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NONWOVEN RAYON FABRIC

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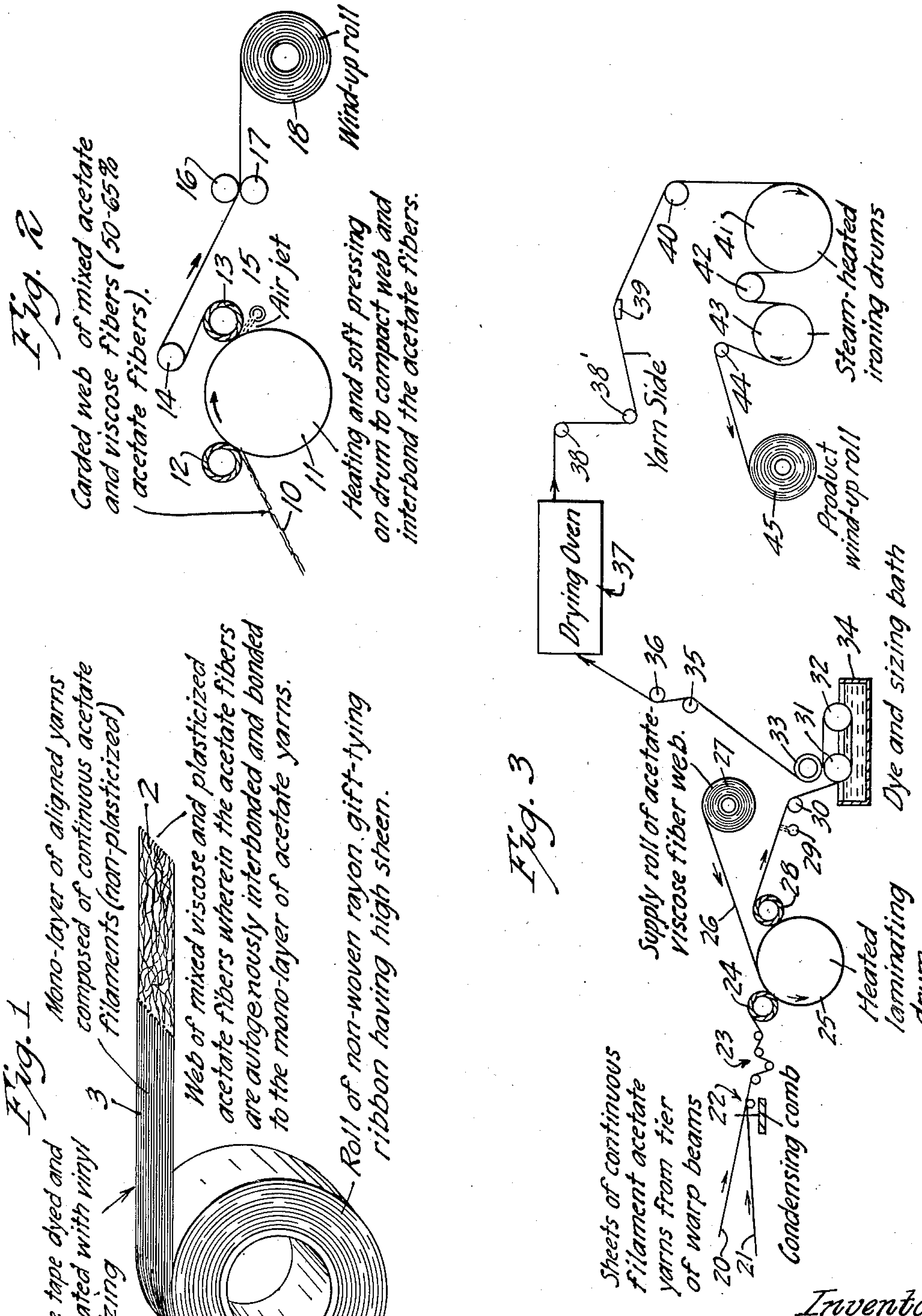

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NONWOVEN RAYON FABRIC

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This invention relates to novel non-woven rayon fabrics useful for decorative purposes. The invention provides gift-tying ribbons for use in tying and decorating de luxe gift packages, and also useful for tying and decorating floral corsages, bouquets, wreaths, potted plants, and the like. The present fabrics can also be employed in decorating store windows and counter displays, and for window drapes.

The object is not merely to provide fabrics which are cheaper than woven rayon fabrics, but to provide decorative fabrics and ribbons which are distinctive and which have unique properties arising from their novel composition and structure. The invention makes possible the production of beautiful gift-tying ribbons at less than half the cost of woven satin ribbons, and they have certain desirable features that make them acceptable for use in place of the latter.

The present fabrics, and ribbons slit therefrom, have a high wet strength and are not damaged by contact with water. This is very desirable in connection with use for floral wrapping and decorating, as flowers are commonly wet or moist. They can be readily dyed and printed to obtain various colorations and decorative effects. The dyeing operation can advantageously be included in the basic manufacturing operation.

This fabric is made from three types of rayon fibers which are combined together in unique fashion to produce a novel combination of properties. The fabric is formed of a tissue-like base layer composed of a heterogeneous mixture of staple viscose (regenerated cellulose) fibers and staple plasticized acetate (cellulose acetate) fibers, and a top layer of aligned yarns of non-plasticized continuous acetate filaments, the yarns running lengthwise of the fabric (or ribbon) in parallel shoulder-to-shoulder relation and in single depth (forming a mono-layer). The two layers are laminated together and the composite is unified by virtue of the bonding of the plasticized acetate fibers to each other and to the overlying acetate yarns at the various points of contact. This bonding is autogenous, being produced by heating and pressing, the plasticized acetate fibers thereby being fused to each other and to the yarns without the use of extraneous binder material. A large number of fine yarns per inch width are employed, which makes for flexibility and results in a high surface sheen, in contrast to the soft, lusterless, fibrous appearance of the reverse surface.

The fabric is impregnated with a flexible

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water-resistant sizing of vinyl resin or the like to provide an almost imperceptible coating on the yarns and fibers which eliminates any tendency to fuzziness and to freeing of filaments when the fabric is cut or slit. This sizing superficially coats the yarns and does not penetrate sufficiently to bond the interior filaments together, the latter remaining free and capable of relative movement.

This structure results in a combination of different lengthwise and crosswise properties which is advantageous in tying ribbons. The fabric has a resilient but crush-resistant "hand." Ribbons have adequate lengthwise tensile strength for binding packages (contributed largely by the yarns). The crosswise tensile strength is relatively much less and yet is adequate. The collapsible crosswise structure and the limited degree of stiffness, together with the "non-slip" back surface, makes it possible to tie the ribbon with small tight knots that will not slip. The ribbon is non-puckering when looped or tied into a bow. The non-slip fibrous back surface helps to hold the loops and bows in place when the ribbon is used in making fancy bows and pompoms. The bows and the loops have the proper combination of resiliency and stiffness to be well-formed, firm and crisp, and yet are flexible and yieldable because the ribbon is not too stiff.

It will be evident that a combination of many different properties in desirable degrees of effect has been achieved by the present fabric construction. Extensive usage in the gift-wrapping departments of stores and for home gift-wrapping, have demonstrated that a worth while innovation has been made which appeals to the public fancy.

The invention can best be described in further detail in connection with the accompanying drawing, followed by an illustrative "example."

In the drawing:

Fig. 1 is a schematic cut-away perspective view of a roll of gift-tying ribbon made according to this invention;

Fig. 2 is a diagrammatic elevation view serving as a flow-sheet and showing illustrative apparatus for heating and unifying the carded fiber web which provides the base layer of the composite fabric;

Fig. 3 is a diagrammatic elevation view serving as a flow-sheet and showing illustrative apparatus for completing the manufacture of the fabric, ready for slitting and winding into rolls.

Referring to Fig. 1, there is shown a roll 1 of the gift-tying ribbon, which is cut away so as to reveal the basic structural arrangement. The ribbon consists of a tissue-like inner or base layer 2 formed of a compacted carded mixture of staple plasticized cellulose acetate fibers (about 50 to 65% by weight) and staple viscose fibers, which both have a length of at least approximately one inch; and an outer or top layer 3 formed of a mono-layer of aligned cellulose acetate yarns in shoulder-to-shoulder relation, each of which is composed of a substantial number of hair-like continuous filaments (non-plasticized). Such yarns are to be distinguished from those formed by spinning staple fibers.

The composite structure is unified by virtue of the autogenous interbonding at their crossing points of the plasticized cellulose acetate fibers of the base layer; and the autogenous bonding of these same plasticized acetate fibers to the non-plasticized acetate yarns of the top layer, at their points of contact. The autogenous bonding results from heating and pressing, firstly of the fiber web during its production, and secondly of the mono-layer of yarns and the fiber web when they are laminated together. The acetate filaments of the yarns are not plasticized and do not bond to each other along their lengths under the conditions employed. Sufficient plasticizer bleeds from the staple acetate fibers to the exterior acetate filaments of the yarns at the contact points to result in interbonding between the two layers. The fibers substantially completely retain their integrity and uniformity throughout their length in consequence of the soft-pressing technique employed; whereas if hot-calendering between hard-surfaced rolls were to be used the acetate fibers would become mashed and cut. The acetate fibers of the base layer form a unified network within which the viscose fibers are distributed; and the latter are unbonded and held only by mechanical restraint and frictional contact.

The composite fabric is impregnated by a dyed vinyl resin sizing composition (or the like) which imparts the desired coloration and at the same time provides a very thin flexible water-resistant film coating upon the fibers and yarns. When making a white fabric the dye is omitted; but use can be made of a fluorescent dye that intensifies the white appearance. This sizing film prevents fuzziness and the freeing of filaments which might otherwise result from looseness of structure and from cutting and slitting, and it provides a film-like filling between the contiguous yarns but without covering the yarns sufficiently to provide a flat-surfaced coating thereon. The sizing does not penetrate into the individual yarns sufficiently to glue the interior filaments together, the coating being superficial. The sizing material is present in such small proportion as to be almost unnoticeable to the naked eye. The fibrous natures of the exposed faces of the fabric are apparent to the eye and to the touch. When a finger nail tip is drawn over the surfaces in a crosswise direction a rasping feel and sound plainly demonstrates the fibrosity. The yarn surface has a slick feel in the lengthwise direction. The sizing has only a minor effect on the crosswise and lengthwise tensile strength characteristics and on the lamination strength, which are mainly due to the previously mentioned autogenous interbonding of the acetate fibers and filaments. The fine, relatively long, fibers of the thin tissue-like base layer are free to flex and move between the crossing points and this makes for a high degree of flexibility of the base layer in all directions. The viscose fibers increase the crosswise strength of the fabric and keep it from being too crisp. The free movement of the viscose fibers results in improved workability of the ribbon. The ribbon has a greater lengthwise tensile strength than a woven cloth ribbon of the same weight and, unlike the latter, it combines adequate degrees of stiffness and resiliency in the lengthwise and crosswise directions to form crisp loops and bows, with the ability to "collapse" in the crosswise direction to form tight knots when tied. The absence of weaving and the use of yarns of the continuous-filament type results in a high sheen due to the parallelism and smoothness of the yarns. The yarn side of the ribbon is very slick and shiny in appearance.

Referring to Fig. 2, which shows the making of continuous webs of the fibrous base layer material of the fabric, a carded fiber web 10 is shown coming from a carding machine (not shown) and being fed into the apparatus. This web is composed of a mixture of about 50 to 65% by weight of plasticized staple acetate fibers with the remainder being staple viscose fibers.

The carding machine is not shown as it is not special equipment and such machines are well known. By a carding machine is meant not only those which are technically termed carding machines, but also Garnett machines which operate to form carded webs. The carding procedure straightens out the fibers and forms a loose open-mesh fluffy web of interlaced fibers which pass over and under each other in a heterogeneous fashion. Each fiber is crossed by numerous other fibers along its length. An example of a suitable Garnett machine for present purposes is one in which the working rolls have 22 teeth per inch, the finishing cylinder has 24 teeth per inch, and the finishing doffers have 28 teeth per inch. The mixture of cellulose acetate and viscous fibers can be prepared for carding by throwing the fibers, in the desired relative proportion, into a "picker" which blends the mixture and opens the fibers. The fiber mixture can be humidified or moistened to render it in best condition for carding. Exposure to a room atmosphere at 65% humidity properly conditions the fibers.

Heating of the carded web is produced by a polished steel drum 11, rotated about a horizontal axis by an electric motor (not shown). The drum rotates in a clockwise direction in this view. This drum has a diameter of about 16 inches. It is heated by electric heating elements mounted on a fixed spider or frame (not shown) located within the drum, but may of course be heated in any other suitable manner.

Pressing of the fiber web against the heating drum is produced by the soft rolls 12 and 13 which bear against the drum surface and are free to turn. Roll 12 is located so that it contacts the heating drum near its top, and roll 13 is spaced beyond, about one-fourth of the distance around the drum. These pressing rolls are each made of a light sheet-metal cylinder having a diameter of 5 inches upon which is wound five turns of finely woven glass cloth having a smooth type surface, forming a cloth layer approximately ⅛ inch thick. The cloth is wound on in a clockwise direction and the outer end is left free so as to trail through the nip, preventing wrinkling. The turns of cloth hold together so that this end does not flap. The glass cloth provides a soft flexible surface which will not stick to the heated fiber web.

The pressing rolls are pressed against the heating drum by their weight and by adjustable spring or weight loading devices at each end (not shown), the total pressure being less than 10 lbs. per inch width of the web. In operation the softness of the roll results in a peripheral contact distance of about ¼ inch. An idea of the softness of the pressing operation can be gained from the fact that a large diameter pencil lead (0.085 inch diameter), mounted by means of adhesive tape on a piece of paper, can be passed through the nip without damage to the lead (the lead being parallel to the axis of the roll). A wooden dowel of 0.160 inch diameter can be passed through the nip. This light-pressure soft-roll pressing action is entirely different from the pressure effect produced by the calenders used in textile mills, which have hard rolls forming the nips through which sheet material is passed under heavy pressure.

The carded fiber web **10** is shown coming from a carding or Garnett machine to the present apparatus where it is drawn in at the nip between the heating drum **11** and the first pressing roll **12**, where it is subjected to a first pressing to compact the fibers, and to heating in contact with the polished surface of the heating drum. The web travels around with the surface of the rotating heating drum to and through the nip between the heating drum and the second pressing roll **13**, by which time the thermoplastic fibers will all have been softened sufficiently to insure proper interbonding. During the travel interval between the nips, the web is thus subjected to heating under slight tension but without being pressed. This arrangement holds the web in smooth contact with the heating drum surface and prevents wrinkling or distortion.

The bonded web in heated condition, having passed through the nip of the second pressing roll **13**, is drawn up and around the latter roll and is thus separated from the surface of the heating drum. It then passes to and around a freely-turning wood guide roll **14**, located above and forwardly of the pressing roll. It then is drawn back to and between the nip of a pair of steel pull rolls **16** and **17**, which are driven in synchronism with the rotating heating drum by means of a chain drive (not shown) connected to the motor which drives the heating drum. The upper roll **16** is surfaced with heavy paper so as to exert greater traction on the web. These pull rolls draw the web under tension from the second pressing roll, which results in holding it smooth while cooling down. The fully formed product then goes to the wind-up roll **18** where it is wound on a core. The wind-up roll is driven by the rotating pull rolls through a slip-belt drive (not shown) which keeps it rotating at the correct speed as the web is wound up.

Stripping of the bonded web from the heating drum is facilitated by the air-jet **15**, which is a horizontal tube having a slit orifice and is located behind the nip between the second pressing roll **13** and the heating drum **11**, so as to direct a jet of compressed air toward the nip.

The temperature of the heating drum to be employed will depend on the softening temperature of the thermoplastic cellulose acetate fibers of the web, and should be high enough to cause the desired interbonding with the use of only a light pressing action, but not so high as to melt or flatten out these fibers at their crossing points

or to cause the non-thermoplastic viscose fibers to cut into the thermoplastic fibers.

Reference is now made to Fig. 3 which illustrates the further procedure used in completing the fabric of this invention. The non-plasticized continuous-filament acetate yarns are drawn under tension from a pair of warp beams (not shown) located above each other to form a tier. The two "sheets" of yarns, **20** and **21**, are shown coming in from the left to the condensing comb device **22**, which is shown schematically as these combing devices are well known in the textile industry. Here the yarns are interfitted to form a single sheet of contiguous yarns of the necessary density (number of "ends" per inch width). The resultant sheet of yarns is drawn over and under a series of smoothing or spreading bars **23** to flatten and even them out, and then passes over and around a pressing roll **24** and through the nip between this roll and heated steel drum **25**, which rotates in a counter-clockwise direction. (This drum has a diameter of about 20 inches and is of the same kind as drum **11** of Fig. 2, previously described.) The pressing roll is a 5 in. dia. steel roll which is covered with at least five layers of glass cloth, to provide a soft, resilient, non-sticking surface. It bears against the heating drum with a light pressure (less than 10 pounds per inch of width) and is similar in action to the previously described roll **12** of Fig. 2.

At this point the mono-layer sheet of yarns joins the unified tissue-like web **26** of mixed acetate and viscose fibers, whose manufacture has been described in connection with Fig. 2, this web being drawn from supply roll **27**. The fibrous web **26** is drawn into contact with the surface of the rotating heating drum; the aforesaid sheet of yarns thus overlies the fibrous web and contacts the surface of the pressing roll; and both layers are drawn through the nip. The pressure and temperature are adjusted so as to press the yarns against the fibrous web in a manner that will produce autogeneous lamination without mashing or cutting the acetate fibers.

The laminated fabric moves with the surface of the rotating heating drum for about two-thirds of a revolution and then passes under a second, similar, pressing roll **28**, which also is covered with glass cloth and exerts a soft-pressing action. During the interval the fibrous web is heated and a small amount of the plasticizer content of the acetate fibers is driven out and seeps into the surfaces of the overlying acetate yarns, thereby conditioning them so as as to insure bonding when the hot fabric is pressed under the second roll. The tension on the yarns causes them to lie flat in parallel relation as they are bonded in place.

The laminated fabric then leaves the drum and passes over an air jet **29**, which cools it, and then passes over roll **30** and down into the dye and sizing bath **34**, which contains an alcoholic solution of dye and vinyl resin (or the like), maintained below 88° F. Herein the fabric passes under steel roll **31** to steel roll **32**, then back to the nip between roll **31** and the overlying vulcanized rubber roll **33**, where excess solution is squeezed out, and then upwardly to and over carrying rolls **35** and **36** and into the drying oven **37**. The latter rolls are covered with polyethylene film to prevent color blotching. The drying oven is shown symbolically as such ovens are well known. In passing through this oven, the fabric travels under tension back and forth between carrying rolls while being heated at about 150° F. until dry.

The dried fabric from the oven passes around guide rolls 38 and 38', and then bears against an anti-wrinkle slat 39 (which contacts the yarn side) to smooth out the fabric web, then around guide roll 40, ironing drum 41, guide roll 42, ironing drum 43, guide roll 44, and goes to the wind-up roll 45, where the finished fabric is wound into jumbo rolls. The yarn side contacts the surface of the ironing drums. The winding tension pulls the material through the entire apparatus and maintains the fabric under tension as it is dried in the oven and as it passes over the anti-wrinkle slat and the ironing drums, in consequence of which a smooth, unwrinkled fabric product having a shiny surface is obtained. The ironing drums are steam heated and have a surface temperature of about 165° F.

The foregoing apparatus (both Fig. 2 and Fig. 3) has been operated successfully at a web travel rate of 60 feet per minute, thus producing the product at the rate of 1,200 yards per hour.

Example

The construction details of a preferred illustrative fabric used for making tying ribbons will now be described.

The cellulose acetate yarns are designated as bright acetate of 150 denier weight, low twist, each yarn consisting of 41 continuous filaments (non-plasticized). The sheet of combined yarns as received at the laminating drum consists of 75 yarns ("ends") per inch width.

The web from which the base layer is formed (Fig. 2) is a carded mixture of 60% by weight of plasticized cellulose acetate staple fibers (3 denier, 1¼ inch length), and 40% of viscose fibers (1½ denier, 2 inch length). The acetate fibers are plasticized with about 30% by weight of a sulfonamide type plasticizer (for instance, Monsanto's "Santicizer 8," which is a mixture of ortho and para N-ethyl toluene sulfonamides), thereby rendering them potentially adhesive to each other. This permits of proper bonding together of acetate fibers and lamination of the layers by heating and soft-pressing as previously described. The relative proportioning of the two types of fibers is fairly critical. If the proportion of plasticized acetate fibers is materially less than 50% there will be inadequate unification of the fabric structure. If the proportion is materially greater than 65%, the fabric will be rendered too stiff to have the desired properties.

Fabrics used for making gift-tying ribbons have a weight of about 40 to 50 lbs. per ream (weight of 320 sq. yds.); the weight of the fibrous base layer being about 12 to 14 lbs. per ream; that of the yarn layer being about 28 to 36 lbs. per ream; with the dye and resin sizing contributing about 1 lb. per ream to the total weight. Such fabrics have a caliper thickness of about 4 to 6 mils, a lengthwise tensile strength of about 25 to 35 lbs. per inch width, and a crosswise tensile strength of about 1 lb. per inch width. The caliper thickness of the yarn layer per se is about 2 to 4 mils.

The carded fibrous web is unified by employing a heating drum temperature of 370 to 380° F., with the pressing rolls (12 and 13 of Fig. 2) adjusted to exert a pressure of the order of ⅔ lb. per inch width of the web (i. e. each roll exerts a total pressure of 40 lbs. on a 60 in. width web). The yarn sheet is laminated to the fibrous web by employing a heating drum temperature of 385 to 395° F. with the first pressing roll adjusted to exert a pressure of 2 to 6 lbs. per inch width and the second roll 3 to 8 lbs. (see rolls 24 to 28 of Fig. 3). The final adjustments of temperatures and pressures are controlled during manufacture to obtain the best results on the basis of testing and visual inspection of the products.

Alcohol-soluble dyes were chosen to color this fabric because of their brilliance and ease of handling. Examples are the tanic acid lakes of basic dyes, which dye both the acetate filaments and fibers and the viscose fibers, as well as the vinyl resin sizing. These dyes are water-insoluble in the fabric product. Use can also be made of the regular anthraquinone dyes, which dye the acetate filaments and fibers but not the viscose fibers. Alcoholic-water dye solutions have a tendency to loosen the yarns from the base layer. The alcohol-soluble vinyl resin component of the dye bath overcomes this and in addition acts as a sizing for the yarns and fibers as previously described. As illustrative plasticized polyvinyl acetate resin for this use is a copolymer of 72% vinyl acetate and 28% 2-ethyl butyl maleate (the latter providing an "internal plasticizer" effect to increase flexibility). This vinyl resin is alcohol-soluble, water-resistant, thermoplastic, flexible, clear and transparent, and adheres to the fibers and filaments. It imparts some water-repellency to the fabric which, even in the absence of the sizing, has a high wet-strength. The resin sizing does not interfere with the decorative color appearance and workability of ribbons slit from the fabric. Equivalent film-forming polymers can be used as will be evident to those skilled in the art of synthetic resin coatings.

A typical dye bath is illustrated by a well-mixed solution of denatured ethyl alcohol containing 15% added water, 3½% of the plasticized vinyl acetate resin and sufficient dye to impart the desired color intensity. For instance, in making fabric to be converted to pink tying ribbons, a 50 gallon batch might contain 40 grams of "Printan Paper Red B" dye (sold by Geigy Company, Inc.). The added water (making a total water content of about 20%) prevents the alcohol from appreciably attacking the surfaces of the acetate filaments and fibers. Otherwise, the alcohol, upon penetrating into the yarns, would dissolve into the filament surfaces sufficiently to cause shrinking and cause the interior filaments of the yarns to interbond upon subsequent drying, thereby distorting and stiffening the fabric.

I claim:

1. A non-woven rayon fabric of the character described, essentially consisting of a tissue-like web serving as the base layer and formed of a compacted carded mixture of staple viscose rayon fibers and plasticized staple acetate rayon fibers which both have a length of at least approximately one inch, said acetate rayon fibers being in the proportion of about 50 to 65% by weight and being autogenously interbonded at their crossing points to form a network within which the viscose rayon fibers are distributed, and a monolayer of aligned yarns of non-plasticized continuous acetate rayon filaments laminated to one face of said tissue-like web by autogenous bonding to said plasticized acetate rayon fibers, the composite rayon fabric being impregnated by a flexible water-resistant sizing that superficially coats the yarns without materially stiffening the fabric, and the fabric having a high sheen on the yarn side.

2. A roll of decorative gift-tying ribbon slit from the fabric specified in claim 1 and wound

on itself, the yarns extending lengthwise in the ribbon, said ribbon tying with a hard knot and providing resilient well-formed bows and loops.

3. A non-woven rayon fabric as specified in claim 1, having a ream weight of the order of 40 to 50 lbs., the ream weight of the fibrous base layer being of the order of 12 to 14 lbs. and that of the yarn layer of the order of 28 to 36 lbs., having a caliper thickness of the order of 4 to 6 mils, and having a lengthwise tensile strength of at least about 25 lbs. per inch width.

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REFERENCES CITED

The following references are of record in the file of this patent:

10

UNITED STATES PATENTS

Number	Name	Date
1,211,443	Heany	Jan. 9, 1917
2,332,233	Katz	Oct. 19, 1943
2,354,702	Protz	Aug. 1, 1944
2,422,969	Johns	June 24, 1947
2,503,024	Boese et al.	Apr. 4, 1950

FOREIGN PATENTS

Number	Country	Date
128,707	Switzerland	Nov. 16, 1928