of weft elements and barrier material as needed to provide extending warp end portions extending from the remaining barrier material, bringing the so-extending warp end portions into lapped relation, filling the space between the adjacent edges of the barrier material with a material bonding the said warp end portions together and thereafter clearing the fabric of said barrier material.

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