Jan. 17, 1967 B. T. R. REYMES-COLE 3,298,205

KNITTED FOOTWEAR

Filed July 23, 1962 2 Sheets-Sheet 1

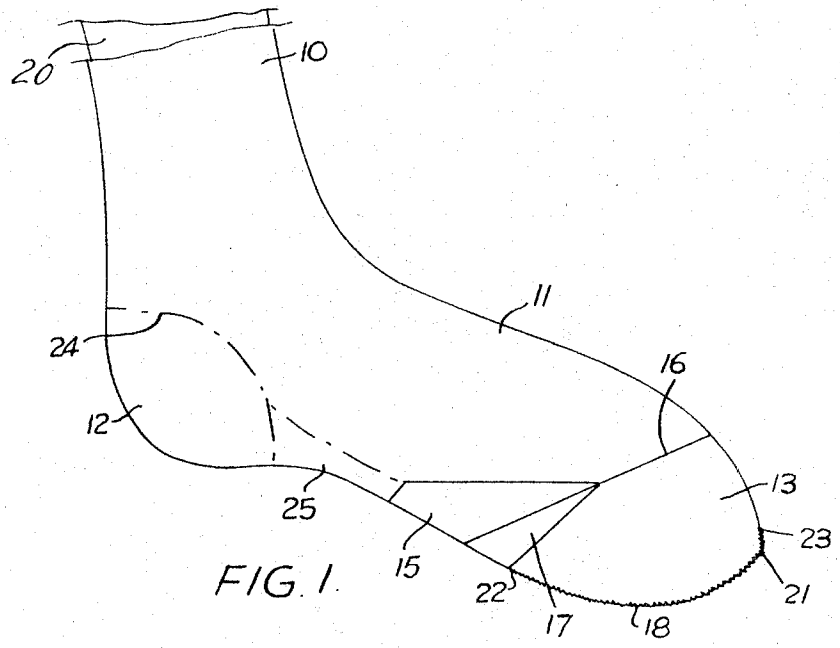


FIG. 1.

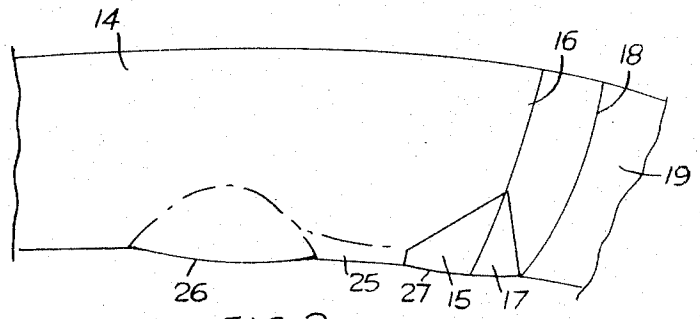


FIG. 2.

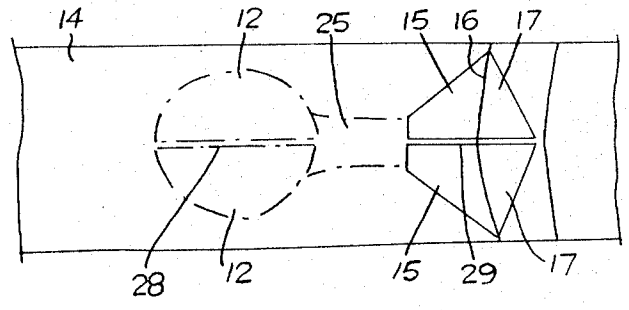


FIG. 3.

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Filed July 23, 1962 2 Sheets-Sheet 2

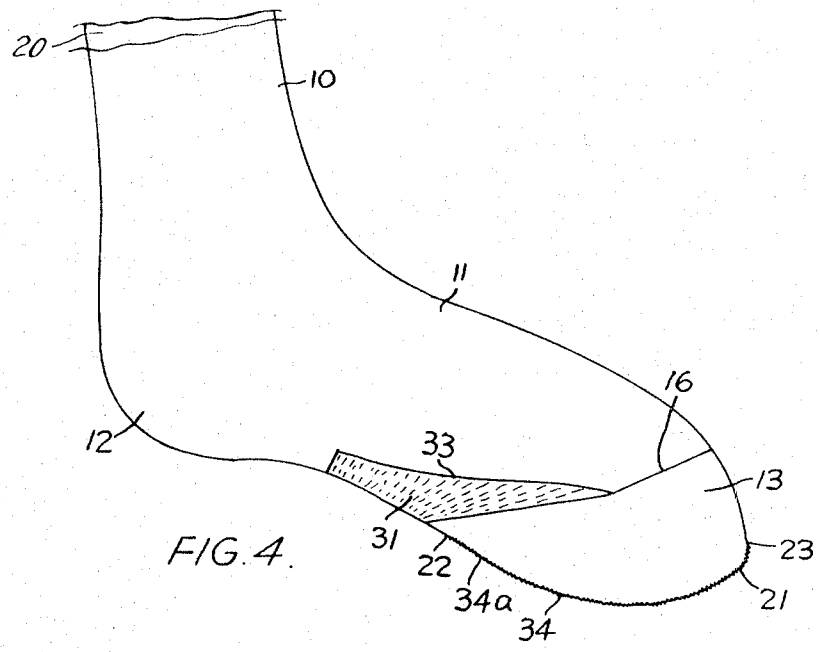


FIG. 4.

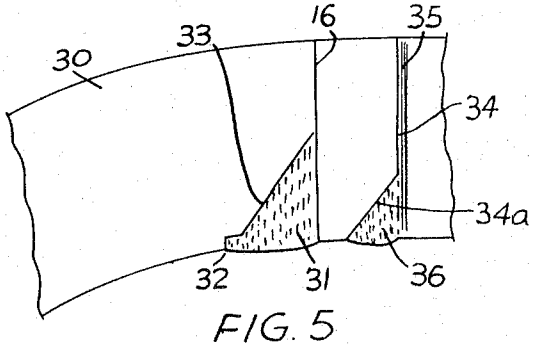


FIG. 5

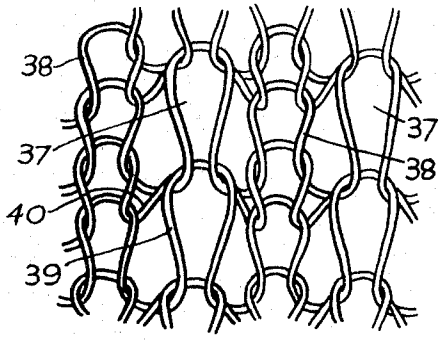


FIG. 6

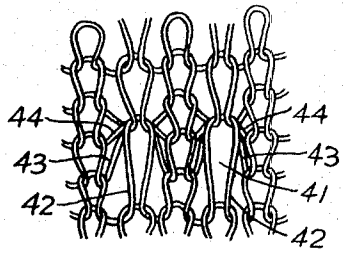


FIG. 7.

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KNITTED FOOTWEAR

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5 Claims. (Cl. 66—185)

This invention is for improvements in or relating to knitted footwear and has for one of its objects to facilitate the production of a well shaped toe end in a hose formed from a tubular knitted blank. Another object is to provide a hose having a toe end portion of neat and pleasing appearance.

In the manufacture of hose from circularly knitted fabric knitted by substantially continuous rotary knitting to form a tube which is subsequently closed at one end and subjected to a shaping operation, the formation of the requisite shaping of the toe portion presents certain problems tending to hamper the accurate formation of a correct shape which can be retained more or less permanently, without tendency for weakening the fabric. For example at the toe end of the foot the formation of the shape by closing the tube by seaming or linking and subsequently stretching the toe end tends to produce a very undesirable bulkiness beneath the toe towards the ball of the foot. The invention seeks to provide a procedure and article in which this and other difficulties are partly or wholly avoided in a simple and convenient manner.

In accordance with the invention there is provided a method of producing an article of hose which comprises the steps of knitting a hose blank in tubular form, with the part of the blank to form the toe end part knitted rotationally at least partly from thermoplastic yarn, and forming at a portion of the blank which is to be held in the region of the toe end of the foot bottom an area of fabric having a knitted structure in which parts of courses of loops have been knitted closer together than in neighbouring parts of the fabric so as to shorten the length of the fabric wale-wise in that region, closing the toe end of the blank by a join line extending from one to the other of the top and bottom lines of the foot, shaping the toe end by drawing the closed end of the fabric on to a board and stretching it to the shape of the board, and setting the fabric in the shape dictated by the board. This procedure not only enables hose to be formed with substantial absence of bagginess under the forward end of the foot but also facilitates the uniform production of hose to required length dimensions with uniform toe shaping.

The shortening of the fabric in the said area as just referred to causes the tubular fabric blank on leaving the knitting machine to be distorted so that its terminal course lines are caused to be diverted at one part of the width of the tube towards the portion used to form the under part of the foot. This provides for initial shaping such that the blank can be closed by linking or seaming along a course line with the join line initially diverted towards the under part of the foot. The amount of surplus fabric at that location to be disposed of in the final shaping of the foot is consequently reduced.

In a preferred procedure the wale-wise shortening of the fabric in the said area of the foot bottom is effected by the incorporation of tuck stitches. The concentration of the tuck stitches of the fabric in said area is caused to be such as to provide the required degree of shortening along the wales and gives the fabric the desirable property of increased capability of being stretched widthwise. In the case of a tubular blank knitted of tuck stitch mesh fabric in parts other than the under part of the foot bottom, the tuck stitch structure in the said area is caused to have a greater concentration of tuck stitches than is the fabric at neighbouring parts of the fabric.

In practising the invention the join line forming the toe end closure is conveniently positioned forwardly of the area of fabric which is shortened length-wise of the wales. This enables the shortened fabric structure to tend to cause the bottom end of the join line to be pulled under the foot thereby assisting in avoidance of undesirable bulkiness under the toe towards the ball of the foot. The part of the blank which is to form the toeward end of the foot may be knitted with reinforcement extending from a complete course line towards the toe end and the join line may be formed within such reinforced area.

The improved method may include the step of forming the heel part by knitting it at least substantially wholly by rotation in one direction from thermoplastic yarn with incorporation of tuck stitches spread throughout the heel part and so formed as to cause the heel part to be more readily capable of widthwise stretch than the instep part of the fabric, the shaping of the heel part being obtained at least partly by stretching it widthwise on the board and setting it to the shape thereof. The fabric blank may be knitted with incorporation of an area extending along the foot bottom from the heel part to the region under the toe end which has its courses drawn closer together lengthwise of the wales to shorten it in relation to the neighbouring parts of the fabric.

The invention further comprises a knitted article of hose produced from a tubular knitted blank and having the toeward end part of the foot incorporating thermoplastic yarn and closed by a join line extending from one to the other of the top and bottom lines of the foot and having an under toe area behind the join line wherein parts of courses of knitted loops are knitted closer together than in neighbouring parts of the tube, the toe end of the foot being shaped at least partly by distortion of the fabric to the shape of the board and being set to the shape of the board. The under toe area is conveniently shortened longitudinally of the wales as compared with neighbouring parts of the fabric by the incorporation of tuck stitches in said area. The toe end part of the hose may have reinforcement extending to the toe tip from a complete course line which runs from above the toe end downwardly and rearwardly on each side to a position under the foot.

In a convenient form the hose has its heel part knitted at least substantially wholly by continuous rotary knitting with incorporation of thermoplastic yarn and with tuck stitches in greater concentration than are present in the instep part opposite the heel, the heel part being shaped at least partly by being stretched widthwise to pouch form and set in such shape.

The foregoing and other provisions of the invention will be more fully apparent from the following description of certain convenient forms of articles of hose and their manner of manufacture illustrated by way of example in the accompanying drawings in which:

FIGURE 1 is a laid-out view of the foot and ankle portions of a ladies' stocking shown in position on a board which is partly broken away,

FIGURE 2 is a view on a smaller scale of a portion of a laid-out tubular fabric blank from which the stocking foot in FIG. 1 is formed,

FIGURE 3 is a view of the portion of the fabric blank as seen from another direction,

FIGURE 4 is a view corresponding to FIG. 1 but illustrating a different form of construction,

FIGURE 5 is a view on a smaller scale of a laid-out portion of a tubular fabric blank from which the stocking foot of FIG. 4 is formed, and

FIGURES 6 and 7 are enlarged fabric diagrams showing fabric structures which can be used at certain parts of the stocking foot.

Referring firstly to FIGS. 1 to 3 the portion of the stocking shown therein comprises a portion **10** at the bottom of the leg, an upper foot portion **11**, a heel portion **12** and a toe end portion **13**. The stocking is knitted at least substantially wholly by continuous rotary knitting to form a tubular blank part of which is indicated at **14** in FIGS. 2 and 3, with the toe end part **13** and the under foot part indicated at **15** in FIG. 1 knitted at least partly from a thermoplastic yarn such as nylon or other man-made fibre. The stocking may be knitted throughout entirely from such yarn or with incorporation of thermoplastic yarn only in parts which are to be shaped and set in the processing of the stocking blank. The first alternative is generally preferred.

In knitting the blank **14** the under-foot part **15** which is of tapering shape as shown widening up to a course line **16**, is knitted as an area of fabric having a structure in which the parts of courses included in it are formed of loops which have been knitted closer together than in neighbouring parts of the fabric so as to shorten the length of the fabric walewise. Forwardly of the area **15** there is preferably an area **17** tapering sharply to the bottom centre line from the course line **16** this being similarly formed of portions of courses in which the loops have been knitted closer together in the direction along the wales than in the neighbouring parts of the knitted blank. When the blank **14** has been completed it is closed by seaming or linking along the line **18** and the material at **19** beyond the line **18** trimmed away. The blank is afterwards placed on a board indicated at **20** in FIG. 1, the toe end drawn to the shape of the board and then set in that shape. The toe end part **13** of the hose is preferably, though not necessarily, reinforced as by the inclusion of splicing yarn along with the main yarn knitted in complete circular courses from the course line **16** to a position beyond the join line **18** which is also a complete course line in the embodiment of FIGS. 1 to 3.

The shortening of the fabric areas **15** and **17** in the direction along the wales may be effected by drawing shorter than normal loops in plain knitted fabric whilst knitting those areas. It is generally preferred however to shorten these fabric areas lengthwise of the wales by knitting them as tuck fabric with tuck stitches spread throughout the area in greater concentration than any tuck stitches incorporated in the upper part of the toe and the instep and leg regions. If these other regions are knitted as mesh fabric they will contain relatively widely spaced tuck stitches and the areas **15** and **17** will be knitted with more closely arranged tuck stitches. On the other hand a less concentration of tuck stitches in the areas **15** and **17** will suffice if the other areas are knitted of plain fabric. The modified structure occurring in the areas **15** and **17** can be secured by varying the action of the needles of the knitting machine by means of an adjustable cam which may be a stitch cam or a clearing cam, the adjustment being made by moving the cam up and down during portions only of the rotations of the needle cylinder the extent of such portions being varied progressively.

In FIG. 2 the tubular blank **14** is shown laid flat folded along the top and bottom centre lines of the foot and it will be seen that the effect of shortening the fabric along the wales in the areas **15** and **16** is to distort the tubular blank **14** to a somewhat curved form as seen in FIG. 2 so that the course lines **16** and **18** are caused to slant bending in towards the bottom centre line. This is advantageous in assisting shaping of the foot part on the board **20** and it makes possible a closure of the toe completely along a course line at **18** thus enabling the join to be effected by linking if preferred in order to secure a less bulky seam. Alternatively the join line may be sewn in known manner.

By comparison of the shape of the toe end portion of the hose area before and after boarding as in FIGS. 2 and 1 respectively it will be noted that in boarding the toe end the join line **18** is required to be positioned so as to extend from the region of the toe tip indicated at **21** under the foot to a point indicated at **22** just forward of the ball of the foot. To shape the toe end of the blank in this way it is necessary for the upper part of the toe to become stretched along the wales and for the bottom end of the join line **18** to be caused to merge at the join **22** smoothly into the bottom line of the foot with disposal of a certain bulk of the material which tends to become accumulated immediately behind the point **22** and to become puckered away from the board. The formation of a correctly shaped toe end portion is greatly facilitated by the provision of the areas **15** and **17** in which the fabric is shortened along the wales thereby assisting in causing the fabric to become drawn closely against the board whilst the upper part of the toe fabric becomes stretched longitudinally. Due to the shape of the areas **15** and **17** the variation in structure therein causes the greatest degree of shortening along the wale lines to occur at the bottom centre line of the blank with the degree of shortening being progressively reduced laterally therefrom, i.e. to be graded by progressive reduction in its amount, up to about the middle of the sides of the blank on each side thereof. This is found to facilitate the taking up of surplus fabric immediately behind the point **22** when the blank is drawn on to the board **20**.

It is particularly advantageous to have the areas **15** and **17** on each side of the blank shortened along the wales by the incorporation of tuck stitches. Tuck stitch fabric being somewhat compacted in the direction along the wales and less capable of being stretched in that direction along the courses, the advantage is secured that when shaping the tubular blank **14** on the board **20** widthwise stretch of the fabric is readily obtainable where needed in the areas **15** and **17** and at the same time the density of the fabric is maintained sufficiently to ensure good wearing properties. With tuck stitch fabric in the areas **15, 17**, the shaping of the toe end portion is facilitated by the fact that stretch along the wales in the upper part of the toe tending to contract the coursewise length exerts a drag coursewise on the tuck stitch fabric in the areas **15, 17**, thereby tending to stretch it widthwise and shorten the length of the wales in the parts **15** and **17** and by so doing draw the fabric close to the board with avoidence of the tendency for bagginess. The shaping of the toe end part is thus greatly facilitated without undue stressing of the distorted fabric so that the toe end portion can be set in a particularly good shape which it will retain permanently with the closure line **18** merging smoothly into the bottom line of the foot behind the join **22**. For shaping the toe end the seam line **18** may terminate forwardly at a point **23** immediately behind the toe tip **21** or actually at the toe tip if preferred. With the toe end part **13** reinforced up to the course line **16** it will be noted that in the boarded shape the boundary of the reinforcing extends from above the toe downwardly and rearwardly of the sides to underneath the foot.

The construction of FIGS. 1 to 3 is shown as having the heel part **12** knitted at least substantially wholly by continuous rotary knitting and the fabric in the area grounded at the line **24** from which the heel is formed is conveniently knitted of tuck stitch fabic which may be produced by intermittent variation of the position of a movable clearing cam in a manner as above mentioned. Such tuck stitch fabric will have tuck stitches spread through the area in greater concentration than any tuck stitches occuring in the instep part of the fabric so as to promote greater tendency for the heel part to stretch widthwise when placed on the board **20** to form the shape of the heel pouch by distortion from the tubular blank.

In the stocking shown in FIGS. 1 to 3 a narrow area 25 at the bottom of the foot between the heel part 12 and the areas 15, 17, is also formed with a fabric structure which is shortened in a direction along the wales as compared with the neighbouring fabric at the sides thereof. The part 25 is preferably also constructed of tuck stitch fabric. By shortening the fabric along the wales in the underfoot portion as well as in the portions 15 and 17 the attainment of a good foot shape on the board 20 is assisted. It will be realised that when the foot portion is boarded the upper centre line of the foot part of the blank has a longer distance to reach from the instep to the toe tip 21 than has the bottom line of the foot part of the blank which is required to reach only from the heel to the point 22. Shortening of the fabric in the area 25 thus contributes usefully to the final desired result.

The blank as shown in FIG. 2 is assumed to be knitted with the heel part 12, the underfoot part 25 and the areas 15 and 17 all knitted of tuck stitch fabric. This while compacting the fabric in the direction along the wales tends to pucker it somewhat widthwise causing slight bulging of the blank as indicated at 26 and 27 in FIG. 2 before the blank is placed on a board. The bulge at 26 contributes to the shaping of the heel while the bulge at 27 is taken up by the fabric areas 15 and 17 being drawn widthwise when the toe is shaped on the board.

It is advantageous when knitting the blank 14, during the knitting of the heel part 12 and the areas 15 and 17, to provide a structural change giving a marker line along the bottom line of the foot as a guide to the operative when boarding the hose on the board 20. Such a marking is indicated in FIG. 3 at 28 and 29. In FIG. 3 the hose blank is shown as laid out flat with folds at the sides of the blank instead of at the bottom line as in FIG. 2. It will be seen that the heel area 12 is in two similar parts at opposite sides of the marker line 28 and similarly the areas 15 and 17 are in two similar parts on opposite sides of the marker line 29. There may also be a similar central marker line formed in the area 25 if desired. The marker lines may be formed by a contrast in knitted structure over a small number of wales as compared with the areas 12, 15 and 17. Thus with said areas formed of shorter than normal plain loop structure the wales at 28 and 29 may incorporate stitches of normal length; while when the said areas are of tuck stitch fabric the wales at 28 and 29 may be formed of plain fabric. These differences will be sufficient to provide a sufficiently noticeable line marking to aid the operative in placing the foot of the blank in correct alignment on the board 20.

To aid in securing a proper position for the seam line 18 it is convenient when knitting the blank 14 to produce a variation in fabric structure around the tubular blank at or just beyond the location for the join line 18. This can be done by knitting one or more slack courses at the required position, for example to a tuck fabric, or by a change in the yarn fed to the needle. A marker line is thereby produced giving a clear guide to the operative who is to close the tube as to the required position for the join line 18.

It will be appreciated that the formation of the toe end part of the foot of a hose in the manner just described results in a hose having a particularly well shaped and neat foot portion devoid of any bagginess under the ball of the foot. Furthermore the procedure makes possible the production of batches of hose which are consistently uniform as to size and shape, this being provided for by the fact that the join line can readily be positioned exactly in the required relationship to the neighbouring parts of the hose, as well as by the construction of the under foot portion facilitating movement of the blank into the required shape of the board.

In the modification illustrated in FIGS. 4 and 5, a stocking foot is shown which is knitted from a yarn of nylon or other thermoplastic man-made fibre. A portion of the tubular blank from which the toe end part of the foot is formed is indicated at 30 in FIG. 5 and is knitted to incorporate a shaped area 31 which commences of narrow width at its rearward end 32 and afterwards diverges widthwise on each side along a boundary 33 up to the course line 16 corresponding to the same numbered course line in FIGS. 1 and 2. This tapered area 31 is knitted of tuck stitch fabric having tuck stitches in greater concentration than any present in the adjoining parts of the blank. A marker line corresponding to the line 28 of FIG. 3 may be formed on the bottom centre line between complementary areas 31 on each side. In this construction the closure line is at 34 and 34*a* the upper part being on a course line and the lower part 34*a* extending slantwise of the courses. The area 31 is immediately behind the lower part 34*a*. Between the line 34*a* and the coursewise continuation of line 34 there is a tapered area of fabric which is knitted of a different structure from that between the course line 16 and the line 34, 34*a*. The tapered area to the right of line 34*a*, FIG. 5, may for example be knitted of tuck stitch fabric. To the right of the course line 34 as seen in the figure are knitted courses of cotton waste as indicated at 35. These courses and the altered structure in the area 36 to the right of line 34*a* provide a clear marking as a guide to the operative in closing the blank by a seam running exactly on the lines 34 and 34*a*.

After the blank 30 has knitted the toe end is closed by a seamed join line on the lines 34 and 34*a* and surplus material trimmed away beyond that line. The blank is then drawn on to the board 20 and the toe end part as well as the remainder of the blank brought to the shape dictated by the board. Thereupon the stocking blank is set to that shape by applying heat treatment in known manner. As the foot part of the blank is drawn on to the board the wales above the toe end part are stretched lengthwise causing widthwise tensioning and stretching of the fabric at the sides and underneath the toe. The area 31 containing tuck stitch fabric yields widthwise causing further shortening of the fabric along the wales under the foot immediately behind the rear end 22 of the join line 34, 34*a*, and so pulling firmly against the board the part of the fabric which would otherwise tend to become puckered outwardly from the board.

In the construction of FIGS. 4 and 5 the heel may be formed in any desired manner. Thus it may be formed as a reciprocatorily knitted pouch, or boarded to shape from plain tubular fabric with or without preliminary part shaping by interposition at the heel side of partial courses at intervals between complete courses, or the heel may be boarded to shape from tuck stitch fabric as in FIG. 1. The part of the hose blank between the lines 16 and 34 may be reinforced or not as desired.

FIGS. 6 and 7 illustrate examples of tuck stitch fabric structures suitable for employment in the areas 15 and 17 of FIG. 1 and the area 31 of FIG. 4, and also if desired in the heel area 12 and underfoot area 25 of FIG. 1. In FIG. 6 there is shown a 1 x 1 tuck stitch fabric in which tuck stitches 37 are formed in alternate wales at alternate courses and normal stitches 38 are formed in intervening wales. Each tuck stitch comprises a held loop 39 and a tuck loop 40. This type of structure may be varied by having the tuck stitches staggered in different courses so that all wales contain tuck stitches, or by having tuck and plain stitches in 2 x 2 formation. In the tuck fabric structure of FIG. 7 each tuck stitch comprises a held loop 42 extended over more than one course and two tuck loops 43 and 44 drawn at successive courses, the tuck stitches being knitted in alternate wales. Obviously other variations of tuck stitch fabric are suitable to provide good widthwise stretch properties whilst compacting the fabric along the wales so that lengthwise stretch is resisted.

It will be evident that in either of the constructions illustrated the heel part of the hose may be formed in

any desired manner as mentioned in connection with FIG. 4. The tuck stitch fabric used under the foot part of the hose and if desired in the heel part as above described may be so chosen as to provide also for an increase of density in the fabric for the purpose of reinforcement.

Wherever references are made herein to the procedure of drawing a closed hose blank on to a board or of stretching such blank to the shape of the board it is intended to be understood that the drawing or stretching procedure is preferably carried out only to a sufficient extent to ensure that the shrinkage which takes place in the fabric during the subsequent setting procedure will bring the blank to the exact shape of the board.

What I claim is:

1. A method of producing an article of hose which comprises the steps of knitting a hose blank in tubular form with the part of the blank to form the toe end portion knitted rotationally at least partly from thermoplastic yarn, forming a modified fabric area which is to be under the foot immediately to the rear of a toe end join line, in which area the stitches are so formed as to shorten the fabric walewise relatively to fabric adjoining and outside said area, with the greatest degree of walewise shortening being on the centre line which is to be under the foot, and with the degree of shortening being progressively, reduced laterally therefrom, closing the toe end of the blank by a join line extending from the top to the bottom of the toe end portion up to the front end part of said shortened fabric area proximate said bottom centre line, shaping the toe end portion by drawing the closed end of the fabric onto a board and stretching it approximately to the shape of the board, and setting the fabric in the shape dictated by the board.

2. A method according to claim **1** wherein the knitting of the fabric area in which the fabric is shortened walewise is extended at reduced width to the part of the hose blank which is to form the heel.

3. A method according to claim **1** wherein the shortening of the fabric in said shortened fabric area is produced by a concentration of tuck stitches which by having their held loops stretched from the course in which they are formed to a course beyond the next succeeding course cause the fabric area to be shortened walewise.

4. A knitted article of hose produced from a tubular blank and having the toeward end part of the foot incorporating thermoplastic yarn and closed by a join line extending along the bottom of the toeward end part of the foot and having a modified fabric area under the foot immediately to the rear of the join line, in which area the stitch structure has shortened the fabric area walewise relatively to the fabric portions at opposite sides of said area, with the greatest degree of walewise shortening being on the bottom centre line of the foot, and the degree of such shortening being progressively reduced laterally therefrom, the toe end of the foot having been shaped at least partly by distortion of the fabric to the shape of the board and having been set to the shape of the board.

5. An article of hose as claimed in claim **4** wherein the said shortened fabric area contains a concentration of tuck stitches wherein extension of the held loops transversely of the courses has produced the walewise shortening of the fabric area.

References Cited by the Examiner

UNITED STATES PATENTS

243,425	6/1881	Appleton	66—184
1,110,443	9/1914	Kilbourn et al.	66—186
2,145,197	1/1939	Holmes	66—178 X
2,320,250	5/1943	Solar	66—187
2,357,630	9/1944	Cole	66—187
2,701,458	2/1955	Ducharme	66—187 X
2,740,279	4/1956	Getaz	66—187
3,085,410	4/1963	Liozillon	66—185
3,221,522	12/1965	Nebel	66—185
3,228,198	1/1966	Nebel	66—185

FOREIGN PATENTS

1,194,507	5/1959	France.
19,926	1906	Great Britain.
445,622	4/1936	Great Britain.
599,610	3/1948	Great Britain.
881,077	11/1961	Great Britain.
578,115	6/1958	Italy.

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