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L. J. PICARD

2,493,830

HOSIERY

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Fig. 1.

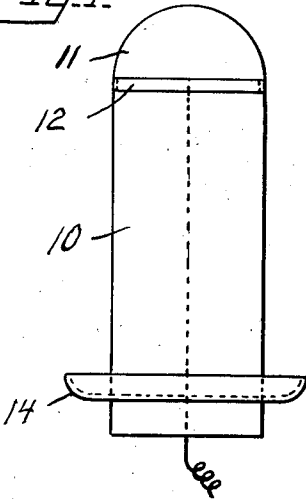


Fig. 2.

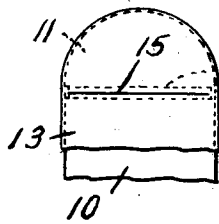


Fig. 3.

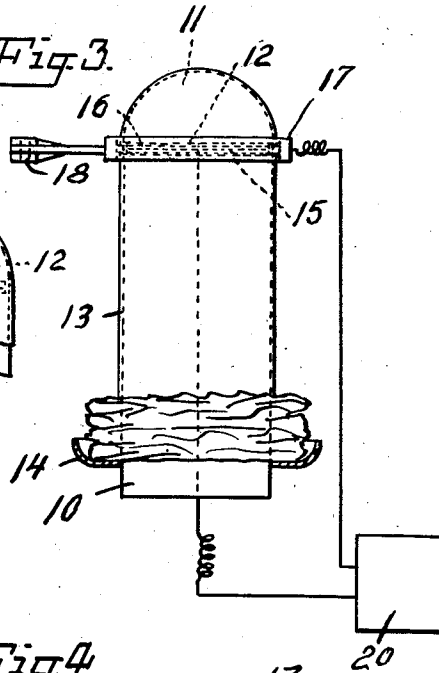


Fig. 5.

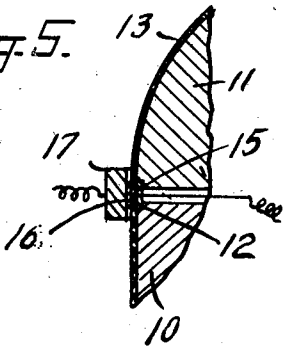


Fig. 4.

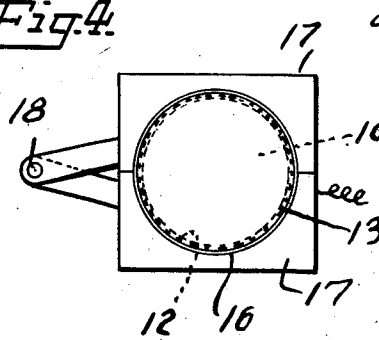


Fig. 6.

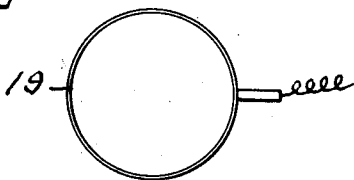
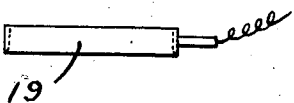


Fig. 7.



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HOSIERY

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3 Claims. (Cl. 28—73)

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This invention relates to hosiery, and has for its object the provision of certain improvements in hosiery manufacture.

Hose are customarily knit on one of two types of machines, flat or circular. When knit flat, the hose is known as full-fashioned or fully shaped. The hose comes off this machine flat, and is folded together and seamed down the back to form a tube. The toe and heel are then attached, leaving a small opening at the end of the toe or at the end of the heel, or at both ends, which is closed by a chain stitch in an operation known in the industry as looping.

Much the greater volume of hose is commercially fabricated on circular knitting machines. This machine customarily produces the entire hose, but leaves an opening between the toe and body portions. The opening is usually on top and extends over about half the circumference at the point where the toe joins the body portion. Approximate each edge of the opening, a loose course or open stitch is put in and knitting continued a short distance, say about one-quarter inch or more, beyond the loose course to leave a marginal portion for looping. An operator (looper) then manually folds together the two mating halves of the marginal portion beyond the loose course so that the open stitches of the two halves of the loose course are aligned. This is a painstaking and tedious operation, and one of the major problems of the hosiery mill is to secure enough loopers for the mill's machine capacity. With the marginal portion so folded, the operator places the hose on a looping machine in which a chain stitch through the mating loose course closes the opening and simultaneously clips off the excess marginal portions. With trained operators the looping operation takes about 45 seconds for each hose.

The present invention is especially adapted to close the toe opening left after fabrication of a hose on a circular knitting machine, but is equally applicable for closing any opening in a machine-fabricated hose, such for example as the aforementioned toe and heel openings in full-fashioned hose. In accordance with the invention, a thermoplastic bonding agent is associated with the juxtaposed and mating edges of the opening, and while so associated the agent is subjected to high frequency dielectric heating until it softens sufficiently to impregnate the adjacent and contacting portions of the hose and upon cooling forms a strong bond therebetween. The resulting finished hose is characterized by having the initial opening closed by the thermoplastic bonding agent.

The foregoing and other novel features of the invention will be best understood from the following description taken in conjunction with the accompanying drawing, in which

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Fig. 1 is an elevation of a hose-supporting mandrel suitable for the practice of the invention.

Fig. 2 is a detail elevation of the mandrel with a hose supported thereon.

Fig. 3 is an elevation of the mandrel and associated elements during the stage of high frequency dielectric heating.

Fig. 4 is a top plan of the equipment shown in Fig. 3.

Fig. 5 is a sectional elevation of a detail of the equipment shown in Fig. 3, and

Figs. 6 and 7 are plan and elevation, respectively, of a modified form of the movable electrode.

The hose supporting mandrel comprises a cylindrical body portion 10 topped by a hemi-spherical dome 11. An electrode 12, such as a flat metal ring, is provided at the junction of the body portion 10 and dome 11. The electrode may be about 1/4 inch wide and inlaid so that its outer face is flush with the outer adjacent surfaces of the body portion and dome. The electrode is electrically connected to one terminal of a source of high frequency electric energy (20 in Fig. 3) such as high frequency oscillator.

A hose 13, having the open toe characteristic of circular knitting, is pulled over the dome 11 with the greater length of the hose, especially in the case of women's hose, caught and held in a shelf or trough 14 surrounding the lower part of the body portion 10. The hose is knitted with no loose or open stitch and no marginal portion, but on the contrary knitting is terminated so that the toe and adjacent body portions of the hose have their desired completed shape when the mating edges of the opening are juxtaposed. In pulling the hose over the dome 11 and adjusting it for subsequent treatment, the mating edges of the opening are carefully juxtaposed as indicated by the line 15 in Figs. 2 and 5 showing those edges in exact abutting, juxtaposed position. The juxtaposed mating edges (15) of the toe opening overlay the electrode 12.

A band 16 of thermoplastic material is next placed over the juxtaposed mating edges of the toe opening. The band completely surrounds the hose on the mandrel and, of course, overlaps the juxtaposed mating edges of the toe opening. A movable electrode is then placed around the thermoplastic band 16. In Figs. 3 and 4, this electrode includes two semi-circular parts 17 connected by a hinge 18. The effective electrode surface is a metallic ring closely surrounding the band 16 when the two parts of the electrode are closed and locked together. In Figs. 6 and 7 the movable electrode is a metal ring 19, slightly tapered on the inside surface if desired, which can be slipped over the thermoplastic band 16. The movable electrode is elec-

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trically connected to the other terminal of a high frequency oscillator or other suitable source of high frequency electric energy, diagrammatically illustrated in Fig. 3 by numeral 20.

Fig. 5 diagrammatically illustrates the relative positions of the juxtaposed mating edges of the toe opening, thermoplastic band and electrodes at the start of dielectric heating. High frequency (say of the order of 200 megacycles) electric energy is supplied by the oscillator or the like 20 to the electrodes 12 and 17 (or 19). Where the thermoplastic material is Vinylite, whose softening temperature is around 150° F., and the band is approximately 0.03 cm. thick, 0.70 cm. wide and 19 cm. in circumference, a heating period of 10 to 12 seconds for one kilowatt of output is required. With nylon (whose melting temperature is about 480° F.) as the thermoplastic material, the required heating period for one kilowatt of output is about 28 seconds. With an oscillator of 2.5 kilowatt output, such as is now readily available, the dielectric heating contemplated by the invention can be carried out in from 5 to 15 seconds, although heating periods up to 30 seconds are not too long economically.

In the course of the high frequency dielectric heating, the thermoplastic material softens or melts and impregnates the portions of the hose adjacent the juxtaposed mating edges of the toe opening. Upon cooling, the plastic material forms a strong bond between the toe and body portions of the hose. Thus, the initial toe opening is closed by the thermoplastic bonding agent. The thermoplastic binder, in the form of the invention hereinbefore described, extends all around the hose at the junction of the toe and body portions, although it is only required, for bonding purposes, at the initial toe opening. Where it is undesired to have any thermoplastic binder on portions of the hose other than for closing the initial toe opening, a flat strip of thermoplastic material may be used in lieu of a band, and may be temporarily held over the juxtaposed mating edges of the toe opening by a film of adhesive or the like. It is also possible to use the thermoplastic material in other forms, such as a tacky powder or paste which can be applied by brushing, spraying or the like to the vicinity of the juxtaposed mating edges of the toe opening on the mandrel.

The invention is particularly applicable to nylon hose since the thermoplastic material may then be a band or strip of nylon, and in subsequent dyeing the thermoplastic binder will take the dyes in substantially the same manner as the knitted nylon thread. Where the thermoplastic binder is not the same as the material of the knitted hose, it may, after dyeing, be of a somewhat different shade than the knitted hose, but its relatively small area and its location at the toe of the hose generally makes any such difference in shade of no practical significance.

A wide variety of thermoplastic materials are suitable for the practice of the invention. The thermoplastic binder should be resilient and elastic and of sufficient strength to serve as an effective bonding agent. Its softening or melting temperature should be not less than about 150° F. and preferably somewhat higher in order to permit laundering of the hose in relatively hot water. On the other hand, for economic reasons, the softening or melting temperature of the thermoplastic material should not be too high, and I prefer materials with softening or melting temperatures under 500° F. In addition to Vinylite

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and nylon, other vinyl chloride and vinyl acetate polymers or co-polymers, styrene resins, urea-formaldehyde resins, phenolic resins and various other thermoplastic synthetic resins are obtainable with characteristics suitable for the purposes of the invention.

The invention is applicable to all types of machine-fabricated hose made, for example, of silk, nylon, cotton, rayon (including the regenerated cellulose, cellulose ester and similar varieties), wool etc. With cotton and rayon hose, the thermoplastic binder may advantageously be of a cellulosic base.

A suitable source of high or radio frequency electric energy is the Megatherm high frequency generator. While I have hereinbefore mentioned a high frequency of 200 megacycles, this is not necessary since the contemplated dielectric heating can be attained with any radio frequency power developed by an oscillator or by any other suitable means.

I claim:

1. The improvement in closing the open toe of a machine-fabricated hose which comprises placing the mating edges of the opening between the toe and the body portion of the hose in juxtaposed, flat-seaming position over a mandrel having one electrode of a high frequency dielectric heating apparatus, with the juxtaposed edges overlying said electrode, associating a thermoplastic bonding agent with the juxtaposed mating edges, placing a second electrode of the high frequency dielectric heating apparatus over the juxtaposed mating edges and the associated thermoplastic bonding agent, and causing a high frequency current to pass between said electrodes until the thermoplastic material softens and unites with the juxtaposed edges, whereby on cooling of the softened thermoplastic material the juxtaposed edges will be bonded together.

2. The improvement in closing the open toe of machine-fabricated hose which comprises placing the mating edges of the opening between the toe and the body portions of the hose substantially in abutting, juxtaposed position over a mandrel having one electrode of a high frequency dielectric heating apparatus, with the juxtaposed edges overlying said electrode, associating a thermoplastic bonding agent with the juxtaposed mating edges, placing a second electrode of the high frequency dielectric heating apparatus over the juxtaposed mating edges and the associated thermoplastic bonding agent, and causing a high frequency current to pass between said electrodes until the thermoplastic material softens and unites with the juxtaposed edges, whereby on cooling of the softened thermoplastic material the juxtaposed edges will be bonded together.

3. The improvement in closing the open toe of a circular knit nylon hose which comprises placing the mating edges of the opening between the toe and the body portions of the hose in juxtaposed, flat-seaming position over a mandrel having one electrode of a high frequency dielectric heating apparatus, with the juxtaposed edges overlying said electrode, associating a thermoplastic bonding agent with the juxtaposed mating edges, placing a second electrode of the high frequency dielectric heating apparatus over the juxtaposed mating edges and the associated thermoplastic bonding agent, and causing a high frequency current to pass between said electrodes until the thermoplastic material softens and impregnates the juxtaposed edges, whereby on cool-

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ing of the softened thermoplastic material the juxtaposed edges will be bonded together.

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