United States Patent [19]

Jackson

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[54] **WARP KNITTED GARMENTS AND APPARATUS AND METHOD FOR MAKING THE SAME**

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[73] Assignee: **Union Carbide Corporation,** New York, N.Y.

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[21] Appl. No.: **117,925**

Related U.S. Application Data

[62] Division of Ser. No. 776,938, Nov. 19, 1968, Pat. No. 3,656,324.

[52] **U.S. Cl.** **66/87;** 66/177

[51] **Int. Cl.²** **D04B 23/02**

[58] **Field of Search** 66/177, 87, 175, 176

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Primary Examiner—Ronald Feldbaum
Attorney, Agent, or Firm—Pearson & Pearson

[57] **ABSTRACT**

A double needle bar, warp knitting machine, of the Raschel type, produces a continuous, two ply web formed of two superposed, warp knit, single fabrics, cross interlooped along successive course-wise extending strips, spaced apart wale-wise, to form a succession of open ended, course-wise extending tubes. Elastic yarns are laid in wale-wise of the tubes so that when the doubled web is severed into individual tubes and the tubes are turned through 90°, the elastic yarn runs circumferentially of the tube to form an elastic garment such as a girdle, panty brief, or the like. One end of each tube is open to form a waist opening, while the other end is discontinuously cross-interlooped in a walewise direction to form limb or neck openings in the tubular garment.

7 Claims, 15 Drawing Figures

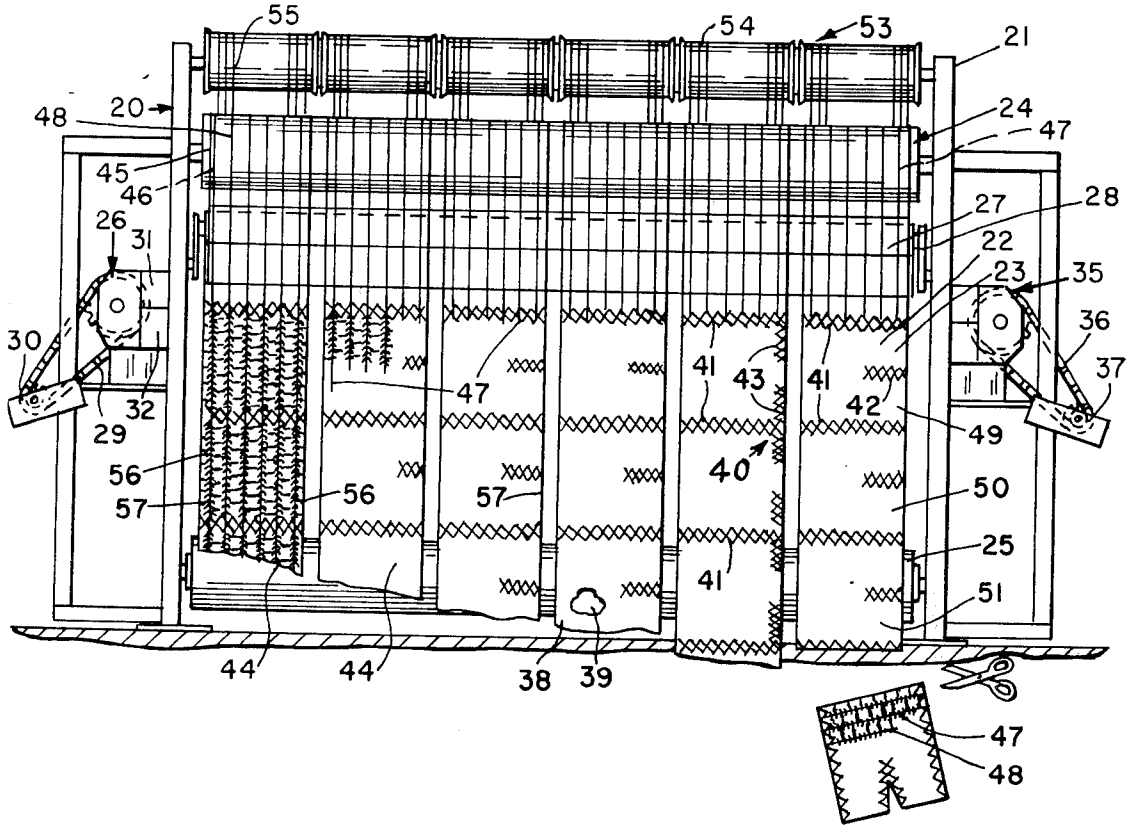


Fig. 1.

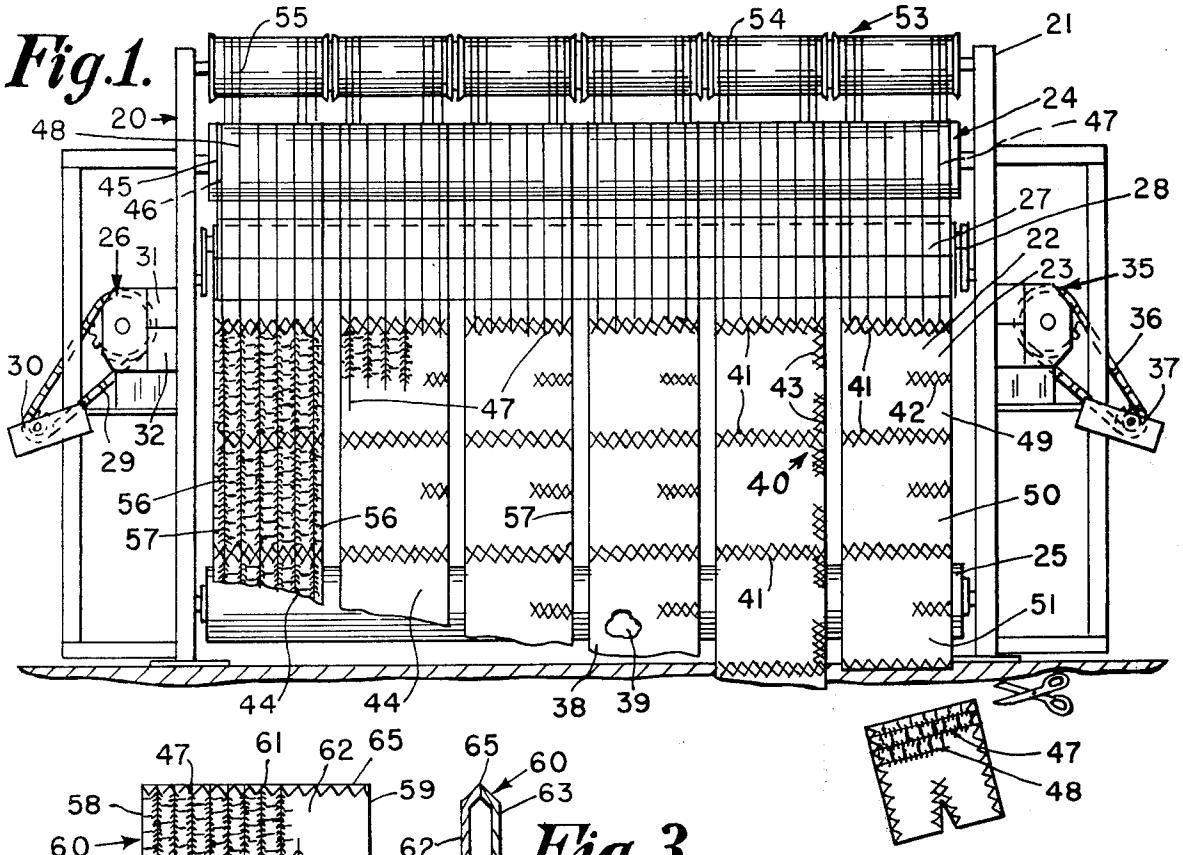
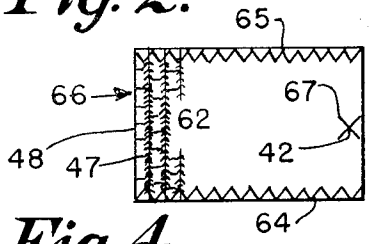


Fig. 3.

Fig. 2.



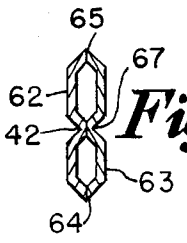


Fig. 5.

Fig. 4.

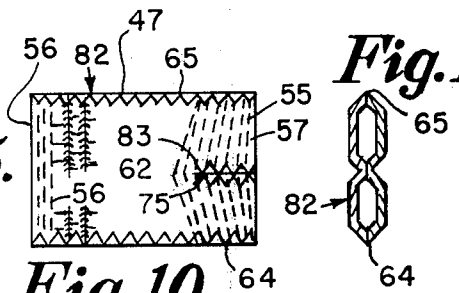


Fig. 11.

Fig. 10.

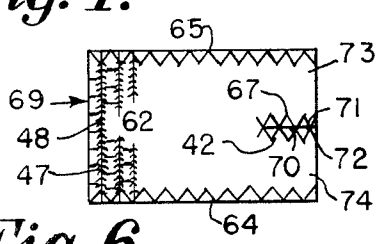




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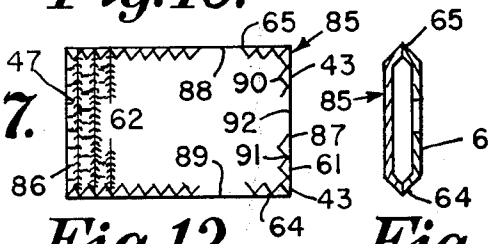
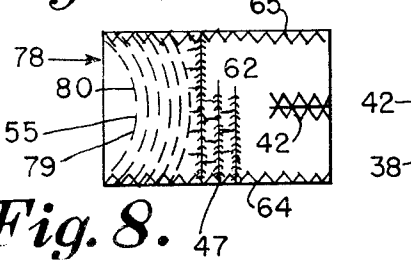


Fig. 6.

Fig. 12.

Fig. 13.



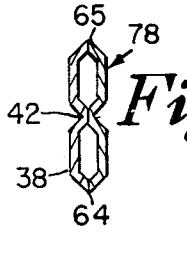


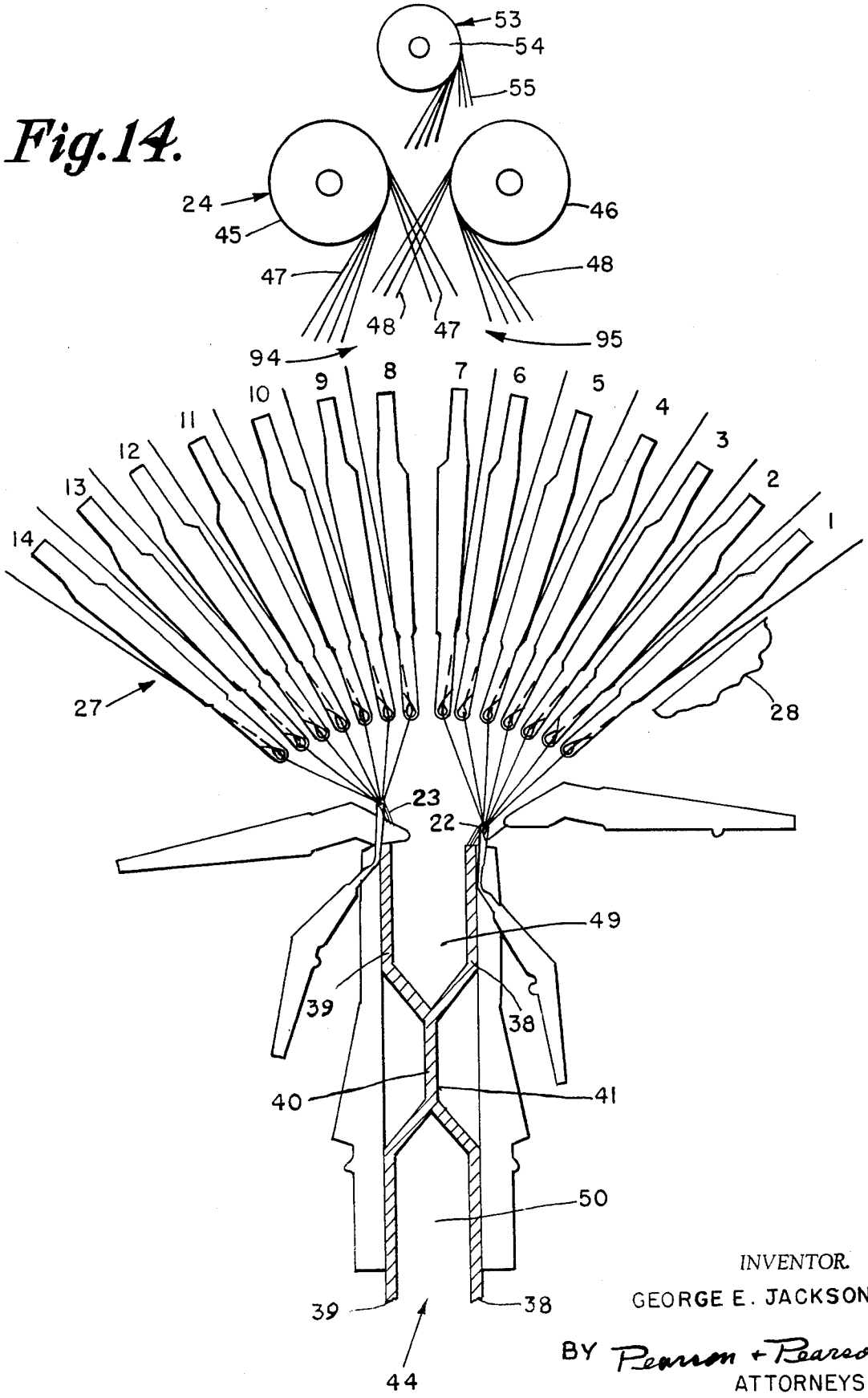
Fig. 8.

Fig. 9.

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Fig.14.



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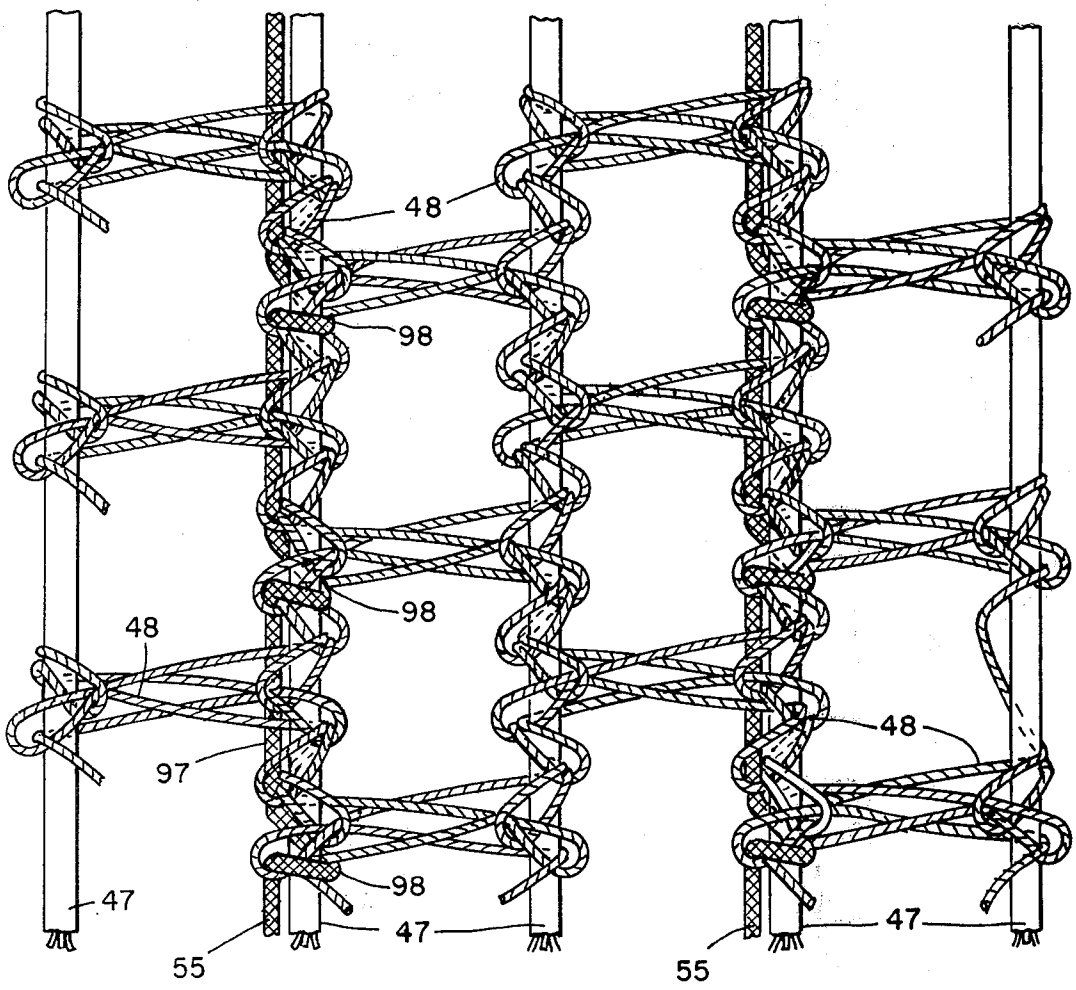


Fig. 15.

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WARP KNITTED GARMENTS AND APPARATUS AND METHOD FOR MAKING THE SAME

This application is a divisional of application Ser. No. 776,938 filed Nov. 19, 1968, now U.S. Pat. 3,656,324.

BACKGROUND OF THE INVENTION

It has long been known to make tubular, knitted garments, such as sheer, knitted, ladies stockings, fishnet stockings, sweaters, or other garments on conventional circular knitting machines. Flat bed knitting machines have also been used for this purpose, for example, on double V bed machines of the Burson type. Of late fishnet hosiery has been produced on an 8 guide bar, double needle bar, Raschel Knitting machine. Cocker Machine and Foundry Co. of Gastonia, North Carolina now manufactures a "Fashionmaster" double needle bar, 14 guide bar, Raschel knitting machine with a special shifting pattern drum. This pattern shifting device permits the principle of double fabric knitting to be employed in producing fishnet stockings and the like and also permits the joining of the fabrics at spaced intervals to form the crotch of fishnet panty hose. As in the conventional circular knitting machine, the tubular fishnet hose, or panty hose, so made, in accordance with present day machines and skills, on flat bed warp knit machines, has the tubes running warp-wise, or longitudinally, of the knitted web. If elastic yarns are laid in warp-wise to such power net, or fishnet, tubes, the elastic yarns are in parallelism with the axes of the tubes, and have longitudinal, but not the circumferential expansibility and retractability such as desired in girdles.

Thus in the present state of the art, those skilled therein have used the available multiple guide bar, double needle bar, Raschel machines, such as the Cocker-Fashionmaster, to produce back to back leotard blanks, with knitted-in crotch portions, and with the tubular leg portions running warp-wise in the conventional manner. No departure from such conventional practice has probably been considered possible, or desirable, for the reason that such blanks can be conventionally shaped by simply varying stitch quality over predetermined intervals to tighten or loosen the same with a variance in take down pressure, thereby tapering the leg portion and narrowing the waist portions. Reference is made to an article in Knitted Outerwear Times, of Apr. 29, 1968, Pages 46–49, in which then current knowledge and experiments in this field are discussed.

SUMMARY OF THE INVENTION

It is the basic concept of this invention to depart from the practice of producing continuous webs of panty hose, or leotard back-to-back blanks of warp-wise tubular construction, shaped and knitted inside and outside seams and crotches, and, instead, to produce continuous webs of stretchable garments, such as girdles with stretch yarns laid in warp-wise but with the tubes running normal thereto, or across the warp, of the warp knitting machine and formed of power net fabric or of similar Raschel warp knitted fabrics. The concept does not involve shaping since this can be accomplished after the finished garments are made by well known heat treatment, boarding steps.

The above mentioned Cocker 14 bar warp knitting machine, plus a second pattern drum, is set up so that eight guide bars knit two single, superposed power net fabrics simultaneously, four guide bars to each needle bar. The remaining six guide bars form the bands and crotch. At predetermined areas, or zones, or after a predetermined number of power net stitches, the crotch guide bars make inter-connecting stitching motions to cross interloop the superposed single fabrics to form a crotch and after a predetermined number of additional power net stitches, all guide bars are shifted to make inter-connecting stitches across the warp to form the horizontal side seams of the horizontally disposed tubes of the garment, the resulting cross interlooped side seam bands being severable for forming individual tubular garments. The concept of warp knitting power net in a continuous web of individual course-wise extending tubular garments results in the spandex yarns of the power net being laid in warp-wise of the web but transversely of the tubes, so that when the garment is cut from the web and turned through 90° the elastic yarns will be circumferential of the garment. Similarly a plurality of filler yarns are stitched and floated on the face of the fabric at spaced zones transversely of the web, to run warp-wise and form waist edge bands and leg edge bands which also run circumferentially of the garment when the garment is cut from the web and turned through 90°.

By the above process, the making of single fabric power net, cutting the same into pattern blanks, sewing the blanks into garments, sewing on waist tape and leg tape, etc., is eliminated, and a continuous web of elastic girdles, panty hose or the like is produced in one operation on one machine, and automatically, without manual cutting and sewing. The continuous web of elastic garments is taken off the machine in large rolls and dyed, or otherwise finished in roll form, whereupon the individual finished garments are cut from the web along the cross interlooped bands, turned inside out to hide any seams, and the garments may then be boarded to add any desired shaping. Special control panels, or appliques, may be sewed onto the basic elastic, tubular garment to add decorative effects for styling or sales appeal, or may be incorporated into the web on the machine.

Garment length is controlled by varying the knitting width, transversely of the warp knit web and around-the-body size is controlled by changing the shifting points of the shifting pattern drums so that more, or less, power net fabric is knitted between shifting points on the warp knitting machine.

BRIEF DESCRIPTION OF DRAWING

FIG. 1 is a diagrammatic front elevation of a double needle bar, Raschel type, warp knitting machine constructed in accordance with the invention, some of the continuous webs being illustrated as spread out, rather than wound up, for clarity.

FIGS. 2–12 are front elevations, and FIGS. 3–13 are corresponding end elevations in section which diagrammatically show some of the various embodiments of the product of the invention.

FIG. 14 is a diagrammatic, enlarged end elevation of the knitting portion of the machine of FIG. 1, illustrating the fourteen guide bars, double needle bars, two-ply single fabrics unconnected, and a connected, cross interlooped band, and

FIG. 15 is a still further enlarged fragmentary view showing the power net of one panel of a garment of the invention with the waist, or leg, band filler strands stitched and floated therein.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1 a double needle bar, fourteen guide bar Cocker Fashion Master Raschel, warp knitting machine 20 is illustrated, this machine being well known and commercially available in the trade. It is described in an article entitled "New Cocker Fashion Master Raschel for Shaped Panty Hose, Leotards, Etc.," in Knitted Outerwear Times of Oct. 2, 1967, and further described in the previously mentioned article in that magazine of Apr. 29, 1968. As so described, and sold, the machine 20 comprises a frame 21 having double needle bars, or beds, 22 and 23, power net warp beam means, or body yarn warp beam means, termed the first warp means 24 herein, a wind up roll 25, and a first pattern forming means 26.

The machine 20, prior to this invention, and as explained in the said articles, is capable of knitting shaped, back to back, warp-wise extending tubular, panty hose or leotards of power net and is also capable of producing thermal underwear. The guide bars 27 are mounted on a swingable frame 28 for traversing back and forth in a path transverse to the needle bars 22 and 23, and each guide bar is reciprocable on the swingable frame, in parallelism with the axis of the needle bars, under the control of a pattern chain 29 carried by a pattern drum 30, all in a known manner. The pattern drum 30 is shiftable sidewise to actuate different sets of the pattern chains, for example, to change from knitting the warp-wise inner and outer selvedges to knitting across the span between the two legs to form the crotch and then back to tubular leg knitting. The pattern forming means 26 also includes sensing means 31 in the form of a cycle timer 32, for counting the number of stitches and actuating a shuttle for making predetermined cut lines, or points, on the continuous web produced by the machine 20.

In this invention, the machine 20 includes a second pattern forming means 35, identical with means 26, and arranged to control some of the 14 guide bars 27 in cooperation with means 26 to create the product of the invention. The pattern chains 36 and shiftable pattern drum 37 of the second pattern forming means 35, permit the formation of a pave of superposed, unconnected, single, power net fabrics 38 and 39, with every other course floated, and each single fabric knitted on one of the two needle beds 22 and 23 by four guide bars respectively, thus using eight of the fourteen bars 27. As is well understood in the art, all of the guide bars repeatedly oscillate transversely back and forth in the space between the needles of both beds, and when a loop around a needle is desired, the particular guide bars are moved axially of the needle beds to wrap the strands around the needles to form loops. The pattern control 26, 31 and 35, after a predetermined number of stitches, causes cross interlooping between fabrics 38 and 39 to take place also for a predetermined number of stitches to connect the two ply web into a single composite fabric 40 along a narrow band such as the full width, course-wise extending side seam band 41, or along the shorter crotch bands 42, or along the short, wale-wise extending bands 43.

The first warp means 24 includes at least two warp beams 45 and 46, beam 45 supplying the spandex strands 47 and beam 46 supplying the nylon strands 48 to the double needle beds 22 and 23. Thus a set of spandex and nylon body yarns are warp knitted into power net fabric 38 on needle bed 22, and a second set of spandex and nylon body yarns are warp knitted into power net fabric 39 on the other needle bed 23. The superposed, single fabrics 38 and 39 advance continuously downward from the knitting zone of the machine in a wale-wise direction, and with the laid in spandex yarns 47 extending wale-wise of the web for wind up on the wind up roll 25. The spandex yarns 47 are laid into each stitch of the respective single fabrics 38 or 39 and locked into the stitches, and the loops of the nylon strands 48 run generally warp-wise of each web 44 to form generally vertical wales therein.

It will thus be seen that the machine 20 produces a plurality of continuous webs 44, each formed of the superposed, single power net fabrics 38 and 39, and, at spaced intervals, cross interloops the fabrics 38 and 39 to form successive narrow transverse single ply bands 41 which divide each web into a series of interconnected transversely extending, circumferentially stretchable, open-ended tubes, such as 49, 50 and 51.

It will be understood that the web 44 can be the full width of machine 20, and cut into individual narrower webs of garments along the selvedge bands, or, as shown, the webs 44 may be initially separated so that selvedge cutting is not necessary.

A second warp means 53 is preferably provided, consisting of warp beam 54 containing a supply of filler yarns, such as 55, for creating a waist edge band 56 and a leg edge trim 57, for each continuous web 44 at spaced intervals across the machine 20. The filler strands 55 may be of any desired yarn material, such as spandex, wrapped with a fibrous strand, and are guided by the seventh and eighth guide bars of the set of guide bars 27. Filler strands 55 may be laid in, or knitted in, as desired.

The successive, individual, interconnected tubes 49, 50 and 51 produced by the machine 20, extend transversely, or horizontally, in a course-wise direction, and may be of power net only, or power net with spandex fillers laid in wale-wise, or with spandex and filler yarns both laid in wale-wise, but obliquely, by Atlas lapping. When the webs 44 are cut along the narrow side edge seam bands 41, either before or after other treatment, the cut is along the central, longitudinal axis of the band to thereby form individual separate tubes. Each tube has open ends as at 58 and 59, and when turned through 90° and turned inside out to cover the seams, a finished garment is achieved.

In FIGS. 2 and 3, a stretch girdle 60 is shown, which has been cut from a tube such as 49, 50 or 51. The knitted garment 60 comprises a generally tubular circumferentially stretchable and retractive knitted body 61, having a front panel 62 formed of fabric 38 and a rear panel 63 formed of fabric 39. The loops of the knitted fabrics run wale-wise circumferentially around the tubular body. The spandex yarns 47 also run wale-wise of the fabric circumferentially thereof and are locked into the body stitches. The side edge seams 64 and 65, which were cut along the cross interlooped bands 41, join the front and rear panels into a tube and extend coursewise of the body 61, which is axially thereof, so that the side seams are interknitted, rather than sewn, as in the prior art.

In FIGS. 4 and 5, a garment 66 is shown, which is identical with girdle 60, except that a short length 42 thereof has been cross interlooped, intermediate of the

side edge seams 64 and 65, to form a crotch area 67, thus creating a panty girdle.

In FIGS. 6 and 7, a garment 69 is shown, which is also similar to garments 60 and 66, except that the cross interlooped crotch portion 42 thereof is of substantial length and has been cut at 70 along the longitudinal centre line to form inside seams 71 and 72 of garment legs 73 and 74. The cut 70 is of less length than the band 42 to form a crotch portion 75.

In FIGS. 8 and 9, the garment 78 is similar to garment 60 and includes a plurality of additional, or filler, yarns, such as 55, which have been laid in, or knitted in, to the fabric 38 forming front panel 62 is a wale-wise herringbone pattern 79. These yarns form a restraining area 80 centrally of the front panel, similar to the restraint and semi-restraint panels now sometimes sewed onto girdles for applying pressure on selected portions of the human body. The obliqued restraining filler yarns 55 may be novelty yarns from a separate feed means and are Atlas lapped in a manner well known in the trade.

In FIGS. 10 and 11, a garment 82 is shown, which is similar to garment 69, but includes the waist edge band, or trim, 56, and the leg edge band, or trim, 57, formed by the filler yarns 55. It should also be noted that some of the filler yarns 55 may be Atlas lapped into a triangular area 83, which covers the crotch area 75, making the same less translucent than the power net of the body.

In FIGS. 12 and 13, the garment 85 consists of a basic tubular body, 61, having cross interlooped side seams 64 and 65, circumferentially running spandex strands 47, and top and bottom selvedges 86 and 87. However, the cross interlooping along the side seam bands 41 has been interrupted at 88 and 89 to form sweater arm holes and the selvedge 87 has been cross interlooped along short bands 43 to form shoulders 90 and 91 which define a neck hole 92.

All of the garments depicted in FIGS. 2–13 are characterized by having generally tubular, circumferentially stretchable and retractive knitted bodies, such as 61, formed of a front knitted panel 62 and a rear knitted panel 63, each panel being knitted from a separate set of individual, warp yarns such as at 94 and 95 (FIG. 14). In each garment the nylon loops of the power net run wale-wise of the fabric 38 and 39 of the panels, which direction is circumferential of the body 61. The stretchable, retractive spandex yarns 47 of the fabric 38 and 39 is laid in wale-wise of the fabric, and locked into the stitches, these elastic yarns also running circumferentially of the body. The garments are free of sewed side edge seams and sewed waist and leg tapes and instead the front and rear panels are joined into a tube by the cross interlooping of the body yarn stitches along the side seams 64 and 65 which have been cut from the bands 41. The bands 41 extend course-wise of the fabrics 38 and 39 and run axially of the body 61 to form the interknitted side seams of the invention.

In FIG. 14, the guide bars of the machine 20 are numbered 1 to 14, and the function of each guide bar in knitting the novel product of the invention is set out below:

Guide bar 1 Spandex 47 of power net 38 on needle bar 22.

Guide bar 2 Spandex 47 of power net 38 on needle bar 22.

Guide bar 3 Nylon 48 of crotch and leg tube.

Guide bar 4 Nylon 48 of power net 38 on needle bar 22.

Guide bar 5 Nylon 48 of crotch and leg tube.

Guide bar 6 Nylon 48 of power net 38 on needle bar 22.

Guide bar 7 Filler 55, waist, (or leg) band net 38 on needle bar 22.

Guide bar 8 filler 55, waist (or leg) band net 39 on needle bar 23.

Guide bar 9 Nylon 48 of power net 39 on needle bar 23.

Guide bar 10 Nylon 48 of crotch and leg tube.

Guide bar 11 Nylon 48 of power net 39 on needle bar 23.

Guide bar 12 Nylon 48 of crotch and leg tube.

Guide bar 13 spandex 47 of power net 39 on needle bar 23

Guide bar 14 Spandex 47 of power net 39 on needle bar 23

Power net fabric 38 is knitted from spandex guide bars 1 and 2 and nylon guide bars 4 and 6 on needle bed 22 while power net fabric 39 is knitted from spandex guide bars 13 and 14 and nylon guide bars 9 and 11 on needle bed 23. The waist band of fabric 38 is knitted from guide bar 7 and the waist band of fabric 39 is knitted from guide bar 8.

Four guide bars 3, 5, 10 and 12 are required to make the crotch section, two guide bars for each needle bar. These guide bars are threaded for only a short section at one end 95 of the garment and make stitching motions of regular power net. The main guide bars 4, 6, 9 and 11 are threaded up to the point of the crotch guide bars 3, 5, 10 and 12 and knit a power net stitch.

Moving in unison, the main net guide bars and the crotch guide bars make a power net fabric 38 and 39 on each needle bar. To form the crotch section of the garment, the crotch guide bars are required to make interconnecting stitching motions on each needle bar at predetermined intervals. These interconnecting stitches will connect the two single fabrics 38 and 39 into one composite fabric 40 for the desired number of stitches and along the transversely extending distance desired for the crotch area.

After a predetermined number of interconnected stitches, such as will form a narrow band, for example, one half inch wide, a shift is made back to the plain, or regular, power net stitch to again form two superposed, separate fabrics 38 and 39, each on its own needle bar 22 or 23.

Single fabric knitting continues on each needle bar for a predetermined number of stitches until the next side seam 41 is reached. Thereupon, all guide bars are shifted to make interconnecting stitching, or cross interlooping, so that a unitary, composite single fabric 40 is achieved for the desired width of the band 41. This shift requires both drums 30 and 37 to be moved. After a predetermined number of stitches, such as to form a band 41 one or two inches in width, the drums are again shifted to cause all guide bars to again form double fabrics 38 and 39. A new garment is thus started.

The filler yarns 55, threaded in guide bars 7 and 8, continue to supply filler strands 55 into the power net fabrics 38 and 39, along a waist band zone, along a leg band zone, or along an intermediate zone for Atlas lapping, depending on the particular tubular garments being warp knitted, the resulting filled areas being ver-

tical bands of uniform width, or obliqued bands, of uniform width, when lapped sidewise.

The yarns **55** are floated for several courses on the face of the fabric, as at **97**, and are then knitted into the fabric, as at **98**, as shown in FIG. **15**.

The particular guide bar arrangement described above may be varied. For example, the main net guide bars and crotch guide bars could be interchanged on each side and the leg and waist band filler yarns could be carried in guide bars **1** and **14** by appropriate rearrangement of the threading of the bars.

It will be seen that in each embodiment of the tubular garment of the invention one end of the tube is open to form a waist opening, while the other end, except in the case of the girdle of FIGS. **2** and **3**, is partially closed by discontinuous areas or bands of cross-interlooping to form crotch or shoulders and define neck or limb openings in the garments, as at **42, 43, 90, 91** and **92.**

What is claimed is:

1. The process of knitting a generally tubular garment adapted to conform to, and fit the human body, on a double needle bed, warp knitting machine, said process comprising the steps of:

knitting two superposed, single knit fabrics on said machine to form a two ply web advancing continuously in a walewise direction thereon;

periodically, after a predetermined number of stitches, cross interlooping said single knit fabrics to connect the same in a narrow, full width, substantially continuous band extending in a course-wise direction, thereby forming a succession of course-wise extending, open-ended tubes;

between said course-wise extending bands, at one end of each said tube, discontinuously cross interlooping said single knit fabrics to connect the same in predetermined areas thereof for a predetermined number of stitches extending in a walewise direction, and then single fabric knitting the same in other predetermined areas thereof for a predetermined number of stitches in a walewise direction, thereby forming a shoulder, or crotch, partial closure associated with at least one limb, or neck, opening at said one end; and

between said course-wise extending bands, at the other end of each said tube, single fabric knitting said end to maintain a full opening, free of any partial closure, cross interlooping or interconnection to serve as a waist opening of a garment.

2. A process as specified in claim **1**, plus:

the step of laying in a plurality of stretchable retractive yarns walewise of at least one of said single knit fabrics and locking said yarns into the stitches thereof, and

severing each successive tube from said web and turning the tube through an angle of ninety degrees so that said stretchable retractive yarns will extend in a circumferential direction when worn as a garment on the human body.

3. A process as specified in claim **1**, wherein:

said discontinuous cross inter-looping of said fabrics in a walewise direction at one end only of each said tube to form a crotch area at said end includes the step of cross interlooping for a substantial distance in a course-wise direction to form an elongated crotch area;

and the step of severing along the centre line of said elongated crotch area to form bifurcated leg tubes at said end.

4. A process as specified in claim **1**, plus:

the step of laying in a plurality of stretchable retractive yarns walewise of at least one said fabric, and

the step of incorporating into said single fabrics an additional set of yarns extending walewise of said web to form a waist band or edge trim on the garment formed by said tube.

5. A process as specified in claim **1**, plus:

the step of incorporating into at least one of said single fabrics an additional set of yarns extending walewise of said web and atlas lapping said yarns in a herringbone pattern for a substantial distance course-wise to form a restraint panel in a garment formed by each tube.

6. The process of knitting a generally tubular garment adapted to conform to, and fit the human body, on a double needle bed, warp knitting machine, said process comprising the steps of:

knitting two superposed, single knit fabrics on said machine to form a two ply web advancing in a walewise direction;

periodically joining said single knit fabrics for a predetermined number of stitches by course-wise extending strips of cross interlooping to thereby form a succession of open ended course-wise extending tubes;

single fabric knitting to maintain each said tube at least partially open proximate each opposite end thereof;

and joining said fabrics together proximate at least one of said ends, for a limited number of courses and wales by discontinuous cross interlooping of the body yarn stitches thereof in a walewise direction for a predetermined number of stitches;

the said discontinuous cross interlooping at the said one end of said tube defining neck or limb openings therein and forming crotch or shoulder areas therein.

7. A process as specified in claim **6**:

plus the step of incorporating walewise extending stretchable-retractive yarns into said web;

and severing each said tube from said web into individual tubular garments having said stretchable-retractive yarns extending in a circumferential direction therearound.

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