Sept. 25, 1962 A. BURLESON 3,055,198

KNITTING MACHINE WITH MEANS TO HEAT YARN ENROUTE TO THE NEEDLES

Original Filed July 31, 1957 2 Sheets-Sheet 1

FIG. 1.

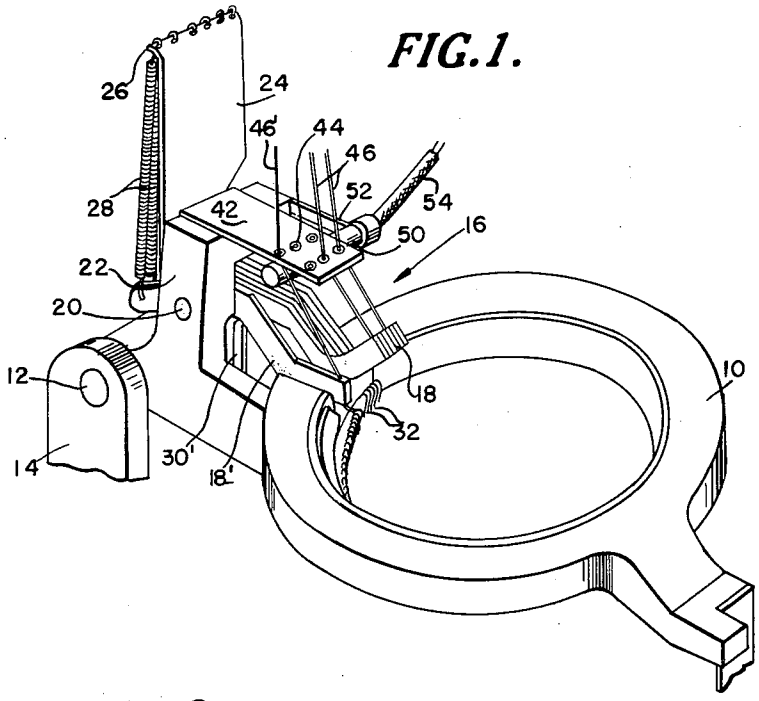
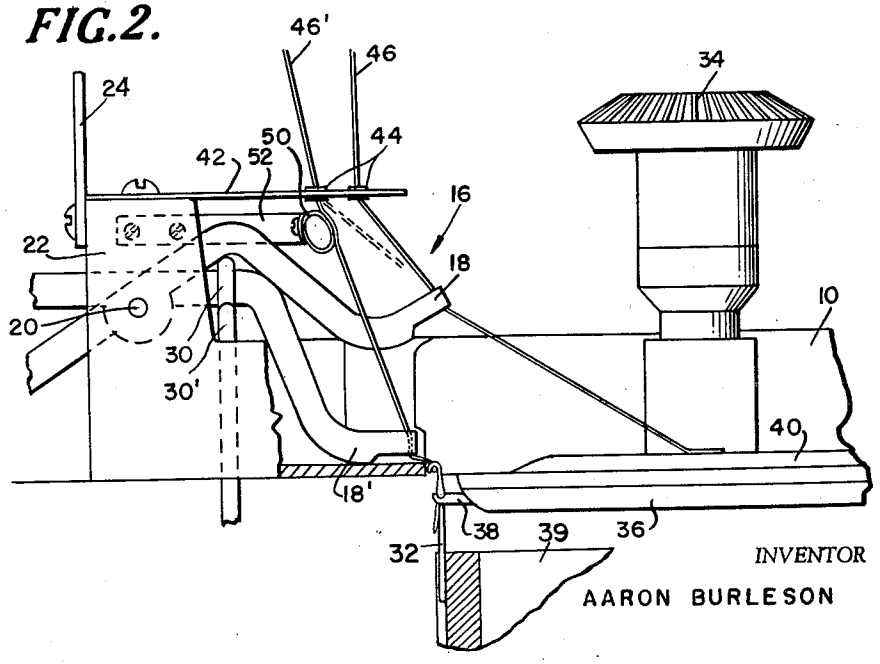


FIG. 2.



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FIG. 3.

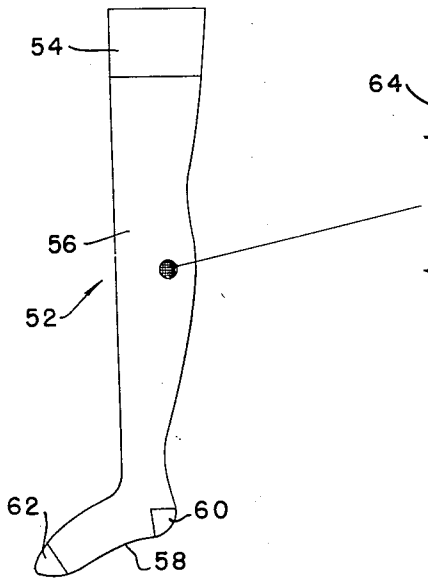
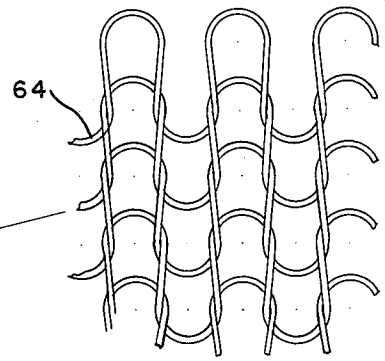


FIG. 4.



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KNITTING MACHINE WITH MEANS TO HEAT YARN EN ROUTE TO THE NEEDLES

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Original application July 31, 1957, Ser. No. 675,472. Divided and this application Mar. 9, 1960, Ser. No. 13,746
4 Claims. (Cl. 66—125)

This invention relates to knitting, and in particular to an improved method of knitting with thermoplastic yarns, such as nylon. The invention relates also to improvements in circular knitting machines, and to novel knitted fabrics manufactured thereby. This application is a division of my co-pending application Serial No. 675,472, filed July 31, 1957.

In the circular knitting of seamless hosiery, a constant number of needles is utilized throughout the welt, leg and foot. In order to shape the stockings to the contours of the leg, the stitch length is varied as the knitting proceeds. At the top of the stocking, as will be evident, the stitch is larger than in the ankle and foot areas. There are, however, limitations to the shaping of stockings by means of stitch length variation. If the cylinder of the knitting machine is adequate in diameter to make a welt of generous size, the ankle and foot areas of the stocking are prone to be too large, tightening of the stitch in these areas being insufficient to narrow them down to desired relative size. If a knitting machine of smaller cylinder diameter is utilized, to produce a stocking of acceptable fit in the angle and foot, the welt and knee areas of the stocking tend to be tight fitting. A compromise is usually effected, wherein the welt and knee areas are tighter than might be desired, and the ankle and foot areas looser. After knitting, seamless hosiery made of thermoplastic yarn can be further shaped by boarding, but the knee and welt areas still present a problem in that they have a tendency to be too tight.

One procedure hitherto utilized in overcoming this problem is to preshrink or preset the welt yarn before knitting, so that there can be but little or no welt shrinkage after the hose have been knit. As received from the manufacturer, nylon yarn usually has about 10 or 12% residual shrinkage, and the welt yarn may be relaxed or shrunk to this degree by special treatment prior to knitting. In further processing of the hose so knit, the leg and foot are shrunk but the welt is not, whereby a welt of greater relative size is achieved. Preshrinking of the welt yarn, however, increases its stiffness, and introduces other difficulties. It is difficult, for example, to knit preshrunk yarn so as to form loops properly in the knitting machine, the yarn tending to be too stiff and to not hold its shape as drawn by the needles and formed by the sinkers. In subsequent operations, stitches or loops that distort remain in this condition, causing distortion and "crows' feet" or "tracking" in the finished fabric. The use of preshrunk welt yarn also introduces the problems of uneven dyeing, non-uniformity of stretch between welts and stitch breakdown, all of which lower the quality of the stockings. While improved fit may be achieved in this manner, then, other manufacturing difficulties are introduced, and the quality of the goods is lowered.

It is a principal object of the present invention to provide an improved method of knitting with thermoplastic yarn, whereby uniform stitch formation is effected, and the knitting operation is facilitated. A particular object is the provision of a method of knitting seamless hosiery having improved shape and fit, and fabric clarity, particularly in the welts thereof. A related object is the provision of a method of knitting seamless hosiery utilizing

welt yarn directly from the pirn, without intermediate processing.

Another object of the invention is the provision of novel circular knitting machine structure, including yarn heating means in close proximity to the cylinder thereof.

Yet another object of the invention is the provision of knitted fabric comprising thermoplastic yarn relaxed and set in knitted shape during the knitting operation. A related object is the provision of a seamless stocking of improved shape and fit, and outstanding quality. Further objects will be in part evident, and in part pointed out hereinafter.

The invention and the novel features thereof may best be made clear from the following description and the accompanying drawing in which:

FIGURE 1 is a perspective view of the latch ring and knitting station elements of a conventional seamless hosiery circular knitting machine,

FIGURE 2 is a side elevational view of the mechanism of FIGURE 1, partially broken away for the sake of clarity,

FIGURE 3 is a side elevational view of a seamless stocking knit in accordance with the present invention, and

FIGURE 4 is an enlarged fragment of a representative portion of the body fabric of the stocking of FIGURE 3.

Referring to the drawings, FIGURE 1 illustrates a portion of a conventional seamless hosiery machine, which may be for example a 400-needle Model KN Scott & Williams machine. As shown, the latch ring **10** is pivotally mounted by means of pivot **12** between brackets **14** extending upwardly from the bed plate (not shown) of the machine, and encloses the knitting station indicated generally as **16**. At the knitting station, a plurality of yarn fingers **18** are provided, the yarn fingers being individually retractable, and functioning as interchangeable yarn feeds. The yarn fingers are pivotally mounted at **20** in the latch ring lug **22**. A bracket **24** extends upwardly from latch ring lug **22**, and from the outwardly turned bracket end **26** a tension spring **28** extends to the outer end of each yarn finger. On the opposite side of pivot **20**, each yarn finger is engaged from below by a thrust bar **30**, operative in conventional manner from the main drum of the machine.

The yarn fingers are normally maintained in up or inoperative position by their associated thrust bars, the springs **28** being thereby extended. Downward movement of any thrust bar, for example to the position **30'**, permits the engaged spring **28** to displace the associated feed finger **18** to active position, as shown at **18'** in FIGURE 2, whereby the feed finger is disposed in close proximity to the path of the knitting needles **32**. In FIGURE 2 is also illustrated the dial drive pinion **34**, adapted to drive the dial **36** and its transfer jacks **38** in synchronism with the rotary cylinder **39** of the machine, and the independent needles **32** carried thereby. The dial is surmounted by the usual dial cap **40**.

The customary yarn guide plate **42** is mounted on the latch ring lug **22**, and extends over the yarn fingers **18**. The yarn guide plate **42** is provided with a plurality of eyelets **44**, and yarns **46** extend through eyelets **44** and the drilled inner ends of the yarn fingers **18**. As shown in the drawing, yarns **46** extend to the inactive yarn fingers **18**, and the yarn **46'** extends to the finger **18'** in operative or knitting position. All machine elements described to this point are conventional.

In accordance with the present invention, a heating element **50** is disposed between the yarn guide plate **42** and the yarn fingers **18**, as by bracket **52** extending from the latch ring lug, and extends generally transversely of the yarn finger group. The heating element may be of any conventional type, but preferably is an electrical

heating element, supplied with current by the conductor **54**. The heating element is desirably constructed of metal and smooth surfaced, preferably being chrome plated.

Function and operation of the apparatus illustrated in the drawing will now be described, this illustrating also the method of the invention. At the beginning of the knitting operation, all yarns are inactive, and extend through their respective eyelets **44** and feed fingers **18** to the dial cap **40**, where they are clamped by the usual means, not shown. Upon the initiation of welt knitting the thrust rod **30'** is lowered by movement of the main drum of the machine, and the engaged yarn finger **18'** is thereby permitted to drop to active or operative position, as illustrated in the drawing, under the impetus of its spring **28**. The nylon welt yarn **46'** is thereby drawn between the hooks of the knitting needles **32** and taken in the hooks of the succeeding needles, and welt knitting proceeds.

In accordance with the present invention, the welt yarn **46'** in being moved from the inactive dotted line position shown in FIGURE 2, to the active position shown in solid lines therein, is brought into wiping contact with the heating element **50**. The heating element is maintained at a temperature of about 450° F., and is preferably thermostatically controlled. The heating element **50** may be of such size and shape that from three-fourths to one inch of the welt yarn in active position is in contact therewith. The traveling welt yarn is thereby heated to a temperature above about 220° F., to a temperature in the range of from about 220 to about 400° F.

The welt yarn may be nylon yarn as received from the manufacturer, having usually 10 or 12% residual shrinkage. The yarn in passing the heating element **50** and being heated to the temperature specified is softened and relaxed, and about one half the residual shrinkage is taken out in passage from the yarn guide plate **42** to the needles of the machine.

The softened and pliable yarn remains at elevated temperature while passing through the yarn finger **18'** and while engaged by the hooks of the needles **32**, and through the stitch formation. That is the yarn remains hot while stitches are formed therein by the needle hooks and sinkers, and then cools and sets in knitted shape. Cooling and setting of the yarn takes place, usually, after about one half revolution of the cylinder. The softened yarn facilitates uniform stitch formation, and the stitches so formed maintain their shape in further processing of the stocking, and resist distortion.

At the end of the welt, the thrust rod **30'** and the yarn finger **18'** are elevated into inoperative position, whereby the welt yarn **46'** is displaced to the dotted line position indicated in FIGURE 2, out of contact with the heating element. Substantially simultaneously, a body yarn **46** is dropped into the knitting, and knitting of the leg proceeds. As shown, the yarns **46**, which may be for example a body yarn used in the leg and foot of the stocking and a heel and toe yarn, may be threaded through eyelets **44** displaced outwardly from the heating element **50**, so that these yarns are not heated when active. In this manner, the method of invention may be confined to the welt of the stocking, with the attendant advantages of improved fit and high quality. As will be understood, the method of the invention may be utilized in other portions of the stockings as well, or in the entire stocking. As will be evident from the drawing, all yarns threaded through the row of eyelets immediately above the heating element will contact the heating element when active, and all yarns threaded through the row of eyelets disposed outwardly of the heating element will be unaffected thereby when active.

FIGURE 3 illustrates a conventional stocking indicated generally as **52**, including the usual welt **54**, leg **56**, foot **58**, heel **60** and toe **62**. FIGURE 4 represents the appearance of a body yarn **64** knit in accordance with the present invention, the loops thereof being characterized by uniformly excellent shape, whereby the fabric exhibits excellent clarity and general appearance, and freedom from distortion and "tracking".

In accordance with the procedure described, the heating element may remain at operative temperature at all times. In special circumstances, the heating element may be permitted to cool during portions of the knitting cycle, and may be heated during other portions only, some preliminary heat-up time being provided before yarn heating commences. Control of the heating element in this manner may be effected by a simple switch actuated by the main drum of the machine. It may be desirable, in some cases, to provide means for raising the active yarn off the heating element, in the event the machine stops for any reason. Such mechanism may be actuated, for example, by an inertia switch.

While heating of the yarn may be accomplished in simple fashion by the heating element described and illustrated, it will be evident that other heating devices may be employed as well. For example, the yarn may be heated by passage through a tube, or by radiant or induction heating. It is necessary only that the yarn be heated to proper temperature in close proximity to the yarn feed, or to the needles, so that it remains in softened condition while stitches are formed therein.

While the invention has been illustrated in connection with a circular hosiery knitting machine, it will be evident that it may be utilized in connection with other types of knitting machines. Similary, the invention may be utilized with thermoplastic yarns other than nylon.

It will thus be seen that there has been provided by this invention a machine in which the various objects hereinbefore set forth, together with many practical advantages are successfully achieved. As various possible embodiments may be made of the several features of the above invention, all without departing from the scope thereof, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawing is to be interpreted as illustrative, and not in a limiting sense.

I claim:

1. In a circular knitting machine, a rotary cylinder with independent needles, a yarn feed operative adjacent the path of said needles, and means for heating the yarn sufficiently to soften it, said yarn heating means being mounted adjacent the yarn path to said feed and in close proximity along said path to said yarn feed, whereby said yarn remains in softened condition during stitch formation.

2. In a circular knitting machine, a rotary cylinder with independent needles, a group of individually retractable interchangeable yarn feeds operative adjacent the path of said needles, and means for heating the yarn sufficiently to soften it, said yarn heating means being mounted adjacent the yarn path to said group and in close proximity along said path to said yarn feed group, whereby said yarn remains in softened condition during stitch formation.

3. In a circular knitting machine, a rotary cylinder with independent needles, a yarn feed finger retractable from operative position adjacent the path of said needles to inoperative position spaced therefrom, and a heating element for heating the yarn sufficiently to soften it, said heating element being mounted in close proximity to said feed finger, said heating element being disposed adjacent the yarn path to said feed finger when the latter is in operative position and in close proximity to said finger along said path, whereby said yarn remains in softened condition during stitch formation.

4. In a circular knitting machine a rotary cylinder with independent needles, a group of interchangeable yarn feed fingers individually retractable from operative

position adjacent the path of said needles to inoperative position spaced therefrom, a yarn guide plate overlying said feed fingers, and a heating element mounted between said guide plate and said feed fingers, said heating element being disposed adjacent the yarn path from said guide plate to at least one of said feed fingers in operative position.

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