March 12, 1963 M. NEBEL 3,080,740

CIRCULAR KNITTING MACHINE

Filed March 30, 1960 4 Sheets-Sheet 1

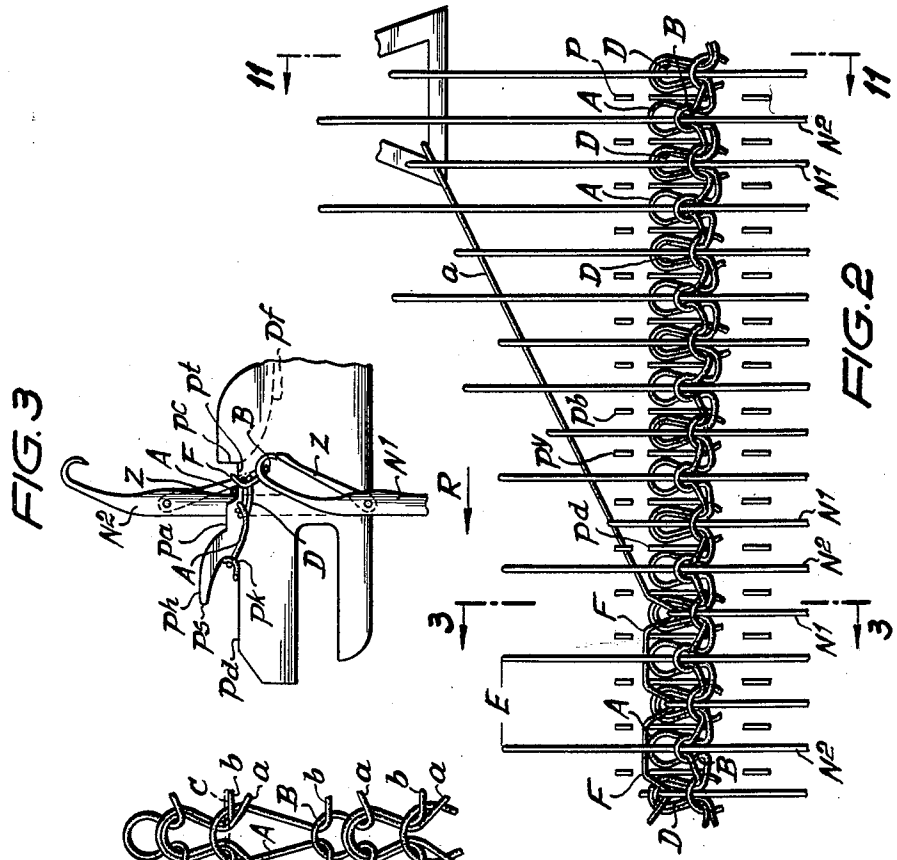


FIG. 2

FIG. 3

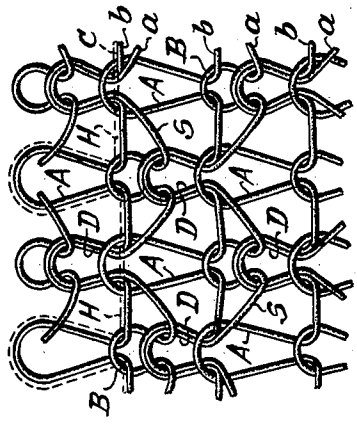


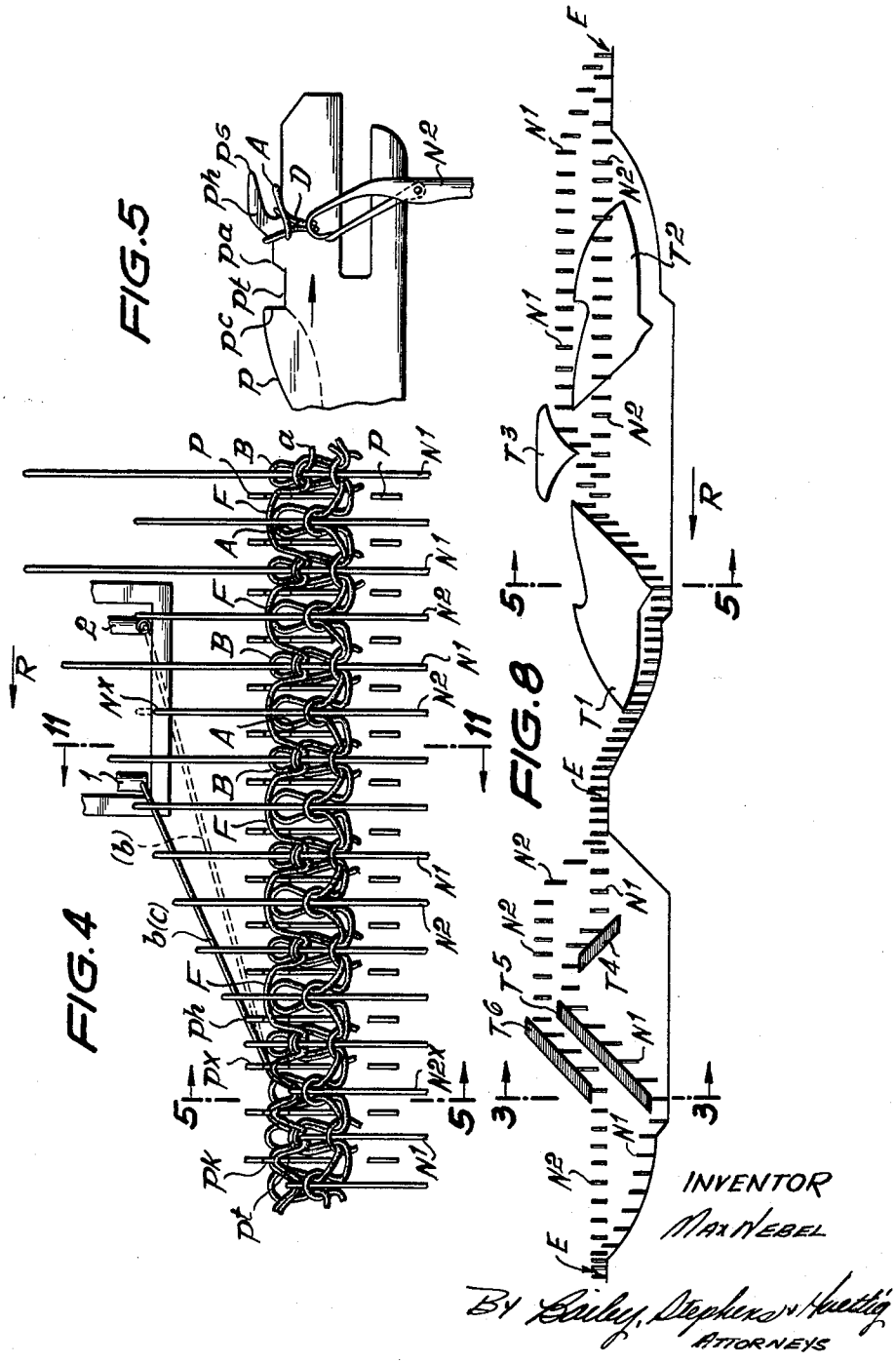
FIG. 1

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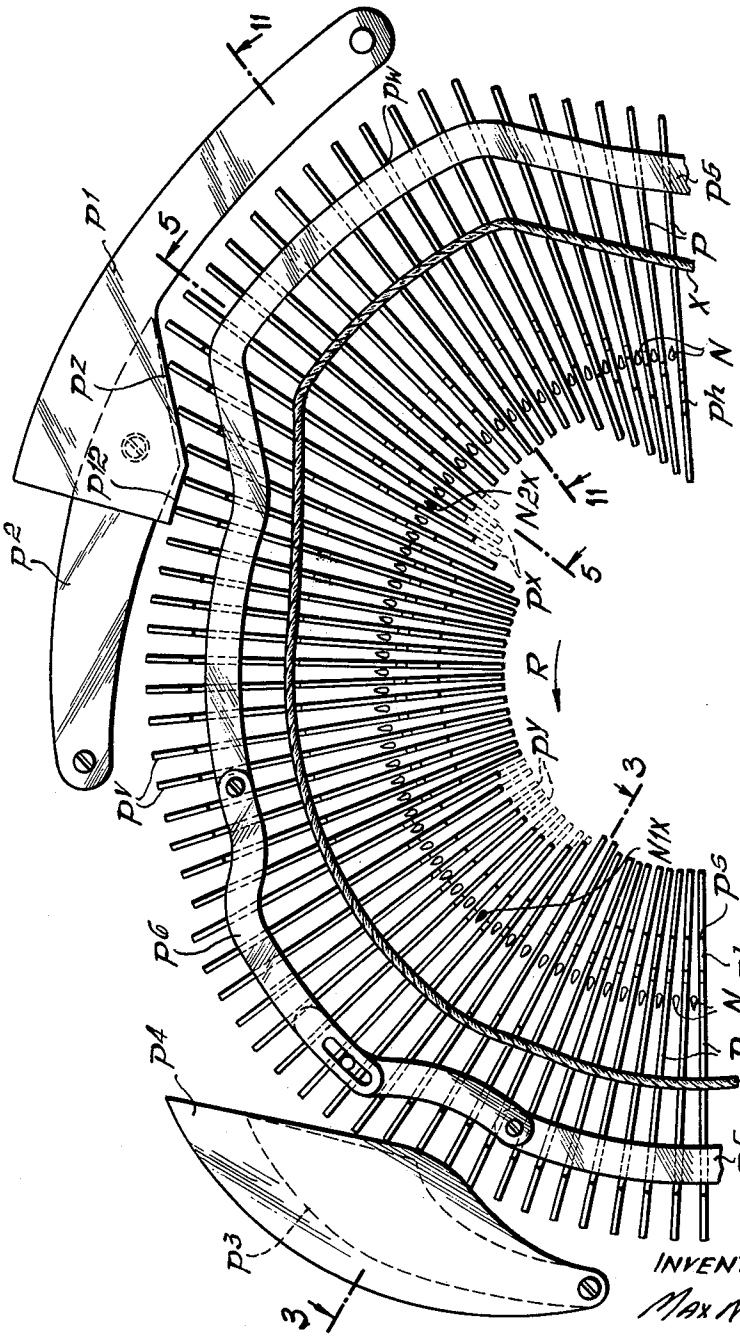


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CIRCULAR KNITTING MACHINE

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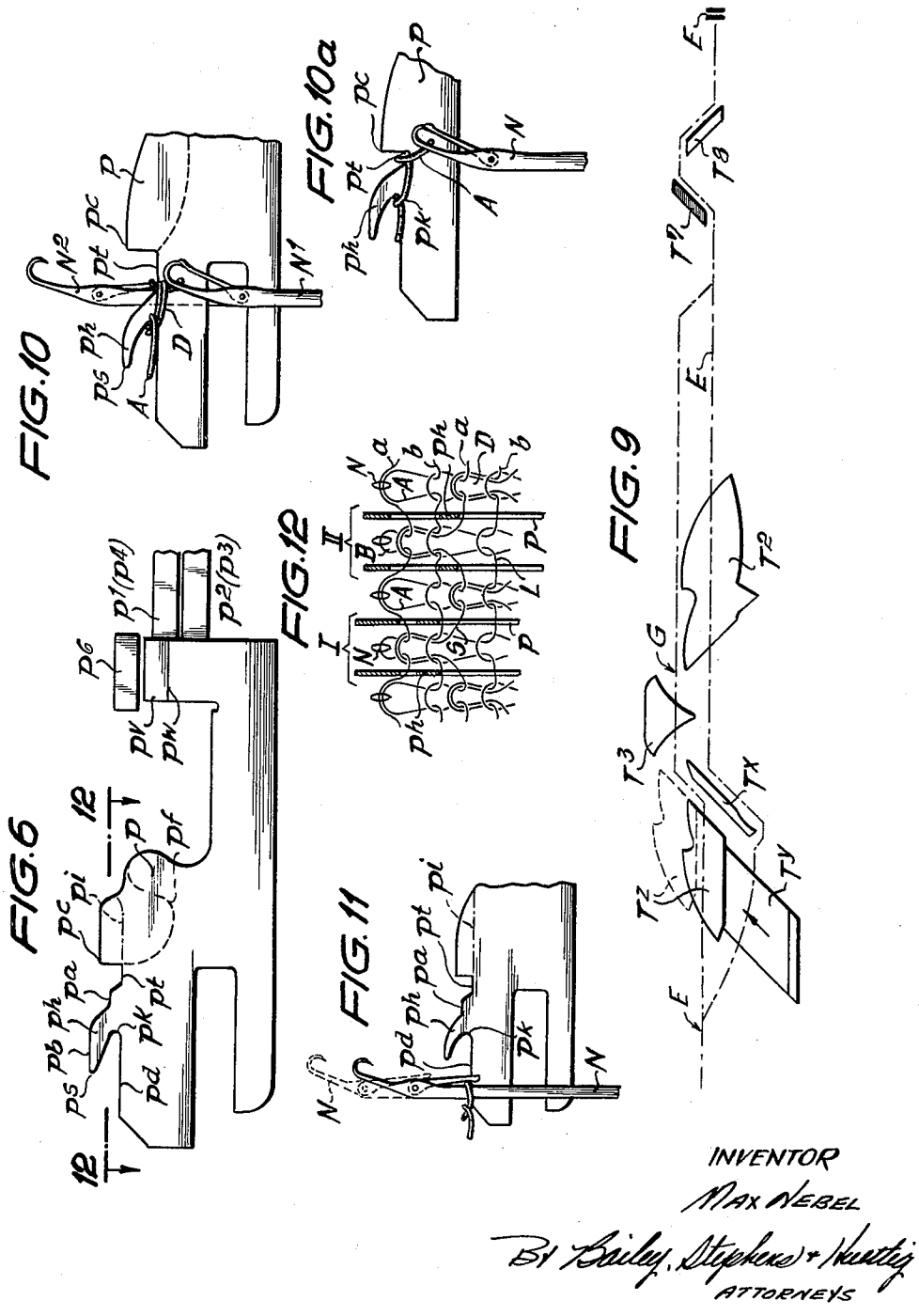
FIG. 7



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3,080,740

CIRCULAR KNITTING MACHINE

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Filed Mar. 30, 1960, Ser. No. 18,560
13 Claims. (Cl. 66—108)

The invention relates to the manufacture of run-resistant circular knitted fabric of various stitch-length and constructions, on circular knitting-machines having needles and sinkers.

It is an object of the invention of drawing the loops of these fabrics in two different lengths during two loop-forming processes, by arranging that yarn from the preceding course, which, due to the activity of certain needles has not been formed into loops, is without the use of transfer-sinkers linked into loops and knitted in at the following course.

It is also an object of the invention to produce a run-resistant knitted fabric in which a course using a small amount of yarn alternates with a course using a larger amount, and in which the course using a small amount of yarn has ordinary loops alternating with tuck-loops, and, in the course using a larger amount of yarn, large loops alternate with smaller ones having two threads being a combination of tuck-loops from the previous course and alternate large loops of the following course.

The invention can be carried out on twin-feed or even four-feeder seamless hose machines. In the case of four-feeder-machines, these form one working unit and on a twin-feed machine one feeder produces large loops on all needles while at the second feeder alternate needles form small loops and the remaining alternate needles, selected by jacks, receive yarn but do not form normal loops.

It is a further object of the invention to provide a run-resistant knitted fabric comprising successive pairs of courses, one course in each pair having short loops in alternate wales and having long loops in the intermediate wales, and the other course of each pair having long loops in said alternate wales, drawn through said short loops of said one course, and having normal loops in said intermediate wales, these last with the long loops of said one course being drawn as double loops through the long loops of said other course of the preceding pair of courses, and said short loops in such one course being drawn through the double loops formed in the preceding pair of courses.

In an earlier method, it was proposed to use needle-butts of varying heights, and thereby to select needles to be drawn to different levels with regard to loop-forming and knocking-over. This method, however, made the machine very complicated.

In the machine for carrying out the present method, the cams and needles required for the earlier method are replaced by simpler means, that is: a new process and specially shaped sinkers are used to produce the non-run fabric. During knocking over, these special sinkers influence the loops of the previous course. This is carried out in conjunction with various needle-movements upwards and with the aid of well-known selection-mechanisms.

The attached drawings show diagrammatically the fabric produced by this invention and the sinkers and method of production for a seamless-hose machine:

FIG. 1 shows the loop-structure of the run-resist fabric;

FIG. 2 shows the position of the needles seen from the rear during the formation of one course of the structure;

FIG. 3 shows the position of a needle in side-view in conjunction with a sinker;

FIG. 4 shows the movements of the needles viewed from the rear during the formation of one course of the alternative structure;

FIG. 5 shows the needle and sinker in sideview in positions appertaining to the forming of the structure shown in FIG. 4.

FIG. 6 shows the shape of the novel sinker.

FIG. 7 shows a section of the needle-and-sinker-circle together with a plan-view of the relevant sinker-cams;

FIG. 8 shows the arrangement of the needle-cams and the path of the needle-butts of a twin-feed machine;

FIG. 9 shows the special cams for actuating the needles;

FIG. 10 shows the knocking-over position of needles and sinkers in side-view;

FIG. 10*a* is a fragmentary view similar to FIG. 10 with only one needle shown;

FIG. 11 shows a sectional view of the retired sinker (on line 11—11 of FIGS. 2, 4 and 7.)

FIG. 12 shows the position of the sinkers in relation to the loops during and after knocking-over.

The fabric shown in FIG. 1 is knitted in its basic form without the additional thread *c* shown in broken lines.

This basic structure consists of course *a* with small loops B, which alternates with course *b*, with large loops A and two-thread loops D. When forming course *a*, small loops B are formed on alternate needles. The thread in between the loops B in this course is formed into a loop D at the next course *b* when all needles knit. The result is that alternate needles in course *b* form loops D with two threads which lie between the large loops A having single threads.

By forming the thread-floats between the loops B in course *a* into loops and combining them into double loops D in the following course *b*, loops B are pulled together and form small anti-run loops.

In order to ensure that these non-run loops B occur in all wales in the fabric, odd needles are used to form them in one two-course cycle and even needles in the next. The particularly large single stitch loop A is formed by holding these loops during the formation of course *a*.

By forming consecutive courses of loops using different amounts of yarn per stitch, forces are created in the fabric having different directions of pull, and this effect in conjunction with the small non-run loops B and the long thread portions S, produces a highly ladder-resistant fabric. In addition, a fabric having a good appearance is created. According to a further feature of the invention, this ladder-resistant structure can be improved by feeding an additional thread *c* during course *b* only and then only to those needles which form the large loops A. This additional thread is shown in broken lines in FIG. 1. Where this additional thread is not knitted in, it becomes the floating thread H. When this feature of the invention is included, the length of the additional thread *c* lies between the length of thread needed in course *b* to form loops A, D, and the length of thread needed in course *a* to form loops B, D. This type of fabric is particularly useful for knitting the reinforced parts of a stocking, i.e., high-splicing and sole, where the additional thread *c* is used only in parts of the fabric tube.

In order to produce the run-resist fabric shown in FIG. 1 on a seamless hose machine, it is necessary to be able to select needles into alternating series, namely: odd needles N^1 and even needles N^2, which can be done with the aid of well-known selection mechanisms.

In carrying out the invention, the run-resistant fabric shown in FIG. 1 is produced on machines having at least two feed-points, and in which at one feed-point alternate (odd) needles knit small loops B and produce course *a*, while remaining (even) needles in this course take the yarn and tuck. At the next feed-point all needles knit

course *b*, in which course alternate needles have only one thread and form large single loops and the remaining needles carry two threads, one of which is a tuck-loop from the previous course (shown at F in FIG. 2) and the needles produce a two-thread stitch "D." This course *b* is followed by the next cycle, but this time the needles which formed small loops in course *a* in the previous cycle now tuck, and the needles which did not form loops in the course *a* of such previous cycle now do so (FIGS. 2 and 3).

To produce this fabric, specially shaped sinkers P have to be used, one of which is shown in FIG. 6. It includes a hook P*h* which, from a point P*s* slopes gently rearwards on its upper or outer edge until it reaches the loop-forming surface P*a*. This surface P*a* is shown higher than the normal loop-forming surface P*d*, but it may, in some cases, be at the same height as, or lower than, surface P*d*. The most important feature of this sinker lies in the fact that the said sinker-hook P*h* from the sinker-throat P*k* to the said surface P*a* is not wider than the greatest width of a needle—preferably a little smaller.

In addition to such main feature of the new sinker, there is behind the loop-forming surface P*a* another, but lower, knocking-over surface P*t*. The higher surface P*a* forms the large loops and the lower surface P*t* forms the smaller loops. If as in FIG. 10 there is only the one surface P*a* instead of the two surfaces P*a* and P*t* and with an edge P*c* which is higher than or in the line of the sinker hook P*s*, then this edge P*c* can be used for an additional knock-over with regard to the last-formed course of loops. The edge P*c* generally can be omitted in all cases in which it is not necessary to knock-over also the stitches of the last-formed course of stitches. This knock-over of the stitches of the last-formed course of stitches increases the quality of fabrics if a yarn of higher denier (higher gauge) is used. If very thin yarn is used, the edge P*c* generally can be omitted.

FIG. 6 shows that cams P^2 and P^3 and additional cams P^1 and P^4 act respectively on the high butts P*v* and low butts P*w* of the sinkers. As an example, the cam P^6 for retiring the sinkers acts from above on the low-butt sinkers P*w* in order to influence the sinkers P. It is, however, possible to use camming parts constructed differently from those shown.

In twin-feed machines, one revolution of the machine yields one complete cycle. Although the level to which the needles are lowered remains unaltered at each feed-point, alternate needles form small loops, while remaining alternate needles tuck (in the hook). At the second feed-point, all needles form large loops at a knocking-over point which is positioned somewhat higher than the first one. The tuck-loops which have been formed on alternate needles at the preceding course are now incorporated into smaller two-thread loops while the remaining alternate needles form with the aid of the outward moving sinkers particularly large loops. At the next cycle, the needle-alternation is displaced by one needle, so that odd needles tuck in one cycle and even needles tuck at the next cycle.

Since the level to which the needles are lowered remains unaltered, the normal holding-down sinkers and their movements are unsuitable to form courses where small and large loops alternate. A new type of sinker coupled with a new method of working influences the loops which have to be knocked-over in such a way that these are either knitted in with the tuck-loops of the preceding course or they act as normal holding down sinkers.

In order to produce the non-run fabric, needle-and-sinker-movement is so correlated that prior to the point where the needles draw loops, the sinkers are thrust forward earlier than usual and remain forward so that the yarn at the course where alternate needles tuck is formed into small loops by the rearmost lower surface of the sinker, while during the course in which all needles form large loops, these are formed over that surface on the sinker nearest to the sinker throat.

A further forward movement of the sinkers causes the course of large loops to be knocked over. The needles for both courses are only lowered far enough to form small loops. A rearward movement of the sinkers, before small loops are formed on alternate needles at the second feed-point is not necessary, since this course is advantageously knocked-over, either over a previous course of small loops positioned in the throat of the sinker or over a course of large loops positioned on the knocking-over surface to the rear of the sinker throat.

The rearward movement of the sinkers away from the needle-circle is effected in the main at the main feed-point when the second feed-point is out of action and when reciprocating knitting is carried out for knitting the heel and toe of the hose.

It is possible, according to this invention, to form the course where alternate needles form small loops either in the manner described above or at the main feed-point. In this case, it is necessary to withdraw the sinkers sufficiently that the loops are formed over that surface which is immediately behind the sinker-hook.

It is also possible to withdraw the sinkers, no matter what sort of loops are formed, at the second feed-point out of the needle-circle, and they can then be thrust forward earlier than normal below the yarn as it runs to the needles.

All these possibilities result in bringing the course of loops which has been formed last on to the loop-forming surface behind the sinker-hook and the sinker-throat. The normal sinker-throat then acts on the course of loops which has been knocked over previously and the one which has been knocked over before that.

This type of sinker-movement can also be used for ensuring good knocking-over of the loops when knitting other standard fabric structures.

To move the sinkers in the manner described above, the sinker-cap is fitted with suitably shaped auxiliary cams which can be put into and out of action when required.

The additional thread, when used, reinforces the large loops, so that only the small loops consist of one thread. Fabric knitted in this way is particularly suitable in seamless hosiery for knitting the reinforced parts of the stocking, i.e., the high-splicing, the sole and toe.

In order to incorporate the additional thread only at every second course by means of float-plating (i.e., one thread is knitted by all needles and the other is knitted only by selected needles and floats across non-selected needles), the following procedure is adopted:

The two threads are fed to the needles behind each other and the leading thread is formed into large loops by all needles while the trailing thread is formed into loops by alternate needles only while the remaining alternate needles form the thread into floating thread parts.

The fabric shown in FIG. 1 is produced as follows: It is supposed that according to FIG. 2, the loops A are on the needles N^2 and the loops D on the needles N^1. The sinker-hook P*h* according to zone II of FIG. 12 is forward, holding down the loops from the previous course *a*, and behind that sinker-hook are the loops A, D of the course *b*. All needles N^1 and N^2 rise to clearing height prior to yarn-feeding, so that their old loops A, D slip over the latches on to the stems of the respective needles. The needles now pass the yarn-feeding point and they all take yarn for knitting course *a*, but at this stage only needles N^1 actually descend down to knocking-over level to form small loops. The needles N^2 on the other hand move down only to a position where the thread F of course *a* rests upon the open latch as Z, see FIG. 3 and remain there for the time being. The position of the needles N^1 and N^2 is shown in side-view in FIG. 3. Here the needles N^2 which remain high produce thread-portions F, and the needles N^1 produce small loops

B because, when using the lower knocking-over surface P*t* of the sinker, the distance between that knocking-over surface and the head of the needle is small.

After this part of the cycle has been completed, the needles N^2 move circumferentially to the left in FIG. 2 while moving downward, but still maintaining the thread-portions F upon the open latches Z of needles N^2 (FIG. 3) because the thread has been drawn down by the needles N^1. At the next feed-point these needles, while in the position described, receive the yarn for the next course *b*. Here, the new yarn is formed into loops and combined with the portions F held on the latches into a two-thread loop D. In this course, the needles N^1 holding the small loops B are raised to clearing height and clear their loops off the latches on to the stems of the needles. FIGS. 4 and 7, taken together, show that the sinkers during knitting at the main feed-point retire outwards in the normal manner, thus freeing the loops of course *a*, so that the loops of this course can pass in front of the hook P*h* and into the throat P*k*. The needles N^1 and N^2 then take the thread for course *b* and form loops with it.

In order to produce extra long loops for the loops A, D in course *b*, without altering the knocking-over position of the needles in relation to the other yarn-feed-point which knits course *a* with small loops B (compare FIGS. 3 and 5), the thread in this course *b* is formed into long loops over the higher loop-forming surface P*a* of the sinker P and a little away from the needle hook in a slanting manner. For this purpose, the sinkers are thrust forward sooner than usual and sufficiently far between the needles that the loop is formed by all the needles over the higher loop-forming surface immediately behind the sinker-hook P*h*.

To enable the sinkers to perform this movement, cams P^{11} and P^{12} of the additional cam section P^1 (FIG. 7) guide the sinkers. When the needles have reached their lowest position, i.e. needles N^2 at point N^2x in FIG. 7, the sinkers are further guided inwards by the cams P^{11}, P^{12} of the additional sinker-cam section P^1, and gradually move to their normal knocking-over position. The sinkers, however, due to their novel shape and the new method of working, move further inwards than would be the case with the normal sinker-cam-section P^2 of FIG. 7.

The type of sinker used ensures that the loops of the last-formed course are formed over the surface P*a* of the sinker, thereby shifting the knocked-over needle-loops from the previous course by means of the normal sinker-throat P*k* behind the needles (similar to FIG. 10 but with all needles in the low position). Since in the following course *a*, consisting of loops B engaged only through the double loops D, the loops A are now finally formed into large loops. The latter are longer than the neighboring loops B, D together.

Prior to forming the course *a*, it is possible to withdraw the sinkers P from the needlec-ircle; it is, however, more advantageous to let them remain in the needle-circle during the formation of course *a* and to withdraw them just prior to forming course *b*.

In any case, the rearward movement of the sinkers is effected at the main knitting-point, FIG. 7, irrespective of whether course *a* or *b* has been knitted at the main-feed-point. The sinkers P can remain forward in the needle-circle at the auxiliary yarn-feed-point FIG. 7.

As an example, FIG. 3 shows the position of the needle and sinker in side-view when the sinkers remain forward in the needle-circle, between the main-knitting-point and the auxiliary-knitting-point shown in FIG. 7, supposing that the main-feed-point has knitted course *b* and the auxiliary feed point has knitted course *a* behind the sinker-hook P*h*.

As has already been described in relation to FIGS. 3 and 7, the sinkers are sufficiently far forward in the needle-circle during the forming of course *b* that the loop-forming surface P*t* on the sinker is below the hook of the needle.

As can be seen in zone II of FIG. 12, the sinker-hooks P*h* of the sinkers P are in the sinker loops S—L of the preceding course *a* so that the sinker-throats P*k* close in upon the loops B of this course. This causes the sinkers P to extend their field of action to knocking over the loops off the needles and shifting the loops behind the needles and then the following loops A, D of course *b* and the loops B of the last formed course *a*.

The sinker in this case requires a wide cut-away portion from the surface P*a* to the edge P*c*, FIG. 3, in order to accommodate two courses of loops. The sinkers are moved through the needle-circle for this purpose, and the movement is effected when knocking-over the loops of the preceding course *a*, over the loops A, D belonging to course *b* which were formed at the main-feed-point, FIG. 7. The sinkers then remain in the holding-down position until knocking-over course *b*.

The large loops A, D, of this course must be knocked-over, over the small loops B of the last course *a* which were formed at the auxiliary knitting-point. To act in accordance with zone II of FIG. 12, with regard to the additional loop-length, the sinkers with their throats P*k* move further through the needle-circle as shown in FIGS. 3 and 7.

If, however, the sinker is moved rearwards out of the needle-circle prior to forming course *a*, or, for example, before reaching the auxiliary feed-point, and then by means of the cam-part P^4 and the cam-track from P^{10} to P^{11} is brought underneath the yarn back into the needle-circle, in order to form loops with the yarn on the surface P*a*, then the sinker-throat closes in upon the loops of the preceding course B. This process is shown in FIG. 10 (side-view) and in zone I of FIG. 12 (plan-view).

When knocking-over is completed, the sinker cam parts P^1 and P^4 and the cam-tracks P^{11} and P^{12} cease to act on the sinkers, and the sinkers, as is usual, move a little rearwards. By means of the spring X (FIG. 7) they then press by their sinker hooks P*h* against the sinker-loops S.L. of the particular course until the next loop-forming process.

If, however, the sinkers are moved outwards of the needle-circle prior to some or all loop-forming processes, and the sinker-hooks are moved out of the sinker-loops, this is carried out in the normal manner when the needles are in the clearing position, see the dotted line position of the needle N in FIG. 11. The fabric is lifted a little upwards with the needle. This is followed by a downward movement of the needle N to the full-line position of FIG. 11 so that the loops on the needles are brought back to the surface P*d* of the sinker and when the sinker-nose P*s* re-enters the needle-circle, the fabric is brought into the sinker throat P*k*.

Following the described loop forming processes, FIGS. 2–5 are two loop forming cycles, where the selection of needles for knitting and tucking has been reversed as mentioned above.

The sinker-cam parts P^1 and P^4 for both knitting-systems can be put into and out of action and can be set for increasing or decreasing the sinker-thrust by means well known in the art; FIG. 7 shows a section of the sinker-ring; it also shows the movements of the sinkers in relation to the needles N and the main and auxiliary feed-points with such important parts as the guard-cam P^5 and the usual cam-parts P^2 and P^3 and the cam P^6 for withdrawing the sinkers, which can be put out of action. The sinker-spring X is also shown.

This invention, as far as the knock-over is concerned, is also advantageous for knitting seamless footwear from ordinary plain fabric, especially for knitting a very loose double-welt.

The operation of the sinker P for knitting plain fabric (see FIG. 10) is the same as for knitting course *a* in FIGS. 3 and 10.

In order to effect a flawless knock-over of the old loops over the new loops, it is essential that the sinker-throats P*k*

close in on the sinker-loops of the preceding course. In order to do this, it is necessary to form loops of the last course over the loop-forming edge P*a* of the sinkers. The sinkers which have meen moved rearwards at the commencement of a plain course or a course *a*, are now moved inwards again so that the noses P*s* of their hooks move through the needle circle inwards when the needles have moved sufficiently downwards toward the knock-over point for the sinker-nose P*s* to move underneath the yarn (that is sinker P*y* in FIG. 2).

By means of the additional cam-parts P^4 (PI), this movement of the sinkers in conjunction with the descending needles, is continued between the needles until the yarn to be looped is behind the sinker-hook P*h* and on the sinking surface P*a*, where it is then formed into loops, see FIGS. 10 and 10*a*.

Since the sinker-hook P*h* from the sinker-throat to the loop forming surface P*a*—P*k* is not as wide as the width of the needle in cross section, there is no pressure upon the sinker S nor on the preceding course L in the sinker throats as the yarn is formed into loops behind the sinker-hooks P*h*.

When the special needle-movements for producing non-run fabric are not used, and the additional sinker-cam P^1 moves the sinkers as described, plain fabric is produced while using the invention for knocking-over. In this way a double-welt knitted from plain-fabric and a piece of plain-fabric following the double welt prior to starting the non-run part of the hose can be knitted.

FIGS. 8 and 9 shows by way of example parts of the needle-cam-system in their correct order for acting on the needle-butts. FIG. 8 shows needle cams T^1, T^2, and T^3 for the main-feed-point, and cams T^4, T^5 and T^6 for the auxiliary feed-point. The shaded cam-parts are those which can be put into and out of action. With regard to the needles, N^1 and N^2, only the butts are shown in FIG. 8, and only the path of movement of the butts is shown in FIG. 9.

The selection of the needles for the required cam actions is effected by means of a well-known selection unit, not shown, working in conjunction with needle-jacks.

In FIG. 8, it is supposed that loop-forming for course *a*, FIG. 2 has been carried out by the auxiliary feed-point. Before reaching cams T^4, T^5, T^6, the needles (i.e. needles N^2) are lifted from their rest position by their jacks sufficiently high to be lifted over the stitch-cam T^5 so that they can be lowered back to the rest position by cam T^6. The needles N^1 on the other hand are at the same time lifted by cam T^4, but only sufficiently high that their loops go below the latches Z of the needles. They are then lowered in the normal manner by stitch-cam T^5. These needle-movements are shown in FIG. 2.

Course *b* is formed at the main-feed-point with the aid of cams T^1, T^2 and T^3, FIG. 8. At the formation of this course, cam T^2 is withdrawn from contact with the needle-butts and the needles N^1 which have formed loops B at the auxiliary feed-points are lifted through their jacks sufficiently high that their loops pass over the latches on to the stem of the needles, FIG. 4.

Needles N^1 are then lowered by cam T^3 until they are handed over to the stitch cam T^1 which lowers the needles to knock-over level.

Needles N^2 on the other hand, which at the auxiliary feed-point did not form loops, but only received yarn F, move on from there in the rest-position E until they reach stitch cam T^1 which lowers them. The needle-movements are shown in FIG. 4.

When considering the arrangement of the cams in FIG. 9, it is supposed that course *a* is formed by the main yarn-feed-point. FIG. 2 shows that in order to produce these needle-movements it is necessary to alternate the lowering of needles N^1 to knock-over level with lowering the needles N*a* not far enough to cause the latches to close the needle-hooks so that the yarn remains upon the open latch Z. For this purpose, the stitch cam T^1 is divided into two parts for circular knitting, namely a flat stitch-cam T*x*, and, at an interval of one needle-trick, the cam Tz which corresponds in shape with cam T^1.

The cam Tz is fitted to a slide Ty which moves the cam from its lower position for normal working (in full line position) slantwise upwards (in dotted line position) for knitting the course *a*. Cam Tz when in the raised position, lifts the needles through their jacks from their rest-position E to the raised position G. (The path of the needle-butts is in dot and dash lines.) Since cams T^3 and T^2 are not in action, these raised needles can carry on over cam T*x* until they reach cam Tz which lowers them to position E, FIG. 9.

The other needles which have to form loops move in the rest-position E, over cam T^2, until they meet stitch cam T*x* which lowers they to knock-over level.

Prior to this, all needles which have formed loops at the auxiliary feed point are lifted by cam T^8 from the rest position until their loops have passed over the latches on to the stem of the needles. After this, they are moved down to the rest position by cam T^7.

If it is required to produce the fabric FIG. 1 with an additional thread *c* which must be added only to the loops A, the well-known float-plating process is then used. In this method, certain needles knit both yarns and others only one yarn.

This is illustrated in FIG. 4. Here, it is supposed that the needles N^2 form the double threaded loops D and these are followed by a needle which takes only one yarn. The two yarns are fed to the needles with a plating-lead from the yarn-feeders **1** and **2**. The ground thread *b* must be fed by the yarn-feeder **2**, and the additional thread *c* is fed by the yarn-feeder **1**, FIG. 4.

If, for instance, the needles N^2 pass the yarn-feeders **1** and **2** in a lower position than the needles N^1, the leading thread *b* (shown in dotted lines FIG. 4) is fed by feeder **2** into the hooks of all needles, while the trailing thread *c* from feeder **1** is unable to feed into the hooks of needles N^2 and thus passes behind these needles.

The needles N^1 then form this thread *c*, over 2 loop-forming surfaces P*a* of two adjacent sinkers, into long loops.

To use the thread *c* as a reinforcement thread for the high-splicing and the sole of a stocking, it is—as is well known—only fed to needles within a certain section of the needle-circle.

It is to be understood that the invention is not limited to the fabric, machines and procedures shown and described, as modifications within the scope of the appended claims which involve no departures from the spirit of the invention nor any sacrifice of the advantages thereof, may occur to persons skilled in the art.

What is claimed is:

1. A method of operating a circular knitting machine having a plurality of needles each having a hook and a movable latch which comprises, in one course, the steps of opening the latches of all the needles, advancing all the needles with open latches, feeding yarn into the hooks of all the needles, retracting and closing the latches of alternate needles forming a first group only, and forming relatively short loops on the needles of said first group during such retraction; in a second course, the steps of advancing the needles of the first group, during such advancing opening the latches of the needles of said first group so as to cast off said small loops onto the needle stems, feeding yarn to all of the hooks, retracting all of the needles, during such retraction closing the latches of all of the needles, whereby the needles of a second group composed of the remainder of the needles contain two threads, forming shorter double loops on the needles of the second group and longer loops on the needles of the first group during such retraction; in a third course, the steps of advancing all of the needles, during such advancing opening the latches of the needles to cast off the loops formed on all of the needles onto the needle stems, feed-

ing yarn to all of the hooks, retracting and closing the latches of the needles of the second group only, and forming relatively short loops on the needles of the second group during such retraction; and in a fourth course, the steps of advancing the needles of the second group, during such advancing opening the latches of the needles of said second group so as to cast off such small loops onto the needle stems, feeding yarn to all of the hooks, retracting all of the needles, during such retraction closing the latches of all of the needles, whereby the needles of the first group contain two threads, and forming shorter double loops on the needles of the first group and longer loops on the needles of the second group during such retraction.

2. A method of producing run-resistant knitted fabric on a circular knitting machine with a needle circle and a sinker circle and having at least two feeding points, which comprises opening the latches of all the needles, at one feeding point forming small loops with alternate needles only, whereas the remaining group of needles only receive the threads but do not knit, moving said remaining group of needles with the thread overlying the open latches thereof to a position to receive thread in the second feeding position, feeding the thread to all of the needles at the second feeding position, forming relatively large loops with all of the needles, the needles of such remaining group forming double loops, and repeating such steps reversing the action of the needles.

3. A method of manufacturing run-resistant fabric on a circular knitting machine having at least two feeding points, which comprises during one revolution of the machine opening the latches of all the needles, advancing all of the needles, feeding thread thereto, and retracting only alternate needles to the knocking-over point and forming small loops thereon, whereby the thread remains upon the open latches of the remaining group of needles; at the next feeding point advancing all the needles, feeding then thread thereto and retracting all of the needles, to produce large loops on the needles of such remaining group and smaller double loops on the said alternate needles, and repeating such steps reversing the action of the needles.

4. A method of operating a circular knitting machine having a plurality of needles each having a hook and a movable latch which comprises, in one course, the steps of opening the latches of all the needles, advancing the needles with open latches, feeding thread into the hooks, retracting and closing the latches of alternate needles forming a first group only, and forming relatively short loops on the needles of said first group during such retraction; in a second course, the steps of advancing the needles of the first group during such advancing opening the latches of the needles of said first group so as to cast off said small loops onto the needle stems, feeding thread to all of the hooks, retracting all of the needles, closing during such retraction the latches of all of the needles, whereby the needles of a second group composed of the remainder of the needles contain two threads, forming shorter double loops on the needles of the second group and longer loops on the needles of the first group during such retraction; in a third course, the steps of advancing all of the needles, during such advancing casting off the loops formed on all of the needles onto the needle stems, feeding thread to all of the hooks, retracting and closing the latches of the needles of the second group only, and forming relatively short loops on the needles of the second group during such retraction.

5. A circular knitting machine having a plurality of needles having hooks and latches for closing the hooks, and having a plurality of sinkers arranged between the needles, each sinker having two shoulders of different height, said machine having at least two feeding points, comprising means operable during one revolution of the machine for advancing all of the needles at one feeding point to receive yarn, means to retract, alternate needles only forming a first group, means to knock over the latches of the needles of said first group, means for positioning the sinkers during such retraction with respect to the needles of such first group so that the loops formed thereon engage the lower of the shoulders of the sinkers to form small loops, means at a second feeding point to advance the needles of the first group, to open the latches thereof and to feed yarn to all of the needles, means operable to retract, all of the needles, means to knock over the latches of all of the needles, means for positioning the sinkers during such retraction so that the loops formed on the needles engage the higher shoulders thereof to form long loops, and means to repeat such operations alternately with the two groups of needles.

6. In a machine as claimed in claim 5, said sinker having a hook with a nose above the sinker throat and a normal knocking-over surface in front of the hook, said shoulders being located behind the hook, the hook sloping gradually rearwards to one of said shoulders.

7. In a machine as claimed in claim 6, the shoulder adjacent the hook lying higher than said other shoulder and at the same height as the normal knocking-over surface.

8. In a machine as claimed in claim 6, the shoulder adjacent the hook lying higher than said other shoulder and higher than said normal knocking-over surface in front of the hook.

9. A circular knitting machine as claimed in claim 8, comprising means for positioning the sinkers during such retraction at the second feeding point so that the parts of the loops of the previous course engage the normal knocking-over surface to form the short double loops together with the yarn fed at the second feeding point.

10. A circular knitting machine having a plurality of needles each having a hook and a movable latch, and means for advancing and retracting the needles, which comprises means to form a first course including means for opening the latches of all the needles, means for advancing all of the needles with open latches, means for feeding yarn into the hooks, means for retracting and closing the latches of alternate needles forming a first group only, and means for forming relatively short loops on the needles of said first group during such retraction; means to form a second course comprising means for advancing all of the needles of the first group, means operable during such advancing for opening the latches of the needles of said first group and casting off said small loops onto the needle stems, means for feeding yarn to all of the hooks, means for retracting all of the needles, means for closing during such retraction the latches of all of the needles, whereby the needles of a second group composed of the remainder of the needles contain two threads, means for forming shorter double loops on the needles of the second group and longer loops on the needles of the first group during such retraction; means to form a third course comprising means for advancing all of the needles, means operable during such advancing to cast off the loops formed on all of the needles onto the needle stems, means for feeding yarn to all of the hooks, means for retracting and closing the latches of the needles of the second group only, and means for forming relatively short loops on the needles of the second group during such retraction; and means to form a fourth course comprising means for advancing the needles of the second group, means operable during such advancing for opening the latches of the needles of said second group so as to cast off said small loops onto the needle stems, means for feeding yarn to all of the hooks, means for retracting all of the needles, means operable during such retraction for closing the latches of all of the needles, whereby the needles of the first group contain two threads, and means for forming shorter double loops on the needles of the first group and longer loops on the needles of the second group during such retraction.

11. A circular knitting machine according to claim 5,

having a stitch-cam for circular knitting which is divided into two parts, a flat stitch-cam part and another part shaped to produce the corresponding needle-movements and located at a distance at least as great as the width of the needle-feet from the other part; said flat part being fixed and the other part being movable upwards so that this part can move downwards the feet of those needles which are to move over the stitch cam.

12. A sinker having two shoulders of different height and having a hook with a nose above the sinker throat and a normal knocking-over surface in front of the hook, said shoulders being located behind the hook, the hook sloping gradually rearwards to one of said shoulders, the shoulder adjacent to the hook lying higher than said other shoulder and higher than said normal knocking-over surface in front of the hook.

13. A sinker having two shoulders of different height and having a hook with a nose above the sinker throat and a normal knocking-over surface in front of the hook, said shoulders being located behind the hook, the hook sloping gradually rearwards to one of said shoulders, the shoulder adjacent to the hook lying higher than said other shoulder and at the same height as the normal knocking-over surface in front of the hook.

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