Sept. 15, 1931. H. P. DWORSKY ET AL 1,823,034

RUBBERLESS ELASTIC FABRIC

Original Filed July 31, 1928 2 Sheets-Sheet 1

Fig. 1

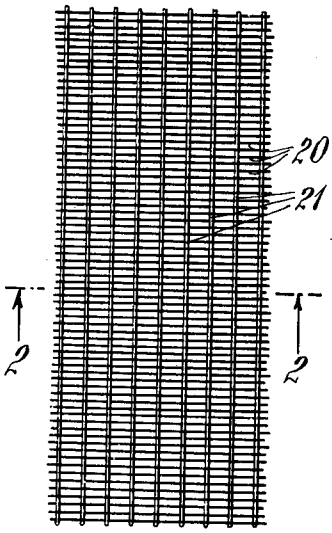


Fig. 2



Fig. 3

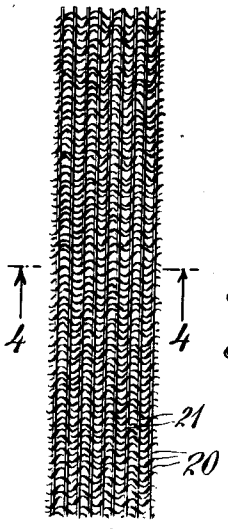


Fig. 4



Fig. 5

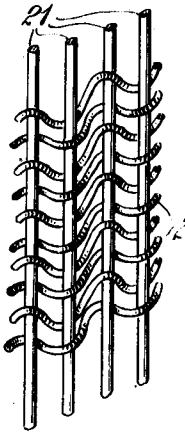


Fig. 6

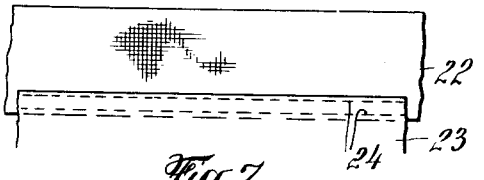


Fig. 7

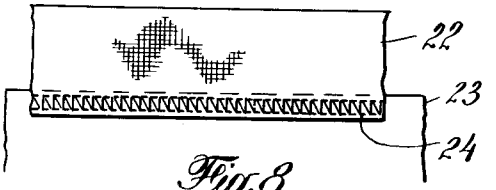


Fig. 8

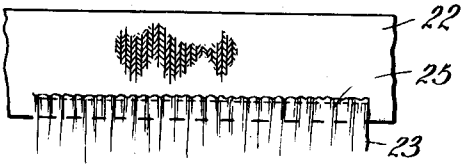


Fig. 9

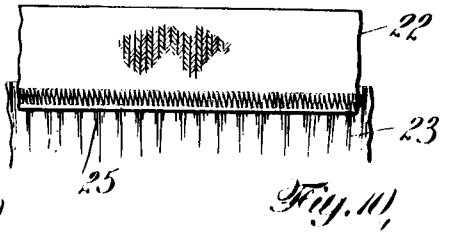


Fig. 11

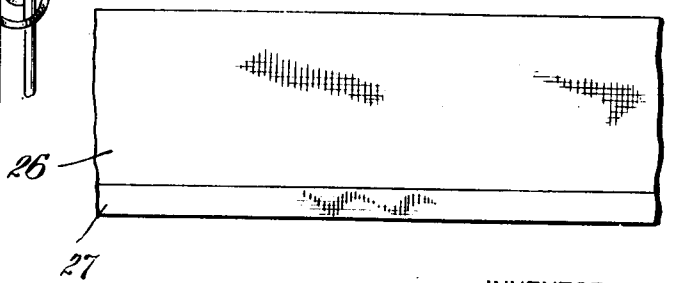
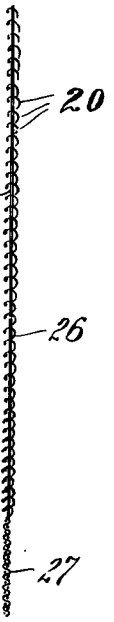


Fig. 14



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RUBBERLESS ELASTIC FABRIC

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Fig. 11,

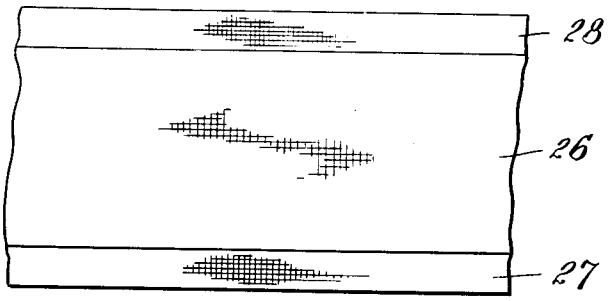


Fig. 12,

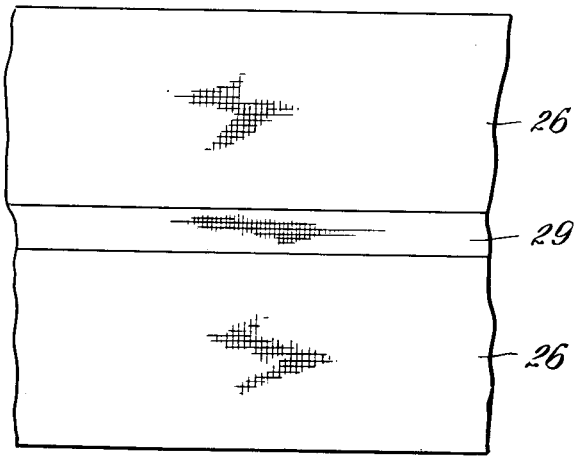


Fig. 13,

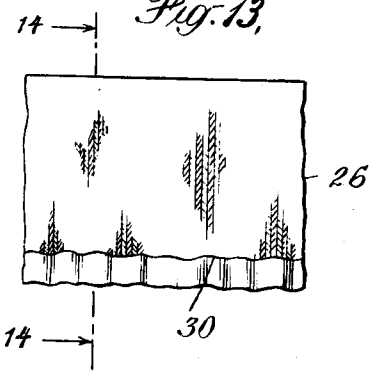


Fig. 15,

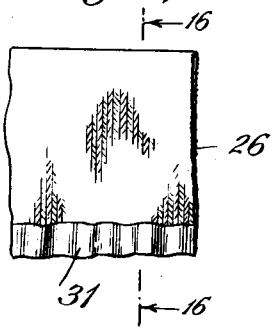
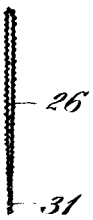


Fig. 16.



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1,823,034

UNITED STATES PATENT OFFICE

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RUBBERLESS ELASTIC FABRIC

Continuation of application Serial No. 296,481, filed July 31, 1928. This application filed November 1, 1930. Serial No. 492,782.

The present invention relates to elastic material which does not posses its elastic properties by virtue of having india rubber contained therein. More especially, our invention relates to an elastic fabric constructed of fibrous material that ordinarily is relatively inelastic, but which is rendered elastic by the particular arrangement of the material in the fabric, resulting from the particular process to which we subject the fibrous material. This application is a continuation of our co-pending prior application Serial No. 296,481 filed July 31, 1928.

Elastic fabrics made either wholly or in part of india rubber have a wide use in the manufacture of various articles, chiefly articles of apparel, such for example as waist bands, garters, arm bands, inserts in men's underwear, in certain kinds of shoes or house slippers, and the like. The employment of rubber in elastic materials for such uses has certain disadvantages, among which are a limitation of the useful life of the material because of the relatively rapid deterioration of the rubber, the liability of permanent injury to the rubber even when the articles are relatively new, by subjection to high temperatures, either inadvertently or during the cleansing or washing of the garments into which the rubber elastic material may be incorporated. Moreover, there are certain disadvantages in the manufacture of elastic fabrics in which rubber is employed, caused by the fact that a highly elastic material must be subjected to special treatment during the weaving, and other manufacturing operations, while such precautions need not be taken in weaving ordinary fabrics.

It is the primary object of our present invention to provide a rubberless material, and particularly a rubberless fabric which possesses sufficient elastic properties to enable its successful employment for many purposes in place of elastic material containing india rubber.

It is another object of our invention to provide a rubberless elastic material, the elastic properties of which tend to increase, or at least maintain, substantially their original effectiveness with use instead of deteriorating with use, as in the case of india rubber.

Another object of our invention is to provide a rubberless elastic material which possesses the property of potential elasticity, or in other words, a material in which the elastic properties thereof remain inert or latent until it is desired to develop them.

A further object of our invention is to provide a rubberless material which initially possesses substantially non-elastic properties, but which is capable of assuming elastic properties to a substantial degree when subjected to suitable treatment.

Our invention will be better understood by referring to the accompanying drawings, which by way of example illustrate several embodiments of the invention, and to the further detailed description of the invention in connection with these drawings. Referring to these drawings:

Figure 1 is an enlarged plan view of a short length of our improved fabric before the impartation of the elastic properties thereto;

Fig. 2 is a longitudinal section taken on line 2—2 of Fig. 1;

Fig. 3 is a plan view of the fabric illustrated in Fig. 1 after the impartation of the elastic properties thereto;

Fig. 4 is a longitudinal section taken on line 4—4 of Fig. 3;

Fig. 5 is a view of a small section of the fabric illustrated in Fig. 3 greatly magnified and shown in perspective.

Figs. 6 to 9 inclusive are a series of views illustrating the ease with which our improved fabric may be associated with a garment, or other article.

Figs. 10 to 12 inclusive are views illustrating a modified form of our improved elastic fabric;

Fig. 13 is a view of the section of fabric shown in Fig. 10 after the development of the elastic properties therein;

Fig. 14 is a conventional or diagrammatic sectional view taken on line 14—14 of Fig. 13;

Fig. 15 is a further modification showing a section of fabric made in flattened tubular form; and

Fig. 16 is a section taken on line 16—16 of Fig. 15.

In carrying out our invention, we first select a thread of the right size to produce the desired texture in the finished fabric. Thus we may use a 24/2 ply thread or yarn, which means that the thread consists of 2 plies, each having a yarn count of 24. The number of plies is relatively unimportant, however, since single ply yarn, or yarn having any number of plies may be used.

This yarn is given an extremely tight twist, far in excess of the ordinary twist given to yarn which is intended to be woven into ordinary fabrics. The retractile force of the finished elastic fabric is dependent to a large extent on the amount of twist imparted to the yarn, and we therefore raise the twist to the utmost practicable limit without destroying the yarn in the course of manufacture. As an indication of the amount of twist which we employ, with a 24/2 ply yarn, we use from 40 to 50 turns per inch length of completely twisted yarn.

The number of turns per inch, however, depends upon the yarn count, and is equivalent to the square root of the yarn count multiplied by a constant which depends on the character of the material. Thus the finer the yarn, the greater the number of turns per inch that can be given thereto.

After the twisting is completed, the yarn is then conditioned before weaving it into the fabric. In conditioning the yarn, we place the yarn under tension and then moisten it while it is subjected to the tension, and then dry it while still maintaining the tension upon it. In imparting the twist to the yarn it is necessary to maintain the yarn under a certain tension, which increases with the degree of twist. If this tension is removed after the twisting of the thread, the thread will be found to possess a certain degree of elasticity, but the amount of contraction in length, and retractile force is not sufficient for the purposes for which the fabric of our invention is to be employed.

The conditioning of the yarn above explained causes a setting of the fibers in their twisted condition, and when the tension is removed from the yarn after the moistening and drying operations, the tightly twisted yarn will be found to remain substantially straight and to retain substantially all of the twist which has been given to it.

Under actual production conditions the thread is passed through a twisting machine, and as the desired amount of twist is imparted to the thread, it is wound upon bobbins. This winding of the yarn on the bobbins subjects the yarn to sufficient tension for the conditioning. This conditioning is then carried on by moistening the yarn while wound on these bobbins, and this moistening is effected preferably by subjecting the bobbins to a steam bath so as to effect a steaming of the yarn.

In the steaming operation the application of moisture to all of the fibers of the yarn is the important consideration, and this can most quickly and thoroughly be done by means of water vapor at a moderately warm temperature. A high temperature is not necessary, and steam in the neighborhood of 212° F. is quite satisfactory. Steam at a lower temperature than this is also entirely sufficient.

The yarn is thoroughly dried while it still remains on the bobbins, and before it is transferred to the tubing upon which it may conveniently be stored or shipped. After the yarn is thoroughly dry it is ready for warping, and the yarn is easily placed in the warping frame because the steaming and drying of the yarn after twisting has the effect of neutralizing the tendency of the yarn to retract freely of itself, the fibers being set in their tightly twisted condition.

The fibrous material which we preferably employ for the production of our improved fabric is cotton, and it is desirable to use a good grade of the long staple variety. Other fibrous materials may be successfully employed, however, such for example as silk, wool and linen.

After the conditioning of the yarn is completed, it can be made up into fabric in various ways, or, if desired, may be used merely as thread or cord for certain purposes. This yarn or thread after conditioning possesses latent or potential elastic properties, the elastic properties of the material remaining inert or latent until developed by the immersion or moistening of the yarn or fabric with water and permitting the material to dry in a free state without the application of tension thereto.

In this way we are able to produce a potentially elastic thread and a potentially elastic fabric which remains inelastic until its elastic properties are developed by appropriate treatment at a subsequent time when it is desired to render the fabric elastic.

The potentially elastic thread after conditioning, may be woven into the fabric shown in Fig. 1 of the accompanying drawings wherein the warp threads 20 consist of the tightly twisted potentially elastic yarn. The weft or filler threads 21 are in this particular fabric made of yarn which is twisted only to the ordinary extent, and which therefore is relatively soft and can be easily compressed between the hard and tightly twisted threads 20 when the fabric is subjected to stretching.

The filler threads 21, because of the compressing action of the longitudinal threads 20 can be made relatively large in diameter so as to more completely fill the interstices of the fabric.

In the section shown in Fig. 2 it will be seen that the longitudinal or warp threads 20 are relatively straight even though they are tightly twisted and the section of fabric is in its free state and not under tension.

In Fig. 3 the section of fabric shown in Fig. 1 has been treated by immersion in water and then by drying, and the fabric has shrunk to approximately one-half its original length, and this treatment has resulted in the longitudinal threads 20 assuming a spiral or spring-like shape passing alternately above and below the weft threads 21. This arrangement of the threads is brought out perhaps most clearly in Fig. 4 where the weft threads 21 are shown substantially in a single plane, with the spiral shaped warp threads intertwined between them.

As shown in Fig. 3, the longitudinal or warp threads are twisted all in the same direction, that is, they are given a direct twist. However, if desired, alternate warp threads may be given a direct twist, and the intermediate threads a reverse twist. Or, if desired, a group of adjacent warp threads may be given a direct twist, and the next group given a reverse twist. Moreover, the weave of the fabric may be a plain weave, or a twill, or a satin weave, or any of their derivatives, in single, double, or multi-ply form.

Because of its latent elastic properties, our fabric lends itself conveniently to a great variety of uses wherein an inelastic material is preferred from the standpoint of facility and economy of manufacture. Thus, for example, our improved fabric, prior to developing the latent elastic properties therein, can be sewed or attached by any other suitable means to any flexible relatively inelastic material, such for example as knickers, trousers, pajama trousers and the like, to form the ankle band, leg band or waist band thereof, to blouses, shirtwaists, jackets and the like, to form the neckband or waistband thereof, and also to dustcaps, hats and bonnets, portières, draperies, lamp shades, chairs and couch covers, shoes, etc. Then after attachment to such other articles, the elastic properties are developed in the material by moistening and drying, and the frilled or shirred effect produced by the retraction of the fabric following the application of the moisture, is evenly distributed throughout the extent of the attachment.

If the attachment occurs at relatively short intervals, alternating with intermediate intervals of detachment, the shirred effect produced by the retraction of our improved fabric is a series of relatively small convolutions alternating with larger convolutions, and thus various combinations and designs of shirred effects may be produced.

Thus in Figs. 6 to 9 inclusive a section 22 of our improved rubberless elastic fabric is shown attached to a portion of some other garment 23 which is made of relatively inelastic material, such for example as a pair of knickers. This section 22, as it comes from the loom, and while the threads thereof are still straight and inelastic as indicated by the cross-hatching in Figs. 6 and 7, is stitched as indicated at 24 to the garment 23.

The outside of the garment is shown in Fig. 6, and the reverse side in Fig. 7. After the stitching is completed, the section 22 of the potentially elastic material is moistened with water and allowed to dry, and thereupon the longitudinal threads assume the spiral or helical form previously described, as indicated diagrammatically by the cross-hatching in Figs. 8 and 9.

In this way the elastic properties are developed in the fabric 22, and the fabric shrinks evenly throughout its length, and this produces a uniform shirring or gathering, as indicated at 25. Fig. 8 shows the appearance of the material on the outside and Fig. 9 its appearance on the reverse side.

The elastic properties of our improved garment are susceptible to constant recuperation as the result of repeated washing of the material in water. The retention of the elasticity, however, is not dependent upon such repeated washing. The washing or laundering of a garment containing our improved elastic material has therefore no objectionable effect other than the ordinary wear produced by laundering, and, on the other hand, the elastic properties of the garment are improved thereby. If the garment is worn where the elastic fabric is subjected to the influence of the moisture from the body, there is a continuous renewal of the elastic properties of the material.

The fabric may consist entirely of material possessing potential elastic properties, or it may be made in part of such material and in part of material that does not possess these properties, that is to say, a composite fabric may be made if desired, a portion of which possesses latent elasticity, and a portion of which is ordinary inelastic fabric.

The potentially elastic portion of such composite fabric may extend along any given line longitudinally of the fabric, and may spread laterally over any desired portion of the width of the fabric. In Figs. 10 to 12 inclusive several modifications of fabric of this kind are illustrated. In each of these figures numeral 26 indicates the portion of the total width of the fabric which is made of potentially elastic material.

In Fig. 10 the lower marginal portion 27 is woven as an ordinary fabric which does not possess elastic properties. In Fig. 11 a similar marginal portion 27 extends along the lower edge of the fabric, and a similar marginal portion 28 extends along the upper edge, while in Fig. 12 there is a single insert 29 of non-elastic material placed intermedi-

ate the portions 26 of potentially elastic material.

The relative widths of the potentially elastic, and non-elastic portions may be varied as desired to suit the particular use to which the fabric is to be put. Moreover the fabric shown in Fig. 12 may, if found desirable, be increased in width, repeating the alternate stripes of potentially elastic, and non-elastic material so as to make a fabric having a plurality of stripes of non-elastic material, as well as a plurality of stripes of potentially elastic material.

Referring now to Fig. 13, there is here shown a strip of fabric of the same original woven length as that of Fig. 10, but in which the elastic properties have been developed in the latent elastic portion 26. This figure illustrates the shirring or gathering effect which is produced in the non-elastic portion 27 when the shrinking takes place. The contrast between the loose character of the weave of the elastic portion 26 and the tightly woven inelastic portion 27 is brought out in Fig. 14. It is to be understood, however, that this figure is a diagrammatic or conventional representation of the threads of the fabric, inasmuch as the actual arrangement of the threads can be seen in Figs. 1, 3 and 5.

The advantages of the modified forms of our improved fabric as illustrated in Figs. 10 to 12 inclusive are that the portions 27, 28 and 29 respectively of the non-elastic material afford means for attaching the fabric with great rigidity to any desired portion of a garment which is made of relatively inelastic material. For example, when stitching the improved fabric as shown in Figs. 6 to 9 inclusive to a relatively inelastic material, it is desirable to set the sewing machine so that it will form a comparatively loose stitch for the purpose of permitting the shirring or gathering, such as is indicated at 25 in Figs. 8 and 9, to be formed evenly when the elastic properties are developed and the accompanying shrinking takes place in the elastic portion of the fabric.

For some purposes this loose stitching may be undesirable, and by using the modified form of our improved fabric shown in Figs. 10 to 12 inclusive, this loose stitching is avoided, because the non-elastic margins or inserts 27, 28 and 29, can be sewed as tightly as desired to the portion of the garment to which they are attached. The shirring then takes place along the border line 30 (Fig. 13) between the elastic and non-elastic portions.

Our improved fabric may conveniently be made in tubular form, and when so made, has certain advantages over the flat form for certain uses. In employing the fabric as a waistband or belt, for example, it is necessary that a predetermined amount of retractile force, or force of restitution be provided for. This may be done with a single thickness provided the individual threads of the fabric are sufficiently coarse.

It is preferable, however, to weave the fabric of relatively fine yarn, and utilize two or more thicknesses of the fabric to increase the retractile force to the required amount. The tubular form is neat and attractive in appearance, provides a double thickness of elastic material, is readily and cheaply woven, and is easily applied to various kinds of garments as a waistband or belt. Moreover, it possesses the desired amount of retractile force even when woven of relatively fine thread.

The tubular form may be woven either as a plain tube, or with a marginal portion or insert 31 of non-elastic material, as shown in Figs. 15 and 16. It is particularly easy to weave an exceptionally strong non-elastic portion 31 into the tubular form, since it is only necessary to interweave the two sides of the flattened tube to form the non-elastic portion.

It is preferable, for reasons of economy, that the warp threads so interwoven shall possess only the ordinary amount of twist. This is not necessary, however, because even if these threads possess potentially elastic properties, these properties are not developed in the margin by moistening and drying inasmuch as the threads in this margin are not in their free state, but are so tightly and closely interwoven that the assumption of the spiral or spring-like form is prevented.

This is caused by the fact that the density of the threads in the margin is increased to a sufficient extent to prevent this change. The density of the warp threads is automatically doubled by the interweaving of the two sides of the flattened tube, and the spacing of the warp threads is intentionally increased to the desired extent.

Any of the modified forms of our improved fabric illustrated in Figs. 10 to 12 inclusive may conveniently be woven in the tubular form.

Our improved fabric may be woven on a narrow loom or a broad loom or upon any other loom on which other textile fabrics are commonly woven.

Moreover, if desired, the improved fabric of our invention may be so woven that it possesses latent elasticity in the lateral, instead of the longitudinal direction, by implanting in the weft yarn, but not the warp yarn the potential elastic properties, as hereinabove described.

Our improved fabric may also be woven so as to have latent elasticity both laterally and longitudinally by imparting the potential elastic properties to both the weft and warp yarns.

A very large number of different combinations of areas of potentially elastic, and non-elastic material may be arranged in one

fabric, if desired. Thus our improved fabric may be so woven that its latent elasticity exists laterally or longitudinally, or laterally and longitudinally, in squares, rectangles, circles, ovals, and other geometrical figures in alternating sequence with each other or with areas of inelastic material. By this means, when the elastic properties of the potentially elastic areas are developed, the form of the fabric is permanently changed from a perfectly flat sheet to a sheet having a more or less complex shape to suit the particular purpose for which the fabric is desired to be used.

Furthermore, the weaving of our improved fabric may be done in straight, curvilinear, or spiralinear form, or in any desired combination of these.

The word "unsized" is used in the appended claims to describe the thread or fabric of the present invention which is set in its potentially elastic condition without the addition of a size or adhesive.

We claim:

1. As a new article of manufacture, an unsized substantially inelastic but potentially elastic woven fabric having warp and weft groups of threads, the threads of one of said groups being twisted beyond their kinking points but being unkinky and having the fibers thereof set in said condition.

2. As a new article of manufacture, an unsized substantially inelastic but potentially elastic woven fabric having warp and weft groups of threads, the threads of one of said groups being loosely twisted, and the threads of said other group being twisted beyond their kinking points but being unkinky and having the fibers thereof set in said condition.

3. As a new article of manufacture, a flattened tubular woven fabric having warp and weft threads of fibrous material, the weft threads in each side of the flattened tube being substantially straight, and the warp threads being of helical spring form with the flights of the helices looping the weft threads and rendering the material elastic and the two sides of the tubular fabric being interwoven along a margin of the flattened tube sufficiently tightly to prevent the weft threads from assuming spring-like form, and providing a non-elastic marginal portion which is normally in shirred condition and has a length equal to the stretched length of the elastic portion of the flattened tubular fabric.

4. As a new article of manufacture, an unsized substantially inelastic but potentially elastic thread of fibrous material, said thread being twisted beyond its kinking point and of itself capable of remaining unkinky and set in such condition when left alone without the aid of any outside agency.

5. The method of making elastic thread which comprises twisting a thread of relatively inelastic fibrous material beyond its kinking point, subjecting the thread to tension sufficient to maintain the same in an unkinky condition, moistening the thread while under such tension, drying the thread while maintaining said tension, relieving the tension, the thread still being substantially inelastic, and subsequently permitting the thread to kink and become elastic by moistening and drying the same while in its free state.

6. The method of making an elastic thread which comprises twisting a thread of relatively inelastic fibrous material beyond its kinking point, subjecting the thread to tension sufficient to maintain the same in unkinky condition, subjecting the thread to the action of steam while under such tension, drying the thread while maintaining said tension, relieving the tension, the thread still being substantially inelastic, and subsequently permitting the thread to kink and become elastic by moistening and drying the same while in its free state.

7. The method of making an elastic thread which comprises twisting a thread of relatively inelastic fibrous material beyond its kinking point, subjecting the thread to tension sufficient to maintain the same in an unkinky condition, winding the thread while under such tension upon a bobbin, moistening and drying the thread while it remains upon the bobbin under tension, unwinding the thread from the bobbin and relieving the tension, the thread still being substantially inelastic, and subsequently permitting the thread to kink, and become elastic by moistening and drying the same while in its free state.

8. The method of making an elastic thread which comprises twisting a thread of relatively inelastic fibrous material beyond its kinking point, subjecting the thread to tension sufficient to maintain the same in an unkinky condition, winding the thread upon a bobbin while under said tension, subjecting the thread while upon the bobbin to the action of steam, drying the thread while maintaining said tension, unwinding the thread from said bobbin and relieving the tension, the thread still being substantially inelastic, and subsequently permitting the thread to kink and become elastic by moisteneng and drying the same while in its free state.

9. The method of making an elastic fabric which comprises twisting a thread of relatively inelastic fibrous material beyond its kinking point, subjecting the thread to tension sufficient to maintain the same in an unkinky condition, moistening the thread while under such tension, drying the thread while maintaining said tension, relieving the tension, the thread still being substantially inelastic, weaving said thread into a fabric,

and subsequently moistening and drying the fabric while in its free state to permit the thread to kink and become elastic.

10. The method of making an elastic fabric which comprises twisting a thread of relatively inelastic fibrous material beyond its kinking point, subjecting the thread to tension sufficient to maintain the same in an unkinky condition, subjecting the thread to the action of steam while under such tension, drying the thread while maintaining said tension, relieving the tension, the thread still being substantially inelastic, weaving said thread into a fabric, and subsequently moistening and drying the fabric while in its free state to permit the thread to kink and become elastic.

11. The method of making an elastic fabric which comprises twisting a thread of relatively inelastic fibrous material beyond its kinking point, subjecting the thread to tension sufficient to maintain the same in an unkinky condition, winding the thread on a bobbin while under such tension, subjecting the thread to a steaming and drying operation while under tension on the bobbin, unwinding the thread from said bobbin and relieving the tension, said thread still being substantially inelastic, weaving the thread into a fabric, and subsequently moistening and drying the fabric while in its free state to permit the thread to kink and become elastic.

12. The steps in the method of making an elastic fabric which comprise twisting a thread of relatively inelastic fibrous material beyond its kinking point, subjecting the thread to tension sufficient to maintain the same in an unkinky condition, moistening the thread while under such tension, and drying the thread while maintaining said tension.

13. The steps in the method of making an elastic fabric which comprise twisting a thread of relatively inelastic fibrous material beyond its kinking point, subjecting the thread to tension sufficient to maintain the same in an unkinky condition, winding the thread upon a bobbin while under such tension, and moistening and drying the thread while it remains upon said bobbin under tension.

In testimony whereof we affix our signatures.

HAROLD P. DWORSKY.
OSCAR S. LAWTON.