

[54] **METHOD AND MACHINE FOR
MANUFACTURING STOCKINGS**
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[57] **ABSTRACT**

A method for manufacturing seamless panty hose and the like having a panty portion and two legs integral therewith, the method including the steps of knitting the legs with continuous rotation of the needle cylinder and the panty portion with reciprocating movement of the needle cylinder. During reciprocation substantially all the needles are made to knit to form substantially complete courses having ends at the end of each stroke of the reciprocating movement in such a way that the ends of the courses define a waist opening in the panty portion. There is also disclosed a circular knitting machine for carrying out this method and comprising control means for causing substantially all the needles to knit at each reciprocation during the manufacturing of at least a part of the panty portion.

[56]

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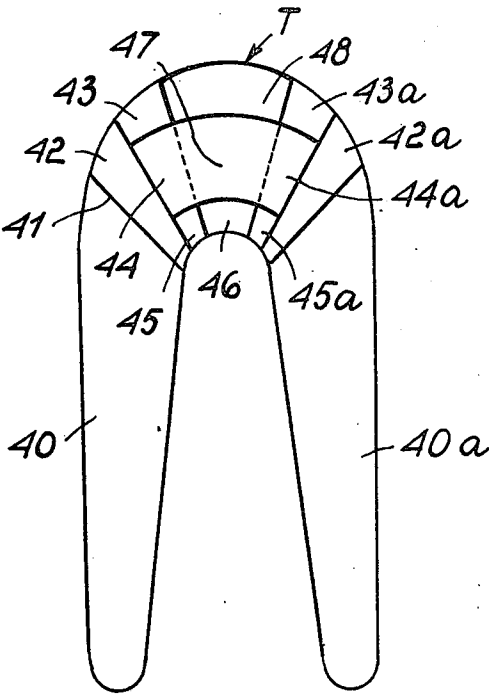
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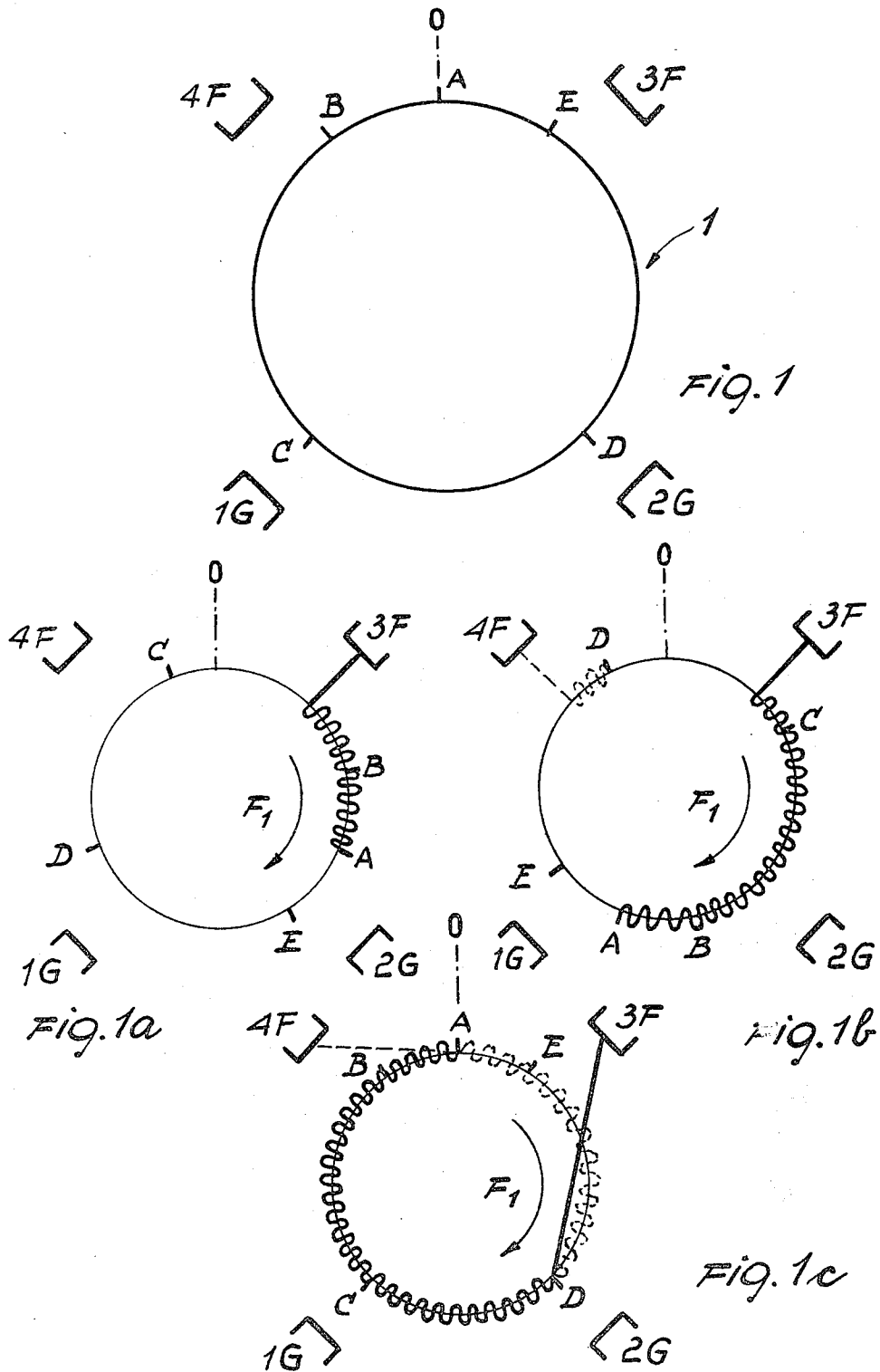
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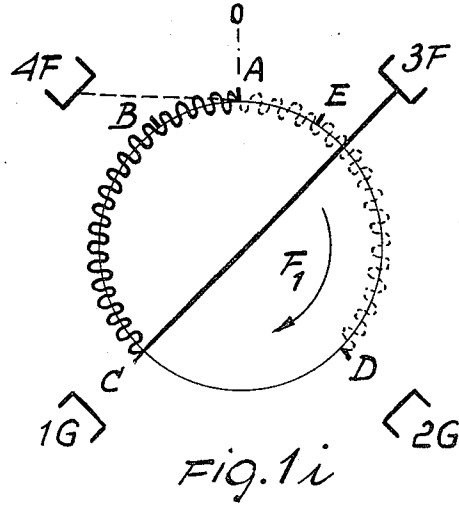
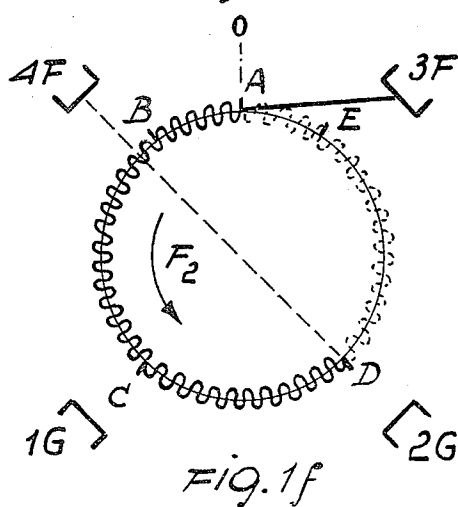
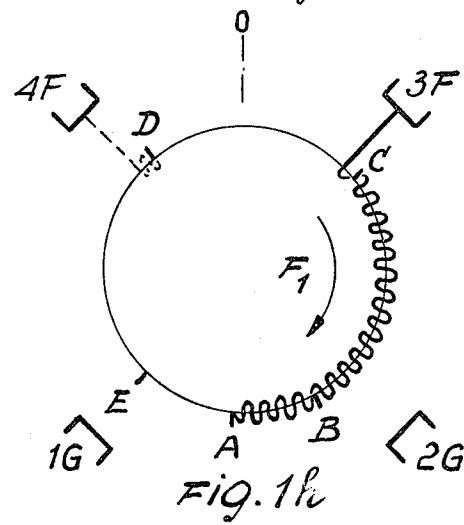
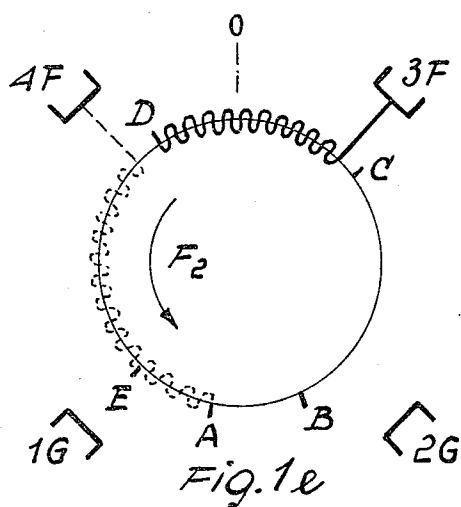
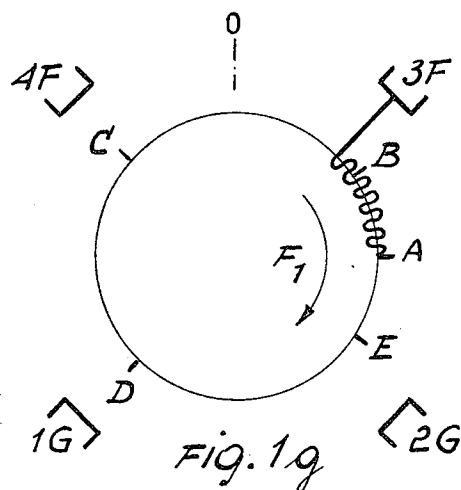
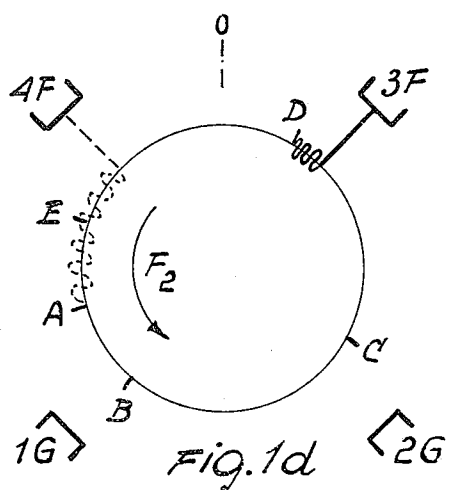
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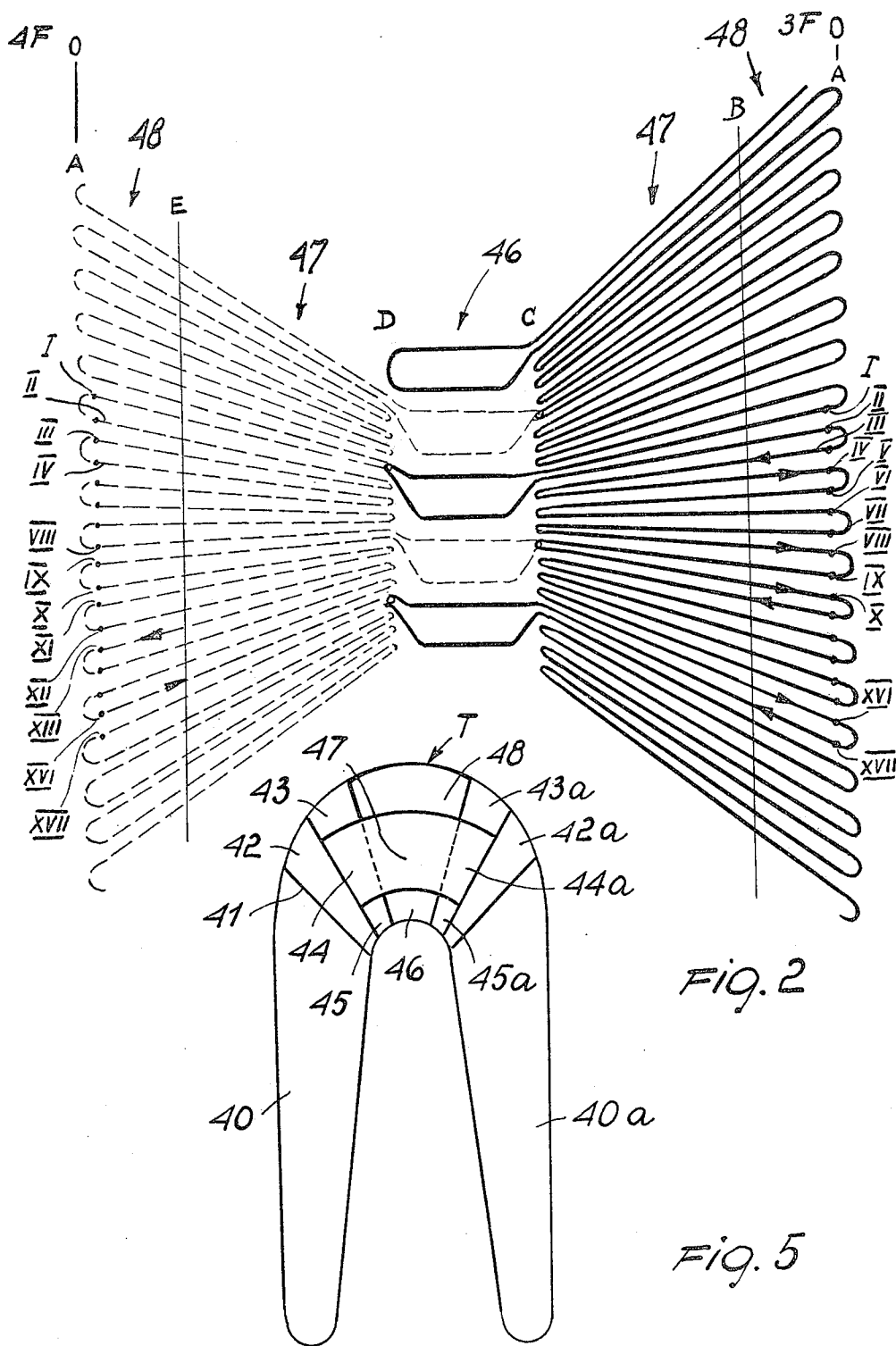
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14 Claims, 18 Drawing Figures









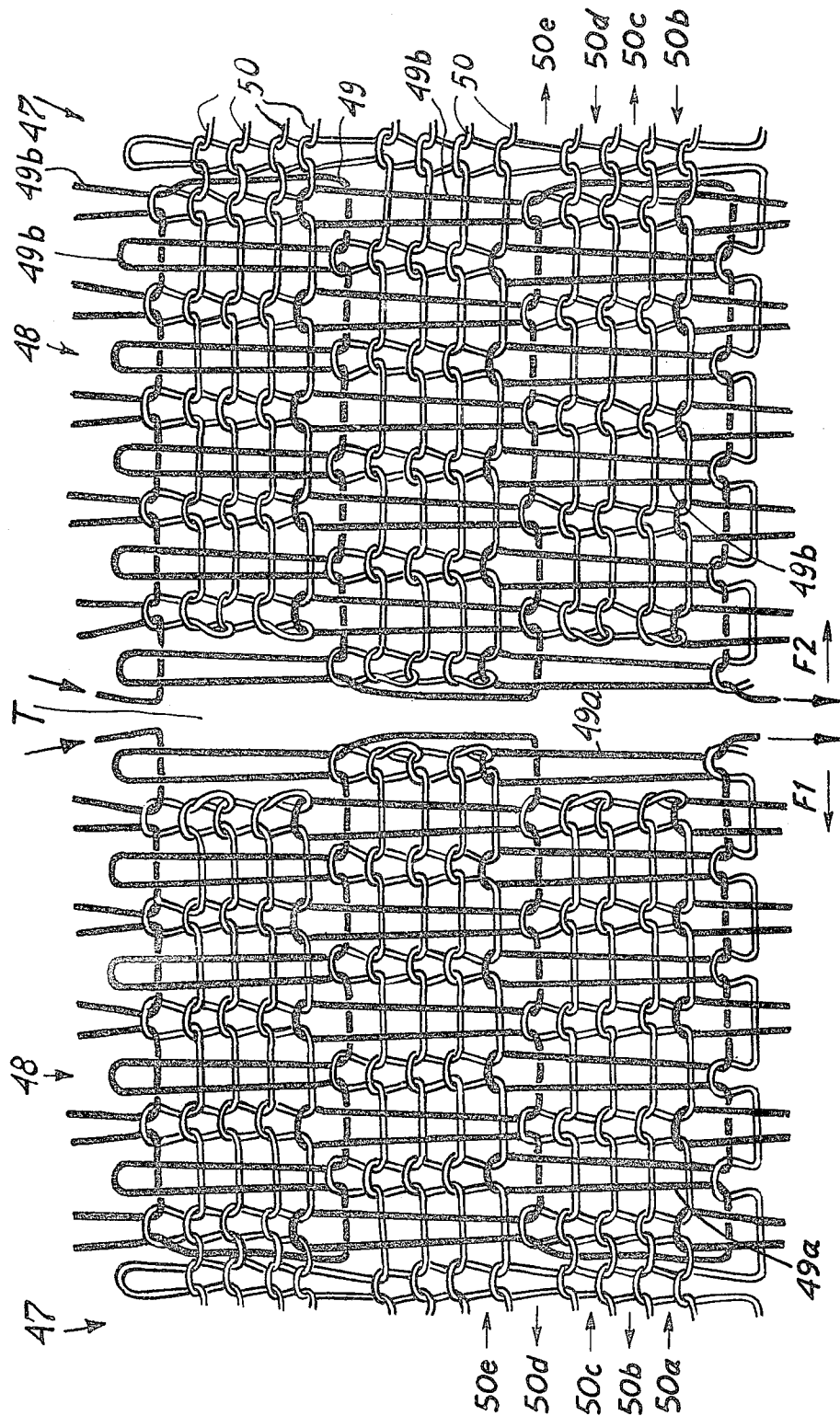
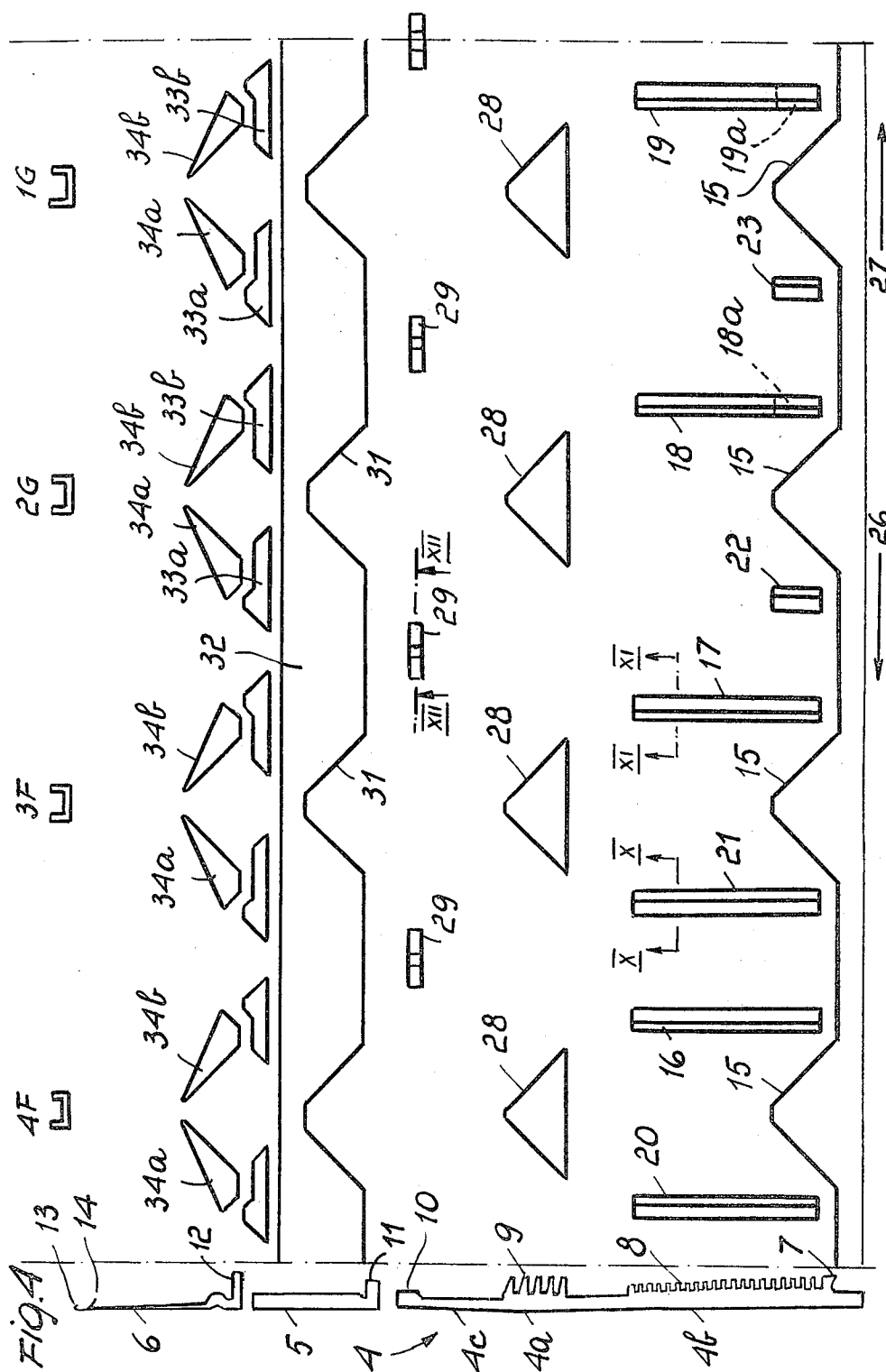


Fig. 3



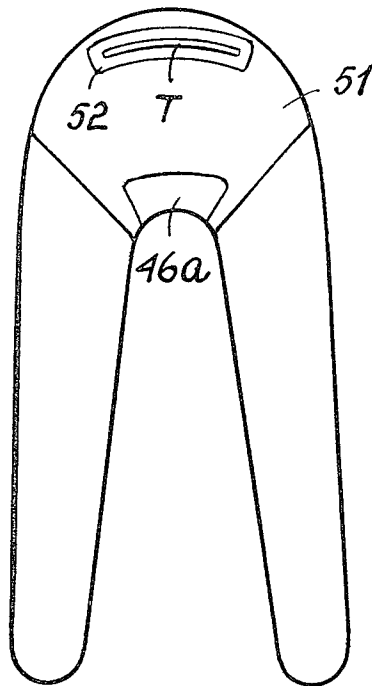


Fig. 6



Fig. 10



Fig. 11



Fig. 12

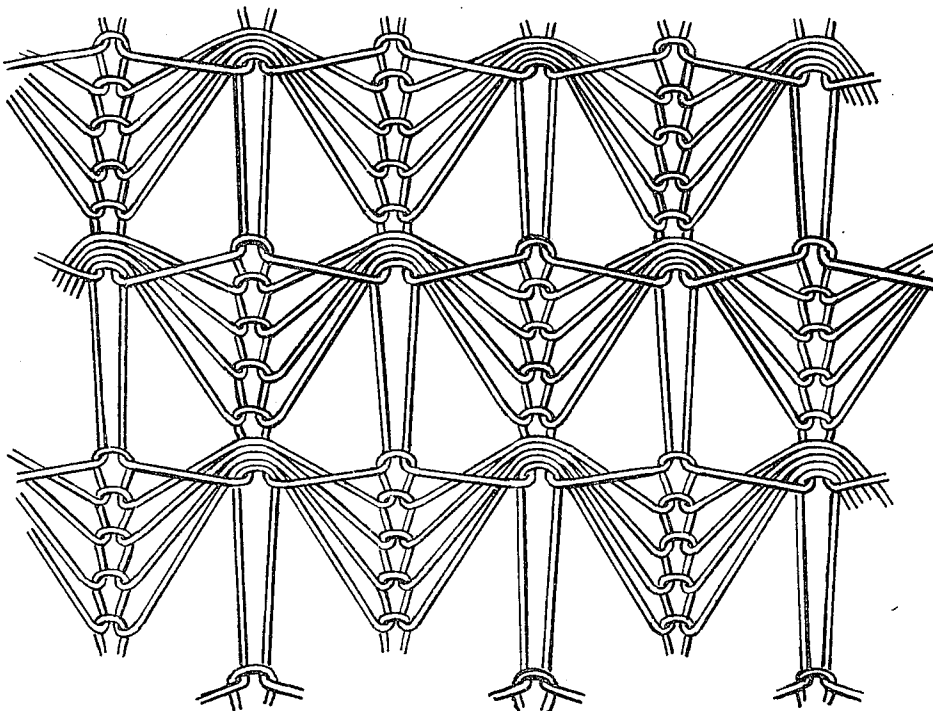
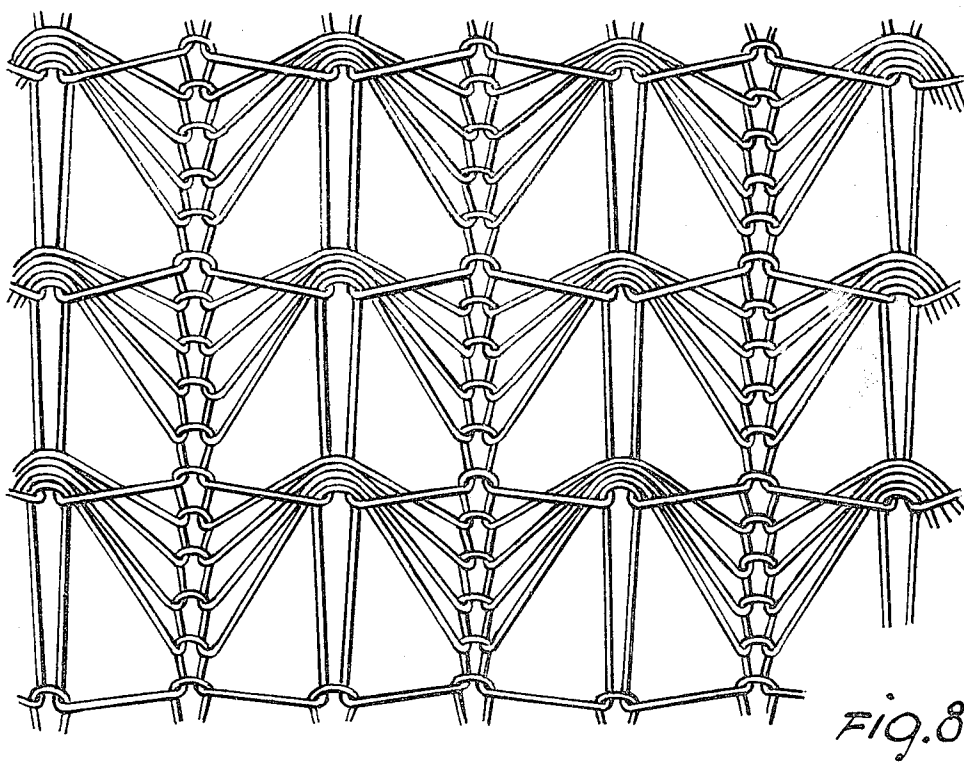
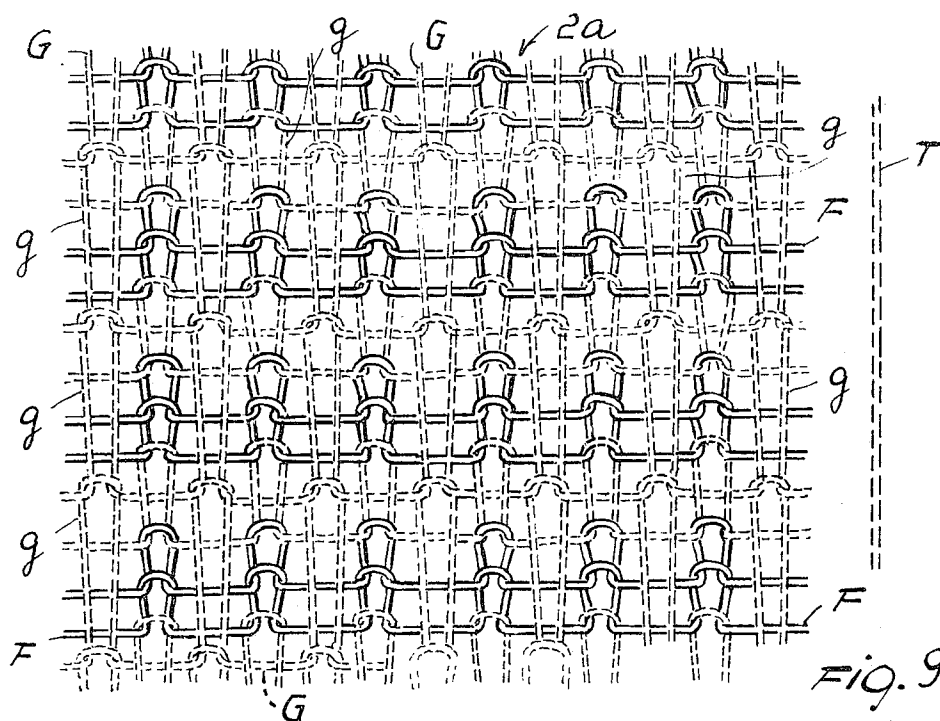


Fig. 7



METHOD AND MACHINE FOR MANUFACTURING STOCKINGS

BACKGROUND OF THE INVENTION

The present invention relates to a method and a machine for manufacturing seamless panty hose and the like.

Circular knitting machines are presently used in hosiery for stockings and are well known.

All circular knitting machines for stockings of known type possess members arranged to exclude and reoperate the latch needles in order to make possible the narrowing and widening operations necessary for manufacturing special parts of the stockings, such as the heel.

Of the articles obtainable on such machines, the so called stocking tights have been particularly well received on the female hosiery market during recent years.

These stocking tights are in practice the result of joining a pair of long female stockings to a pair of pants. Because of the configuration of such a garment it is evident that the manufacturing complexity far exceeds that of all other types of hosiery products. At present two knitting and manufacturing processes are used for said stocking tights. The first comprises the knitting of the individual parts which are then sewn together. The second consists of the following stages: the formation of a knitted tube constituting a first stocking starting from its toe, then the formation of the central zone or panty portion, and then the formation of a second stocking (also consisting of a knitted tube) finishing with the toe of this latter. In this manner a knitted tube is obtained on the circular machine. It is thus evident that a product so obtained requires further manufacturing stages, such as for example a cut longitudinal to its own axis in a position corresponding with the waist of the finished garment, and an elastic band must then be sewn at said cut to enable the garment to be supported. Said band must exert its elastic action in the direction of the width of the stockings. This procedure gives rise to many disadvantages, both from the point of view of the speed and hence economy of production, and from the point of view of the quality of the finished product. In fact the need for supplementary manufacturing operations on the basic product as removed from the circular machine implies a considerable use of labour with a consequent increasing of times of manufacture, and the execution of cutting operations leads to imperfections and weak points in the structure of the finished product.

SUMMARY OF THE INVENTION

An object of the present invention is to eliminate substantially all the aforementioned disadvantages by providing a circular knitting machine for stockings able to produce hosiery products, particularly stocking tights, completely finished on the machine itself, so eliminating all the finishing operations outside the machine.

Another object of the present invention is to provide a circular knitting machine for stockings capable of increasing to a maximum the speed of production.

Still another object of the invention is that of providing an improved method for manufacturing seamless panty hose and the like.

These and further objects which will be more evident hereinafter are attained by a method for the manufac-

ture of stockings, particularly stocking tights, including the formation by knitting, on a circular hosiery machine, of a first leg of said tights, a central pelvis part following said first leg and connected to it, and a second leg following said central pelvis part and connected to it, and comprising the steps of driving, during the manufacture of said central pelvis part, the needle cylinder of said circular machine fed with at least one feed of normal yarn, with reciprocating motion, making substantially all needles of said cylinder enter into operation, each rotation of said cylinder extending angularly through approximately one complete turn, said reciprocating motion being such as to produce, at least in a middle zone of said central pelvis part, a longitudinal aperture substantially parallel to the axis of said needle cylinder.

BRIEF DESCRIPTION OF THE DRAWINGS

Further characteristics and advantages of the invention will be more evident from the detailed description of a preferred but not exclusive embodiment of the method according to the invention for the manufacture of complete stocking tights, given by way of non-limiting example with reference to the accompanying drawings in which:

FIG. 1 is a diagrammatic representation of the main section of a needle cylinder of a circular stocking machine of the single cylinder type with four feeds;

FIGS. 1a, 1b, 1c are stages in the formation of a first course of knitting;

FIGS. 1d, 1e, 1f are stages in the formation of a second course of knitting;

FIGS. 1g, 1h, 1i are stages in the formation of a third course of knitting;

FIG. 2 is a diagrammatic representation of a section of knitting made with reciprocating motion;

FIG. 3 is a detailed representation on a very enlarged scale of a section of knitting fabric comprising rubber yarns or threads for elasticization;

FIG. 4 is a diagrammatic representation of the cam unit of a circular machine for carrying out the method according to the invention, showing at the side a needle with its selecting jack.

FIG. 5 is a diagrammatic representation of a pair of stocking tights;

FIG. 6 is a further diagrammatic representation of a pair of stocking tights;

FIGS. 7 and 8 show further embodiments on a very enlarged scale of a section of knitted fabric in the crotch zone;

FIG. 9 shows a further embodiment on a very enlarged scale of a section of elasticized fabric at the longitudinal aperture;

FIG. 10 is a section along plane X—X of FIG. 4;

FIG. 11 is a section along plane XI—XI of FIG. 4;

FIG. 12 is a section along plane XII—XII of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The method for producing tights according to the invention comprises a first stage in which a knitted tube is formed, to form a first leg 40 (FIG. 5), starting from the toe and arriving at the junction with the pants, the joint line being indicated by the reference numeral 41 (see FIG. 5). The method of forming this leg is known in various types of knitting (net, plain, etc.), and comprises the use for example of four feeds of normal yarn, with continuous rotational motion of the needle cylin-

der. It should be noted that the continuous rotation of the needle cylinder continues successively to form the zone 42, but the yarn is changed using the thickness which will be selected to form the pants and which is normally greater than that of the other parts. The central zone is now made with reciprocating motion, this motion comprising essentially two distinct stages. During the first stage two types of yarn are used, namely a normal or body yarn and an elastic yarn; in the first stage an annular or tubular portion is formed, while driving the cylinder with reciprocating motion, which precedes the cut T, and comprises an elastic zone 43 in one section of said portion, an intermediate zone 44 and a crotch zone 45 on the diametrically opposed side. The second stage is analogous with the first (again with reciprocating motion) but in addition to forming the remaining part of the crotch 46 and the intermediate front and rear central portions 47, it also forms the waist opening defined by the cut T and the two elasticized zones 48 to the sides of the cut of a tubular panty portion. The method corresponding to the first stage is successively repeated, but from the other end of the cut with the formation of the zones 43a, 44a and 45a. Finally a zone 42a is repeated passing from reciprocating motion to continuous rotation of the needle cylinder, and then the knitting of the second leg 40a, in accordance with the known method, is carried out. A description will now be given with particular reference to FIG. 1 of the second of said two stages for manufacturing the pants, i.e. that which forms the panty portion with the waist opening T and adjacent zones 46, 47, 48. For simplicity it will be first considered that the zones 48 are not elasticized, but are as the zone 47.

It should be remembered that FIGS. 1a, 1b, 1c, 1d, 1e, 1f, 1g, 1h and 1i are diagrammatic representations of the main section of a needle cylinder, indicated overall by the reference numeral 1. The arrows F1 and F2 show the direction of motion in the return and forward sense, respectively during reciprocation, whereas the letters A, B, C, D and E define needle groups and the reference numerals 1G, 2G, 3F and 4F indicate four yarn feeds, 1G and 2G indicating feeds of rubber or elastic yarn, and 3F and 4F indicating feeds of normal yarn of which the body of the panty portion is knitted; 1G and 2G give normal yarn during continuous rotational motion.

For purposes of clarity the needle groups will be numbered as first, second, third, fourth and fifth needle group, whereby the first needle group includes needles arranged between B and C, the second needle group includes the needles diametrically opposite and arranged between D and E, the third needle group includes needles arranged between C and D and the fourth and fifth needle group include needles arranged between A and B and A and E, respectively.

To form the zones 46, 47, 48 of the tubular panty portion the needle cylinder moves with reciprocating motion, each stroke being of about 360° but even to a greater or less extent (such as 400°), which is followed by the next stroke, again of approximately 360°, but in the opposite direction with the dead centre at 0 that is at the generatrix of the needle cylinder along which the waist opening will be defined. The formation of the first course is started by the return stroke, along the arrow F1. Needles are selected by selectors which will be described hereinafter, in a manner which will be described, so that the needles of the section or group ABCD now operate, taking the yarn from the feed 3F,

whereas when the needles of the section DEA start to operate they take yarn from the feed 4F (see FIGS. 1a, 1b, 1c and FIG. 2). More exactly, A is the intersection of a vertical imaginary geometrical separation plane with the needle cylinder, the first needle after A in the direction AB takes yarn from feed 3F, the first needle from A in the direction AE takes yarn from feed 4F. Obviously there is one needle in position D taking yarn both from 3F and 4F to knit the zones together. Starting from the position shown in FIG. 1, the needle cylinder 1 moves in the direction of the arrow F1, and as can be seen from FIG. 1a, the needles of the cylinder 1 take the yarn from the feed 3F starting from the point A towards B. As rotation continues in the direction of the arrow F1, further cylinder needles take yarn from the same feed 3F, until after a rotation of about 360° there is a sector of needles ABCD just fed from 3F (FIGS. 1b and 1c), while the needles of the remaining sector DEA have taken the yarn from the feed 4F.

Thus a first course is formed for which all the needles of the needle cylinder 1 have taken up yarn, this first course consisting of a section with yarn from the feed 3F (indicated by a continuous line) and a section with yarn from the feed 4F (indicated by a dashed line). FIG. 2 shows diagrammatically the fabric being developed with the courses shown in roman numerals. It can be seen that the middle zone 46 is formed with a smaller number of courses than the remaining zones, in order to give a fan effect for producing a curved configuration at the crotch.

As can be seen from said FIG. 2, the first course also concerns said zone 46.

After the needle cylinder 1 has rotated through approximately 360°, that is for an extent of substantially a complete turn, the motion reverses for the formation of the second course, with rotation through a further 360° approximately, after which there is a new reversal of motion for a further 360° approximately, and so on, while the fabric is being formed in sectors so as to permit the needles to be discharged at each reversal, while the cut T is being formed defining a waist opening. In fact, since at the point A the first needle in the direction AB and the first needle in the direction AE each take a yarn from a different feed at different times and reciprocation ends at point A no continuity is obtained in knitting at this point and substantially complete courses are formed having ends defining a knit selvage edge at point A. It is, however, also possible to exclude one or a few needles from knitting at the end of each reciprocation to form courses each having slightly spaced adjacent ends proximate to point A defining the waist opening.

During formation of the second course, the needle cylinder 1 moves in the forward direction, as indicated by the arrow F2, the needles are selected so that all needles of the section AED take yarn from the feed 4F and all needles of the section DCBA take yarn from the feed 3F (see FIGS. 1d, 1e, 1f and FIG. 2). Also in this case (in this second course) all needles have taken up yarn (and consequently the zone 46 is also concerned). Obviously there is one needle in position D taking yarn both from feed 3F and feed 4F to knit the adjacent zones together.

In forming the third knitted course, the cylinder 1 is in the return stage (arrow F1), the needles are selected so that those of the section ABC take the yarn from feed 3F, whereas those of the section DEA take it from 4F. Thus all needles with the exception of those of the

section or group CD have picked up yarn (see FIGS. 1g, 1h, 1i and FIG. 2). In other words the third course does not concern the zone 46 and a partial course has been formed to the side of crotch zone 46.

In forming the fourth course, (rotation of the cylinder 1 in the direction of the arrow F2) the needles of section AED take yarn from the feed 4F and the needles of the section CBA take yarn from 3F. All needles with the exception of those of the section CD have taken up yarn.

The fifth course is a repetition of the third.

The sixth course is a repetition of the fourth.

The seventh course is a repetition of the third.

In the eighth course (direction F2) the needles of the section AEDC take yarn from 4F and those of the section CBA from 3F. All needles take up yarn thus forming a substantially complete course having ends at point A.

In forming the ninth course, the cylinder 1 is in the return stage, arrow F1, the needles of section ABC take thread from the feed 3F, and those of section CDEA from 4F. All needles have taken up yarn. Obviously there is one needle in position C taking yarn both from feed 3F and feed 4F to knit the adjacent zones together.

In forming the tenth course, the cylinder 1 is in the forward stage F2, the needles of section AED take yarn from the feed 4F, and those of section CBA from 3F. The needles of section CD do not take up yarn.

The eleventh course is a repetition of the third.

The twelfth course is a repetition of the fourth.

The thirteenth is a repetition of the third.

The fourteenth is a repetition of the fourth.

The fifteenth is a repetition of the third.

The sixteenth is a repetition of the fourth.

The seventeenth is a repetition of the first.

Thus the position has returned to that previously described relative to the first course, after which the operation proceeds in an analogous manner.

Knitting is continued in this manner for the section desired, remembering that knitting is prosecuted by repeating a certain number of cycles each of which comprises sixteen courses.

FIG. 2 shows a diagrammatic example of the knitting thus obtained, in which each course is represented by a continuous line for the feed 3F, and a dashed line for the feeds 4F. It is well deducible from this figure that substantially complete courses are formed at regular intervals at the crotch zone 46 joining together the partial courses, whereby the crotch zone 46 is formed by a number of courses smaller than that of the front and rear central portions 47. Thus the crotch zone 46 is knitted by the needles of the third intermediate needle group CD and the front and rear central portions 47 by the needles of the first and second needle group BC and DE.

To form the zones 43, 44, 45 and 43a, 44a, 45a (FIG. 5) the procedure is the same as described for zones 46, 47, 48 remembering to raise one more pair of needles so that, working with reciprocating motion, they take the yarn from both the feeds 3F and 4F and produce a fabric which is joined where previously the cut T was formed. Said zones 43, 44, 45 and 43a, 44a, 45a thus define tubular portions formed by complete courses. In place of two, only one, or more needles can be raised, all taking yarn from both 3F and 4F, to have the desired overlapping.

With the method heretofore described a pair of stocking tights is obtained with an aperture T and manufactured in correct stocking tights form. Stocking tights with an elasticized part at the two sections BA and AE, i.e. at the sides of the aperture T, may be produced directly on the circular machine in the following manner. Two feeds 1G and 2G of rubber or elastic yarn are provided, 2G being for the section AB and 1G for the section AE.

FIG. 3 shows a preferred knitting pattern obtained with elastic yarn inserted in the normal knitting pattern.

In said figure the rubber yarn is indicated by a single line whereas the normal yarn is indicated by a light double line.

The elastic thread is inserted into the fabric during manufacturing of zones 48 (FIGS. 3 and 5) in the following manner.

The feeds 1G and 2G of rubber yarn are caused to become operative.

The feed 1G feeds the needles of fifth group AE of the needle cylinder; said needles are selected so that they take up the yarn, for example every five reciprocations in a return stage (arrow F1), only from the elastic yarn feed 1G. Said needles are selected alternately that is according to a 1:1 selection, i.e. one is selected and one is not. In this manner a course of elastic yarn 49 is inserted for every four courses of normal yarn 50 (see FIG. 3).

The feed 2G feeds the needles of fourth group AB of the needle cylinder; said needles are selected in such a manner that at every fifth course of knitting they take the yarn in the return stage only from the elastic yarn feed 2G, as in the case of the group AE. In group AB the needles are also selected alternately. In this manner one course of elastic yarn is inserted for every four courses of normal yarn (see FIG. 3).

In FIG. 3 of the drawing, for simplicity, a knitting pattern symmetrically relative to plane A is represented. Assuming that course 50a is being knitted as shown on left bottom side of FIG. 3 while the needle cylinder is oscillating as indicated by arrow F1, and that portion 47, which has been knitted by all the needles of second group DE taking up body yarn from feed 4F, is being terminated, a selection of the needles of fifth group AE takes place as stated above, causing the odd needles to take up body yarn to continue course 50a towards aperture T, while the even needles do not take up any yarn since they have taken elastic yarn at the previous course, as shown by loops 49a at the left bottom side of FIG. 3.

Reciprocation is now inverted at aperture T and course 50b is knitted in opposite sense with the same odd needles across portion 48. The even needles continue to hold the elastic yarn. Course 50b is continued with all the needles of second group ED, while the needles of first group BC all knit the opposite portion of course 50b at portion 47 towards the first loop of course 50b shown on right bottom side of FIG. 3. Needles of fourth group AB are now selected as stated above and the odd needles of this group continue to knit course 50b while the even needles do not knit any yarn since they have taken elastic yarn at the previous course as indicated by loops 49b at the right bottom side of FIG. 3.

The said operation continues, in the example shown, for four strokes of reciprocation, that is for four courses including also courses 50c and 50d during

which only the odd needles knit while the even needles hold the elastic yarn.

At course 50e, while the needle cylinder is still moving according to arrow F1, the odd needles of group AE, which had previously taken body yarn, take up elastic yarn and the even needles of the same group, which had held the elastic yarn, take up the body yarn, thereby forming stitches of elastic yarn in bridge arrangement over four courses of body yarn. An additional course of elastic yarn is therefore formed across portions 48, as shown in FIG. 3. The odd needles now hold the elastic yarn for the next four courses as previously made the even needles. The operation is analogous for the needles of group AB.

After the next four courses knitted by the even needles with body yarn, the odd needles newly take up and knit body yarn and the even needles take up and hold elastic yarn as previously described.

Obviously the number of courses of normal or body yarn between the courses of elastic yarn may be varied at will. The elastic yarn thus forms elongated loops 49a and 49b (FIG. 3), extending parallel to the cut T and forming a bridge connection over four courses of normal yarn 50. Said disposition is particularly advantageous in that the rubber yarn exerts its own elastic action in a direction parallel to that of the aperture T, so forming around said aperture an elastic belt.

For strengthening and elasticizing the end points of the aperture T, the zones 43 and 43a are also elasticized, with the formation of a fabric of the type shown in FIG. 3. In these zones the reciprocating motion is maintained, but there are needles raised at point A to take up body yarn from two feeds and interknit this yarn so that the formation of the aperture T is avoided, and a tubular shaped fabric portion is obtained.

FIG. 4 shows diagrammatically the configuration of a cam unit of a circular hosiery machine for carrying out the method according to the invention heretofore described. With reference to said FIG. 4, the positions of four feeds are indicated by 1G, 2G, 3F and 4F. 3F and 4F supply body yarn for the fabric both during continuous motion and during the three reciprocating motion stages described. 1G and 2G supply body yarn for the fabric during continuous motion, whereas for the reciprocating motion stages they supply rubber or elastic yarn instead of body yarn.

On the left-hand side of FIG. 4 are shown a selector jack 4, an intermediate jack 5 and a needle 6. The selector 4 comprises a hook or lower butt 7, a set of pattern butts 8, a set of larger butts 9 and an upper butt 10. Both the pattern butts 8 and larger butts 9 are partly or totally suppressed according to the knitting pattern to be obtained. The selector 4, intermediate jack 5 and needle 6, slide in a longitudinal groove in the needle cylinder 1 in known manner. The profile of the selector 4, which is in contact with the base of the groove, is slightly angled with its vertex at 4a, which divides it into two straight portions 4b and 4c so that the base of the groove is touched in turn either by the section 4b or section 4c in known manner.

The intermediate jack 5 possesses a butt 11. The needle 6 comprises a butt 12, a hook 13 and a latch 14. As shown in FIG. 4, jack control cams of the circular machine for carrying out the method according to the invention comprise four fixed cams 15 of trapezoidal profile for engagement with the butt 7 of the selector 4. Close to the cams 15 there are eight packs of patterning levers 16, 17, 18, 19, 20, 21, 22 and 23 which engage

with the butts 8 of the selector 4. Said patterning levers, which are mobile radially with respect to the needle cylinder by the action of known mechanisms, are shown sectioned along the lines X—X and XI—XI, in FIGS. 10 and 11 and have profiles indicated overall by 24 and 25. The levers 16, 17, 18 and 19 engage with the butts 8 of the selectors 4 during continuous motion of the cylinder 1, the direction of rotation of which is indicated by the arrow 26. The levers 20 and 21 operate during the return stroke of the reciprocating motion in the first and second stage, the direction of rotation being indicated by the arrow 27, and act on the needles which take up the yarn for knitting the fabric. The levers 22 and 23 operate during the return stroke in the second stage, and act on the needles which take up the rubber yarn. The sections 18a and 19a of the levers 18 and 19 act during the forward stroke in the second stage of the reciprocating motion, on the needles which take up the rubber yarn. Above the patterning levers there are four mobile cams 28 of trapezoidal profile above the cams 15, but of a smaller height than the cams 15, said cams 28 being provided for forming held loops and working alternately with the cams 15, in engagement with the butts 9 of the selector 4. Above and between two successive cams 28 there are four cams 29 for controlling all the selectors, said cams 29, shown in section on a line XII—XII, having a profile indicated overall by the reference numeral 30 in FIG. 12. Above the cams 29 there are four fixed hollow cams 31 for lowering the selectors 4, and which engage with the butt 11 of the intermediate jacks 5. The cams 31 are defined by a single relief body 32, above which there are four fixed counter-cams 33a, four fixed counter-cams 33b, four fixed needle lowering cams 34a and four fixed needle lowering cams 34b. The cams 34a and counter-cams 33a engage with the butt 12 of the needle 6 during the forward motion of the needle cylinder 1 (arrow 26), and the cams 34b and counter-cams 33b engage with the butt 12 during the return motion (arrow 27).

Engagement between the butt 12 of any needle 6 and the cams 34 or 34b takes place evidently only if the needle 6 has been raised by the selector 4 by means of engagement of the butt 7 with the trapezoidal cams 15 or the engagement of the butt 9 with the cams 28. However advantageously in known manner, said cams 34a and 34b exert on said butt 12 a controlling action only for the needle 6. In fact the lowering of the selector 4 is controlled by the engagement between the butt 11 of the intermediate jack 5 and the hollow cams 31, this engagement taking place slightly before that between the butt 12 of the needle 6 and cams 34a and 34b. Thus the needle is not overstressed. The action of the cams 28 is conventional.

It is important to note that in the cam unit described there are four knitting cams for the return motion, i.e. 34b, two more than is normal, because the machine containing said cam unit uses four feeds also during reciprocating motion. It should also be noted that in the cam unit described there are eight packs of patterning levers of which four, 20, 21, 22 and 23, are for the return motion of the needle cylinder 1. The machine further comprises control means for operating said patterning levers such that during each reciprocation substantially all the needles are selected to knit at both strokes of each reciprocation during the manufacturing of the panty portion lying adjacent the waist opening T, while during manufacturing of the tubular portions ar-

ranged adjacent the ends of the waist opening at least one needle knits yarn from two adjacent feeds.

The circular knitting machine equipped in this manner is arranged to operate according to the previously described sequence with the aperture and the elasticized parts at the waist already formed directly on the machine, without requiring successive finishing operations (with the exception evidently of dyeing and forming). Obviously the machine may be set as required, thus for example the manufacturing stages with the cylinder in reciprocating motion may be arranged for cycles of any number of rows (in the example heretofore described the cycles each comprised 16 courses).

It is also possible for example, in the zones of normal fabric obtained by continuous or reciprocating motion of the cylinder, to knit only with the odd needles or the even needles to give a more elastic knitting rather than smooth.

However with the above knitting in the crotch zone 46, because of the reduced number of courses in this zone and the fact that the fabric consequently remains on the needles, during this manufacturing stage enlargements of the stitches may sometimes take place with a consequent undesired expansion of the fabric in the crotch zone.

In order to avoid this disadvantage a second method of procedure is provided for the method according to the invention by means of which a conveniently dense fabric is obtained at the crotch zone with a consequent satisfactory fan disposition of the fabric thereabout, which enlarges from said crotch zone towards the longitudinal aperture T.

In this method of application, manufacture of the panty portion is made using one or more feeds of normal yarn, it being possible in this latter case to form said crotch zone with yarns of different characteristics (for example cotton) than those used in the remaining parts (for example a synthetic fiber) so as to confer on the garment highly satisfactory hygienic characteristics with a consequent greater commercial value.

The said second form of application of the method according to the invention for manufacturing stockings, and particularly stocking tights, consists of manufacturing a crotch zone by driving the needle cylinder fed with at least one feed of normal yarn with reciprocating motion, in a sector of knitted fabric diametrically opposite the resulting longitudinal aperture, with a number of courses equal to that provided in the adjacent zones of the central pelvis portion, knitted during the same working stage. Advantageously said crotch zone is made like a tuck stitch knitted fabric.

With reference to FIGS. 6 to 9, the method according to the invention comprises the use of a circular knitting machine with one or two feeds of normal yarn arranged so as to operate with reciprocating motion during the formation of the pelvis portion. More precisely, said reciprocating motion takes place as previously described with rotations of approximately 360° (for example 356°-358°) so as to form an aperture T (FIG. 6) disposed in the longitudinal direction in the tubular fabric forming the stocking tights.

The portion 46a (FIG. 8) at the crotch is provided with a number of courses equal to the number in the adjacent parts of the panty portion 51. The fabric at the crotch zone 46a may be obtained by a conventional setting of the needles as shown in FIG. 7, or in another form as shown in the figure.

In the examples shown in FIGS. 7 and 8, the stitches are held by alternate needles for a certain number of courses (five in the illustrations), either maintaining the same needle operation over the entire development of the zone 46a (FIG. 8) or alternating the needles after each of said number of courses (FIG. 7).

During reciprocating motion of the cylinder for the formation of the panty portion 51, one of the two feeds 3F and 4F (FIG. 1) of normal yarn feeds the needle sector AED, whereas the other feed of normal yarn feeds the remaining needle sector DCBA. In the sector CB the needles are selected so that alternate needles are raised by cams 28 to a height such that they take up new yarn without forming a stitch with the previous yarn which remains held on the corresponding needle to obtain fabrics having stitches as shown in FIG. 7 or FIG. 8.

The manufacture continues unchanged for the entire stage with reciprocating motion of the cylinder, while feeding the sector AED with one feed of normal yarn and the sector DCBA with the other feed of normal yarn, for the entire pelvis part 51.

The longitudinal aperture T is formed at the point A whereas in the sectors AE, AB, rubber yarn is provided from the two feeds 1G and 2G. At these latter sectors elasticized fabric is obtained as shown in FIG. 9, with the insertion of rubber yarn G between the normal yarns F. The rubber yarn G (shown dotted in FIG. 9) is inserted so as to form elongated loops g across a certain number of courses so as to give elastic tension in the direction of the aperture T.

The structural characteristics of the elasticized fabric may be easily observed by an expert in this art from FIG. 9, which will consequently not be further described.

The stitch fabric in zone 46a of the crotch gives a smaller degree of elasticity in this zone and a greater compactness between the stitches with respect to the remaining zones of the stocking tights. In this manner a contraction is formed in the tights at the zone 46a, with a consequent fan disposition of the panty portion 51.

The elasticized part 52 (FIG. 6) around the aperture T, is in reality composed of a number of courses which is double the number in the remaining parts of the panty portion 51 as the rubber yarns from the feeds 1G and 2G have been inserted in addition to the two normal yarns from the feeds 3F and 4F.

However, as the number of courses in the crotch zone 46a is equal to the number of courses in the pelvis zone 51 between said zone 46a and the elasticized parts 52, manufacture is possible even with a single feed of normal yarn. This makes it possible to use circular machines with a single feed of normal yarn.

Inversely, it is possible to use circular machines with more than two feeds of normal yarn, giving further advantages. It is possible in fact with three feeds to feed the needle sector CD (for forming the fabric in the zone 46a) with different yarn from that used in the remaining two feeds. In this manner it is possible for example to form the zone 46a in cotton and the remaining parts with synthetic yarn (cotton from the hygienic point of view is more valuable than synthetic yarns and consequently enables garments to be made having greater commercial value).

Summarizing, with the method according to the invention a circular machine may be used with three feeds of which two supply rubber yarn and one supplies normal synthetic yarn, or again a circular knitting ma-

chine may be used with five feeds of which two provide rubber yarn, two provide normal synthetic yarn and one provides cotton yarn.

Evidently it is also possible to use circular knitting machines with a different number of feeds.

The circular machine used must evidently be constructed with suitable controls so as to obtain the required needle selection and a reciprocating motion of the needle cylinder of sufficient amplitude during the formation of the pelvis portion.

It is a particular advantage of the present knitting machine that of avoiding difficult modifications in order to vary the shape of the pants and of obtaining a flaring of such pants to a greater or less extent only by changing the number of the chain loops which control the forward movement of the cam drum and the selections, i.e. the chain which determines the number of courses in the tubular fabric.

The invention so conceived is susceptible to numerous modifications, all of which lie within the scope of the inventive idea.

I claim:

1. A method for manufacturing seamless panty hose and the like having a tubular panty portion with a waist opening and two legs integral with said panty portion on a circular hosiery knitting machine having a needle cylinder, the method including the steps of knitting a first of said legs by continuously rotating said needle cylinder and forming complete courses, knitting a panty portion adjacent said waist opening by reciprocating said needle cylinder and knitting said tubular panty portion with substantially all the needles of said needle cylinder during each of at least a number of strokes of reciprocation and controlling the needles to form a knit selvage edge at the end of each of said at least a number of strokes of reciprocation to define said waist opening, and knitting a second of said legs by continuously rotating said needle cylinder and forming complete courses.

2. A method as claimed in claim 1, further including the step of knitting tubular portions between said legs and said tubular panty portion adjacent said waist opening by reciprocating said needle cylinder and forming at least some complete courses.

3. A method as claimed in claim 1, including the step of knitting at least some wales of the courses adjacent said waist opening with an elastic yarn.

4. A method as claimed in claim 2, including the step of knitting at least some wales of the courses forming said tubular portions adjacent said waist opening with an elastic yarn.

5. A method as claimed in claim 1, including the steps of knitting a crotch zone substantially diametrically opposite said waist opening and a front and rear central portion of said tubular panty portion by feeding yarn to a number of needles of said needle cylinder to form partial courses at the sides of said crotch zone and further feeding at regular intervals said yarn to a further number of needles of said needle cylinder to knit courses across said crotch zone joining together said partial courses at regular intervals, whereby said crotch zone is formed by a number of courses smaller than that of said front and rear central portions of said panty portion.

6. A method as claimed in claim 5, including the steps of knitting said crotch zone and said frontal and rear central portions of said panty portion on a circular hosiery knitting machine having two feeds spaced from

one another and needles grouped in two substantially opposite needle groups and an intermediate needle group arranged between said two substantially opposite needle groups, wherein said partial courses forming said frontal and rear central portions are knitted by the needles of said two substantially opposite groups of needles with a yarn fed by that of said two feeds which is opposite thereto and said courses across said crotch zone are knitted by the needles of said intermediate needle group with a yarn fed at regular intervals after a predetermined number of reciprocations by one and the other of said two feeds, said partial courses being joined to said courses of said crotch zone by feeding at least one needle at one end of said groups with the yarns of both said feeds.

7. A method as claimed in claim 2, including the steps of knitting said tubular portions between said legs and said tubular panty portion adjacent said waist opening on a circular hosiery knitting machine having two feeds spaced from one another and needles grouped in two substantially opposite needle groups and an intermediate needle group arranged between said two substantially opposite needle groups, wherein said tubular portions are knitted by feeding yarn to the needles of said two substantially opposite needle groups to form partial courses joined together at one end thereof and by feeding at regular intervals said yarn to the needles of said intermediate needle group to form courses joining together said partial courses at the other end thereof at regular intervals, whereby during reciprocation of said needle cylinder at least one needle at the end of adjacent needle groups is operated to take up yarn from both the feeds for joining together said courses at said ends.

8. A method as claimed in claim 1, including the steps of knitting some wales of elastic yarn adjacent said waist opening of said tubular panty portion knitted of a body yarn on a circular hosiery knitting machine having a needle cylinder with a generatrix along which said waist opening is defined, said needle cylinder including a first and a second needle group arranged symmetrically with respect to said generatrix and opposite to each other, a third needle group arranged between said first and second needle group substantially opposite said generatrix and a fourth and a fifth needle group adjacent each other and arranged opposite to said third needle group between said first and said second needle group, and further having two feeds for said body yarn and two feeds opposite thereto for said elastic yarn, wherein said wales of elastic yarn are knitted by feeding said elastic yarn to the needles of said fourth and fifth needle group.

9. A method as claimed in claim 8, further including the steps of knitting additionally to said wales of elastic yarn some wales of said body yarn by feeding selected needles of said fourth and fifth needle group with said body yarn fed by said feeds for body yarn and the remaining needles of said fourth and fifth needle group with said elastic yarn fed by said feeds for elastic yarn at regular intervals, thereby to form courses of body yarn arranged between courses of elastic yarn.

10. A method as claimed in claims 9, wherein knitting of said wales of elastic yarn and said wales of body yarn is carried out by effecting a 1:1 selection of the needles of said fourth and fifth needle group to divide them into even needles and odd needles, said even needles knitting said body yarn for a number of courses while said odd needles take up said elastic yarn at the

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beginning of said number of courses and hold it without knitting during formation of said number of courses, and subsequently said odd needles knitting said body yarn and said even needles holding said elastic yarn, so as to form elongated loops of elastic yarn defining a bridge connection over groups of courses of body yarn.

11. A method as claimed in claim 1, including knitting a crotch portion of said panty portion by selecting needles and forming held loops.

12. A circular hosiery knitting machine for manufacturing tubular panty hose and the like having a panty portion with a waist opening and two legs integral with said panty portion, comprising a needle cylinder having needles slidable therein, means for reciprocating said needle cylinder by an extent of substantially a complete turn, at least one feed for feeding a body yarn and two feeds for feeding elastic yarn, selecting mechanisms including patterning levers arranged along the periphery of the needle cylinder to select said needles at both strokes of each reciprocation to knit the yarn of a corresponding feed, and control means for causing substantially all the needles to knit at each of at least some strokes of reciprocation during the knitting operation of said tubular panty portion and for controlling the needles at the end of each said strokes of reciprocation to form a knitted selvage edge during manufacturing of at least a part of said panty portion to define said waist opening.

13. A circular hosiery knitting machine as claimed in claim 12, including two adjacent feeds for feeding said body yarn, wherein said needle control means further include means for causing at least one needle to knit

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together the yarns fed by said two adjacent feeds at the end of each reciprocation to form tubular parts made of complete courses adjacent the ends of said waist opening.

14. A circular hosiery knitting machine as claimed in claim 12, comprising needles grouped in a first and second needle group arranged diametrically opposite to each other, a third intermediate needle group arranged between said first and said second needle group, and a fourth and fifth needle group arranged between said first and said second needle group opposite to said third needle group, further comprising two feeds for feeding said body yarn to said needles of said first and second group during reciprocation of said needle cylinder such that each of said first and second needle groups is fed by that one of said two feeds which is arranged substantially opposite thereto, and for feeding said body yarn at certain times to said needles of said third needle group such that each of said feeds supplies yarn alternately and said third needle group is not fed during other times, and two feeds for feeding said elastic yarn to said fourth and fifth needle group such that each of said fourth and fifth needle group is fed by one of said feeds feeding elastic yarn and by a corresponding one of said feeds feeding said body yarn arranged opposite to the corresponding needle group, the machine wherein said selecting mechanisms include means for controlling at least one needle at at least one end of said groups to knit together the yarns fed to said groups by different feeds.

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