March 6, 1956 W. P. UTERMOHLEN, JR., ET AL 2,737,466

SPLICED FABRIC

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Fig. 1

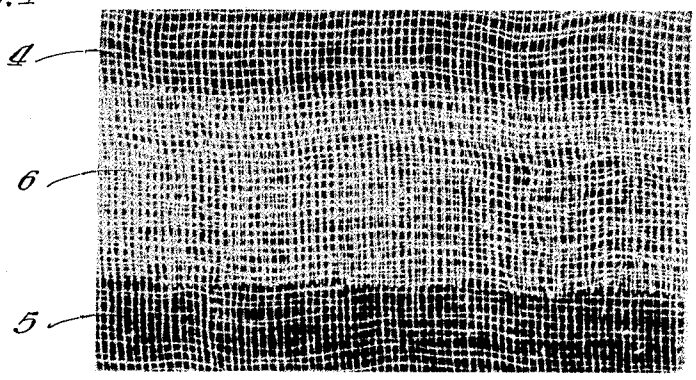


Fig. 2

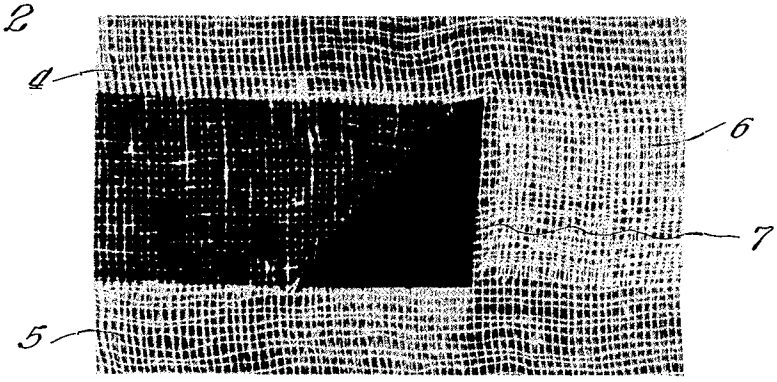
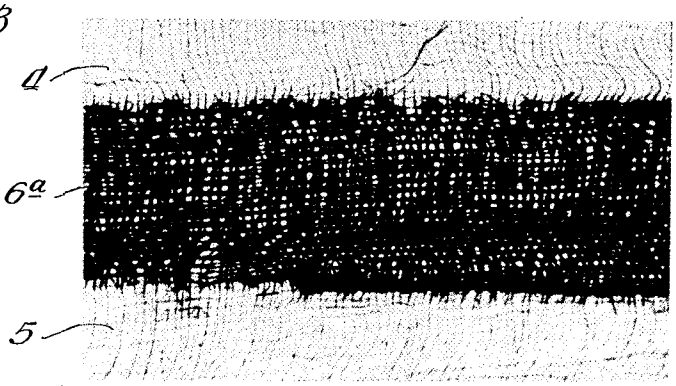


Fig. 3



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2,737,466

SPLICED FABRIC

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4 Claims. (Cl. 154—43)

The present invention relates, generally, to the splicing or interconnecting of lengths of fabrics or other sheet material for processing, and more particularly the invention relates to a plastic composition in the form of a tape which is adapted to be used in effecting the interconnection of lengths of fabric.

In the manufacture of the certain types of woven fabric, as for example surgical gauze, the initial material produced by the looms is an unbleached cloth known as "gray cloth," and this material is collected in rolls as it is woven. The rolls of gray cloth are subsequently inspected for defects and any defective portions are cut therefrom. For most uses the gray cloth which has passed inspection is then subjected to further finishing operations.

The finishing operations may include chemical treatment steps, mechanical treatment steps, or a combination thereof depending upon the ultimate product desired. Before finishing the inspected gray cloth, however, the shorter lengths of material which result from the removal of the defective cloth from the rolls, are joined together into a continuous strip. Under some conditions, it is desirable to join together a number of the rolls of inspected gray cloth to produce a large roll which can be passed through the finishing operations in a single run. Heretofore, the known splices for joining lengths of fabric have had rather specific application. For example, certain types of splices have been able to withstand the chemical treatment to which the cloth is subjected, but these splices have not been flexible enough to pass through the mechanical treating operations without causing excessive damage to the cloth. On the other hand, most known splices which are flexible enough to withstand the mechanical steps without damaging the cloth are subject to deterioration during the chemical treatment steps.

Moreover, splices for certain types of materials and especially porous, lightweight materials such as gauze, netting, certain non-woven fabrics, etc., desirably interconnect lengths of material in such manner that the splice does not adversely affect the usefulness or appearance of the spliced together material. Such splices which do not alter the desirable properties of the spliced materials will be designated "passable" splices since the spliced region of the material will pass the final inspection to which the finished fabric is subjected. Desirably, the so-called "passable" splices are also capable of withstanding both the mechanical and the chemical treatments to which the fabric is subjected during the various stages of processing. However, all of the known splices which will withstand either the chemical processing or the mechanical treatment have the property of impairing the porosity of the fabrics in the spliced area or roughening or discoloring the fabric.

Accordingly, the principal object of the invention is to provide an improved splice for textile materials which will maintain its flexibility and strentgh through all of the chemical and mechanical processing steps incident to the finishing of rough or gray cloth and the fabrication of the

finished cloth into a merchantable product. A more specific object of the invention is the provision of a tape of plastic composition which may be heat sealed to abutting or overlapping ends of lengths of a porous, lightweight fabric such as surgical gauze, the heat sealed composition providing a flexible bond which will resist the chemical and mechanical action during the finishing operation and which will be flexible enough to pass through fabricating machines when the cloth is being formed into a finished fabric article.

A further object of this invention is the provision of a method and splicing material which provide a bond which is capable of remaining in the finished fabric article without impairing the usefulness thereof, i. e. to provide a "passable" splice.

The finishing of gray cloth to produce, for example, surgical gauze, may include the chemical steps of desizing, caustic treatment, bleaching, etc., and the mechanical steps of webbing, spreading, and drying. The lengths of gauze web produced by the loom or the shorter lengths as determined by the inspection procedure, are spliced together or otherwise joined prior to the finishing operations. Heretofore, this has been effected, in most mills, by a sewing operation. Sewing the ends of the gauze together provides a splice which will withstand the chemical and physical treatment during processing, but webs which have been sewn together become greatly distorted by the mechanical finishing operations. Specifically, the mechanical finishing operations tend to draw the warp threads of the fabric together while the woof or filler threads bunch together near the splice. The relative movement of the warp and filler threads results in a length of material which is distorted and "necked in" in the region of the splice.

In accordance with the usual practice, after the finishing operations, but before the fabric is manufactured into its ultimate product, the distorted portions of the material around each of the splices is cut-out so that the gauze will be capable of passing through the fabricating machinery. In some instances, it may become necessary to remove 4 or 5 yards of material on each side of each of the sewn splices. The acceptable gauze is then respliced with a flexible splice, i. e. a splice which will pass through the fabricating machinery employed in making the ultimate product. If, for example, the gauze is to be used as a wrapper for a sanitary napkin, the spliced gauze passes through a machine which folds the gauze around the absorbent filler of the napkin and through cutting and stacking machinery.

Some use has been made of flexible splices which will withstand mechanical converting operations and which comprise a plastic composition sealed to the ends of the strips of fabric to effect the interconnection thereof. These splices, while flexible under usual atmospheric conditions are not adapted for use in the chemical finishing steps since the heat, pressure, and chemicals employed cause the splice to deteriorate or to become so stiff and brittle that it becomes unsuitable for the subsequent fabrication steps. Further, in the case of non-woven fabrics which are manufactured from bleached stock, the fabric or cloth passes between hot calendering machinery and drying rolls for the plastic binder. The heat and pressure in these operations has a deleterious effect on all of the known flexible splices, so that the non-woven fabrics must be first spliced with a splice which will withstand the heat and pressure. Then, after the hot processing, the original splice is removed and the fabric is respliced with a splice which will maintain its flexibility under the conditions of fabricaton.

In order for a plastic material to provide a splice which will withstand the chemical and mechanical steps during the finishing operations without distorting or damaging the

fabric (such a splice being known as process splice), it must have several very specific properties. First, the splicing material must not break down during the chemical processing to form products which tend to weaken the fibers, and in addition, the splice must be resistant to chemical action during the caustic and bleaching steps. The splice must not contain any compounds having a substantial volatility and it must be stable at elevated temperatures. The splicing material must also be dimensionally stable, since a distortion of the fabric in the region of the splice will result in the loss of substantial lengths of fabric. Furthermore, the finished splice must not be appreciably thicker than the cloth which it joins together, and it must be capable of withstanding repeated flexings before, during, or after the chemical treatment. Finally, the splice must be capable of securely bonding to the fibers of the fabric and to distribute the strains and stresses incident to the passage of the fabric through the processing and fabricating apparatus so that fraying and distortion of the cloth is avoided.

We have discovered that all these desirable properties of a process splice are provided when the ends of two pieces of cloth are heat sealed together with an unstressed tape which constitutes a mixture of thermoplastic substances including, basically, a copolymerized resin comprising specific amounts of vinyl chloride and vinyl acetate, and a non-volatile plasticizer. In order to obtain all of the advantages of this invention, the copolymerized resin should desirably contain more than about 90 percent by weight and preferably more than 94 percent by weight of vinyl chloride, and at least about 4 percent vinyl acetate. The copolymerized vinyl chloride and vinyl acetate is plasticized with a relatively large amount of the non-volatile plasticizer.

For the purposes of this application the term "non-volatile plasticizer" refers to a plasticizer which when mixed with the copolymerized vinyl chloride and vinyl acetate (50 parts by weight plasticizer to 50 parts by weight of the copolymerized resin) will show a loss in weight of less than 3 percent when a sample of plasticized resin is heated to a temperature of 82° C. for 72 hours in accordance with standard procedure D–744–44T of the A. S. T. M. Suitable plasticizers which fall within this definition are dioctyl phthalate, trioctyl phosphate, dioctyl sebacate, dioctylthiodibutyrate, and dibutoxy-ethyl dithiodiglycolate. Particularly effective results have been obtained with the non-volatile plasticizers which are salts or esters of octyl alcohol.

The amount of plasticizer employed may range from 30 to 65 percent based upon the weight of the final plasticized resin. The preferred percentage of plasticizer when dioctyl phthalate, trioctyl phosphate, or a mixture of the two compounds is employed is preferably from about 55 to 60 percent.

In addition to the plasticizer, it is desirable to add from 1 to 5 percent by weight, based upon the weight of the unplasticized resin, of a heat stabilizing compound for vinyl chloride resins. Various of these stabilizers are known in the art, for example the following compounds have been successfully employed: the oxides and carbonates of calcium and magnesium, organic compounds of zinc and strontium, e. g., dibutyl tin malate, dibutyl tin acetate, dibutyl tin laurate, dibutyl diphenyl tin, tetrabutyl tin, strontium acetate, and lead compounds such as lead carbonate, lead acetate, etc.

In compounding the splicing material, the copolymerized vinyl chloride and vinyl acetate may be dispersed in cyclohexanone, methyl ethyl ketone, or other suitable solvent, and the stabilizer and plasticizer may be thoroughly mulled and mixed with the dispersed resin. A coloring pigment may or may not be added to the material depending upon the use for which it is intended. The resulting mixture of resin, plasticizer, stabilizer, and solvent, a thick viscous liquid, is then cast upon a suitable surface and is dried slowly to provide a cast sheet. The cast, sheet material may then be cooled and cut into strips of proper width for use in splicing the ends of fabric. When cyclohexanone is employed as the solvent, the dispersing of the resin and the plasticizer may be accomplished at room temperature. However, in order to obtain the desired amount of the co-polymerized resin in the casting liquid (about 14 percent by weight), it is desirable to employ elevated temperatures and pressures when methyl ethyl ketone is employed.

Alternatively, the splicing material may be compounded by mechanically dispersing the plasticizer and resin together without the addition of a solvent and with or without a coloring pigment until the ingredients are thoroughly mixed. A small quantity of solvent may then be added to the milled mass which may then be further milled to produce a casting liquid. When this method is employed, a casting liquid having a higher solids content may be obtained.

The tape may be cast upon either a smooth or a roughened surface, e. g., a polished metal or glass surface, upon a uniformly roughened surface, or upon a sheet of paper which is impervious to the resin. The surface upon which the plastic splicing material is cast is determined by the surface texture desired on the finished splicing tape. When a slightly roughened surface is employed in forming the tape, the roughened surface taken on by the tape reduces any tendency of plies of superposed tape to adhere to one another.

In use, the strip of tape resulting from the casting and drying operation is placed across the overlapped or abutting ends of two runs of fabric and is heated by an iron or other suitable heating element to fuse and mold the plastic composition to the ends of both of the runs of material. A splice of this character has been found to have a high binding power, to be flexible under all processing conditions, and to maintain its flexibility, even after a high temperature caustic soak. Furthermore, the heat and pressure applied during the splicing operation reduce the thickness of the splicing material so that the splice is not appreciably thicker than the layers of material which are joined together. Hence, the splice will pass through fabricating machinery without any difficulty. In order to produce the most desirable splice for all conditions, the splicing tape should be wider than the overlap of the lengths of fabric being spliced. Thus, the plastic material of the splicing tape is fused or heat sealed to the overlapped portions of fabric and to the fabric on each side thereof.

One series of steps for making a splice embodying various features of the invention is shown in the accompanying photolithographs wherein:

Fig. 1 shows a pair of overlapped but unspliced lengths of surgical gauze, the gauze being placed on a dark background;

Fig. 2 is a view similar to Fig. 1 showing a length of splicing tape inserted between the overlapped lengths of gauze, a part of one of the overlapped lengths being cut away to show the splicing tape;

Fig. 3 shows a completed splice disposed on a light colored background.

As is shown in the accompanying figures two lengths of surgical gauze **4** and **5** are overlapped in the area **6** (Fig. 1). In the region of the overlapped area **6**, a strip of splicing tape **7** is disposed between the layers of gauze (Fig. 2), and this tape is fused by a suitable source of heat to produce the finished splice in the area **6***a* (Fig. 3). As will be noted from Fig. 3 the spliced area **6***a* exhibits substantially the same porosity as the overlapped but unspliced area **6** shown in Fig. 1.

As has been noted above, the strip of splicing material is cast and is not formed by extrusion, calendering, or like processes. The casting operation produces a resin strip which is not prestressed in any direction and which is, therefore, dimensionally stable. The use of an un-

stressed, cast tape substantially eliminates any tendency of the spliced area to become distorted. This insures that the threads of the material being processed will not be deranged, thus eliminating the substantial waste of fabric which occurred prior to the use of the present splicing method.

Example I

As a specific example of the method of making a splicing composition in accordance with the invention, 30 parts by weight of copolymerized vinyl chloride and vinyl acetate, the vinyl chloride comprising 95 per cent of the copolymerized resin and the vinyl acetate comprising about 5 per cent of the copolymerized resin, are dissolved in 120 parts by weight of cyclohexanone. Twenty parts by weight of dioctyl phthalate and 20 parts of trioctyl phosphate are then mulled together with about 1 part by weight of lampblack, it being desired to produce a black colored tape. About 1 part by weight of stabilizer, in this case lead acetate, is also mulled into the plasticizers. The mulled mixture of the plasticizers, the stabilizer, and the lampblack pigment is then dissolved in the cyclohexanone dispersion to form the casting liquid. Films are then cast from the cyclohexanone mixture on polished plate glass. The solvent is then slowly evaporated from the mixture by the use of infrared heating lamps. The cast sheet which then has a thickness of 9 mils (.009 inch) is then cooled and cut into strips which are 1½ inches wide.

Example II

Thirty parts of a commercial resin which comprises about 94 per cent vinyl chloride, 5 per cent vinyl acetate and 1 per cent of a stabilizer, dibutyl tin malate, is dispersed in 120 parts of cyclohexanone. Forty parts by weight of dioctyl phthalate is mulled with 1 per cent by weight of lamp black and the mulled mixture is dissolved in the cyclohexanone dispersion of the resin. This mixture is then cast upon a dense paper web and air dried at room temperature to form a sheet 6 mils thick. The paper web is a kraft sheet having a coating of clay and casein which provides a surface to which the resin is nonadherent. The dried sheet of resin is subsequently cut into strips ¾ inch wide.

When lengths of fabric are spliced with the strips of material or tapes made in accordance with the procedure set forth above, the ends of the fabric being spliced are placed in close proximity to one another and a length of tape is placed in a position wherein the tape extends over a portion of both of the pieces of fabric. After the tape is in position, heat and pressure are applied to the tape to fuse the plastic material thereby causing it to adhere to the threads of the fabric. The black color which is imparted to the tape by the lamp black pigment in Examples I and II enables an operator to readily locate the finished article which contains the splice so that it can be removed during the final inspection. Unless a coloring pigment is employed, the spliced portion of the material is scarcely noticeable and might easily pass inspection. Furthermore, when a colored splice is used the spliced piece of cloth may be located by a photoelectric detector, and then the article of which the spliced material constitutes a part may be automatically ejected by known machinery. In addition, the coloring material in the tape readily enables the operator to determine whether or not the splicing material is properly fused to the fibers of the material being joined together. The dark colored tape produced by the procedures set forth in the specific examples rapidly fuses into the fibers of the pieces of fabric under the influence of a heating element without danger of scorching the fabric on either side of the splice.

For general use in the finishing and fabrication of cloth and cloth articles, the dimensions of the splicing tape are not of particular importance. For example, splicing tapes having a thickness of from 2 to 20 mils and a width of from ⅜ to 2 inches have been successfully employed under various conditions. However, the dimensions of the tape are of considerable importance when the tape is employed for joining runs of lightweight porous materials such as gauze, netting, or the like. A tape which is too thick tends to damage the gauze in the region of the splice as the spliced gauze is passed through squeeze rolls or the like, and in the event that the tape is too thin, the bond between the lengths of gauze is broken during processing. Extensive commercial operations have shown that the splicing tape for such purposes should be cast and dried in a sheet of uniform thickness. For the splicing of gauze, the thickness of the sheet should be from 2 to 9 mils. This sheet is desirably cut into strips ranging in width from ¾ to 1¼ inches, the narrow width being employed when the tape is cut from the thicker sheet, the wider width being employed when the tape is cut from the thinner sheet.

When the thickness of the strip of splicing material is maintained within certain definite limits, the resulting splice will constitute a "passable" splice for gauze and other net-like fabrics. The spliced area of fabric joined together with specially proportioned splicing tape exhibits substantially the same softness as the original material and, in addition, the plastic substance adheres in a tight film to the fibers of the fabric so that the openings or pores in the material are not substantially reduced in size. A tape which may be used in this manner for surgical gauze and the like should preferably be less than about 3 mils in thickness. Desirably, the width of a tape for this purpose should be between about 1 and 1½ inches in width. Preferably the cast material should be colorless and, therefore, no pigment is added to the resin so that it will retain its transparent, water white appearance.

Example III

As a specific example of the method of making a splicing composition for use in producing a passable splice with surgical gauze the following procedure is followed. Twenty-seven parts by weight of the resin used in Example II is dispersed in 105 parts by weight of cyclohexanone. Forty parts by weight of dioctyl phthalate is dissolved in the dispersion of the resin and the cyclohexanone. The mixture is cast upon a polished stainless steel plate and the solvent is evaporated slowly from the layer formed on the plate. The layer, which is cast with a thickness of about 2 mils, is then cut into strips about 1¼ inches wide. The ends of lengths of surgical gauze are overlapped and a length of the tape is placed in a position wherein the tape extends over the overlapped portions of the gauze. Heat and pressure are applied to the tape with a sealing iron to fuse the plastic material.

The spliced area after processing was inspected and was found to have retained about 80 per cent of its original porosity and to exhibit substantially the same softness as the original gauze. The spliced area was not detectable except under close inspection, and an examination under a magnifying glass showed that substantially all of the resin material of the tape was disposed around the fibers of the fabric in a uniform layer which did not, in any way, affect the general appearance of the gauze fabric.

In the foregoing there has been described a means for producing a plastic tape which may be employed in splicing fabrics. A splice made in accordance with the invention will withstand the chemical action during the steps of bleaching, desizing, etc., and will be sufficiently flexible to pass through the usual fabricating machinery. Furthermore, the finished splice is very thin but still has a strength equal to that of the finished fabric. When a tape in accordance with the invention is employed in splicing together lengths of material, it is unnecessary to resplice the material after chemical processing and, in addition, the material around the splice will retain its

original dimensions so that it becomes unnecessary to waste large portions of the fabric.

Moreover, when the thickness of the splicing tape is closely controlled, less than about 3 mils, and the color is matched with that of the fabric, a substantially invisible splice for porous, net-like fabrics is obtained, which does not adversely affect the porosity, the color, or the softness of the fabric. This spliced area may readily be fabricated into a finished article without the necessity of removing the spliced area from the run of material.

In addition to the finishing operations which have been described, a splice in accordance with the invention will withstand the conditions encountered in Sanforizing, wrinkle proofing, and dyeing processes. Moreover, the finished splice will pass through hot calendering equipment without danger of the splice bleeding or sticking to the calender rolls.

Various of the features of the invention which are believed to be new are set forth in the appended claims.

We claim:

1. As an article of manufacture, a pair of runs of porous fabric which are overlapped and heat sealed together over at least a portion of the overlapped area by an unstressed, dimensionally stable cast film of a copolymerized thermoplastic composition comprising at least about 90 per cent vinyl chloride by weight and at least 4 per cent vinyl acetate by weight, and a plasticizer, the thickness of said film being in the range from 2 to 20 mils, the sealed together area of the fabric being characterized by a porosity which is not substantially less than the porosity exhibited by two overlapped but unsealed layers of the same fabric, and a flexibility substantially as great as the flexibility of the overlapped but unsealed layers.

2. As an article of manufacture, a pair of runs of surgical gauze which are overlapped and heat sealed together over the entire overlapped area by an unstressed, dimensionally stable cast film of a copolymer of vinyl chloride and vinyl acetate containing over about 90 per cent by weight of vinyl chloride and at least about 4 per cent by weight of vinyl acetate, 30 to 65 per cent by weight of a non-volatile plasticizer, and a stabilizer, the sealed together area of the fabric being characterized by a porosity which is not substantially less than the porosity exhibited by two overlapped but unsealed layers of the gauze fabric, and a flexibility substantially as great as the flexibility of the overlapped but unsealed layers.

3. As an article of manufacture, a pair of runs of surgical gauze which are overlapped and heat sealed together over the entire overlapped area by an unstressed, dimensionally stable cast film of a copolymer of vinyl chloride and vinyl acetate containing over about 90 per cent by weight of vinyl chloride and at least about 4 per cent by weight of vinyl acetate, and 30 to 65 per cent by weight of a non-volatile plasticizer, said film being less than about 3 mils in thickness, the sealed together area of the fabric being characterized by a porosity which is at least about 80 per cent of the porosity exhibited by two overlapped but unsealed layers of the same fabric.

4. As an article of manufacture, a pair of runs of porous fabric overlapped and bonded together over at least a portion of the overlapped area by a film of a copolymerized mixture containing at least about 90 per cent by weight vinyl chloride and at least 4 per cent by weight vinyl acetate together with a plasticizer, said film having been cast and thereafter cooled to produce a non-stressed, dimensionally stable structure which upon fusion splices the two runs of fabric together without substantial distortion of the spliced area, said film being sufficiently thin to retain substantially the flexibility of the overlapped fabric runs.

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