United States Patent [19]

MacBean

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[54] **WOVEN CLOTH SEAM**

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[73] Assignee: **JWI Ltd.,** Montreal, Canada

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** ..... **428/223;** 139/383 A; 162/348; 162/DIG. 1

[51] **Int. Cl.**[2] **B32B 7/08;** D21F 1/12

[58] **Field of Search** ..... 245/10; 162/DIG. 1, 348; 156/157, 158, 159, 502, 137; 139/383 A; 28/72 R; 161/53

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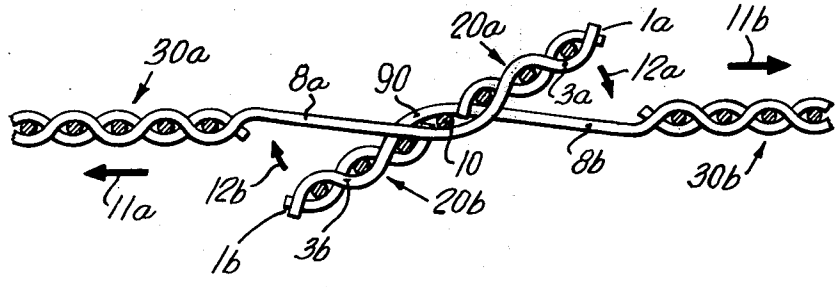
Primary Examiner—S. Leon Bashore
Assistant Examiner—Richard V. Fisher
Attorney, Agent, or Firm—Alan Swabey; Robert E. Mitchell

[57] **ABSTRACT**

This invention relates to a seam for joining together the ends of sheets of woven cloth, and especially cloth woven of synthetic materials. Such a woven cloth comprises warp strands in the longitudinal direction thereof and interwoven weft strands. To form the seam of the invention, the weft strands are either removed from or not woven into areas adjacent each end of the cloth, the unwefted areas being separated from the ends of the cloth by first and second areas in which the weft strands remain. The unwefted areas are separated from each other by a third wefted area which comprises the main body of the cloth. Thus, the first and second areas are joined respectively to different ends of the third area by the unwefted continuation of the warp strands in the unwefted areas. The unwefted warp strands are crimped, some in an upward and some in a downward direction, and the crimped warp strands are intermeshed. The crimps are adjacent one another along the width of the cloth so that the crimps co-operate to form a cylindrical-like opening along the width of the cloth, and a pintle pin, or a hinge, is inserted into the opening to thereby fasten one end of the cloth to the other end. The seam is especially useful to join the two ends of woven cloth fabrics used in paper making machines such as cylinder covers and Fourdrinier wires.

17 Claims, 9 Drawing Figures



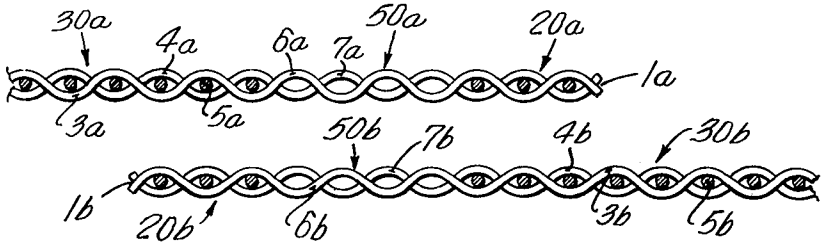


FIG. 1

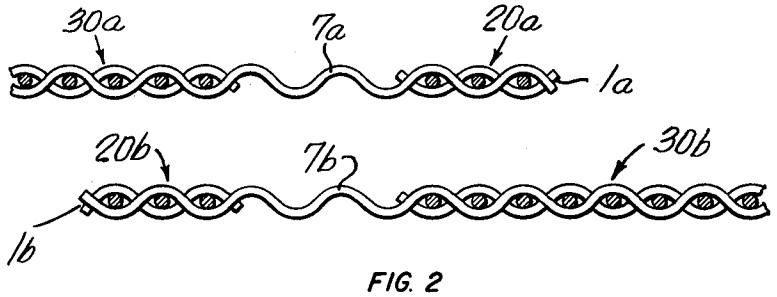


FIG. 2

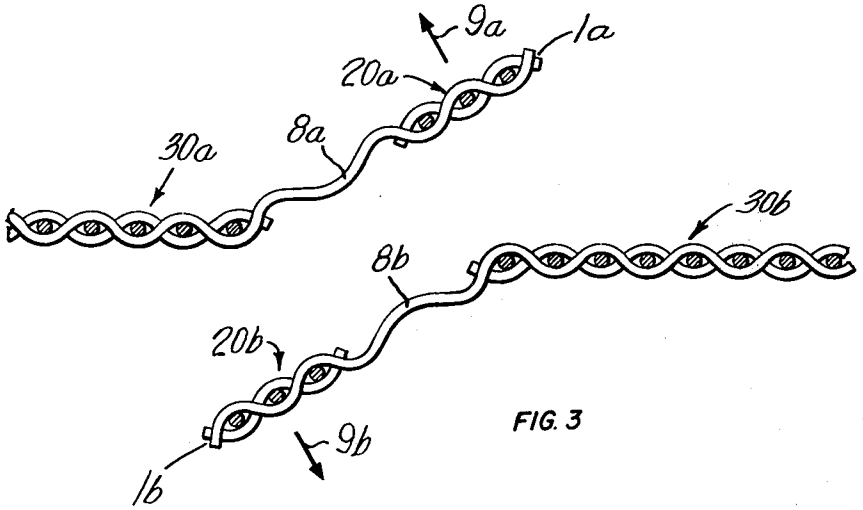


FIG. 3

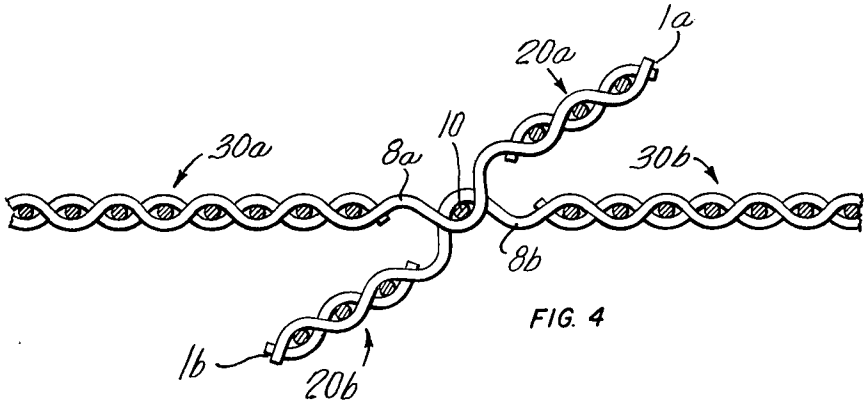


FIG. 4

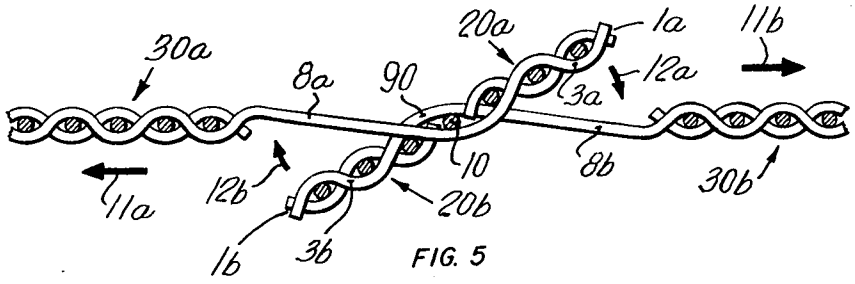


FIG. 5

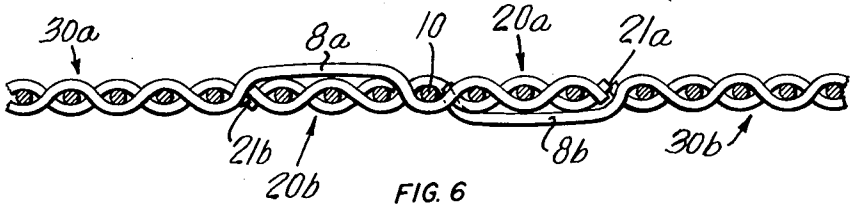


FIG. 6

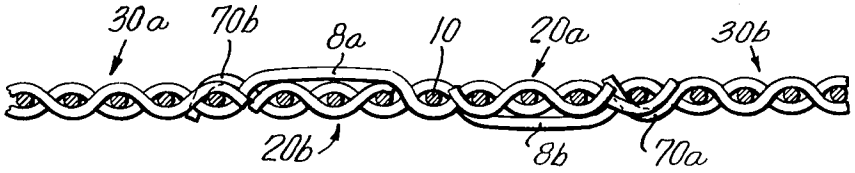


FIG. 7

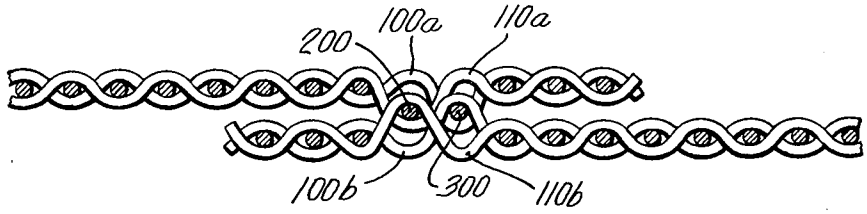

200
100a
110a
100b
300
110b

FIG. 8

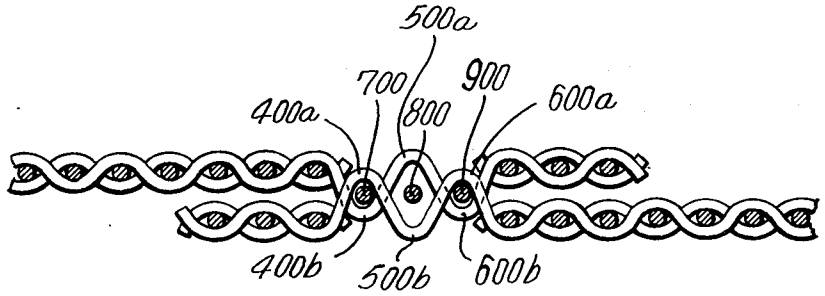

500a
700
900
600a
400a
800
400b
500b
600b

FIG. 9

WOVEN CLOTH SEAM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a seam for joining together ends of sheets of woven cloth. More specifically, this invention relates to a seam for joining together sheets of cloth woven from a synthetic material.

The inventive seam is particularly useful for joining opposing ends of a sheet of woven cloth to thereby form an endless loop of the woven cloth. Specifically, the seams of the invention are useful for woven filter covers, usually referred to as cylinder covers, which are applied to cylinder molds used in the preparation of stock for paper making machines. It is especially useful when the covers are woven from synthetic strands which may shrink onto the cylinder, usually by heat treatment. In addition, the seam may be used for joining the ends of woven fabric base material of a needled press felt of the type which is used in the press section of a paper making machine. Further, the seam can be used to join the ends of woven fabric conveyor belts, as well as the ends of a woven cloth Fourdrinier wire used in paper making machines.

The seam is useful having regard to woven cloth whose warp and weft strands comprise synthetic or metal or a combination of the above materials.

2. Statement of the Prior Art

It has been the practice to have cylinder covers made exclusively of cloth woven of bronze or stainless steel. The metal cloth is fitted tightly around a cylinder mold and joined by welding or brazing in a butt joint which is flush with both top and bottom surfaces. In a refined version of the brazed seam, great care is taken to prepare the edges to be joined so that drainage across the seam will be substantially uniform. Care is also taken to avoid forming projections which might cause premature wear or development of fatigue stresses by flexing of the cloth. This fused metal joint, besides being almost completely undiscernable, has adequate fatigue and tensile strength. In less critical applications, a soldered or spot welded lap joint is used.

Recently, there has been a growing demand in the paper industry for cloth woven of synthetic strands which generally possess better corrosion, fatigue and damage resistance than bronze or stainless steel. A serious drawback in the use of synthetic strands, however, is the difficulty in making a joint or seam which will have adequate strength and uniformity of drainage. It is not possible to fuse the synthetic strands together as is done in the case of metal strands because the molecular orientation in the synthetic is destroyed in the heating process and the resultant joint is much too weak. Adhesives have been tried but these also have been unsuccessful as they invariably produced a weak seam.

Various methods have been used in the past for joining the ends of pre-fitted cylinder mold covers which must be applied to the molds at locations, usually customers' mills, where they cannot be welded or brazed. Perhaps the most common method, in cases where a simple lap joint is not acceptable, has been to reinforce the ends of the cloth that are to be joined with simple stitching, using a synthetic or metal thread, to prevent cross strands from unravelling. A metal rod having a diameter of approximately 3/16 inch is then stitched to each end and alternate stitches or groups of stitches are looped over the rod and sewn through the cloth in an uneven pattern so that tensile stress applied to the finished seam will be spread over several cross strands rather than being concentrated on one cross strand. Just prior to installation of the cover on the cylinder mold, the loop forming rods are withdrawn from the preprepared ends of the cloth, the loops at one end are intermeshed with the loops at the other end and a pintle pin is inserted to form a hinge type joint.

Another method of joining the ends of a cylinder cover is to simply sew the ends together by stitching through the reinforcing stitchings with a slightly larger thread.

These methods of making the seam leave either a mesh blockage or an overly large open space at the joint which is objectionable.

In the case of a woven cloth belt that is to be needled to make an endless press felt, it has been usual practice to make the seam in the same manner as that of a Fourdrinier forming fabric wherein projecting longitudinal strands are interwoven with additional cross strands. (See, for example, British Pat. No. 1,264,818 — D. G. MacBean). Woven seams have been successful as far as strength, flatness and drainage considerations are concerned, but the process of making them requires highly skilled personnel, expensive machinery and is time consuming and such effort is not warranted where the whole cloth, including the seam, is to be covered with a batt of fibrous material.

A conveyor belt or the base fabric of a press felt may be seamed with a simple joint where the ends of cloth are folded back, lapped and sewn together, but this method invariably produces a gross lump and complete mesh blockage at the joint.

SUMMARY OF THE INVENTION

The present invention minimizes or overcomes the objectionable features of the above types of seams in a novel manner as described below.

In accordance with the invention, a seam for joining together the two ends of a woven cloth is provided; said cloth comprising a plurality of warp strands in side-by-side relationship along the width of the cloth, each said warp strand extending in the lengthwise direction of the cloth, a first area of warp adjacent one end of the cloth and formed by said warp strands with interwoven weft strands, a second area of warp adjacent the other end of the cloth formed by said warp strands with interwoven weft strands, a third area of warp interposed between said first and second set and formed by said warp strands along the length thereof with interwoven weft strands, selected first warp strands of said first area being joined with corresponding warp strands of said third area by a weftless continuation of said first warp strands, selected second warp strands of said second area being joined to corresponding warps of said third area by a weftless continuation of said second warp strands, comprising an intermesh of said first and second continuation strands coupled by a coupling means.

Preferably, the coupling means comprises a hinge or pintle pin.

The invention also relates to a method for making the seam. The principle of this method of joining the ends of cloth may be applied to different types of weaves. For example, plain, twill, 3-and-1 twill, satin weave and Duplex weave may be joined successfully. The method is particularly useful in cases where a cloth sleeve is

formed that is to be applied over a cylindrical filter, each as a cylinder mold, upon which it may be shrunk by heat, or any other suitable treatment, to form a tight fit.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood by an examination of the following description together with the accompanying drawings, in which:

FIG. 1 is a side view of the cloth in the first stage of the production of the inventive seam;

FIG. 2 is a side view of the cloth in the second stage of the production of the inventive seam;

FIG. 3 is a side view of the cloth in the third stage of the production of the inventive seam;

FIG. 4 is a side view of the cloth in the fourth stage of the production of the inventive seam;

FIG. 5 is a side view of the cloth in the fifth stage of the production of the inventive seam;

FIG. 6 is a side view of the end product of the above production steps;

FIG. 7 illustrates a side view of a further embodiment of the invention;

FIG. 8 shows a side view of a third embodiment of the invention; and

FIG. 9 illustrates a side view of a still further embodiment of the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring now to FIG. 1, 1a and 1b represent the two ends of a sheet of woven cloth which ends are to be joined together to form a loop of the cloth. The cloth is, of course, joined at its other ends (the left-hand end of 1*a* to the righthand end of 1*b*), but is shown separated in the Figures for ease of illustration. Nevertheless, the inventive seam can be used, and it is within the scope of the invention to use the inventive seam, to join together two or more separate cloths as will be obvious from the following description.

Each end of the cloth comprises alternate warp strands 3*a*, 4*a* and 3*b*, 4*b* respectively. In the drawings, strand 3*a* is in front of 4*a* and 3*b* is in front of 4*b*. It is, of course, understood that the cloth comprises more than just two warp strands in the width thereof; however, the further warp strands cannot be seen in the side view. Nevertheless, this construction is well known to one skilled in the art and need not be elaborated on here.

Weft strands 5*a* and 5*b* are interwoven in the warp strands, and the warp strands 3*a*, 4*a* and 3*b*, 4*b* comprise warp areas referenced as 30*a* and 30*b* respectively in the drawings. The areas 30*a* and 30*b* are joined as described above to comprise a loop of cloth. This area is hereinafter referred to as the third warp area. A first warp area 20*a* is located at the right-hand end of the cloth while a second warp area 20*b* is located at the left-hand end of the cloth.

The first and third areas are separated by an unwefted warp area 50*a* and the second and third areas are separated by a further unwefted area 50*b*. The wefts from the unwefted areas may be removed after the cloth has been woven. However, in a preferred embodiment, and in the cases where the finished length of cloth being woven in the loom is known beforehand, the weft strands in the unwefted areas are simply omitted in the weaving so that the weft strands do not have to be cut out later. In this way, a great saving in time can be realized.

In cases where it is necessary to remove the wefts, this may be accomplished by use of a miniature chisel.

The number of weft strands removed or omitted in the areas 50*a* and 50*b* will usually exceed by at least two the number of strands remaining in the areas 20*a* and 20*b* respectively to leave space for a coupling means as will be described below. Generally, it is advantageous to remove some 5 – 12 weft strands in the areas 50*a* and 50*b*, and the process is aided when the same number of strands are removed in both areas.

Areas 50*a* and 50*b* comprise alternate strands 6*a*, 7*a* and 6*b*, 7*b* respectively. In the nest step of the process, as illustrated in FIG. 2, some warp strands are cut out all across the width in the unwefted areas 50*a* and 50*b*. The number of warp strands cut out will depend to a large extent on the warp fill factor and the drainage which is to be achieved at the seam. Warp fill factor is given by the sum of the warps in, say, an inch of cloth width multiplied by warp diameter. For example, in a 60 mesh cloth having warp which is 0.010 inch in diameter, the fill factor is 0.6. Expressed in other words, 60% of the available space is taken up by warp strands, and in order to avoid cramming of the warp strands where they intermesh at the joint, as will be described below, it will be necessary to cull out some of the strands at each end. This may be done in a number of ways such as, for example, cutting out every second, third or fourth strand. In cases where the warp strands are thick in relation to the mesh, it may be feasible to cut out two strands together and leave one and repeat this all across the width. It should be borne in mind that seam strength will diminish as more strands are cut out and drainage will diminish as fewer strands are cut out. In any case, drainage is the controlling factor because generally there is ample strength at the seam even when two out of every three strands are removed. In cases where the warp fill factor is low, it may not be necessary to cut out warp strands in the areas that are to be intermeshed and the total number of warp strands at one end may be intermeshed with the total number of warp strands at the other end of the cloth and so pinned together without undue blockage at the joint.

In the example shown in FIG. 2, for ease of illustration, strands 7*a* and 7*b* are shown to remain while strands 6*a* and 6*b* have been removed. The warp strands remaining in the unwefted areas are bent in the directions indicated by arrows 9*a* and 9*b* in FIG. 3 to reduce crimp in the strands 7*a* and 7*b*, and to produce partially uncrimped strands 8*a* and 8*b*. These partially uncrimped strands are then meshed together when the end 1*a* is placed in position over cloth end 1*b* as shown in FIG. 4. A coupling means 10, which can comprise a hinge or pintle pin, is then inserted in the meshed strands.

Tension is then applied to the cloth as shown by arrows 11*a* and 11*b* in FIG. 5 whereby a crimp 90 will be formed at the ends of the strands 8*a* and 8*b*. The pintle pin 10 remains in this joint. At the same time, the ends of the cloth 1*a* and 1*b* will move in the directions indicated by the arrows 12*a* and 12*b* respectively in FIG. 5. The areas 20*a* and 20*b* will then align themselves along the strands 8*a* and 8*b* as illustrated in FIG. 6 to cover up the openings resulting from the removal of the weft strands.

To prevent separation of the warp strands and weft strands at each extreme end of the cover or belt, the warp strands at the extreme end edges **1***a* and **1***b* are preferably heat sealed (welded), or coated with adhesive, or sealed and bonded to the end weft strands **21***a* and **21***b* respectively to prevent unravelling. As a refinement, to make a smoother joint, say, in the case of certain cylinder covers or conveyor belts or sheet forming belts such as are used in Fourdrinier type board or pulp machines where a lump at the seam would be particularly objectionable, some or all of the warp strands may be allowed to project and these projecting strands can then be interwoven into the cloth of the belt at each side of the seam to hold the small sections of cloth or flaps in places as shown in FIG. **7.**

Referring now to FIG. **7,** strands **70***a* and **70***b*, extending respectively from areas **20***a* and **20***b*, are interwoven respectively into areas **30***b* and **30***a*.

In a further embodiment of the invention, as shown in FIG. **8,** where greater strength is required and mesh blockage at the joint is not a prime consideration, two or more crimps **100***a*, 110*a* and **100***b*, 110*b*, of unwefted warp may be enlarged and intermeshed and two or more pintle pins **200** and **300** inserted between the successive crimps. As can be seen in FIG. **8,** none of the warp strands are culled away so that the drainage at the seam is restricted. However, the drainage need not be so restricted as can be seen in FIG. **9.** Here, three crimps **400***a*, **400***b;* 500*a*, 500*b* and **600***a*, 600*b* are formed in the unwefted areas, intermeshed, and three pintle pins **700, 800,** and **900** are inserted between the successive crimps. As in the FIGS. **1** to **6** embodiments, some of the warp strands are culled away.

The production of the FIG. **9** embodiment is greatly facilitated when, in cases where the length is known, accommodation is made in the weaving thereof to form enlarged crimps by weaving in rods in succession in place of regular wefts in the unwefted areas. The rods are later removed, some of the enlarged crimps are cut out, and the remaining ones are intermeshed and fastened with pintle pins.

Although several embodiments have been described above, this was for the purpose of illustrating, but not limiting, the invention. Various modifications which will come readily to the mind of one skilled in the art will fall within the scope of the invention.

I claim:

1. A seam for joining together two ends of a woven cloth having a length and a width;

said cloth comprising;

a plurality of warp strands extending in the lengthwise direction of said cloth and disposed in side-by-side relationship along the width of said cloth;

a first area of warp adjacent one end of said cloth and formed by said warp strands with interwoven weft strands;

a second area of warp adjacent the other end of the cloth and formed by said warp strands with interwoven weft strands;

a third area of warp interposed between said first and second areas and formed by said warp strands with interwoven weft strands;

said third area having a first end adjacent said first area and a second end adjacent said second area;

a selected first set of warp strands of said first area being joined with corresponding warp strands of said third area by a first weftless continuation of said warp strands;

a selected second set of warp strands of said second area being joined with corresponding warp strands of said third area by a second weftless continuation of said warp strands;

each of said warp strands in said first and second weftless continuations of said warp strands comprising a crimp;

some of said crimps extending in an upward direction relative to said cloth, and others of said crimps extending in a downward direction relative to said cloth;

said seam comprising;

an intermesh of said crimps in said first and said second weftless continuations;

said crimps being adjacent one another along the width of said cloth when said warp strands of said first weftless continuation of said warp strands and said second weftless continuation of said warp strands are intermeshed;

whereby the crimps cooperate to form a cylindrical-like opening along the width of the cloth;

and coupling means being inserted in said cylindrical-like opening to thereby fasten one end of said cloth to the other end thereof;

characterized in that said first area of warp lies on said second weftless continuation between said coupling means and the second end of the third area on one side of the intermesh, and in that said second area of warp lies on said first weftless continuation between said coupling means and the first end of said third area on the other side of the intermesh.

2. A seam as defined in claim **1** wherein a first number of warp strands extend, in the lengthwise direction of said cloth, in said first warp area;

and wherein a second number of warp strands extend, in the lengthwise direction of said cloth, in said second warp area;

and wherein a third number of warp strands extend, in the lengthwise direction of said cloth, in said third warp area;

said first, second and third number of warp strands being substantially equal;

said first and second weftless continuations of said warp strands comprising, respectively, fourth and fifth numbers of warp strands;

said fourth and fifth numbers of warp strands being substantially equal and less than said first, second and third numbers of warp strands.

3. A seam as defined in claim **1** wherein the selected first set of warp strands in said first area of warp comprises every second warp strand in said first area of warp;

and wherein the corresponding warp strands in said third area of warp comprises every second warp strand in said third area of warp;

whereby said first weftless continuation joins only every second warp strand of said first area of warp with every second warp strand of said third area of warp; the remainder of the warf strands of said first weftless continuation being culled out;

and wherein the selected second set of warp strands in said second area of warp comprises every second warp strand in said second area of warp;

and wherein the corresponding warp strands in said third area of warp comprises every second warp strand in said third area of warp;

whereby said second weftless continuation joins only every second warp strand of said second area of warp with every second warp strand of said third area of warp; the remainder of the warp strands of said second weftless continuation being culled out.

4. A seam as defined in claim **1** wherein the selected first set of warp strands in said first area of warp comprises every second and third warp strand in said first area of warp;

and wherein the corresponding warp strands in said third area of warp comprises every second and third warp strand in said third area of warp;

whereby said first weftless continuation joins only every second and third warp strand of said first area of warp with every second and third warp strand of said third area of warp; the remainder of the warp strands of said first weftless continuation being culled out;

and wherein the selected second set of warp strands in said second area of warp comprises every second and third warp strand in said second area of warp;

and wherein the corresponding warp strands in said third area of warp comprises every second and third warp strand in said third area of warp;

whereby said second weftless continuation joins only every second and third warp strand of said second area of warp with every second and third warp strand of said third area of warp; the remainder of the warp strands of said second weftless continuation being culled out.

5. A seam as defined in claim **1** wherein the selected first set of warp strands in said first area of warp comprises every second, third and fourth warp strand in said first area of warp;

and wherein the corresponding warp strands in said third area of warp comprises every second, third and fourth warp strand in said third area of warp;

whereby said first weftless continuation joins only every second, third and fourth warp strand of said first area of warp with every second, third and fourth warp strand of said third area of warp; the remainder of the warp strands of said first weftless continuation being culled out;

and wherein the selected second set of warp strands in said second area of warp comprises every second, third and fourth warp strand in said second area of warp;

and wherein the corresponding warp strands in said third area of warp comprises every second, third and fourth warp strand in said third area of warp;

whereby said second weftless continuation joins only every second, third and fourth warp strand of said second area of warp with every second, third and fourth warp strand of said third area of warp; the remainder of the warp strands of said second weftless continuation being culled out.

6. A seam as defined in claim **1** wherein the selected first set of warp strands in said first area of warp comprises every third warp strand in said first area of warp;

and wherein the corresponding warp strands in said third area of warp comprises every third warp strand in said third area of warp;

whereby said first weftless continuation joins only every third warp strand of said first area of warp with every third warp strand of said third area of warp; the remainder of the warp strands of said first weftless continuation being culled out;

and wherein the selected second set of warp strands in said second area of warp comprises every third warp strand in said second area of warp;

and wherein the corresponding warp strands in said third area of warp comprises every third warp strand in said third area of warp;

whereby said second weftless continuation joins only every third warp strand of said second area of warp with every third warp strand of said third area of warp; the remainder of the warp strands of said second weftless continuation being culled out.

7. A seam as defined in claim **1** wherein each length of warp strand enveloping an interwoven weft strand comprises a unit of length;

and wherein each of said first and second weftless continuations of said warp strands comprises a greater number of units of length than its adjacent first and second areas of warp respectively.

8. A seam as defined in claim **7** wherein said first and second weftless continuation of warp strands is at least two units of length greater than its adjacent first and second areas of warp respectively.

9. A seam as defined in claim **1** wherein the warp strands enveloping the last weft strand adjacent one end of said cloth are bonded to said last weft strand;

and wherein the warp strands, enveloping the last weft strand adjacent another end of the cloth, are bonded to said last weft strand adjacent said another end of the cloth.

10. A seam as defined in claim **9** wherein said warp strands enveloping the last weft strand adjacent the one and the another ends of the cloth are coated with adhesive.

11. A seam as defined in claim **10** wherein the warp strands enveloping the last weft strands adjacent the one and the another ends of the cloth are heat sealed to their respective weft strands.

12. A seam as defined in claim **10** wherein the warp strands enveloping the last weft strands adjacent the one and the another ends of the cloth are bonded to their respective weft strands with said adhesive.

13. A seam as defined in claim **1** wherein a first end set of unwefted warp strands projects beyond said first area in a direction opposite to said first weftless continuation of said warp strands; and wherein a second end set of unwefted warp strands projects beyond said second area in a direction opposite to said second weftless continuation of said warp strands; wherein after being coupled by a coupling means said projecting set of weftless warp strands of said first end are interwoven with weft strands in said third area adjacent that end of said third area closest to said second weftless continuation of said warp strands and said projecting unwefted warp strands of said second end are interwoven with weft strands in said third area adjacent that end of said third area closest to said first weftless continuation of said warp strands.

14. A seam as defined in claim **1** wherein each of said warp strands in said first and second weftless continuations of said warp strands comprises a crimp; said crimps of one of the weftless continuation extending in an upward direction relative to said cloth, and said crimps of the other of the weftless continuations extending in a downward direction relative to the cloth;

said crimps being adjacent one another along the width of said cloth when said first weftless continuations of said warp strands and said second weftless continuations of said warp strands are intermeshed; whereby the crimps cooperate with to form cylindrical-like openings along the width of the cloth; said coupling means being inserted in said cylindrical-like openings to thereby fasten one end of said cloth to the other end thereof.

15. A seam as defined in claim **1** wherein said coupling means comprises a pintle pin.

16. A seam as defined in claim **1** wherein each said warp strands in said first and second weftless continuations of said warp strands comprises at least a first crimp and a second crimp;

said first crimps of said first weftless continuation of said warp strands cooperating with said second crimps of said second weftless continuation of said warp strands to form a first cylindrical-like opening along the width of said cloth;

said second crimps of said first weftless continuation of said warp strands cooperating with said first crimps of said weftless continuation of said warp strands to form a second cylindrical-like opening along the width of said cloth;

and first and second coupling means inserted in each said first and second cylindrical-like openings respectively to thereby fasten one end of said cloth to the other end thereof.

17. A seam as defined in claim **16** wherein said first and second coupling means comprises first and second pintle pins respectively.

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