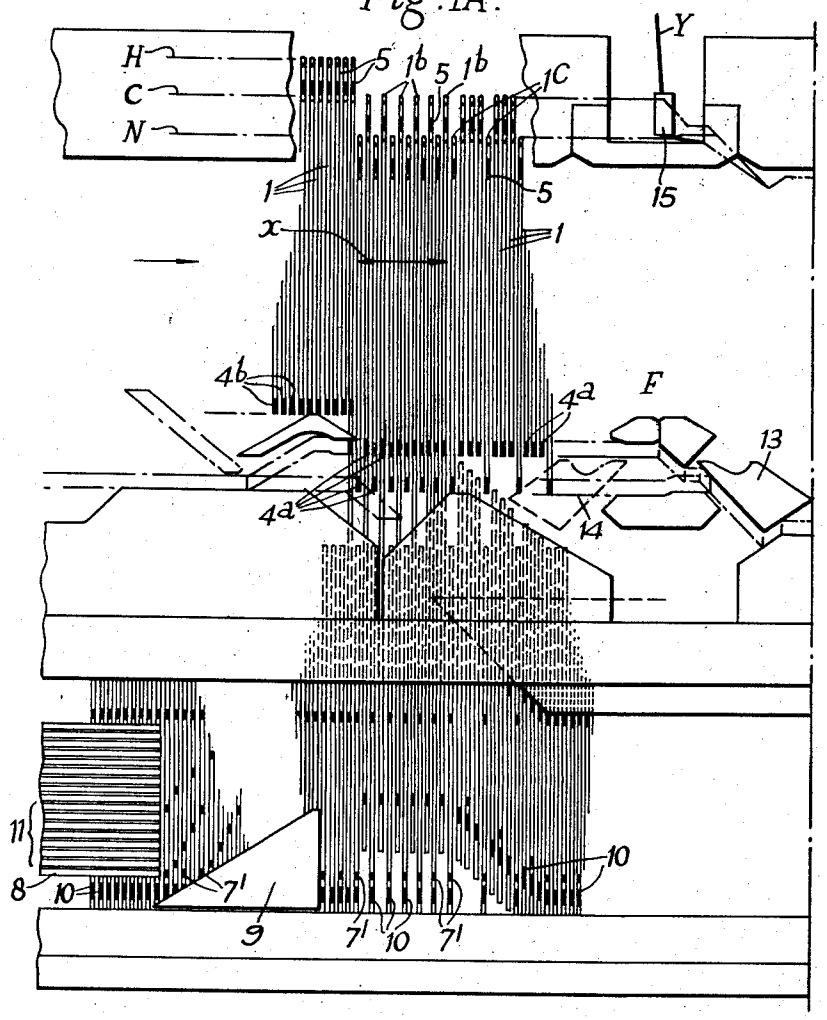
June 18, 1963 A. M. BROWN 3,093,985

METHOD OF KNITTING FINE GAUGE STOCKINGS

Filed July 1, 1959 7 Sheets-Sheet 1

Fig. 1A.



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METHOD OF KNITTING FINE GAUGE STOCKINGS

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Fig. 1B.

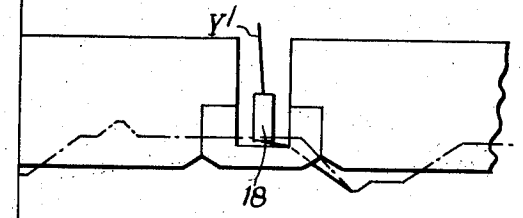

Fig. 2.

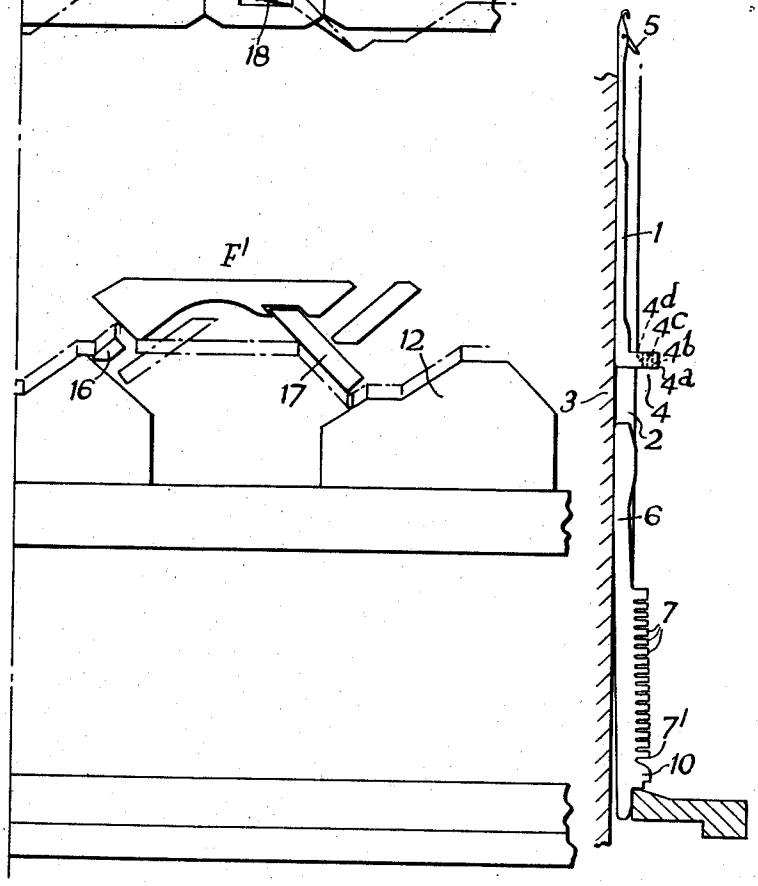

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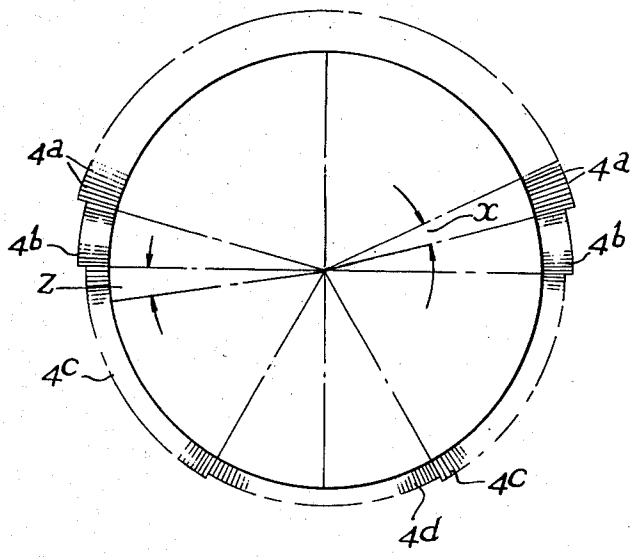
Fig. 3.



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METHOD OF KNITTING FINE GAUGE STOCKINGS

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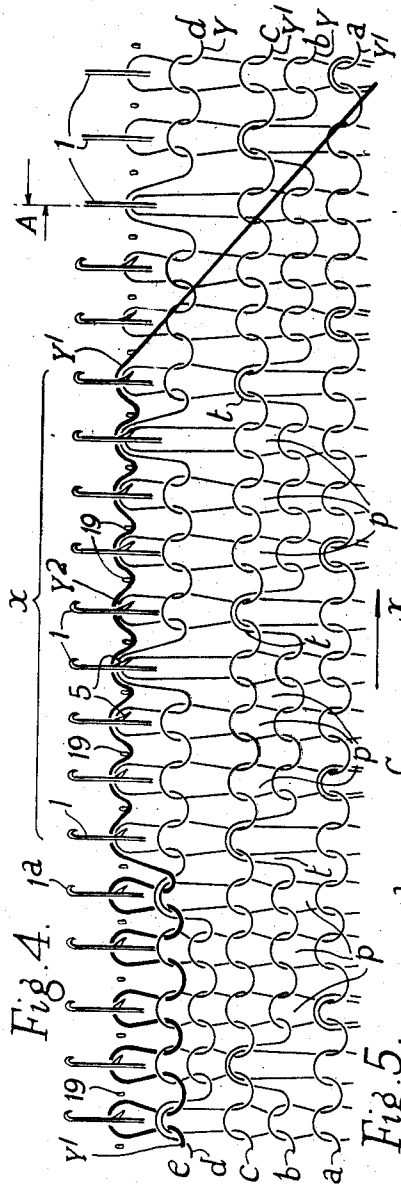

Fig. 4.

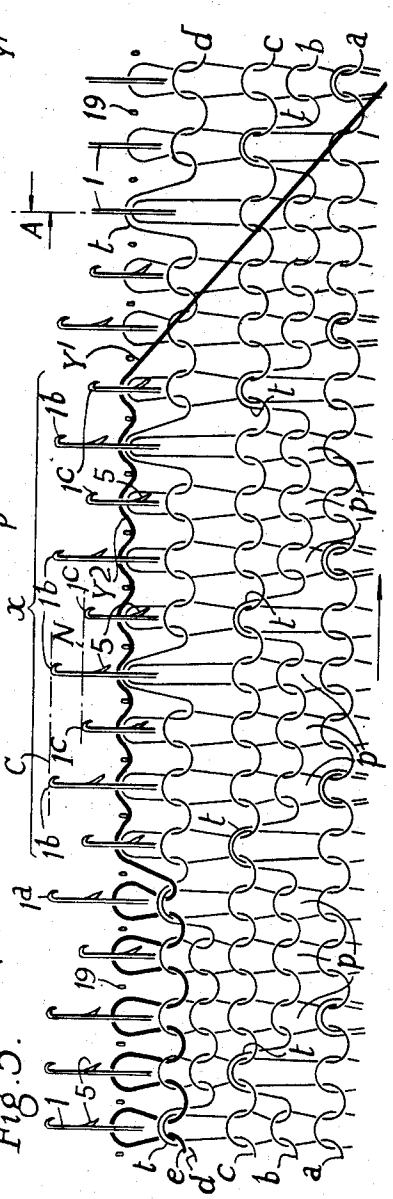

Fig. 5.

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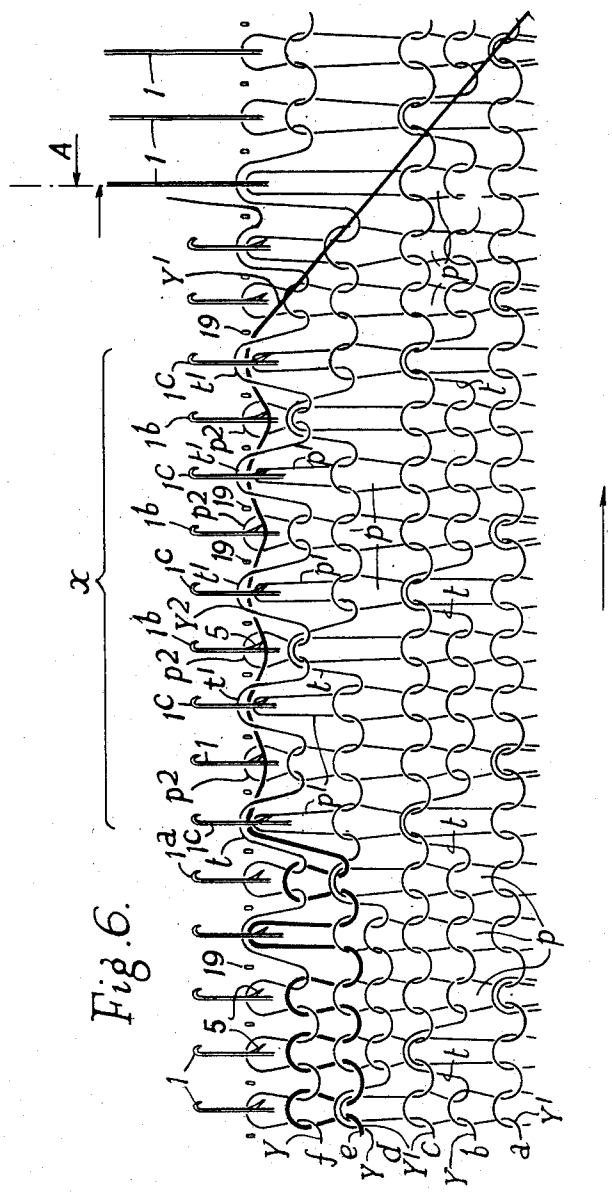

Fig. 6.

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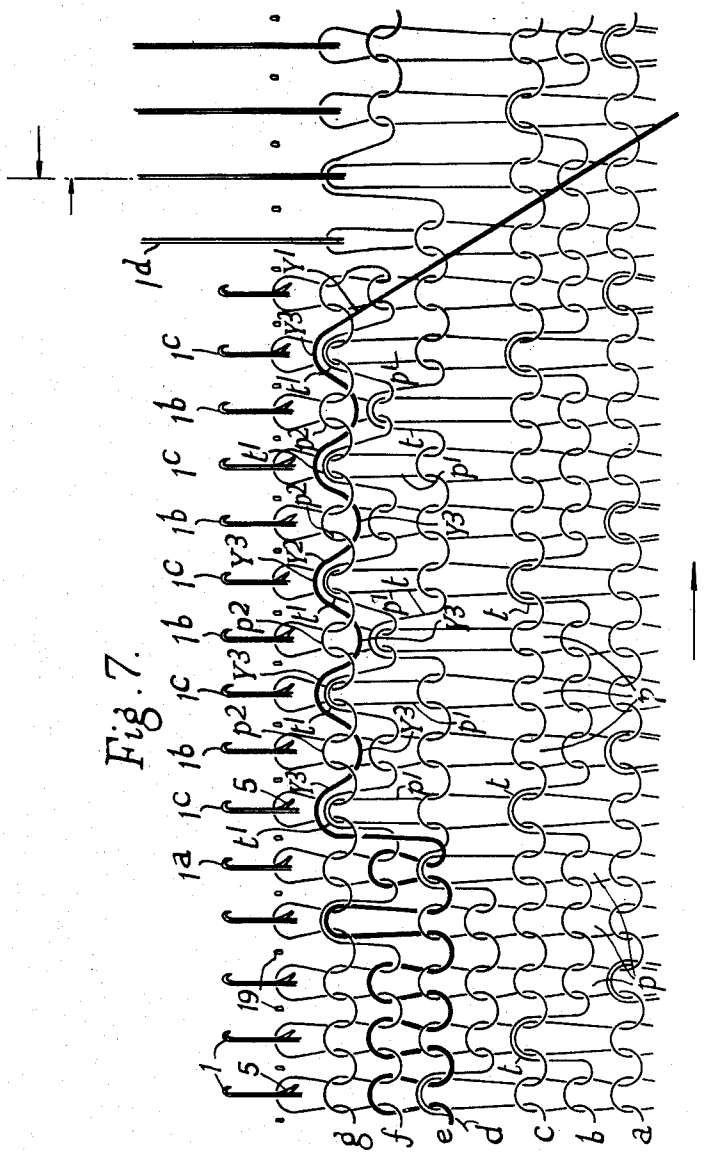

Fig. 7.

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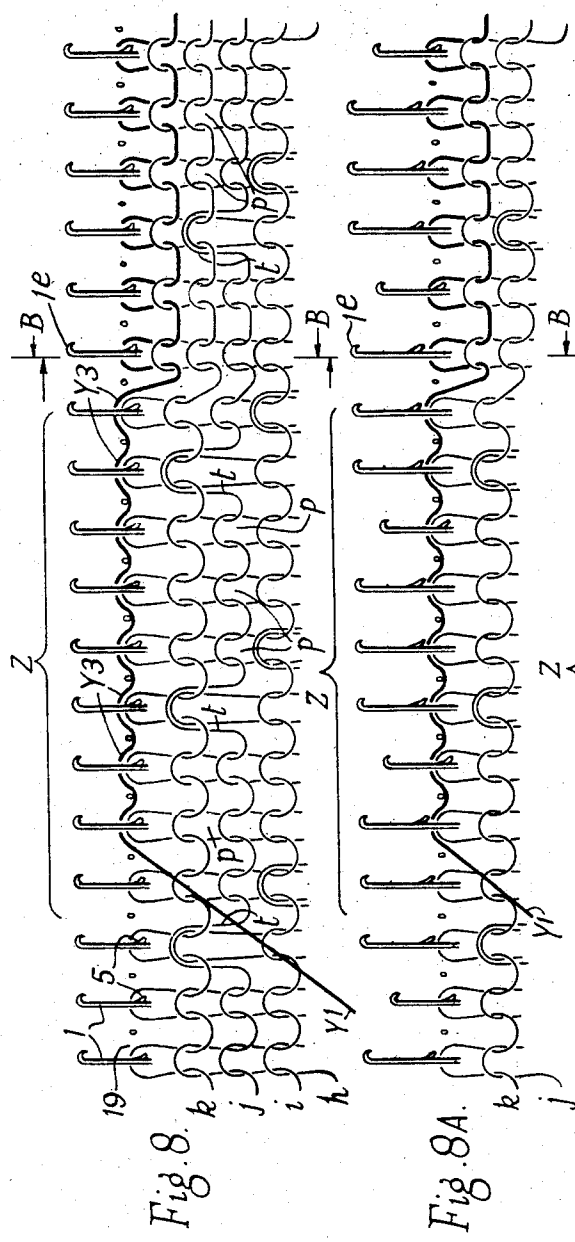

Fig. 8.

Fig. 8A.

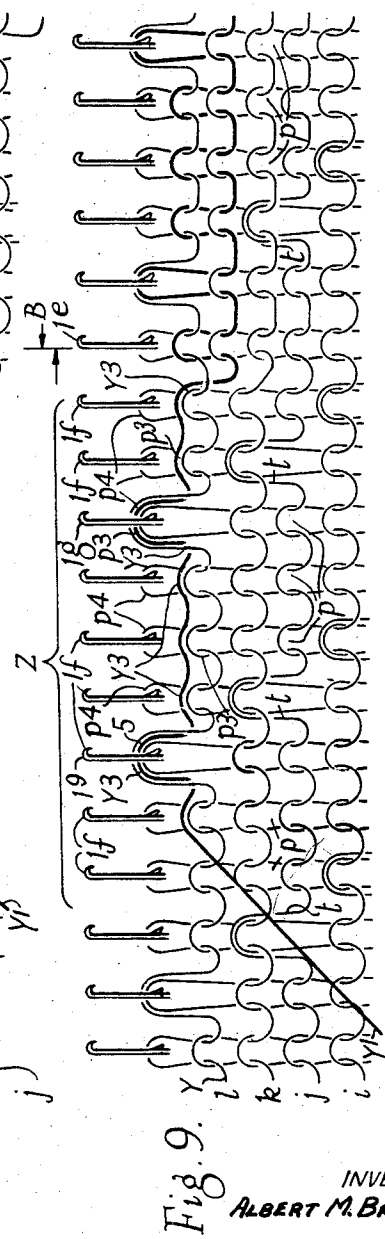

Fig. 9.

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3,093,985

METHOD OF KNITTING FINE GAUGE STOCKINGS

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Filed July 1, 1959, Ser. No. 824,308
Claims priority, application Great Britain July 1, 1958
4 Claims. (Cl. 66—42)

This invention relates to the production of stockings, composed of fine denier yarns, on fine gauge circular latch needle hose machines equipped with sinkers.

By the term "feed" used herein is meant the complete means at a knting station for not only feeding a yarn or thread to the needles, but also the clearing cam for advancing needles to clear, and the stitch cam for retracting the needles to knit and knock-over, at the said station.

A knitting machine of the kind concerned comprises at least two feeders, viz. a main feed, and an auxiliary feed which is adapted to be rendered operative and inoperative, according to requirements.

In making a stocking on such a machine, both the main feed and an auxiliary feed are in operation together during rotary motion of the machine to produce the welt, shadow welt, leg and the instep and foot bottom, whilst for the knitting of the heel and the toes, by reciprocatory motion, an auxiliary feed is conventionally rendered inoperative so that reciprocatory knitting is performed at the main feed only. Moreover, if and when a stocking is to be made with a ring toe, then it is customary to withdraw the auxiliary feed preparatory to the knitting of such toe on the main feed only.

But in changing from two-feed knitting to single-feed knitting, and vice versa, an objectionable "eyelet" has heretofore been formed. Such an eyelet occurs whenever the free and loose end portion of yarn slips back into either the first or last stitch formed depending upon whether the auxiliary feed is being introduced into or withdrawn from operation. The result is the formation of enlarged stitches having the appearance of holes in the fabric.

Thus, for instance, when going from the leg into the heel, or going into the ring-toe, or toe, for which purpose the auxiliary feed is withdrawn, the last needle to clear at the said feed is retracted and draws a loop in the normal manner. Since, however, there is no following loop intermeshed with the fabric, but only a free and loose end portion of yarn, the last formed loop is no longer controlled and becomes unduly extended to produce an undesired eyelet. Then again, when coming out of the heel into the foot at which time the auxiliary feed is reintroduced, the first loop formed at this feed, being uncontrolled, becomes extended to produce an eyelet; this is because the portion of yarn, immediately preceding the first loop and previously extending from the yarn guide to the trapper, is a free and loose end.

The primary object of the present invention is to provide an improved and simple method, involving various procedures, of covering up the unsightly eyelet holes produced in the circumstances described.

Broadly considered, the method of this invention, performed on a circular hose machine of the kind herein referred to, consists of taking into the hooks of all of a group of successive needles (having thereon loops from the preceding course) the free and loose end portion of yarn adjacent to the beginning or the end of the auxiliary feed, depending on whether the latter is being introduced into or withdrawn from operation, causing these needles at the auxiliary feed, in co-operation with sinkers, to distort the said free and loose end portion of yarn into

an undulatory or crimped form by drawing or measuring it into loops extending lengthwise of the needles, and, at a normal succeeding course, locking the undulatory or crimped portion of yarn into the fabric by knitting it together with the loops already retained by some of the said group of needles.

The precise number of needles in the aforementioned group of successive needles (hereinafter for convenience referred to as the "specified group") may, of course, vary. But approximately ten needles, variable within limits one way or the other, is quoted as a convenient number. These needles represent either the first or the last group of needles to pass through the auxiliary feed preparatory to this feed being introduced into or withdrawn from operation.

In any event, it is to be clearly understood that the measured loops formed in the relevant free and loose portion of yarn with the object of distorting it to an undulatory or crimped form are not drawn through any knitted loops cast off the needles of the specified group. On the contrary, the said needles must be prevented from clearing their loops from the preceding course so that the loops then on the latches of these needles will not be cast off but retained in the hooks of the needles together with measured loops of the undulatory or crimped portion of yarn whereby at a normal succeeding course both retained and measured loops will be cast off the relevant needles of the specified group.

The improved method of covering up eyelet holes can be carried out on a circular hose machine of the kind herein referred to set up to produce plain hose. It is, however, primarily the intention to perform the method on a machine set up to produce micro mesh fabric, that is to say fabric knitted on a set of needles of which spaced groups thereof clear whilst intervening needles tuck at the main feed. A well-known arrangement of needles for this purpose involves a 3 x 1 set out, i.e. a formation and operation of jacks associated with the needles such that at the main feed spaced groups of three needles clear whilst intervening single needles tuck. For convenience in description, the examples hereinafter to be described will be confined to the knitting of such micro mesh stockings without, however, any limitation in this respect.

In accordance with an optional feature of the improved method, spaced, e.g. alternate, needles only of the specified group may be deliberately selected to clear and take the undulatory or crimped free end portion of yarn under their latches, the remaining intervening needles of the group retaining the said portion of yarn in their hooks. In this way, when the free and loose end portion of yarn is ultimately knitted into the fabric, the fact that the yarn is only interlooped with spaced wales will enhance the locking effect and make it more difficult to pull out the yarn.

Especially when going into a heel, this deliberate selection of needles mentioned in the last preceding paragraph may be a 1 x 1 selection. For example, where the circular hose machine is equipped with a 1 x 1 welt selector including a jack-raising cam adapted for action upon bottom butts on alternate ones of a set of jacks associated with the needles of the machine, then such a selector may be brought into commission for the purpose of effecting the special 1 x 1 selection of the specified group of needles. Such a selection is naturally quite straight forward when plain hose is being produced. When, however, a hose is being knitted in micro mesh on, say, a 3 x 1 (three clear and one tuck) basis, then the bringing into commission of a 1 x 1 welt selector for the particular purpose just described is effected in

such a way as to temporarily over-ride and modify the 3 x 1 micro mesh selection of the needle-actuating jacks.

Somewhat similar considerations arise when going from the foot into a ring toe or/and a toe. But when going into a ring toe, the first course to be knitted after withdrawal of the auxiliary feed is a circular or round course, in contra-distinction to a substantially half round course produced by reciprocatory knitting as at the commencement of a heel or a toe.

It is not, however, essential in all cases that certain needles of the aforementioned group of successive needles shall be deliberately selected to clear; indeed such a deliberate selection may not be convenient or even possible in some circumstances—for instance when going out of a heel into the foot of a plain hose. In such a case, the very fact that the relevant free and loose portion of yarn is distorted into an undulatory or crimped form, with measured loops extending lengthwise of the needles, ensures that this portion of yarn becomes located in the hooks of at least some of the needles of the group of successive needles and knitted into the fabric together with the loops from a following course. As will be appreciated, this is somewhat of a "hit and miss" method in so far as it cannot be predicted which particular cleared needles of the group will take the undulatory or crimped portion of yarn. But when knitting a micro mesh, in contra-distinction to a plain stocking, the 3 x 1 or other jack selection of the needles can be relied upon to ensure a more positive locking in of the crimped free and loose portion of yarn; this is because one in every few needles of the aforesaid group of successive needles will not be cleared but will remain down at tuck or normal running level so that the undulatory or crimped yarn lies on, instead of being below, the latches of such needles. As previously mentioned, the fact that the undulatory or crimped portion of yarn is not interlooped with every wale enhances the locking-in effect.

In carrying out the method of this invention, the yarn guide, the stitch cam and the clearing cam of the auxiliary feed must be precisely timed suchwise as to produce the results hereinafter to be set forth.

In order that the invention may be more clearly understood and readily carried into practical effect, specific procedures in accordance therewith, carried out on a two-feed circular independent latch needle hose machine set up to produce 3 x 1 micro mesh, will now be described with reference to the accompanying drawings, wherein,

FIGURES 1A and 1B together constitute a developed lay-out of the essential parts of the cam system of the said machine at the main and the auxiliary feeds, a few of the needles being shown in FIGURE 1A,

FIGURE 2 is a vertical sectional view through the cylinder of the machine and depicts one of the needles and the associated needle-actuating jack,

FIGURE 3 is a diagrammatic plan of the butt layout of the complementary series of instep and heel and toe needles in the machine,

FIGURES 4 to 7 are diagrammatic representations of a portion of micro mesh stocking fabric and a few of the needles of the machine shown at successive stages of the procedure adopted when going from the leg into the heel of a stocking, and

FIGURES 8, 8A and 9 are three somewhat similar views showing fabric and needles respectively at the commencement and a later stage of the procedure adopted when going out of a heel into the foot of a stocking.

In the drawings it is to be understood that the loops which are not held loops and which are shown as elongated are so shown in order to clarify the drawing and aid the reader's understanding of same.

Like parts are designated by similar reference characters throughout the drawings.

In the drawings the independent needles are indicated at **1**. These needles, mounted in grooves **2** in a cylinder **3** (FIGURE 2), are provided with knitting butts **4** and

with pivoted latches **5**. Beneath each needle **1** there is provided in the corresponding groove **2** a needle-selecting jack **6** which is furnished with an initially full complement of frangible selector butts **7**. Certain of these butts are broken away, different ones on different jacks, according to paterning requirements. It is, however, convenient here to mention that only alternate ones of the jacks **6** have a bottom butt **7'**, the intervening bottom butts on the remaining jacks being broken away. This 1 x 1 arrangement of the bottom selector butts is to enable the needles **1**, when required, to be appropriately selected for the knitting of a welt in a manner well known to those acquainted with the art. Thus, when such a 1 x 1 selection of the needles is required, a 1 x 1 welt selector lever **8** is so operated as to push back into the needle grooves **2** only the alternate jacks **6** provided with bottom butts **7'**, the remaining or intervening jacks being left forward and inoperative in the position shown in FIGURE 2. Each of the jacks selected by the lever **8** and so pushed back into its groove **2** is enabled to be raised from a normal running or tuck level N to a clearing level C (FIGURE 1A) by means of a jack raising cam **9** which acts on the actuating butt **10** of the jacks **6**.

The machine is set up to produce 3 x 1 micro mesh fabric which means that for straight forward knitting in the leg of a stocking three successive needles **1** are advanced to the level C to clear and a following single needle is permitted to remain down at the normal running or tuck level N throughout the full circle of needles. That is to say, spaced groups each of three needles clear whilst the intervening single needles merely tuck. Such a 3 x 1 micro mesh division of needles is shown towards the right-hand side of FIGURE 1A. This division is effected by suitable actuation of relevant selector levers of the group indicated at **11**.

At the main feed F illustrated in FIGURE 1A there is a forward or leg stitch cam **13** and a reverse or heel stitch cam **14**. A guide **15** feeds a main yarn Y to the needles at the main feed. At the auxiliary feed F' represented in FIGURE 1B, the clearing cam and the stitch cam are indicated at **16** and **17** respectively. The auxiliary stitch cam is followed by a conventional upthrow cam **12**. An auxiliary yarn Y' is fed to the needles **1** at the feed F' through a yarn guide **18**.

The needles **1** of the machine are arranged in two complementary and substantially semi-circular series. Thus, as represented in FIGURE 3, there is a nearly semicircular series of heel and toe needles all furnished with long butts *4a*. A heel is knitted on these needles at the main feed F only by reciprocatory knitting. The long butt needles are complemented by a series of instep needles having medium butts *4b*, short butts *4c* and extra short butts *4d* (see FIGURE 2). As will be seen in FIGURE 3, the short butts *4c* are flanked at opposite sides by groups of the medium butts *4b* immediately adjoining the opposite ends of the series of long butts *4a*, and the extra short butts *4d* are arranged in a panel in the centre of the short butts *4c*. All of the instep needles are, of course, raised to the idle level H known as "heeling" height preparatory to the knitting of a heel. In FIGURE 1A instep needles at the level H, and needles at the heights N and C are clearly shown.

The needles **1** co-operate with sinkers **19**.

A specific procedure adopted when going from the leg into the heel of a stocking will now be described with reference principally to FIGURES 4–7 of the drawings. In each of these figures, the fabric, drawn purely diagrammatically and to a greatly magnified scale, is shown as viewed from the inside of the needle cylinder **3**, looking outwards during knitting. That is to say, the back of the fabric, and the backs of the needles are shown; the needles are, however, turned sideways slightly (as if drawn in perspective) so that the open latches **5** thereof will be seen. In FIGURES 4–7, moreover, the 3 x 1 micro mesh structure can be seen, the spaced groups each of three

plain knitted loops being indicated at *p* and the single intervening tuck stitches at *t*. The needles to the left of the vertical line A in these figures are long butt needles, i.e. the heel and toe needles, whereas the few needles to the right of this line are instep needles which are raised to the idle level H preparatory to the knitting of a heel.

In the procedure now to be described the auxiliary feed F′ is withdrawn from operation towards the end of the series of long butt heel and toe needles of which approximately the last nine or ten or so will be referred to as the "specified group"; this group is indicated at *x* in each of FIGURES 1A and 3. The last needle to knit at the auxiliary feed is indicated at **1***a*. During withdrawal of the auxiliary feed F′, early withdrawal of the clearing cam **16** at that feed must be so timed as to prevent long butt needles of the specified group *x* from being cleared and thereby ensure that these needles shall receive auxiliary yarn Y′ at the said feed and be retracted by the auxiliary stitch cam **17** to stitch drawing level. Thus, on the long butt needles of the specified group *x* being subsequently acted upon by the conventional upthrow cam **12** following the auxiliary stitch cam **17**, and thereby advanced to the tuck or normal running level N, the free and loose end of the yarn Y′ resulting from withdrawal of the auxiliary feed will be retained, by nibs of the sinkers **19**, on the latches of these needles. The measured loops formed of the aforementioned free and loose end of yarn, as a consequence of the specified group of long butt needles being retracted to stitch drawing level, produce the undulatory or crimped effect shown in FIGURE 4.

Thus, FIGURE 4 shows the finish of the auxiliary feed yarn Y′. In further explanation of FIGURE 4 it should be mentioned that course *a* is knitted of the auxiliary yarn Y′ at the feed F′; course *b* is knitted of the main yarn Y at the feeder F; course *c* is again knitted of the yarn Y′ at feeder F′, the tuck loops from this course being held on idle short butt needles whilst making the heel; course *d* is knitted of the yarn Y at F, the plain loops from the last mentioned course being held on idle short butt needles whilst making the heel, and at *e* is shown the end of the last course knitted of the yarn Y′ at the auxiliary feed F′, preparatory to commencement of the heel, the undulatory or crimped loose end portion Y^2 of this yarn extending across the fronts and the open latches of the uncleared needles **1** of the specified group *x*.

Prior to the main feed F, and on the last course of knitting prior to the motion of the machine changing from rotary to reciprocatory for the knitting of the heel, the 1 x 1 welt selector lever **8** is brought into commission to over-ride the 3 x 1 set out so far as the long butt heel and toe needles of the specified group *x* are concerned. That is to say, when going into the heel the nine or ten (more or less) needles of the specified group are, unlike the remaining needles of the machine, in a 1 x 1 relation, i.e. alternate needles **1***b* of the said group are raised to the clearing level C whilst the intervening needles **1***c* of the group are permitted to remain down at the normal running or tuck level N—all as clearly shown in FIGURE 5.

The long butt heel and toe needles now pass through the main feed F for the last time preparatory to the commencement of reciprocatory knitting, and all of such needles are dealt with in the normal way except the needles of the specified group *x* which have not been advanced to clear at the auxiliary feed F′. Accordingly, on completion of this last main feed course of circular knitting, indicated at *f* in FIGURE 6, each of the uncleared long butt needles **1***c* of the specified group *x* will have on its latch **5** one loop *p* from the previous main feed course *d*, plus the undulatory or crimped end portion Y^2 of yarn Y′ from the previously withdrawn auxiliary feed F′ and also a loop *t*′ drawn in the main feed course *f* just completed (see FIGURE 6). Each of the cleared long butt needles **1***b* of this specified group *x*, on the other hand, has on its latch **5** only one loop p^2 drawn in the main feed course *f*.

The first main feed course *g* of reciprocatory knitting at the commencement of the heel is now effected, the first needles to be acted upon at the main feed F being the long butt needles of the specified group *x*; all of the long butt needles are, in fact, now cleared and caused to knit in a normal way at the main feed only.

As a result of the described procedure, the alternate jack raised long butt needles **1***b* of the specified group *x* will have cast off their measured loops Y^3 formed from the free end of the auxiliary yarn Y′ on the last course *f* preceding the heel. As regards the intervening long butt needles **1***c* of the specified group *x* allowed to remain down at tuck or normal running level N, these will cast off their loops Y^3 formed from the free end of the auxiliary yarn on the next course *g*, i.e. the first reciprocation course of the heel, thereby locking-in the said free end of the auxiliary yarn (see FIGURE 7). In FIGURE 7, the long butt needle **1***d* has been picked to idle level H as the knitting of the heel proceeds.

A specific procedure for going out of a heel into the foot of a stocking—again knitted on a 3 x 1 micro mesh basis will now be described with reference to FIGURES 8 and 9.

All the idle needles are brought down in the usual way from the idle level or heeling height H to participate with the long butt needles in the knitting of the foot, and the auxiliary feed is brought back into operation in the following stages:

(*a*) The auxiliary stitch cam **17** is projected part way in opposite to the central panel of needles having extra short butts **4***d* so as to be ready to act on the first normally short butts **4***c* at the appropriate side of the said panel, whereupon the auxiliary stitch cam **17** is moved right in.

The last nine or ten or so needles having short butts **4***c* are, in this case, the needles of the "specified group" (indicated at *z* in FIGURE 3), and by suitably delaying the bringing into action of the auxiliary clearing cam **16** these needles are not advanced to clear on this course.

(*b*) The auxiliary yarn guide **18** is then moved into feeding position to feed yarn Y′ to the short butt needles of the specified group *z* immediately preceding the first cleared medium butt needles. The sinkers **19** of the machine are withdrawn either simultaneously with, or prior to, this stage.

(*c*) The auxiliary clearing cam **16** is moved first part way in opposite to short butt needles in readiness to operate on the oncoming medium butts **4***b* and is thereupon moved fully into position to clear all needles.

The short butt needles of the specified group *z* are accordingly uncleared from the main feed F but receive auxiliary yarn Y′. The said needles are retracted by the auxiliary stitch cam **17** to draw measured loops Y^3 of the free end of the auxiliary yarn Y′ alongside loops in the hooks of these needles drawn at the preceding course. Then, as the short butt needles of the specified group *z* are advanced by the upthrow cam **12** following the auxiliary stitch cam **17** to tuck of normal running level N, the sinkers **19** are projected forwardly to knock-over point. The beginning free end of the auxiliary yarn Y′ is thus distorted to an undulatory or crimped form as illustrated in FIGURE 8.

It is convenient here to mention that in FIGURE 8, all needles to the left of the vertical line B are short butt needles with butts **4***c*, whereas the needles to the right of this line are medium butt needles with butts **4***b*. The first medium butt needle to clear and knit at the start of the auxiliary feed F′ is indicated at **1***e*. The beginning end of the auxiliary yarn is shown at the extreme left-hand side of FIGURE 8. In this FIGURE, moreover, the courses *h* and *i* are instep courses knitted before the heel, whilst the first and second main feed courses after the heel are indicated at *j* and *k* respectively.

At the main feed F all needles, including the specified

group z of short butt needles (but excepting every fourth single needle) are cleared by the micro mesh jack selector, with the undulatory or crimped beginning free end of the auxiliary yarn Y' still in the nibs of the sinkers 19.

During such passage of all of the needles through the main feed they receive main yarn Y, and the latches 5 of short butt needles 1f of the specified group z previously advanced to clear by the 3 x 1 jack selector means, are disposed above the undulatory or crimped free end of the auxiliary yarn Y', whilst such yarn remains on the latches 5 of every fourth uncleared short butt needle 1g of the said group remaining down at the tuck level N. At this stage the sinkers are withdrawn in the usual way.

Consequently, of the specified group z of approximately nine or ten short butt needles passing through the main feed F and drawing loops p^4 of the main yarn Y in the course l, each of the uncleared ones 1g will have on its latch 5 a retained loop Y^3 of the auxiliary yarn Y' and also a loop p^3 drawn at the preceding main feed course k, whilst each of the cleared needles will have under its latch 5 both a loop Y^3 of the auxiliary yarn and also a loop p^3 drawn at the preceding main feed F. The stage corresponding to the completion of the main feed course l following the start of the auxiliary yarn Y' is illustrated in FIGURE 9. All the loops will be cast off all the needles of the specified group z as they next pass through the auxiliary feed F'.

I claim:

1. A method of knitting a stocking on a circular seamless hose knitting machine adapted to operate with rotary as well as with reciprocatory motion and comprising a circular series of independent latch needles; a set of sinkers co-operating with said needles; a main feed; an auxiliary feed having thereat a guide for feeding to the needles an auxiliary yarn, an auxiliary clearing cam and an auxiliary stitch cam; jacks arranged beneath the needles and alternate ones of which are furnished with bottom butts; a 1 x 1 welt selector incorporating a jack-raising cam for action upon said bottom butts, and a micro mesh selector whereby spaced groups of the needles are raised to clear whilst intervening single needles are permitted to remain down at tuck height in the production of micro-mesh fabric, the needles in the machine being divided into two semi-circular series having respectively long and shorter actuating butts, and the heel of the stocking being knitted on the long butt needles at the main feed only by reciprocatory knitting, the said method including the steps of:

(a) withdrawing from operation the auxiliary feed towards the end of the series of long butt needles (of which the last few will be referred to as the "specified group"), when going from the leg into the heel of a stocking,

(b) timing the early withdrawal of the clearing cam at the auxiliary feed so as to prevent the long butt needles of the specified group only from being cleared, thereby ensuring that these needles receive yarn at the said feed and are retracted by the auxiliary stitch cam to stitch drawing level as a consequence of which the free and loose end of the auxiliary yarn resulting from withdrawal of the auxiliary feed is, by co-operation of the said needles with sinkers, distorted into an undulatory form by drawing or measuring such loose end into loops extending lengthwise of the needles,

(c) bringing into commission a 1 x 1 welt selector to over-ride the micro-mesh set out so far as the long butt needles of the specified group are concerned so that when going into the heel the needles of the specified group are in a 1 x 1 relation (1 clear, 1 tuck),

(d) completing the last main feed course of circular knitting preparatory to the commencement of reciprocatory knitting suchwise that on such completion each of the uncleared long butt needles of the specified group has on its latch one loop from the previous main feed course, plus the undulatory end portion of yarn from the previously withdrawn auxiliary feed and also a loop drawn in the main feed course just completed, whereas each of the alternate cleared needles of the said group has on its latch only a loop drawn in the last mentioned main feed course, and

(e) then producing the first main feed course of reciprocatory knitting to commence the heel during which all needles are cleared and the cast off undulatory free end of the auxiliary yarn is locked into the fabric.

2. A method of knitting a stocking on a circular seamless hose knitting machine adapted to operate with rotary as well as with reciprocatory motion and comprising a circular series of independent latch needles; a set of sinkers co-operating with said needles, a main feed; an auxiliary feed having thereat a guide for feeding to the needles an auxiliary yarn, an auxiliary clearing cam and an auxiliary stitch cam; jacks arranged beneath the needles and alternate ones of which are furnished with bottom butts; a 1 x 1 welt selector incorporating a jack-raising cam for action upon said bottom butts, and a micro mesh selector whereby spaced groups of the needles are raised to clear whilst intervening single needles are permitted to remain down at tuck height in the production of micro-mesh fabric, the needles in the machine being divided into two semi-circular series having respectively long, and medium and short actuating butts, the short butts being flanked at opposite sides by groups of the medium butts and having in the centre thereof a panel of needles with extra short butts, and the heel of the stocking being knitted on the long butt needles at the main feed only by reciprocatory knitting, the said method including the following steps, when going out of the heel into the foot of the stocking:

(a) moving the auxiliary stitch cam part way in opposite to the central panel of needles having extra short butts so as to be ready to act on the first normally short butt at the appropriate side of the said panel, whereupon the auxiliary stitch cam is moved right in,

(b) meanwhile delaying the bringing into action of the auxiliary clearing cam so that the last few short butt needles (hereinafter referred to as the needles of the "specified group") are not advanced to clear on the relevant course.

(c) moving the auxiliary yarn guide into feeding position to feed yarn to the short butt needles of the specified group immediately preceding the first medium butt needles, and withdrawing the sinkers either simultaneously with, or prior to, this stage,

(d) then moving the delayed auxiliary clearing cam first part way in opposite to short butt needles in readiness to operate on the oncoming medium butts and then right in to clear all needles,

(e) retracting the uncleared short butt needles of the specified group (having received auxiliary yarn) by the auxiliary stitch cam to draw measured loops of the free and loose end of the auxiliary yarn alongside loops in the hooks of these needles drawn at the preceding course,

(f) thereupon advancing the short butt needles of the specified group to tuck level and projecting the sinkers forwardly to knock-over point as a result of which the beginning free end of the auxiliary yarn is distorted to an undulatory form,

(g) at the main feed, causing the micro mesh jack selector to raise spaced groups of all the needles to clearing height and to leave down single intervening needles at tuck height, the undulatory free end of the auxiliary yarn still being engaged within the sinker nibs,

(*h*) supplying main yarn to all the needles at such main feed and retracting such needles to stitch drawing level so that all needles cast off their loops except the single intervening needles which retain their loops and the undulatory yarn, and

(*i*) at the following auxiliary feed causing all the needles to cast off their loops in the normal way.

3. A method of knitting a stocking on a circular seamless hose knitting machine adapted to knit with rotary motion with knitting on at least two feeds as well as with reciprocatory motion with knitting on only one of said feeds and comprising a circular series of independent latch needles; a set of sinkers co-operating with said needles; a main feed; and auxiliary feed having thereat a guide for feeding to the needles an auxiliary yarn; jacks arranged beneath the needles and alternate ones of which are furnished with bottom butts; a 1 x 1 welt selector incorporating a jack-raising cam for action upon said bottom butts, and a micro mesh selector whereby spaced groups of needles are raised to clear whilst intervening single needles are permitted to remain down at tuck height in the production of micro mesh fabric; the said method including the steps of taking into the hooks of all of a group of successive needles, having thereon loops from the preceding course, the free and loose end portion of the auxiliary yarn resulting from the termination of knitting with one of said motions during a change to knitting with the other of said motions, causing the said needles, in co-operation with sinkers at the auxiliary feed, to distort the said free and loose end portion of the auxiliary yarn into an undulatory form by drawing it into measured loops extending lengthwise of the needles, then bringing into commission the 1 x 1 welt selector to temporarily over-ride and modify the micro mesh selection of the needle-actuating jacks and so effect a 1 x 1 selection of the needles of the specified group whereby alternate needles of the said group are selected to clear with the result that the undulatory free end portion of the auxiliary yarn is disposed under the latches of said alternate needles, the intervening needles only of the group retaining the said portion of yarn in their hooks, and, at a normal succeeding course, locking the undulatory portion of yarn into the fabric by knitting it together with loops already held by relevant ones of the said groups of needles.

4. A method of knitting a stocking on a circular seamless hose knitting machine adapted to knit with rotary motion with knitting on at least two feeds as well as with reciprocatory motion with knitting on only one of said feeds and comprising a circular series of independent latch needles; a set of sinkers co-operating with said needles; a main feed; an auxiliary feed having thereat a guide for feeding to the needles an auxiliary yarn; jacks arranged beneath the needles and alternate ones of which are furnished with bottom butts, and a 1 x 1 welt selector incorporating a jack-raising cam for action upon said bottom butts; the said method including the steps of taking into the hooks of all of a group of successive needles, having thereon loops from the preceding course, the free and loose end portion of the auxiliary yarn resulting from the termination of knitting with one of said motions during a change to knitting with the other of said motions, causing the said needles, in co-operation with sinkers at the auxiliary feed, to distort the said free and loose end portion of the auxiliary yarn into an undulatory form by drawing it into measured loops extending lengthwise of the needles, then bringing into commission the 1 x 1 welt selector to effect a 1 x 1 selection of the needles of the specified group whereby alternate needles of the said group are selected to clear with the result that the undulatory free end portion of the auxiliary yarn is disposed under the latches of said alternate needles, the intervening needles only of the group retaining the said portion of yarn in their hooks, and, at a normal succeeding course, locking the undulatory portion of yarn into the fabric by knitting it together with loops already held by relevant ones of the said group of needles.

References Cited in the file of this patent

UNITED STATES PATENTS

1,377,459	Bosworth	May 10, 1921
2,525,704	Miller	Oct. 10, 1950
2,550,880	St. Pierre	May 1, 1951
3,004,418	McDonough	Oct. 17, 1961

FOREIGN PATENTS

107,712	Australia	June 14, 1939