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KNIT ARTICLE AND METHOD OF MAKING THE SAME.

APPLICATION FILED NOV. 1, 1919.

1,358,799.

Patented Nov. 16, 1920.

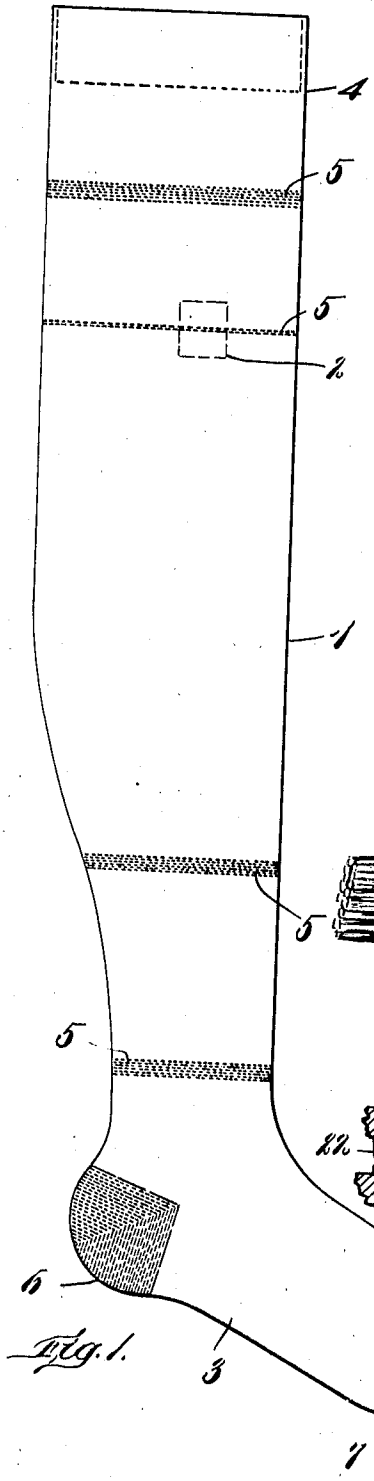


Fig. 1.

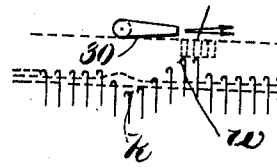


Fig. 6.

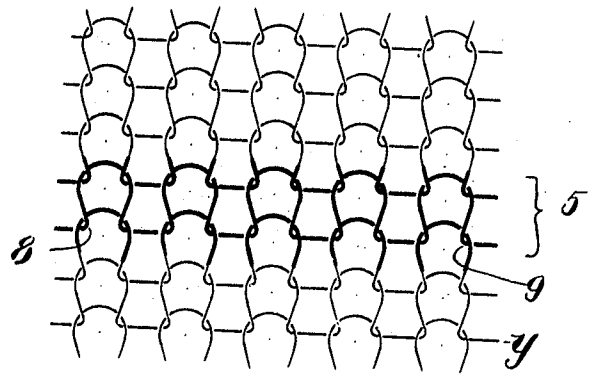


Fig. 2.

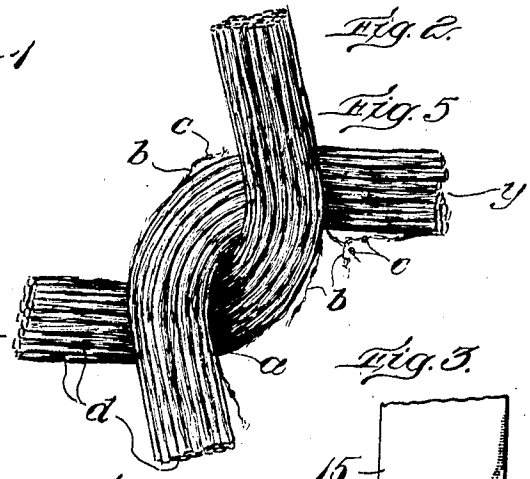


Fig. 5

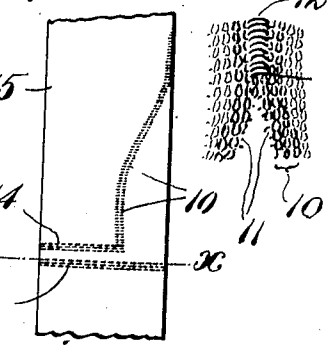


Fig. 3.

Fig. 4.

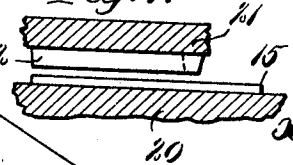


Fig. 7.

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UNITED STATES PATENT OFFICE.

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KNIT ARTICLE AND METHOD OF MAKING THE SAME.

1,358,799. Specification of Letters Patent. Patented Nov. 16, 1920.

Application filed November 1, 1919. Serial No. 335,035.

To all whom it may concern:

Be it known that I, FRANCIS W. TULLY, a citizen of the United States, and resident of Brookline, in the county of Norfolk and State of Massachusetts, have invented new and useful Improvements in Knit Articles and Methods of Making the Same, of which the following is a specification.

This invention relates to knit articles, such as stockings, gloves, underwear or other apparel made of knit web, and to a mode of treatment of such articles or the fabric of which they are made for increasing their durability and facilitating their manufacture.

Ordinary structures of knit fabric can not be cut or severed without exposing the fabric to raveling. This is particularly noticeable in the plain or one-faced fabrics which are most commonly employed for stockings and other apparel. When such fabric is exposed unbound at one edge in the direction of its courses, or the component thread of the knit web is severed anywhere within its edges, "ladders" or "runs" of dropped stitches can not be prevented from starting at the edge or rupture, or from progress so far as there is enough lateral or longitudinal strain on the fabric to pull the unlocked loops successively out of the loops in the next course, for course after course. Such ladders or runs seriously damage the article and can not be repaired satisfactorily. When made during manufacture, they spoil the article for sale, and when occurring in use by the wearer, unless noticed in time and stopped by darning, they ruin the garment for any further use. Similar difficulties attend the cutting of edges and sewing of seams diagonally or longitudinally of such knit webs. Raveling at longitudinal cut edges is difficult to prevent, the structure of the web permitting the cut ends of the yarns to be pulled through the loops with which they are engaged. Sewing without tightly binding a wide edge section of the fabric in a fold or roll is impracticable. The unsewed cut edge is extremely unstable, so that cutting and sewing must be performed together, and then result in a seam so bulky and unsightly as usually to make cut and sewed garments undesirable merchandise.

So far as I am aware, no remedies for lateral raveling of cut edges have been provided. Sewed knit articles have heretofore comprised either a web knit of a relatively unraveling texture, or have been made of selvaged rather than cut blanks. The running of ladders has been sought to be remedied only by changes in the structural texture of the knit web adaptable to practice only by the manufacturer of the stocking or other article; or the proposed remedies have comprised such additions to the knit web as sewed lines made after making the web, which are detrimental to its appearance and damaging to the product as an article of trade. The liability to run into ladders is particularly great in the case of thin, fine and relatively expensive fabrics, such as stockings, gloves or underwear knit of lisle, mercerized cotton, artificial silk or silk.

I have determined by experiment that the quality of the knit web exposing it to damage of the sorts mentioned resides in the flexibility and surface smoothness of the yarns, qualities which enable the end loops of courses at a cut edge or all of the loops of a wale of the fabric [when once unlocked by releasing one of the loops or an end of the component yarn] to be progressively extinguished by stretching the yarn into a straight line at each needle loop in turn. This behavior of the structure I have found to be either wholly avoided or made so difficult as in practice to amount to prevention, when the individual loops are so reinforced, strengthened or treated as strongly to retain their shape, or to cling to the other loops with which they are engaged, or both, so as to prevent endwise stress on the yarn of such loop from straightening out the loop when released from another loop or end normally penetrating and locking it.

A prime object of this invention is to provide a knit web resistant to rupture, raveling or puncture; to provide for the local treatment of the web and of the yarn composing the knit web in such a manner as to prolong endurance to wear, and both to decrease the flexibility of the individual loops, and to increase the strength and the clinging, frictional or tractive effect of one yarn where interlooped with another, and thus to provide areas or lines in the fabric at or standing across the places where raveling, ladders or runs are most liable to occur, and which will stop the further propagation of the defect. Other objects are to provide for treating the fabrics during or after manu-

facture or finishing in such a manner as to enable knit articles without the improved features to be provided with the improved features with little effort and cost, and without necessitating a refinishing operation.

Another object is to provide an article of the class mentioned characterized by areas resistant to raveling and to breakage or puncture, and not substantially different in texture from the remainder of the article, and not requiring any change from the ordinary structure of the knit web in the disposition and interengagements of the yarn or yarns composing this web.

In the accompanying drawings,—

Figure 1 is a side elevation of a stocking illustrating one instance of an article characteristic of the invention;

Fig. 2 is an enlarged diagram of the area 2, Fig. 1;

Fig. 3 illustrates an application of the invention to making a cut and sewed article;

Fig. 4 is a detail of the sewed edges;

Fig. 5 is a greatly enlarged view of the yarns at one of the improved areas in the completed article, showing one of the points of engagement with each other of two of the knit loops;

Fig. 6 is a diagram illustrating a method of making the structure as an incident to the knitting operation; and

Fig. 7 is a diagram illustrating one way of treating a complete article.

Referring now to Fig. 1, the stocking having a leg 1, a foot 3 of any usual type, and a welt 4 or other end finish, such as the rib top useful in a man's stocking, is provided at suitable intervals with stops or barriers 5, and with wear and puncture resisting heels 6 and toes 7, or both. These consist of a section of the fabric so treated as to increase the stiffness or resistance to bending of the yarns composing the knit web at these places, the yarns also being so arranged as to frictionally cling to each other at their points of crossing or engagement, such as at 8 or 9, with increased friction or clinging power. Referring to Figs. 3 and 4, such areas are shown arranged at 10 to protect cut edges until sewed and to strengthen the fabric at the sewed seam 12. Other areas 13 and 14 are shown to prevent longitudinal raveling on either side of a cut on line x, x, made across the folded tubular knit blank 14. Such a blank may be finished by sewing along the line 10, and by transfer to a footing machine of a course of loops between the line x, x, and the area 14; and finishing the top edge 13 as desired.

The improved areas of the fabric are made by applying to the yarn or to the knit web a colloid impregnating or saturating agent adapted to stick together the component fibers of the yarns in the knit web.

While many types of such agents are useful for the mentioned purpose, I prefer an impregnation having the properties of resistance to fusion under heat, such as the heat of ironing, resistance to solution in water, soapy or alkaline solutions such as employed for laundry work, and having colorless transparency when dry.

Such impregnating agent is preferably applied in the form of a solution in one of the particular ways hereinafter mentioned, and in one preferred form consists of a solution of cellulose acetate in acetone or other volatile solvent. One type of such solution may be made according to the following formula, the proportions being preferred but variable:

1. Dissolve 4½ grams cellulose acetate in 50 cc. of pure acetone;

2. Add to solution 1 a clarifier comprising 25 cc. each of pure methyl alcohol and pure benzol.

3. To the solution comprising ingredients 1 and 2 add a softener preferably consisting of about 2¼ grams of salol and 2¼ grams of triphenyl phosphate.

The purpose of the ingredients 2 above is to prevent the solution of cellulose acetate in acetone from drying in an opaque state, and the purpose of the third ingredient is to decrease the hardness and increase the flexibility of the film formed. The quantities and composition of this solution may be varied in accordance with the quantitative effect desired in these directions, and I am aware of many ingredients which may be substituted for those mentioned without departing from the result desired to be gained.

The application of such a solution to the fabric may be by any convenient expedient. A measured quantity for instance, may be sprayed through a stencil upon the fabric at the areas to be treated from the inside or back side of the fabric while the fabric is mounted upon a suitable stretcher or form maintaining its finished folded shape, or the solution may be applied by brushing; but, preferably, the folded tubular blank or article 15, see Fig. 7, lying upon a bed or platen 20 is impressed by a printing block 21 of wood, metal or rubber having surfaces 22 previously coated with an even film of the solution, and corresponding to the areas 5, 6, 7, 10, 13, 14, etc., to be treated, the applied liquid readily reaching both folds of the fabric when the block 21 is pressed upon it. The liquid has a considerable capillary affinity for the yarns, especially for silk, artificial silk and mercerized cotton, and upon application is instantly absorbed into the interstices between the fibers composing these yarns, but little remaining as a surface coating and in the crevices between contacts of adjacent yarns, as at a Fig. 5. Any filamentous projections from the yarn, as at b, gather globules c of the liquid, but

the greater part is found after treatment in the interstices *d* between the component fibers, which are well stuck together.

The treated article is allowed to dry in its original finished shape; drying is rapid without special heat or air-blast treatment. When dry, the loops at the parts treated are found to show the following qualities:

They are (1) elastically stiff, the horny dried pellicle or deposit of amorphous cellulose acetate interpenetrating the spaces of the yarn and binding its fibers together in a relatively solid resilient mass;

(2) the tractive or frictional power of yarn against yarn is greatly increased; while actual adhesion between the yarns at the loop crossings, as at *a* Fig. 5, either does not occur or readily breaks, it is now difficult to move one yarn past the other without first wholly separating them;

(3) the color of the fabric is substantially unchanged; the treated area is visible only as a region of relative stiffness, the fabric bending elsewhere with greater ease. This disappears when the fabric is stretched, as when worn.

(4) washing, or ironing heat, does not substantially affect these qualities.

Quality (2) above is in part attributed to the superior coefficient of friction of the cellulose, in part to the breakage roughness, where adhesions have occurred and parted; and in part to the interengagement of the beaded filaments *b*, *c*.

The treated parts of the fabric are partly protected against absorption of moisture and chemical change, and the treatment is recommended to be carried out after the final dyeing or bleaching operation to which the yarn or article is subjected.

The treated areas can be raveled by taking special pains, but as a protection against the propagation of ladders or the unintended raveling of cut edges, the treatment is highly effective. Seams sewed into cut edges so treated are of as great strength, although engaging the edge at but shallow depths, as those sewed by the prior practice of a deep engagement to include a roll of fabric in the seam; such seams are hence relatively thin and inconspicuous. When the heels and toes of spliced or unspliced stocking feet, or the tips of gloves, or other areas of maximum wear are so treated, comparative tests of wear show a very marked longevity of the improved fabric and resistance to puncture and fraying into holes. The treated areas are somewhat harsher to the touch, and much less absorbent of moisture, but are reported by users as comfortable to wear.

When the structure is employed as a ravel-stop at points in the leg, or at the heels and toes of stockings, and in other similar situations, it may be produced during the knitting operation, as shown in Fig. 6, by arranging a blast nozzle 30 to deliver a spray of the impregnating solution at the proper times upon the yarn *y* entering the needle wave *w* of the machine employed, so that the impregnating solution dries after the yarn has passed the knitting point K, and has been formed into the knit loops. When so applied the applying spray is blown from the nozzle 30 only at such times as yarn for the area to be treated is passing, as during knitting of one or more courses for one of the areas 5, or during making of the heel 6 and toe 7.

I claim:

1. The art of strengthening knit webs comprising supplying to and solidifying in the interstices of the yarn composing parts of the web a stiffening agent insoluble in water and substantially unchangeable under heat to which the web may be subjected without damage to the yarn of which the web is composed.

2. The art of strengthening knit webs comprising impregnating the yarn composing loops of parts only of the web with a colloid stiffening material.

3. The art of protecting knit webs against raveling comprising applying to the loops of local areas of the web an impregnating agent adapted to increase the power of frictional engagement of the yarns of the loops at their points of contact.

4. The art of protecting knit webs against damage in use comprising impregnating series of structural loops of parts of the web subject to ravel, wear or puncture with a colloid stiffening and friction-increasing agent.

5. The art of protecting knit webs against damage in use comprising impregnating series of structural loops of parts of the web subject to ravel, wear or puncture with a colorless, transparent colloid stiffening and friction-increasing agent.

6. The art of treating knit webs comprising applying to the component yarn or yarns of an area of the web a solution of cellulose acetate in a volatile menstruum, and then drying the web.

7. The art of treating knit webs comprising applying to the component yarn or yarns of an area of the web a quantity of a solution of cellulose acetate in a volatile menstruum sufficient to fill the capillary interstices of the yarn in said area, and then drying the web.

8. The art of improving articles made of knit web comprising applying to the finished web at areas subject to damage an impregnating agent adapted to stiffen the individual loops.

9. The art of increasing the resistance of knit articles to damage comprising impregnating the yarn of the knit loops at predetermined areas by capillary absorption into

the yarn loops of the finished article at said areas of a predetermined quantity of a liquid stiffening agent.

10. The art of improving articles made of knit web comprising applying to the web at areas subject to damage a liquid impregnating agent adapted to stiffen the individual loops, the steps including transfer of a film of the liquid agent from a suitable printing surface by pressure against and capillary absorption in the web.

11. A knit article having therein an area adapted to resist raveling characterized by adjacent yarn loops stiffened against straightening under tensile stresses.

12. A knit article having therein an area of web in which the knit loops are composed of yarn impregnated by an elastic and resilient solid.

13. A knit article having therein an area of web in which the knit loops are composed of yarn impregnated by a colorless, transparent and resilient solid.

14. A knit article having therein an area of web containing series of adjacent and substantially discrete loops each characterized by abnormal stiffness of its component yarn due to an elastic solid filling the capillary interstices of the component yarn at these parts of its extent.

15. A knit article having therein an area of the knit web rendered fast against propagation of ladders of drop stitches by the local stiffening of the structural loops of the fabric.

16. A knit article having therein a ravel stop area comprising an area of the structural web rendered fast against propagation of drop stitch ladders by stiffening with a solid elastic impregnating agent insoluble in water.

17. A knit article adapted to be laundried without damage having therein ravel-stop areas bearing an impregnation of a cellulose stiffening agent insoluble in water and substantially unchangeable under laundrying heats.

18. A knit stocking having therein areas disposed to deter the raveling of the fabric and comprising structural loops of the web of which the stocking is composed impregnated with a transparent colorless stiffening agent insoluble in water and unchageable by the moderate heat to which the fabric may be subjected during laundrying.

19. A knit article having deposited in predetermined areas of the knit web of which it is composed a solid resilient impregnating agent distributed in the capillary spaces of the yarn and serving to render the knit loops resistant to change of their form and to reeving freely one through the other, the interstices of the loops remaining open.

Signed by me at Boston, Massachusetts, this twenty-fifth day of October, 1919.

FRANCIS W. TULLY.