Jan. 4, 1944. T. G. HAWLEY, JR 2,338,243

LAMINATED ELASTIC FABRICS

Filed Aug. 5, 1942

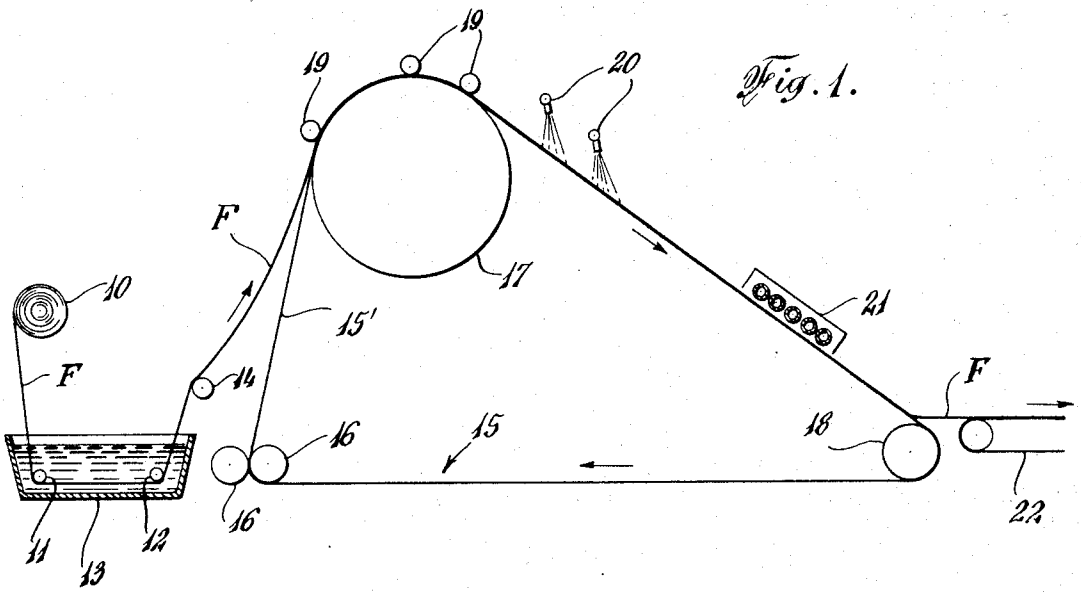


Fig. 1.

Fig. 2.

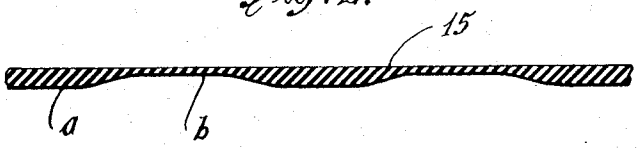


Fig. 3.

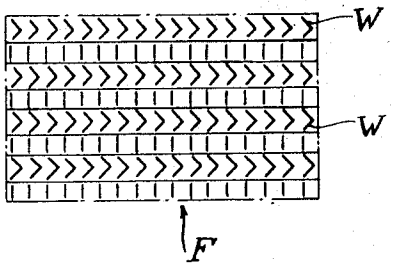


Fig. 4.

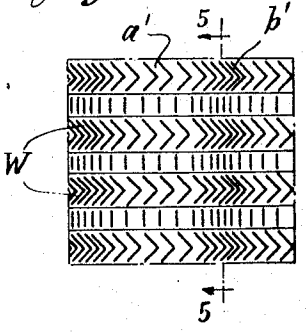
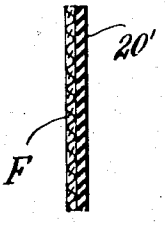


Fig. 5.



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LAMINATED ELASTIC FABRIC

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Application August 5, 1942, Serial No. 453,691

4 Claims. (Cl. 154—48)

This invention relates to laminated textile and rubber fabrics having greater elastic extensibility in some areas than in others. Such invention was broadly described in U. S. Patent No. 2,196,808, granted April 9, 1940, on my application Serial No. 60,579, filed January 24, 1936, which was co-pending with my application Serial No. 293,180, filed September 2, 1939, and of which this application is a continuation-in-part.

It has been proposed heretofore to impart elastic properties to stretchable fabrics such as knitted goods, by calendering sheet rubber onto a surface of the fabric, or by applying to a surface of the fabric a rubber-containing fluid such as solvent rubber cement or an aqueous rubber dispersion such as latex, the purpose of the rubber being to contract after being stretched and return the fabric to its unstretched condition.

It has also been proposed heretofore to stretch knitted fabric in one direction and then apply a coating or sheet of rubber thereto to normally retain the fabric stretched in this direction so as to increase its stretch in a direction at right angles thereto. While the effect of such prior treatments has been to produce an elastic fabric and to increase the property of the fabric to stretch in one direction with a loss of such property in a different direction, the result of such prior treatments has not been to increase on the whole the property of a fabric to elongate over that which the textile fabric originally possessed before the rubber treatment, or to impart greater elastic extensibiilty to some areas than to others.

The present invention relates to a fabric which may be made by a method of treating woven, knitted and other textile fabrics by condensing the fabric more in some areas than in others, and then securing the fabric normally in this condensed condition by an elastic binder of rubber. The invention is described in reference to the method whereby the fabric is wetted to approximately a saturated condition with water or other non-adhesive liquid to render the fabric more plastic, and the adhering action resulting from the substantially saturated condition of the fabric is utilized in condensing the fabric and to retain the fabric in a condensed condition until it can be secured in this condition by a rubber binder.

Pastes, glues and other adhesives may be used to temporarily retain the fabric in the condensed condition, in place of water. However, the use of a non-adhesive liquid such as water for this purpose has the advantage that the water may be readily removed from the fabric by a drying operation after the fabric has been set in the condensed condition by the rubber binder, whereas if an adhesive is used for this purpose its subsequent removal requires an additional step of washing.

The fabric to be condensed, in carrying out the present invention, is preferably placed upon a stretched elastic belt or apron and the fabric may be wetter either before or after it is placed upon this belt. The quantity of water used should be sufficient to practically saturate the fabric in order to render the fabric more plastic and sufficiently adhesive to cause it to adhere to the stretched belt. The quantity of water used should not, however, be sufficient to tend to float the fabric upon the belt. The primary function of the water is to hold the fabric in place upon the belt so that when the belt is permitted to contract it will condense the fabric. The fabric may then be yieldingly secured in this condensed condition by a rubber binder which may take the form of a rubber sheet or rubber coating firmly secured to a face of the fabric.

The primary feature of the present invention resides in the laminated elastic fabric and in the method whereby a lamina of textile fabric is condensed more in some portions than in others to thereby impart to the fabric design or pattern effects and greater elastic extensibility in some areas than in others.

The invention will be more fully understood from the following description when read in connection with the accompanying drawing illustrating one form of mechanism for carrying out the present method.

In the drawing:

Figure 1 is a diagrammatic side elevation of one form of mechanism for carrying out the invention;

Figure 2 is a sectional view through a rubber belt of varying thickness which is adapted to condense portions of the fabric differently; and

Figure 3 is a conventional showing of a piece of knitted fabric before it has been condensed;

Figure 4 is a view showing the textile side of the fabric in Figure 3 after it has been condensed upon the belt of Figure 2 so as to produce pattern effects and greater elasticity in some areas than others; and

Figure 5 is a cross-sectional view on line 5—5 of Figure 4 of a condensed fabric having a rubber binding lamina secured thereto.

The method of the present invention may be employed in treating knitted, woven, lace or

other fabrics to render them elastic, and these fabrics may be condensed either longitudinally or transversely, or both longitudinally and transversely, as desired. However, the degrees to which it is practical to condense the fabric will depend largely upon how open a construction the fabric possessed, as it is obvious that an open loosely constructed fabric may be condensed to a much greater extent than a tightly formed fabric.

A construction is shown in Fig. 1 of the drawing for employing water as a plasticizer to condition the fabric in a way that makes it more responsive to the condensing operation, and the water serves also to cause the fabric to adhere to the condensing belt. The fabric F to be treated, in the construction shown, is drawn from the supply roll 10 about bars or rollers 11 and 12 placed in the tank 13 below the surface of the liquid. This tank may contain water or a diluted aqueous solution. The wet fabric upon leaving the tank 13 may pass upwardly in contact with a guide roll 14 and then onto a stretched elastic belt or apron 15. This belt may be formed of a sheet of rubber or of elastic webbing, and may be porous or nonporous as desired. The porous belt will permit a more rapid drying of the fabric. In practice it is found important in dealing with woven fabrics to use a constant width belt such as a woven elastic belt or a rubber belt which has been treated to maintain its width constant. This is necessary because woven fabric tends to lift off the belt in condensing if the width of the belt changes at this time. If the rubber or elastic belt is subject to high temperatures, the rubber within the belt may be specially constructed or may contain special compounds to prevent its over-cure during subsequent heat treatments. The belt may, if desired, have its fabric-receiving surface made tacky or rough, or it may be flocked or otherwise treated to increase the frictional engagement between the belt and fabric.

The belt is shown as passing between a pair of pinch rolls 16 which grip the belt to prevent slippage therebetween, and these rolls or at least one of them is positively driven to feed the belt. The belt passes upwardly from the pinch rolls 16 about a relatively large drum 17 and after passing part way around this drum its upper run extends in a downwardly inclined direction, in the construction shown, to a free-running roll 18, and then around the roll 18 and to the pinch rolls 16.

The large drum 17 is positively driven at a faster surface speed than the rolls 16. The effect of this is to stretch the portion 15' of the belt between the rolls 16 and drum 17 and to permit this stretched portion of the belt to contract gradually as it approaches the point where it leaves the drum 17 and moves towards the roll 18. The gradual condensing of the fabric such as is secured as the rubber belt 15 passes around the upper part of the drum 17 is much more desirable than a rapid condensing.

It will be seen that in the construction shown the wet fabric F is delivered to the stretched portion 15' of the belt, and it preferably is pressed firmly against the belt by one or more floating and free-running rollers 19. The effect of this is to cause the wet fabric F to adhere to the stretched underlying belt, and since this belt is permitted to contract gradually as it approaches the point where it leaves the drum, the fabric will be condensed by the contraction of the belt to which it adheres as a result of its wet condition. That is, the adjacent parts of the fabric will be crowded more closely together. The roller 19 nearest the discharge point is preferably so positioned that it serves to press the fabric against the belt after it is condensed.

The condensed fabric may be conveyed by the supporting belt beneath the spraying nozzles 20 which serve to spray upon the fabric F a rubber containing liquid such as solvent rubber cement, or an aqueous dispersion of rubber such as latex with or without compounding and/or vulcanizing ingredients and in either a vulcanized or unvulcanized condition of a workable degree. The rubber containing fluid when subsequently treated forms the rubber binder lamina 20' on the fabric F as shown in Fig. 5. The nozzles are preferably inclined as shown to prevent the rubber solution from penetrating too deeply below the surface of the fabric. If desired, the rubber containing liquid and coagulant may be deposited upon the fabric before it is condensed, but the setting of the rubber should not take place until after the fabric is condensed. When the rubber containing fluid is to be deposited upon fabric before the latter is condensed, the liquid is preferably applied to the fabric as it passes around the drum 17. In this case the rollers 19 which would engage the sprayed surface, should be omitted so that the sprayed rubber will not be forced through the fabric by the pressure of the rollers. The fabric upon leaving the spraying nozzles 20 may be carried by the belt past the heating or drying elements 21 to set the rubber containing liquid sufficiently to hold the fabric condensed after it leaves the belt 15.

The fabric may then be delivered to a conveyor apron 22 to be conducted to a vulcanizing chamber, or subjected to any other desired treatment, in which the laminated fabric is completed as shown in plan view in Fig. 4 and in cross sectional view in Fig. 5.

When water or a weak aqueous solution is employed to secure the fabric to the condensing belt it can be readily removed from the belt and fabric by drying, whereas if a paste, glue or other adhesive is used for this purpose it may be necessary to soften the temporary adhesive before the fabric F with the rubber binder is removed from the belt 15. The adhesive may be softened by steaming it. Where temporary adhesives of the type of paste or glue are used they are spread upon the belt 15 at the stretched portion 15' and the fabric F is then applied to such portion as previously described.

The belt 15 is shown in longitudinal cross section in Fig. 2 and as illustrated therein it is made of rubber. It is provided with relatively thick bands *a* and relatively thin bands *b*. When the belt 15 is stretched as in the portion 15', Fig. 1, the bands *b* elongate more than the bands *a*. The fabric F shown in Fig. 3 is a conventional type of knitted fabric before it has been condensed. In condensing such fabric it is applied to the belt 15 while it is stretched and so that the wales *w* extend in the direction of the stretch and transversely to the bands *a* and *b*. After the fabric F is so applied, the tension on the belt is relieved as it passes over the roll 17 as described in reference to Fig. 1. The fabric F is condensed in the direction of the wales *w*. As shown in Fig. 4 the fabric is condensed more in the bands *b'* which were adhered to the bands *b* of the belt than in the

bands *a'* which were adhered to the bands *a* of the belt 15. The variation in condensation is indicated in the drawing by showing the loops represented by the darts (>) closer together in the bands *b'* than in the bands *a'*. Where a woven fabric is condensed the threads running transversely to the condensing direction are crowded together in a manner similar to the loops shown in Fig. 4, and the threads running in the direction of condensing are super-relaxed. The laminated fabric made as above described is composed of an extensible unevenly condensed lamina of fabric F, as shown in Fig. 4, and an elastic lamina of rubber 20' as shown in Fig. 5. Due to such construction it is evident that the rubber lamina 20' opposite the less condensed bands *a'* of the fabric F will be restrained from extending or stretching to as great an extent in the direction of condensation as the other bands *b'* of the lamina of rubber 20', solely by the fabric F, and that the composite fabric will be capable of stretching less in the bands *a'* than in the bands *b'* in the direction transverse thereto.

The effect of condensing a knitted fabric as shown in Fig. 4 and yieldingly securing it in this condition by a rubber binder is to produce an elastic fabric having a relatively long stretch in the direction of its length, which stretch may be well over 100%. The fabric may or may not have its width altered during the condensing operation depending upon whether or not the width of the belt changes. It is also possible through the present method to produce woven and other textile fabrics having a substantial stretch. The rubber binder may be so applied to the fabric that it will only slightly diminish the porosity of the original fabric, or if desired, the binder may be made nonporous and impervious to the air so that it may serve to impart waterproof properties to the fabric, and also make it useful for reducing garments.

Elastic fabric constructed in accordance with the present invention may have one face that is free from rubber so that this face will have the feel and general appearance of the fabric before it was treated, or if desired two such fabrics may be plied together and held by a rubber adhesive applied therebetween, in which case both outer faces of the plied fabric will have the feel and appearance of ordinary textile fabric and in such case the bands *a'* and *b'* of the respective fabric laminae will be placed opposite each other. Elastic fabric constructed in accordance with the present invention may be used in corsets and girdles or for various other purposes where different elastic properties in different portions are advantageous.

It will be apparent from the foregoing that various forms of rubber products may be employed as an elastic binder to yieldingly hold the parts of the fabric in the condensed condition. The term rubber as used in the claims is therefore to be understood as including sheet rubber, rubber cement, aqueous dispersions of rubber such as laxtex, artificial dispersions of rubber, and other forms of rubber or rubberlike materials and other elastic materials containing rubber.

Having thus described my invention what I claim and desire to protect by Letters Patent is:

1. A relaxed laminated elastic fabric comprising a lamina of thread fabric and a lamina of elastic rubber elastically bonded to said lamina of thread fabric, said lamina of thread fabric being condensed more in some areas than in other areas and having greater extensibility in the more condensed areas than in other areas, and said lamina of elastic rubber opposite the less condensed areas of said lamina of thread fabric being restrained from extending to as great an extent as the other areas of said lamina of rubber solely by said lamina of thread fabric.

2. A relaxed laminated elastic fabric comprising a lamina of thread fabric and a lamina of elastic rubber elastically bonded to the entire adjacent surface of said thread fabric, said lamina of thread fabric in its relaxed condition having some areas which are elastically extensible transversely and longitudinally and other areas which are elastically extensible in one of said directions to a lesser extent than the thread fabric in the first mentioned areas, and said lamina of rubber opposite said less extensible areas of thread fabric being restrained from extending to as great an extent in said direction as the other areas of said lamina of rubber solely by said lamina of thread fabric

3. A laminated elastic fabric comprising a lamina of thread fabric and a lamina of porous elastic rubber elastically bonded to said lamina of thread fabric, said lamina of thread fabric being condensed more in some areas than in other areas and having greater extensibility in the more condensed areas than in other areas, and said lamina of elastic rubber opposite the less condensed areas of said lamina of thread fabric being restrained from extending to as great an extent as the other areas of said lamina of rubber solely by said lamina of thread fabric.

4. A relaxed laminated elastic fabric comprising two laminae of thread fabric, an elastic sheet of rubber interposed between said laminae of thread fabric and elastically bonded to each, said laminae of thread fabric being elastically held in a condensed condition in some areas by said rubber sheet to a greater extent than in other areas, the areas of like condensation of the opposite laminae of thread fabric lying opposite each other, and said lamina of rubber opposite said less condensed areas of said laminae of thread fabric being restricted from stretching to as great an extent as the other areas of said lamina of elastic rubber solely by said laminae of thread fabric.

THOMAS G. HAWLEY, JR.