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HEAT SEALABLE YARN AND FABRIC

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textile web having a
transverse butt seam,
free from raised portions,
formed by hot pressing
the sewing thread formed
of two fibrous components
at least one of which is
thermoplastic

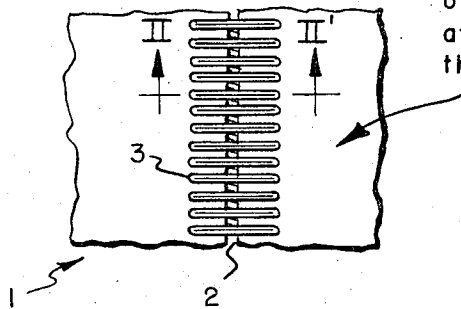


FIG. -1-

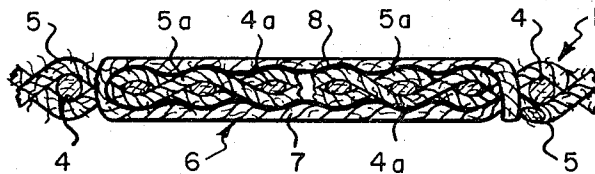


FIG. -2-

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HEAT SEALABLE YARN AND FABRIC

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Continuation-in-part of application Ser. No. 253,605, Jan. 24, 1963, now Patent No. 3,337,381, dated Aug. 22, 1967. This application June 30, 1964, Ser. No. 379,210

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Int. Cl. D06c 25/00; C09j 5/10

5 Claims

ABSTRACT OF THE DISCLOSURE

A heat sealable yarn comprising a substantially homogeneously distributed blend of thermoplastic and non-thermoplastic components. Such yarns are ideally suitable for securing one or more members in a preselected configuration.

This invention which is a continuation-in-part of co-pending application Ser. No. 253,605, filed Jan. 24, 1963, now U.S. Patent No. 3,337,381, relates to heat sealable yarns composed of blends of thermoplastic and non-thermoplastic materials and more specifically to heat sealable yarns suitable for securing one or more members in a preselected configuration.

A wide variety of materials have been employed for securing one or more members in a preselected configuration. The type of securing operations with which the present invention is concerned are securing operations such as for instance joining together ends of textile webs, securing a multi-component group into a unitary package or in general producing a juncture by means of a combination of the physical strength and adhesive characteristics of the medium employed to effect the juncture. Materials which have previously been employed in effecting such a juncture are materials such as for instance sealing tapes, thermoplastic yarns and thermoplastic coated non-thermoplastic yarns. Sealing tapes, while satisfactory for many purposes, are often difficult to handle and present registry problems when the point of juncture is a relatively small area. It is known that a juncture may be effected by means of a thermoplastic material which is heat sealed. The thermoplastic material will, however, generally lose its elongation resistance when sufficient temperature is applied to the material to effect a heat seal. The loss of elongation resistance in the thermoplastic material is a great disadvantage when any stresses are placed on the thermoplastic material in the formation of a juncture. Efforts have been made to overcome the loss of elongation resistance in an all thermoplastic yarn by placing a thermoplastic coating on a non-thermoplastic substrate. Textile materials coated with thermoplastic polymers, however, are often lacking in that degree of flexibility which is necessary when the bonding medium is passed through those tortuous configurations to which the medium is often subjected in the formation of the juncture. In addition, flaking and chipping of the coating may render the machinery with which the bonding medium is being applied, nonfunctional.

As previously mentioned, one of the types of securing operations with which the present invention is concerned is the joining together of ends of textile webs. In certain

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treatments of textile webs, it is often undesirable to have a transverse seam in a running length of web because such a seam will interfere with the treatment. For example, in forming wool fabrics, the fabric is often sheared with a sharp blade to produce the desired surface on the fabric and when employing conventional procedures, a transverse seam interferes with this shearing operation. By conventional procedures, 100-yard lengths of wool fabric are sewn together to form transverse butt seams. When these seams approach the shearing blade, it is necessary to raise the blade momentarily to prevent the blade from cutting the threads in the seam and permitting the lengths of fabric to separate. Because of the speed at which the fabric travels in the shearing operation, as much as a quarter of a yard or more of the fabric is not sheared at the area of the seam and thus is waste fabric. Such a loss of fabric constitutes a considerable expense to the mill over a period of time.

An additional problem in seam bonding is seam slippage, that is to say, the riding of the seam on the warp yarns as the fill yarns compact or vice versa. The problem is especially pronounced where synthetic yarns and especially continuous filament synthetic yarns are employed. It is often necessary to double a fabric in order to prevent such slippage, the process of doubling a fabric over, being in itself expensive as well as wasteful of fabric.

Also, in ordinary textile calendering operations as well as in the laminating and coating trade, where textile webs are subjected to high pressure calendering operations a transverse seam having raised threads presents serious problems. If such a seam is present in the web, the pressure on the calender or laminating rolls ordinarily must be released momentarily and up to several yards of fabric are thus not properly calendered or laminated, because of the speed of laminating and calendering operations. Even if the seam is not raised sufficiently to require releasing the pressure from the pressure rolls, any raised portions at the seam will produce a visible defect in the surface of the coated fabric and thus produce a second, which must be sold at a lower price. Consequently, textile finishers and laminators and coaters sometimes refuse to purchase short lengths of fabric joined by a conventional transverse seam.

It is therefore an object of this invention to provide a heat sealable yarn comprising a homogeneous blend of thermoplastic and non-thermoplastic materials.

It is another object of this invention to provide a heat sealable yarn comprising a homogeneous flexible blend of thermoplastic and non-thermoplastic fibrous materials.

It is a further object of this invention to provide lengths of fabric having a seam formed from a heat sealable yarn comprising a homogeneous blend of thermoplastic and non-thermoplastic materials.

It is still another object of this invention to provide a seamed textile web wherein the seam does not slip and does not interfere with subsequent mechanical treatments of the textile web.

It is an additional object of this invention to provide a seamed textile web wherein the seam does not slip and is not effected by subsequent chemical treatments of the textile web.

In accordance with this invention, it has now been discovered that a heat sealable yarn which will undergo heat sealing operations while retaining substantial

amounts of elongation resistance may be prepared by forming a yarn from a homogeneous blend of thermoplastic and non-thermoplastic materials. The term "homogeneous" as employed herein is meant to include homogeneous blends of thermoplastic and non-thermoplastic fibers as well as homogeneous blends of substantially identical fibers which are non-thermoplastic fibers which are surface polymer grafted with thermoplastic materials.

The yarn should preferably contain from 20% to 70% of a thermoplastic component which flows when heated and from 30% to 80% of a second component which neither flows nor substantially degrades when heated to the flow temperature of the thermoplastic component. Preferably, the yarn contains between about 40% and about 60% of each of the thermoplastic and non-thermoplastic components. A 50:50 by weight mixture has been found to be very satisfactory. While the yarn will usually consist entirely of these two essential components, it can also include other materials, e.g., lubricants, waxes, softeners, sizing materials, etc. As with all yarns, the yarn should be formed of such materials and so constructed as to have sufficient strength to withstand certain tensions such as for instance stitching tensions and wrapping tensions and also so as to have substantial residual strength after the thermoplastic component has flowed in the heating operation so that there will be no substantial loss in elongation resistance. The thermoplastic component and the non-thermoplastic component can be in the form of separate ends of a plied yarn or blended together in the same end or ends or the thermoplastic component may be core spun around a non-thermoplastic continuous filament. Either essential component, however, can be in continuous filament or multifilament form and the other component in spun staple form or they both can be in filament, multifilament or in staple form. The blended continuous filament form is preferred if maximum strength is needed whereas the blended staple form is preferred for maximum homogeneity.

The term "yarn" as employed herein is meant to include any assemblage of fibers and filaments twisted together so as to form a strand. The term "yarn" is considered to include such specific forms as thread, string, cord, twine, rope, and the like.

The term "fibrous" means material in the form of continuous filament or staple and films which have been slit and twisted or folded so as to resemble continuous filament.

It has been found that textile webs may be joined together by sewing to form a transverse butt seam with the yarn formed from a homogeneous blend of thermoplastic and non-thermoplastic materials, the yarn of course being in the form of thread. The seam is then heated under pressure so that the first component flows into the web and the second component is pressed tightly into the face of the web, thereby causing the exposed portions of the thread to be firmly and adhesively bonded to the face of the web. The heat and pressure are then removed, thus producing a seam substantially free from portions raised above the faces of the web.

The advantages of this process will be immediately apparent to those skilled in the art. This process now permits joining of the ends of textile webs by conventional sewing procedures and only a heating unit to which pressure can be applied is required to produce the desirable flat seam. It was surprising to find that as little as 20%, calculated on the weight of the thread, of the first fibrous component is necessary to achieve the desired results. It will be apparent that the exact minimum amount which can be employed in any particular situation will depend upon the adhesiveness of the selected first fibrous component to the selected web. The use of such small amounts substantially eliminates the possibility of any build-up of the thermoplastic material in the heating apparatus used to produce the bonded seam or in any subsequent operation

in which the seamed web is brought in contact with a heated surface. This is particularly important in the wool industry where the wool is subject to decatizing or rotary press operations where any significant amounts of thermoplastic material on the web would be most undesirable. Also, the bonding of the seam can be completed in a very short time, which is especially desirable in such an operation.

This invention is illustrated in the accompanying drawings in which:

FIG. 1 is a schematic view of a portion of a textile web 1 having a transverse butt seam 2 therein formed with sewing thread 3 following this invention, and

FIG. 2 is a highly enlarged schematic cross-sectional view along line II—II of FIG. 1 of a woven fabric containing a transverse butt seam of the type shown in FIG. 1.

As shown in FIG. 2, the woven fabric 1, formed in the conventional manner from a multiplicity of warp ends 4 and filling ends 5 is butt seamed with a bicomponent sewing thread 6 containing a first fibrous component 7 and a second fibrous thermoplastic component 8 which as a result of the hot pressing given the seam, has flowed into the fabric and thus bonds the thread 6 tightly to the faces of the fabric 1. As FIG. 2 shows, the exposed portions of the sewing thread 6 have been pressed tightly into the face of the fabric by pressure which flattens the fabric threads 4a and 5a in the seam area as well as the exposed portions of the sewing thread so that the seam area is at the same height as or even below the level of the faces of the fabric.

Textile webs which can be seamed according to the process of this invention include the woven, knitted and nonwoven fabrics. These fabrics can be formed of natural cellulosic materials, e.g., cotton, synthetic cellulosic material, e.g., unmodified and Polynosic rayons, and wool. Ordinarily, the process will be directed to fabrics consisting entirely of non-thermoplastic materials. However, with the proper selection of the thermoplastic component in the sewing thread used in the process of this invention, the fabrics can consist partially or wholly of the synthetic thermoplastic materials, e.g., ethylene glycol terephthalate polyesters, the nylons, and the polyacrylics. The preferred webs employed in the process of this invention are the woven cotton, rayon and wool fabrics, particularly the latter where the savings in fabric by following the present process is highly significant.

The standard sewing thread construction with respect to plies, count or weight, and twist per inch can be employed. Usually from 2-4 ends of ends with substantial twist in each end and plying twist is employed.

Because the yarn is fibrous, the sewing thread behaves normally in the sewing step and the thermoplastic component flows freely and readily around the fibrous component and into the faces of the textile web when heated and pressed, thus providing superior adhesion.

In the sewing step the ends of the textile web are sewn together to form a butt, i.e., nonoverlapping, seam and the usual industrial railroad or other type sewing equipment can be used for this procedure or the sewing can be conducted by hand.

The textile web at the seam area is then subjected to substantial pressure, i.e., at least 10 pounds per square inch, preferably 25-200 and more preferably 50-100 pounds per square inch, so as to press the exposed portions of the sewing thread firmly into the face of the fabric. The amount of pressure required to do this will depend upon the yieldability of the web and the diameter of the sewing thread. Simple experimentation can readily determine the pressure required. Excessive pressures which cause destructive crushing of the fabric should be avoided. Only that pressure which presses the exposed portions of the sewing thread tightly into the plane of the faces of the web is required.

The fabric is then heated at the seam area, while under

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the pressure described above, to at least the flow temperature of the thermoplastic first fibrous component. Generally it is preferred to heat the seam to at least 25° C. above the flow temperature of the thermoplastic first fibrous component. However, the temperature to which the textile web is heated at the seam area should be below the temperatures which would cause substantial degradation of the web or of the fibrous supporting component, i.e., degradation sufficient to weaken the fabric or the thread so that the web ends will part under conventional tensions applied in subsequent processing. As the preferred thermoplastic components have a flow temperature between about 125° and 200° C., more preferably about 150° to 200° C., the web at the seam area will ordinarily be heated to a temperature between about 150° and 225° C. In general, if the temperature to which the web is heated does not substantially exceed 225° C., sufficient strength in the thread will be retained to hold the seam together in subsequent operations.

If the means for applying pressure to the seam is a heated platen, which is the preferred apparatus for performing the process of this invention, the heating of and applying pressure to the web will occur substantially simultaneously. Apparatus of the type shown in U.S. Patent No. 3,000,434, is suitable for this purpose.

The seam area is heated at the selected temperature for a time sufficient to cause the thermoplastic component to flow through the yarn and into the textile web. This generally requires less than one minute and usually less than 45 seconds, e.g., 2 to 35 seconds, depending, in part, upon the temperature employed, the flow temperature of the thermoplastic component and the efficiency of the heating system employed, e.g., diathermic vs. conductive heating. All that is required is that the flow temperature of the thermoplastic component be reached.

The seam is then permitted to cool below the softening temperature of the thermoplastic component. This causes the sewing thread to adhere tightly to the face of the fabric by a diffusion of the thermoplastic component through the sewing thread and into the fabric. The pressure is, of course, also removed either before, at the same time as or after the heating means is removed from the seam.

It should be understood that in accordance with the invention, the heat sealable yarn may be employed for securing terminal portions of a fabric as well as for forming a juncture between two separate fabric pieces. More specifically, the heat sealable yarns of this invention may be employed in the formation of a fabric selvage. The selvage may conveniently be prepared by employing the heat sealable yarns of this invention as the last warp yarns on either edge of a fabric. Usually about ten such heat sealable warp yarns on either edge of a fabric are satisfactory for the formation of selvages. The fabric containing the heat sealable warp yarns must of course undergo the usual heat sealing operations.

The thermoplastic first component of the above-described yarn is one having a Vicat flow temperature, (A. S. T. M. D569-59, Procedure A) between about 100° and 225° C. Such materials include polypropylene, polyethylene, preferably high density polyethylene, polyvinyl alcohol, polyvinyl acetate, cellulose acetate and other thermoplastic derivatives of cellulose, polyvinyl butyrates, the lower melting nylons, and other fiber-forming polymers and polymeric materials, i.e., those polymers which can be spun and oriented into a fibrous form which can be formed into yarn. To improve various characteristics such as melting point, lubrication, softness and flexibility, the conventional softeners and plasticizers can be incorporated in such thermoplastic materials. Thermoplastic materials which become thermosetting upon heating can also be used, e.g., the aminoplasts and the phenoplasts. Of the thermoplastic first component employed, polypropylene gives outstanding results and is thus preferred.

The second component can be any fibrous material in

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the staple, filament or multifilament form which is conventionally employed in the textile industry to form yarns or threads and which neither flows nor is substantially degraded when heated at a temperature and for a time sufficient to cause the thermoplastic component to flow. Preferably, the second fibrous component is non-thermoplastic, e.g., cotton, rayon, siliceous fibers or wool. The second fibrous component should be a high strength material, i.e. one of sufficient strength to form a useful yarn by itself. For various reasons, and principally low elongation and chemical resistivity, siliceous fibers are preferred as the second fibrous component.

As stated above, the two essential ingredients of the yarn can be intimately blended into one or more ends or they can be separate ends plied together. It has been found, however, that better adhesion is often obtained using the same materials if the two components are intimately blended together.

The thermoplastic component and the non-thermoplastic component may be present in the same fiber where a surface polymer grafted material is employed in the manufacture of the cord. Polymers grafted materials which have been found suitable for purposes of this invention are thermoplastic materials which have been grafted to a fiber selected from the group consisting of cotton, hemp, linen and rayon fibers. Thermoplastic materials which are suitable for use as the thermoplastic component of the polymer grafted fibers are thermoplastic materials such as for instance polyethylene, polypropylene, polystyrene, and polyacrylates. Grafting of the thermoplastic material on the surface of the cellulosic fiber may be carried out according to the process as set forth in Belgian Patent No. 575,559 published Feb. 10, 1959. The process as disclosed in the aforementioned patent calls for titaniation or zirconiati on of the cellulose fiber followed by treatment with an organo metallic alkylation or arylation agent. The cellulose fiber then contains centers of catalytic activity through which olefinically unsaturated hydrocarbon monomers may be grafted to the surface of the fiber. It should be understood, of course, that other grafting processes which will place sufficient quantities of thermoplastic materials on the surface of a non-thermoplastic fiber to render the fiber heat sealable are also suitable for purposes of this invention.

The following specific examples of the heat sealable yarn are given for purposes of illustration and should not be considered as limiting the spirit or scope of this invention.

EXAMPLE I

Eleven ends of 200 denier single monofilament rayon and five ends of 420 denier single filament polypropylene each having manufacturer's twist are plied with 2.5 turns of S twist. The resultant yarn is found to have a minimum break strength of 36 lbs. and to have an elongation of 2.22% when subjected to a 10 lb. load. The yarn gauge is .024 and has a weight of 1118 yards per lb.

EXAMPLE II

The yarn preparation of Example I is repeated using 420 denier single filament cellulose acetate as the thermoplastic component.

EXAMPLE III

Eight ends of two ply 20's yarn composed of 50% spun Avril (regenerated cellulose manufactured by American Viscose Corporation) and 50% polypropylene are given a first twist of 13.15 turns of S twist and a final twist of 2.5 turns of S twist. The resultant yarn which is suitable for use as a bonding cord has a minimum break strength of 22 lbs., a gauge of .034 and a weight of 1021 yards per lb.

EXAMPLE IV

The yarn preparation of Example III is repeated using polyethylene as the thermoplastic component.

EXAMPLE V

Eight ends of two ply 20's yarn composed of 50% spun siliceous fibers and 50% spun polypropylene are given a first twist of 10 turns S twist and a final twist of three turns S twist. The resultant yarn is found to have a minimum breaking strength of 25 lbs., a gauge of about .026 and a weight of 1000 yards per lb.

EXAMPLE VI

The yarn preparation of Example V is repeated using spun polyacrylic fibers as the thermoplastic component.

EXAMPLE VII

Seven ends of 150/1 siliceous fibers having manufacturer's twist and five ends of 420/1 polypropylene having manufacturer's twist are plied together so as to have 2.5 turns of S twist. The resultant yarn which is suitable for use as a bonding cord is found to have a gauge of .0219, a weight of 1012 yarns per lb., a minimum break strength of 29 lbs. and an elongation under a 10 lb. load of 0.68%.

When the yarn of this invention is employed to secure a multi-component group into a unitary package it is important that the yarn or cord have substantial elongation resistance in order that a tightly wrapped package may be prepared. Yarns having substantial elongation resistance have been set forth in Example I through IV. For certain other applications such as for instance joining together ends of textile webs, the compressability of the yarn or thread is also of great importance. The following examples are illustrative of means by which ends of textile webs may be joined by means of a compressed seam, using the yarns of this invention. The examples, however, are merely given for purposes of illustration and should not be considered as limiting the spirit or scope of this invention.

EXAMPLE I-A

Two ends of a conventional all-wool worsted fabric are sewn together using a conventional railroad sewing machine to form a narrow butt seam, employing as a sewing thread a 50:50 mixture of 1.5×1.5 polyethylene staple and cotton staple, spun together into 40's cotton count 10 Z t.p.i. singles yarn and then plied into a 4 ply 15 S t.p.i. sewing thread. A platen about 1.5 inches wide and about 72 inches long is heated to about 200° C.±4° C., is employed to press the sewing thread tightly into the face of the fabric with about 70 lbs./sq. in. pressure. The heat and pressure is applied for about 30 seconds. The platen is then raised so as to permit the seam to cool. The resulting seam is found to present no portions of sewing thread raised above the face of the fabric. Consequently, the fabric can be passed through a shearing operation without raising the blade at the seam area or cutting the sewing threads to any significant extent. The adhesion of the threads on the face of the fabric is excellent and the fabric can pass through a heated rotary press without releasing the threads from the face of the fabric or causing the fabric to stick to the rotary press and without the seam slipping.

EXAMPLE II-A

Follow the procedure of Example IA, using a sewing thread formed of a 30:70 mixture of 1.5×1.5 polypropylene staple and cotton staple, spun into 15's cotton count 16.5 Z t.p.i. singles yarn and then plied into a 2 ply 10 S t.p.i. sewing thread. Press for 30 to 45 seconds. Adhesion is found to be good but somewhat less than when using the 50:50 mixture. No raised portions of the sewing thread will be apparent on either face of the fabric.

Any, some, or all of the following variations can be incorporated into the procedures of Examples IA and IIA:

(a) The proportion of polyethylene or polypropylene to cotton can be varied from 20:80 to 70:30.

(b) The platen temperature can be varied from 190°

to 225° C. and the heating time varied, inversely to the change in temperature, from 10 to 120 seconds.

(c) The pressure can be varied from 25 to 200 lbs./sq. in.

(d) The substrate fabric can be ethylene glycol terephthalic acid polyester, polyacrylic, nylon, cotton, rayon, blends of any of these with wool, or blends of any two or more of these.

(e) The polyethylene or polypropylene can be replaced by cellulose triacetate, polyvinyl acetate, polyvinyl chloride, high density polyethylene, or polyurethane, in staple, monofilament or multifilament form.

(f) The cotton can be replaced by rayon, siliceous fibers or wool in staple, monofilament or multifilament form.

EXAMPLE III-A

Follow the procedure of Example IA using a 3 ply sewing thread formed of two ends of 40's singles cotton and one end of 210/35 multifilament polypropylene plied together. The finished seam is found to display no portions raised above the face of the fabric and adhesion is excellent.

EXAMPLE IV-A

Follow the procedure of Example IA using a sewing thread formed from one end of No. 30 cotton sewing thread (Signal Thread Co.) and one end of 80 denier monofilament polypropylene. Heat under pressure for 45 seconds. As in Example IA, adhesion of the thread to the fabric substrate is found to be excellent and the thread is pressed well into the faces of the fabric.

EXAMPLE V-A

Follow the procedure of Example IA using as sewing thread 25/2 plied yarn formed of a 50:50 mixture of viscose and cellulose acetate blended and spun together. Heat for 45 seconds. A rather stiff seam is found to be formed, but there are no raised portions and adhesion is excellent.

EXAMPLE VI-A

Follow the procedure of Example VA but plasticize the sewing thread before use by padding with butyl phthalyl butyl glycolate plasticizer (Monsanto Sanitizer B-16). A softer, more pliable seam than that obtained using the sewing thread described in Example VA is found to be produced. Adhesion remains excellent.

This procedure using the above-described sewing thread is particularly suited for joining together ends of cotton fabric intended to be plastic coated or laminated.

EXAMPLE VII-A

Follow the procedure of Example IA, using 2 ends of 210/35 Hercules multifilament polypropylene and 2 ends of 200/44 viscose bright rayon plied 17 t.p.i. Press at 205° C. for 30 seconds. A flexible, strong seam is found to be produced adhering tightly to the face of the fabric and presenting no portions raised substantially above the faces of the fabric.

Having thus disclosed the invention, what is claimed is:

1. A length of fabric having a transverse butt sewn seam therein, the exposed portions of a bicomponent yarn forming the seam being pressed firmly into the faces of the fabric so that the seam area presents no portions substantially above the faces of the fabric, and the exposed portions of the yarn being adhesively heat sealed to the faces of the fabric said yarn comprising a substantially homogeneously distributed blend of thermoplastic and non-thermoplastic fibrous components.

2. The transverse butt sewn seamed fabric of claim 1 wherein said fabric is a wool fabric.

3. The fabric of claim 1 wherein said yarn is composed of polypropylene fibers and cotton fibers.

4. A fabric having heat sealed selvages obtained by utilizing from about 1 to 10 heat sealable yarns as the

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last warp yarns on either end of the fabric, said yarns comprising a substantially homogeneously distributed blend of thermoplastic fibers and non-thermoplastic fibers, and thereafter applying heat and pressure to heat seal the selvage.

5. The fabric of claim 4 wherein the thermoplastic fibers are polypropylene fibers.

References Cited

UNITED STATES PATENTS

3,125,404 3/1964 Crawley ----- 8—115.7

10

3,157,021 11/1964 Kitson et al. ----- 57—140
3,293,110 12/1966 Stine et al. ----- 161—169
3,234,061 2/1966 Gardner ----- 156—93
3,121,698 2/1964 Orsino et al. ----- 260—2.5

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10 260—17.4