

**Dec. 23, 1941.**

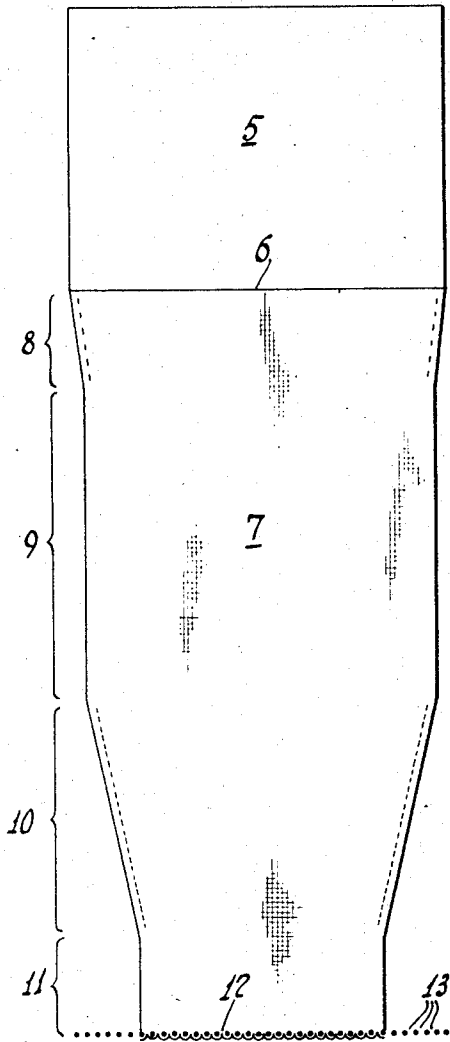
## F. WINESKIE

**2,267,631**

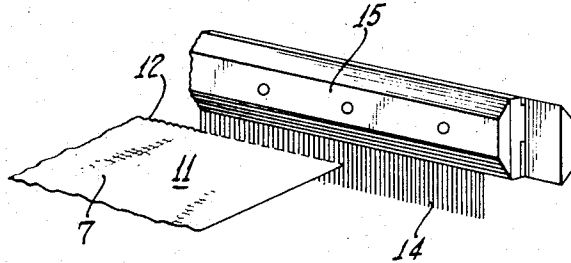
## KNITTING OF FULL FASHIONED STOCKINGS

Filed July 21, 1941

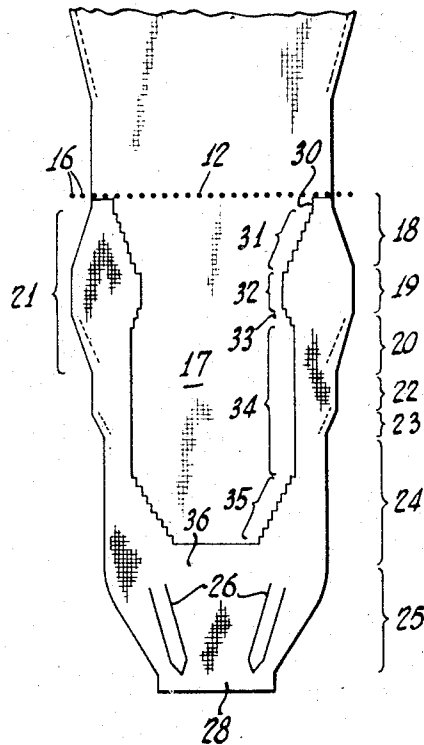
Fig. 1.



T19.2.



T19.3.



## UNITED STATES PATENT OFFICE

2,267,631

## KNITTING OF FULL FASHIONED STOCKINGS

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17 Claims. (Cl. 66—82)

This invention relates to the knitting of full fashioned stockings; and more particularly to a special method, and its product, of flat knitting of such stockings by a novel manner of use or operation of a first or leg knitting machine or so-called legger and a separate second or footing machine or footer, each preferably of generally conventional type, with usual needles and other instruments, but adapted or adjusted mechanically arranged, as by means of modifications easily understandable to a skilled knitter, to carry out the purposes of this invention.

The prevailing mode of manufacturing full fashioned stocking is by the combined use of a larger number of legger machines and a smaller number of separate footer machine in the knitting mill, these being of varying details and different makes but of conventional kinds, and the system being generally satisfactory except for certain drawbacks as will be herein explained. The usual legger has been operated to attend to the knitting of more than the actual leg and as much as 70%, more or less, of the fabric constituting each stocking blank, so that it has been customary to equip a plant with between two and three times as many leggers as footers. The speeds of these machines may be of the order of 60 revolutions or courses per minute, sometimes considerably faster, and each may be formed with a sufficient number of sections to knit twelve pair of stocking or more simultaneously. The legger may have a relatively wide needle bank or bar, for example of 14 inch effective extent, while the needle bar of the footer is usually somewhat shorter, such as 10 inches; in each case the spacing of the needles being of some selected gage, such as 42 gage or 28 needles to the inch. The conventional footer is usually equipped with a greater number of transfer elements or combs for narrowing or fashioning the fabric than is the legger, thus facilitating the employment of the present innovation to be described.

The prevailing system practiced on such conventional legger and footer machines may be as follows. The fabric blank is started on the legger, usually with a length of welt fabric, beyond which is knitted the stocking leg, with suitable narrowings at selected places or zones of knitting progress until reaching the narrowest or ankle portion of the stocking. The knitting then proceeds for some extent of ankle without change of width and continues until reaching that portion of the length referred to as the instep, which corresponds also with the heel. In the meanwhile an extra yarn is introduced at the outer fabric margins for reinforcement of the heel. Upon reaching this point of knitting, at the instep or middle portion of the blank width, the knitting conventionally ceases, after laying a loose course and a number of ravel courses, while at each side

of the fabric the knitting is continued substantially beyond this point to form in a longitudinal manner the reinforced so-called heel tabs or flaps, that finally are terminated with loose and ravel courses. At this stage the knitting on the legger is stopped, with the fabric middle and margins usually cast or pressed off the needles; and the difficult task is undertaken of transferring each partially knitted blank, now removed from the legger, and applying it, with a new disposition of the fabric, to the footer.

This trying operation of bodily transfer of fabric is performed by trained employees, called toppers, whose first operation, for each fabric, is to prepare the heel tabs and then impale the fabric, now at the maximum or heel-instep width, on to the points of a so-called transfer bar, corresponding in spacing with the needles of the knitting machine. In this time-consuming and labor-expensive operation, the heel tabs have to be straightened out into lateral alinement with the instep termination of the fabric middle, so that the points of the transfer bar will take the course loops of the instep part of the fabric, but must take the wales of the outer or marginal heel parts thereof. The latter operation is especially arduous on account of the need of preparing the selected wales to provide loops, and the double character of the reinforced fabric. The ravel courses are now raveled off. By a so-called topping mechanism the entire row of impaled loops is now shifted from the transfer bar to a so-called topping bar having a corresponding set of points. The topping bar is next fitted to the footer, and by the labor of a topping operator assisted by the knitter, the entire row of loops, plain and reinforced, is shifted on to the needles of the footer. The footer is now started into operation and the knitting progresses, with main and reinforcing yarns and with appropriate narrowings, in completing the heel-instep and forming the shank of the foot, and later the French or other toe.

The objections to the prevailing system thus described have been long well understood and they include the following:

(a) An excessive amount of skilled manual work is unavoidable in the double operation of transferring the partly knitted blank from the legger, after partial formation of the heel, and topping it on to the footer, this having to be done at what is a relatively wide part of the finished blank. This objection involves not only undue expense in labor costs but delay in production, and being a delicate operation it presents maximum opportunity for error and resulting defects in the product. This is more especially so since the long line to be transferred is complicated by a mixture of wales and courses as described, and also by the presence in the

loops of the second or reinforcing yarn. The transferring and topping work is hard on the eyesight, so that nightwork is substantially prohibitive, wherefore in rush periods, when the leggers are being used day and night, the footers can not keep up to production so that a mill may be required to be equipped with a greater number of footers than otherwise necessary.

(b) As already explained, there is an unequal division of the knitting work as between the two machines, so that the equipment of a given plant is necessarily unbalanced, having to include a far greater number of leggers than footers under average or normal conditions. The indirect further result follows that in case of wear, breakage or other causes of stoppage in the legger, as with need of readjustment or repair, the loss of production therefrom is unduly emphasized, involving the major portion of the knitted blanks.

(c) By the prevailing system described there is a distinct limitation as to the kind or type of heel which may be produced on hosiery, the customary heel being of the so-called English type involving the knitting in the legger of extended lengths or tabs to be repositioned to provide the heel fabric and involving the transfer and topping difficulties already recited; while by the same system it has not been feasible to produce the rounded or French type of heel, or others consisting of widenings followed by narrowings of fabric, as is so desirable for the best fashioning of the stockings.

(d) To the extent that time is consumed in knitting on the legger the extended fabric lengths to form the heel tabs, consisting of many short courses at each side, there is a loss of knitting time and output; because the portion of the length of the stocking represented by the length of these tabs, representing from about 100 to 150 courses, has in effect to be knitted twice, first on the legger as described, and second on the footer after the redispersing of the heel tabs.

So well recognized have been these and similar objections to such otherwise generally satisfactory prevailing system, that numerous efforts have been made to eliminate the most notorious drawbacks in various ways, but none of them so far as is known is similar to the present invention. Taking alone objection (a) above, involving the excessive amount of difficult manual work in transferring and topping the extended length of reinforced fabric, certain machines have been developed intended to eliminate wholly such transfer thereby to reduce expense of manufacture of stockings; these in general consisting of a combination, in a single machine, of mechanisms for and the operations of both leg knitting and foot knitting, in other words performing and completing the entire knitting of the stocking on a single machine, the latter sometimes being known in the trade as a "single-unit" machine. However, while such improvements have afforded the advantage indicated, they have themselves been objectionable in other ways, some of such further objections being due to the very fact of combining the two stages into a single long continuous stage of knitting. While the introduction of such single-unit knitting machine, or equivalents thereof, afford the mentioned, there result the following among other objections to the combination legger-footer.

(e) The including of all of the successive knitting stages in a single machine tends to render the total process somewhat cumbrous, in that it is

like placing all of your eggs in one basket, so that if anything goes wrong in the knitting of any part of the length of any stocking it affects and delays the entire progress and reduces production. There are various causes of stoppage, which may occur in any one of the 24 sections of the machine and during the knitting of any part of the length of any stocking, as in the leg or in the foot. This may be due to damage or breakage, or merely to minor matters of readjustment, inspection and the like. Every such suspension of knitting, whether at leg or at foot, holds up the entire knitting of both the leg and foot; which contrasts with the older prevailing system wherein stoppages in the leggers fail to suspend progress in the footers, and vice versa. In extreme cases this objection may even require a greater investment for a given output, in the need of a greater number of single-unit machines for the desired rate of production.

(f) The two stages of leg knitting and foot knitting, being tied together in immediate sequence and requiring to be performed with the identical needles and associated instruments, it follows that the machine design and operation can not be of the best character both for leg knitting and for foot knitting. The combined machine loses the advantage of the two-unit system that the legger and footer can be and are each constructed and operated for obtaining the best results in its own stage of the entire work.

(g) While the single-unit or combined machine obviates the need of changing yarns, needles, etc., at the same time the availability of the machine is in some ways more limited than with the two-unit system. Thus, some combined machines as known are restricted as to the type of toe that can be knitted and unadapted to produce satisfactorily the popular French or diamond-point narrowed toe, without special design and complications that serve no function during knitting of the leg.

(h) A practical aspect of the single-unit machine is that it involves a costly investment in new machinery, and the introduction of mechanisms with which the operatives may be unfamiliar, whereas the prevailing separate leggers and footers are not only generally satisfactory but are of too high a value to warrant discarding or junking them for displacement by the single-unit system. In other words the single-unit machine is of far less desirability economically than would be a development (such as is the present invention) which is adapted to be practiced, with only minor changes, adjustments and timings, on the preexisting equipment of separate legger and footer machines as now widely distributed among the established knitting mills.

In order to eliminate certain of the above-mentioned economic objections to the single-unit machine the plan has been used of reconstructing a legger machine to convert it to one-machine use, by adapting it to do the completion of the heel and the foot, following the knitting of the leg. In general it involves operating the instep needles idly without casting off their loops while continuing knitting on the heel or side needles to form the tabs, pressing off the tabs and manually resettling them upon the side needles. This plan does not however overcome the objections noted, although it avoids the discarding of the previous legger machine, without however utilizing the footer machines. For a mill to proceed in this manner by converting the leggers and discard-

ing the footers unavoidably causes a very great reduction in the gross rate of output of the mill. Further, the converted legger machine is incapable of making the desirable diamond-pointed toe. Attempts to convert the footer machine to single-unit use has not proved of any value in modern stocking manufacture.

As already indicated, the general purpose of the present invention is to overcome the existing objections to the older prevailing systems and to the more recent developments. This innovation, although seemingly of simple general character when explained, constitutes a practical solution of the existing problem of obviating or alleviating the enumerated objections, and a valuable advance which it is believed has not been perceived by the host of workers and improvers in this field, since no suggestion thereof has been found in granted patents or other literature or public knowledge or use having to do with the development and improvement of the art of knitting full fashioned stockings.

In approaching a preliminary statement of the nature of the present invention, it is first repeated that the invention involves the production of stockings by the successive use of first and second machines, a so-called legger and a so-called footer, although these terms as conventionally heretofore used are not here applicable in exactly the same sense since, with the present invention, there is a redistribution or allocation of the total knitting operations as between the successive machines, as will more fully appear.

The present invention may first be outlined as consisting of the method of knitting full fashioned stockings upon separate legger and footer machines which comprises knitting upon the legger (in generally conventional manner and with narrowings at selected fashioning zones) the leg of the stocking, but, contrary to known practice, terminating such knitting on the legger substantially at a place of progress which while beyond or below the last of the leg narrowings is short of or above the beginning of the formation of the heel and instep, whereby the last courses knitted on the legger are substantially of the narrowest width of the fabric preceding or above the foot; and thereupon (as by conventional or other suitable transfer or topping modes or steps) effecting the pressing off or bodily removal of the knitted leg fabric from the legger, by a simple disengaging of its last knitted course of loops from the legger needles, and applying or topping corresponding loops of the fabric upon the corresponding needles of the footer; and therefrom proceeding with the knitting of the fabric upon the footer, with conventional or suitable fashioning thereof for the heel and instep, preferably by widening and subsequent narrowing steps, and followed by continued knitting of the foot shank and preferably final narrowing on the same machine for the toe of the stocking.

With this development of method the terms legger and footer may be considered as coming for the first time into their true significance. While the ankle is manifestly a part of the leg, the heel and instep are more properly a part of the foot; and it is believed that for the first time in the art there has now been provided a two-machine system in which the first machine attends completely or only to the knitting of the leg only while the second machine attends completely to the knitting of the foot, including the

heel; this innovation being not a mere formal matter but a substantial and advantageous advance in the art, both technically and economically, as will further appear.

The essence of the present improved method as stated above may be restated more briefly as comprising the knitting of the leg fabric of the blank on a first machine, with suitable leg narrowings, but stopping at a point in the ankle which is below the final leg narrowing but above the place of widening for the heel and instep (and preferably closely above the commencement of such widening) and which is therefore at the narrowest portion of the leg; then detaching and transferring the leg fabric from the stopped first machine and topping it on to the needles of the second machine, which now is a complete foot knitting machine; and thereupon resuming the knitting and proceeding first by suitable widenings of the fabric and then narrowings, in a manner thereby to fashion the fabric into rounded heel projections or caps, followed by suitable continuation of knitting for the foot shank.

By this improvement the several noted objections, above designated (a) to (h) inclusive, are either largely or wholly overcome. For example, meeting objection (b), the division of the knitting work as between the two machines is now more equally and advantageously balanced, so that a mill may be operated with approximately equal numbers of leggers and footers, and incidentally minimizing the production losses mentioned. Objection (f) is overcome, for now each of the two machines may be adapted and specialized for its own particular work, the legger for parallel knitting and narrowings only, giving maximum speed of production of fabric, but only down to or through the ankle, while the footer may be fully equipped for the more elaborate necessary fashioning, including both widening and narrowing of fabric for the heel, and double narrowing for the toe, as well as reinforcing.

The construction of the two machines is not herein shown by the drawing because unnecessary for one skilled in the subject, but many of the usual and conventional elements and mechanisms are to be understood. Thus each machine, at each section, is to have its bank of united knitting needles, accompanied by sinkers and other cooperating instruments. Each machine has its reciprocating main yarn carrier with its guide to lay the yarn upon the needles; and in case ringless fabric is desired there may be three carriers instead of one; and in any case extra carriers are included for various purposes such as laying reinforcing yarns. Conventional or other narrowing devices are understood, usually comprising a group or comb of transfer points at each side for taking from needles, shifting inwardly, and replacing upon needles a marginal group of loops. The footer machine is to have not only means for narrowing, but means for widening the fabric, which may be done with the aid of the narrowing combs or otherwise; and in respect to narrowing functions the footer is preferably provided with split combs, with long and short sections, thus to permit what is known as double narrowing, for the production of the so-called diamond-point toe.

The drawing, which is purely diagrammatic and conventional, shows, in Fig. 1, the character of the structure of the stocking fabric including the welt and leg down to and into the ankle, as far as it is produced in the first or legger

machine according to this invention. Fig. 2 is a perspective view indicating the transition stage, showing on an enlarged scale, a part of the last courses of the leg, carried upon part of a transfer or topping bar, after removal from the first and before topping upon the second machine. Fig. 3 shows the lower part of the leg fabric previously made on the legger machine, and therebeyond the entire foot portion of the fabric, including heel, shank and toe, as knitted upon the second or footer machine in continuation of the previous knitting.

Referring first generally to the disclosures of the drawing, the blank is seen at its upper end to include a welt 5, which is usually knit with its side parallel, without narrowing, and which may be composed either of a single thickness or of doubled fabric, and is usually ornamented to some extent and may include elastic zones. Below the transition line 6 between welt and leg the knitting of the leg 7 may be conventional, with selected narrowings as will be further described and it is shown in Fig. 1 as terminating at a transition line 12, which is imaginary or invisible, being merely the position of the last course knitted on the legger, shown engaged on legger needles 13. While there is no exact line of demarcation between the ankle of a stocking and the foot portions therebelow, the fabric immediately above the line or course 12 may conveniently be considered as the ankle, and the fabric approaching this transition line is preferably parallel-knitted, so that the width of the fabric at this line is of the narrowest width of any part of the fabric preceding the foot.

Fig. 2 indicates how the fabric thus far described is maintained in condition during transfer from the legger for topping upon the needles of the footer machine, the loops of the last course at 12 being individually carried upon the several points 14 of a conventional transfer or topping bar 15, to be topped on to the needles 16 of the footer. In Fig. 3 the preferred formation of the remainder of the fabric is illustrated, comprising the entire foot 17 of the stocking blank, which term is now used to include the heel and instep, the shank of the foot and the toe.

The complete series of steps of an illustrative or preferred embodiment of the invention may now be set forth supplementally to the outline just indicated. Little need be said as to the welt 5, this zone of the fabric extending from the initial or top end course down to the arbitrarily designated transition line 6, which may coincide with some part of the pattern of the welt or with a change from one kind to another of yarn. The welt is preferably knitted with straight or parallel selvage edges, and immediately following is knitted the leg 7 extending from the course or line 6 to the transition line 12 between leg and foot, or between ankle and heel. The leg knitting may follow usual procedure and is shown as comprising a length or zone 8 of progressively narrowed fabric, evidenced by a succession of flare narrowing or fashion marks parallel to the selvage. Next follows a parallel or straight zone 9 and after that a second narrowed zone 10, accompanied by calf fashioning marks. The ankle portion or zone 11 is shown without any narrowing, the fabric having already been reduced to its narrowest width, selected to suit the average ankle size.

This completes the leg, and the imaginary transition line 12 may designate the final regular knit-

ted course, to be included in the completed stocking blank. It is naturally to be understood without detailed mention, that beyond the last regular course of the ankle, knitted on the leg, may be one or a few supplemental courses, as a loose course and some ravel, which are of incidental character, being made use of to aid in the removing or casting-off of the fabric from the needles 13 of the legger and in preparing them for topping on to the footer. This transition step is indicated conventionally in Fig. 2, where a portion of the width of the fabric of the leg 7, namely the ankle portion 11 of the leg, is shown as having been received upon the points 14 of a transfer or topping bar 15, wherefrom after raveling away the extra courses they may be topped on to the bank of needles 16 of the footer machine.

The described reallocation of the fabric knitting work as between the two machines accomplishes several of the important objects of the invention. The objection (a) as to the excessive and peculiarly difficult transfer and topping work has by this change been at least half overcome. The termination of the leg knitting is now at the shortest width of the fabric preceding the foot, being above the top of the heel and below the final narrowing of the leg, so that the number of loops to be transferred and topped is very greatly reduced, as compared with the prior prevailing legger and footer system; and this delicate work is further simplified by the fact that there are no heel tabs to be redispersed and topped, and the course which is to be topped is composed of the main yarn only, since it precedes the reinforcement to be formed by the introduction of additional yarn commencing beyond the ankle and adjacent to the top of the heel. Objection (b) has been overcome, by the re-division of the total work as already above explained. Objection (c) has been overcome, in preserving the use of separate legger and footer machines, as compared with the single unit system wherein any stoppage anywhere suspends production completely, whereas with the present invention a necessary stoppage in the knitting of the leg fabric is without effect upon the production of the foot portions of stockings on the separate footer machine, and vice versa. And objection (f) is overcome, as previously described, in that each of the two machines may be arranged, equipped and adjusted to afford the best mode of operation and results for its particular and special work.

Having now transferred the leg fabric to the footer machine the knitting is resumed and the heel and instep portion is commenced and carried out by fashioning in any known or desired way, typically and preferably by first widening the fabric through the length or zone 18 to the full desired width of heel fabric such as ten inches or more, followed by parallel-knitting a length or zone 19 of the maximum foot width, for a substantial number of courses, and followed in turn by gradually narrowing at zone 20, reducing the fabric width to that which is desired for the commencement of the shank of the foot. Thus is afforded the rounded type or so-called French heel, presenting a bulging projection 21 at each side of the fabric, comprising widening and narrowing zones which may start as a smooth continuation of the ankle selvage and finish smoothly into the line of the shank. The recited objection (d) is eliminated since no heel tabs are

necessary and there is no duplication or going back for repetition of the knitting of a large number of courses. Objection (c) is overcome because the two-machine method is no longer limited as to the type of heel to be formed, and the English type with heel tabs may now be eliminated, and the rounded or French type, with widening and narrowing, made available.

Some description in detail is desirable as to the formation of the rounded heel projections or caps 21. There are several known methods of widening, adapted to be applied along the zone 18 of the diagram. One system is illustrated inter alia in the Berger Patent No. 2,154,602 of April 18, 1939, wherein the reciprocations of the yarn carriers are gradually widened, as by one-needle or two-needle increments; accompanied by the use of the narrowing combs to transfer outwardly selected marginal groups of loops; this mode leaving a series of fashioning marks in the form of small holes or gaps along lines spaced inwardly from the selvage. By another mode, illustratively shown inter alia in the patent of Somers No. 2,230,986 of February 4, 1941, the progressive increases in the throw of the yarn carriers, over additional needles at each widening course, are performed without accompanying transfer of loops and therefore without leaving fashioning holes in the fabric. Numerous earlier patents show various modes of widening adapted for heel projections. The succeeding parallel-knit length 19 affords a greater heel capacity in the projection than would a shape wherein the widening is followed immediately by narrowing, in which latter instance the maximum width at the apex would need to be further increased to afford the same roominess, or in some cases it might be required to substitute wider banks of needles, sinkers etc. The narrowing along zone 20 is readily effected in various ways, preferably by the use of the narrowing combs to transfer marginal groups inwardly at each narrowing course, thus to leave fashioning marks or sutures such as are indicated.

The method thus described, involving the complete formation of the heel, through zones 18, 19 and 20, in the legger machine, affords various possibilities as to the mode of fashioning and as to the heel outline desired. Objection (c) is thus overcome since the English or tab heel construction may be eliminated in favor of the rounded or French style; and objection (d) is obviated, since the entire length of foot fabric, from ankle to toe, is knitted with continuous progress and without the need of repetition to the extent of the number of courses contained in the heel tabs of the older system.

Following the heel projection 21 the knitting of the foot shank proceeds as desired, as with a short straight zone 22, followed by a small amount of narrowing at zone 23, evidenced by fashion marks, in turn followed by a straight or parallel zone 24 leading to the toe. The toe is preferably knit in the same machine and involves a steeper narrowing, along the zone 25; which may be produced by the known system of double narrowing, employing a short and a long comb at each side, effecting inward shiftings of loop groups in a manner to give the so-called diamond-point narrowing or fashioning marks 26. These marks converge into a sharp point which is substantially the end of the stocking fabric, although a short extent of further knitting at zone 28 is customary, which may consist partially

of ravel courses. In the ability of the described method to produce the desirable diamond-point toe narrowing objection (g) is overcome.

Reinforcing of the stocking foot is practically essential in modern production, such reinforcing conventionally extending beneath the entire length of the foot, including heel and toe and upwardly around the back of the heel toward or substantially to the ankle, and at the toe end over the entire width of the foot, and it is an advantage of the present invention that all of such reinforcement may be effected in the second or footer machine as distinguished from commencing it in the legger and interrupting it for transfer. The reinforcing requires in the footer an opposite pair of extra carriers for the reinforcing yarns at the two sides. Fig. 3 shows that approximately at the transition line 12 the reinforcing carriers are put into operation, along with the main carriers, so that all of such carriers continue in uninterrupted operation throughout the entire extent of the knitting in the second or footer machine. At each side the reinforcement is shown as commencing with a lengthwise zone 30 of relatively narrow width, confined to the outer margins which become the back of the stocking above the bulge of the heel. In the course of the knitting progress the first zone 30 at each side, limited by inner and outer carrier stops, is followed by a zone 31 wherein the reinforced area is widened inwardly or reversely, its outer contour conforming of course with the outer contour of the entire fabric. Next follows the parallel reinforcement zone 32, and then a narrowed zone 33. These three zones 31, 32 and 33 thus afford an interior widening, parallel length and narrowing, thus constituting an inward projection or rounding which may be substantially complementary to the selvage rounding at 21. The major portion of the width of the fabric at the instep is thus left free of reinforcement, as is desirable, while the heel reinforcement extends well up at the sides of the heel, improving wearing qualities. Following the reinforcement zone 33 is a parallel knitted zone 34 and then an interiorly widened zone 35, beyond which the reinforcement is carried at 36 entirely across the whole extent of the fabric, as is customary practice and is shown for example in the Berger patent mentioned.

As an illustrative example the successive fabric widths may be as follows, assuming 42-gage or 28 needles to the inch. At zone 5 maximum width 14 inch, 392 needles; at zone 7 width 13.1 inch, 368 needles; at ankle 10 minimum width 8.6 inch, 240 needles. In the footer, at zone 19 maximum width 10 inch, 280 needles; at zone 22 width 8.6 inch, 240 needles; and at zone 24 width 7.9 inch, 220 needles.

An operative advantage of the present invention is the complete dispensing with such a necessarily manual operation as the resetting of heel flap fabrics for continued knitting of the foot. Therein resides the possibility of avoiding all manual impaling and topping of individual loops. At least theoretically the transition course 12 of simple loops may be bodily drawn off the legger needles 13 directly on to the points 14 of a topping bar properly registered in relation thereto, and correspondingly thereafter shifted directly on to the needles 16 of the footer; and mechanisms have been known containing the general principles necessary for removing bodily a course of loops from a bank of needles directly

on to a bank of transfer points, for retransfer therefrom on to another bank of needles.

The economic advantages of the employment of the present invention are of substantial importance supplemental to the practical and technical advantages already indicated. In the first place, regarding the unavoidable necessity of transfer and topping operations when two machines are used, the difficulties, losses and expenses due thereto are practically cut in half by the present invention, due to the minimizing of the length of the course which has to be transferred and topped and to the avoidance of any need of transferring and topping any heel tab constructions, reinforcements or other complications. The cost of transfer therefore is very greatly reduced, and the remaining cost thereof is found to be practically offset by the savings due to the other advantages in the present system, including the segregating of the leg knitting stage from the entire foot knitting stage, on the two machines. The result is that the total cost in manufacturing a given output is far less with the present invention than with the old prevailing legger and footer methods, this money saving being additional to the value of the other items of superiority previously recited.

To take a practical instance we may assume the case of a mill equipped with 33 legger machines and 14 footers. Let us suppose that with the class of labor used and the number of hours worked per week the output under the former system was about 3,000 dozen pairs of stockings per week, this amount of work requiring approximately 30 girls for the transfer and topping operations. Let us next assume the conversion of the mill to the method of the present invention and that the leggers are used in sufficient number, in performing the operations shown in Fig. 1, to keep pace with the 14 footers, performing the additional operations indicated below the transition line 12 in Fig. 3. By this arrangement about 15 girls are found to be sufficient to perform the transfer and topping operations, a reduction of 50%. It is further found that the plant, so converted with relatively slight changes and readjustments in the machines, is capable of an output of 40,000 dozen per week, under the same conditions, an increase of approximately 33%. These advantages figures can be improved by operating the 14 footers or some of them overtime or double time so as to keep pace with the total of 33 leggers. The leggers, with their work terminating at the ankle can increase their production up to 20 percent, benefiting the total output to that extent. The advantages of the present improvement therefore are real, practical and extensive.

Making a comparison with the single-unit developments, and considering that the reduced transfer and topping expenses are practically offset by the value of the other gains, the chief advantage of the single-unit system is thus overcome, and this without incurring the objections (e), (f) and (g) previously mentioned as pertaining to the single-unit system. Further, by the present invention an existing mill is saved from the need of junking valuable existing machines and from the high investment cost of replacing them and is enabled desirably to retain the character of machinery in previous use in the mill; and in these senses the objection (h) is overcome.

If a comparison should be attempted between the operation of the supposed mill equipped with

33 leggers and 14 footers, by the method of this invention, and by the different proposal of converting or rebuilding the legging machines to knit complete stockings thereon, experience has shown that by the use of the converted leggers an output of only 2,000 dozen per week would be expected, or only about 50% of the output under the present invention. A suggestion that has been made to convert footers to single-unit use has not proved practical and needs no further consideration.

There have thus been described a full fashioned stocking knitting method, and the fabric blank or product thereof, embodying the principles and attaining the advantages of the present invention; but since many matters of method, step, arrangement and combination may be variously modified without departing from the principles of the invention, it is not intended to limit the invention to such matters except to the extent set forth in the appended claims.

What is claimed is:

1. The method of knitting of full fashioned stockings upon separate legger and footer flat knitting machines, comprising knitting upon the legger, in generally conventional manner and with narrowings at selected fashioning zones, the stocking leg, but terminating such knitting on the legger substantially at a place of knitting progress or transition line which is beyond or below the last of the leg narrowing zones but is above or short of the beginning of the formation of the heel and instep, whereby the last courses knitted on the legger are at substantially the narrowest width of the fabric preceding the foot; and thereupon, as by conventional or suitable transfer or topping modes or steps, effecting the bodily removal of the knitted leg fabric from the legger by disengaging its last knitted course from the legger needles and applying the fabric upon the corresponding needles of the footer; and therefrom proceeding upon the footer to knit the entire fabric of the foot, with conventional or suitable fashioning thereof for the heel and instep, as by widening and subsequent narrowing steps, followed by continued knitting for the foot shank and preferably finally narrowing for the toe of the stocking.

2. The method as in claim 1 and wherein the leg as knitted on the legger machine commences with the welt at the top and ends with the parallel-knitted ankle of the narrowest leg width, and the transition line of the knitting is at the termination of the ankle and immediately above the beginning of the shaping for the rounded heel of the foot.

3. The method as in claim 1 and wherein the fashioning or shaping of the rounded heel includes a substantial length of parallel knitting at the heel apex between the widening and narrowing thereof.

4. The method as in claim 1 and wherein the leg as knitted on the legger machine commences with the welt at the top and ends with the parallel-knitted ankle of the narrowest leg width, and the transition line of the knitting is at the termination of the ankle and immediately above the beginning of the shaping for the rounded heel of the foot; and wherein the fashioning or shaping of the rounded heel includes a substantial length of parallel knitting at the heel apex between the widening and narrowing thereof.

5. The method of flat knitting of a full fashioned stocking fabric blank comprising knitting the leg fabric on a first machine with suitable leg



narrowings, but stopping such knitting on the first machine at a point in the ankle which is below the final leg narrowing but above the place of widening the blank for the heel or instep and is therefore substantially at the narrowest portion of the leg; then detaching and transferring the leg fabric from the stopped first machine and topping it on to the needles of a second or complete foot knitting machine; and thereon resuming the knitting and proceeding to knit the foot first by suitable widenings of the fabric and then narrowings thereby to fashion the fabric into rounded heel projections, followed by suitable continuation of knitting for the foot shank and toe.

6. The method as in claim 5 and wherein the transition point between knitting in the first and second machines is near the end of the parallel knitting of the leg ankle and the beginning of the widening for the foot heel.

7. The method as in claim 5 and wherein the heel shaping on the second machine is by first widening, then knitting parallel and then narrowing, thereby to afford a rounded and roomy heel projection.

8. The method of flat knitting of a full fashioned stocking fabric blank comprising knitting and narrowing the leg fabric on a first machine having needle bank and cooperating instruments, yarn carrier and narrowing means, but stopping such knitting on the first machine at a point in the ankle which is below the final leg narrowing but above the place of widening the blank for the heel or instep and is therefore substantially at the narrowest portion of the leg fabric; then detaching and transferring the completed leg fabric from the stopped first machine and topping it on to the needles of a second or foot knitting machine having needle bank and cooperating instruments, yarn carriers for regular and reinforcing yarns, and narrowing and widening means; and thereon resuming the knitting and proceeding to knit the foot first by suitable widenings of the fabric and then narrowings thereby to fashion the fabric into rounded heel projections, followed by suitable continuation of knitting for the foot shank and toe.

9. The method as in claim 8 and wherein the transition point between knitting in the first and second machines is near the end of the parallel knitting of the leg ankle and the beginning of the widening for the foot heel.

10. The method as in claim 8 and wherein the heel shaping on the second machine is by first widening, then knitting parallel and then narrowing, thereby to afford a rounded and roomy heel projection.

11. The method as in claim 8 and wherein, on the second or footer machine, having double-narrowing means, the toe of the foot is steeply narrowed in double manner to produce a diamond-point style of toe.

12. The method of flat knitting of a full fashioned stocking fabric blank comprising knitting the leg fabric on a first machine and effecting progressive narrowings of the leg fabric between the top end and the ankle, but stopping such knitting on the first machine at a point in the ankle which is below the leg narrowings but above the beginning of the heel and is therefore at the narrowest portion of the fabric preceding the foot; then pressing off from the needles of the first machine and transferring the leg fabric and topping it on to the needles of a second or foot knitting machine; and thereupon on such second machine proceeding to knit the foot first by fashioning the fabric to produce a rounded heel with widenings followed by narrowings forming heel projections at the two sides, followed by continuation of knitting to produce shank and toe of the foot fabric.

13. The method as in claim 12 and wherein in the production of the rounded heel projection the knitting is performed in parallel manner at the maximum width of the foot fabric and for a substantial length of fabric between the widenings and narrowings thereby to enhance the capacity of the heel portion of the completed stocking.

14. The method as in claim 12 and wherein reinforcing yarn is selectively incorporated during the knitting of the foot, first of narrow width at the margins commencing with the knitting in the second or legger machine, and thereafter internally shaped to suitable contour while extending to both selvages of the fabric.

15. The method of flat knitting of a full fashioned stocking fabric blank comprising knitting the leg fabric on a first machine or legger with suitable leg narrowings, but stopping such knitting on the first machine at a point in the ankle which is below the final leg narrowing but above the place of widening the blank for the heel or instep and is therefore substantially at the narrowest portion of the leg; then detaching and transferring the leg fabric from the stopped first machine and topping it on to the needles of a second or complete foot knitting machine; and thereon resuming the knitting and proceeding to knit the foot, commencing with widenings followed by narrowings of the fabric to fashion the fabric into convex heel projections at the two sides and to form the foot shank and toe, while introducing and selectively incorporating in the structure of the knitted foot a reinforcing yarn of area reaching to the selvage margins at each side, first of narrow width near such margins, and thereafter internally shaped to a predetermined contour during progress toward the stocking toe.

16. The method of flat knitting full fashioned stockings upon separate legger and footer knitting machines, comprising flat knitting upon the legger, in generally conventional manner and with narrowings at selected fashioning zones, the stocking leg, but terminating such knitting on the legger substantially at a transition place which is beyond the last of the leg narrowing zones but is short of the beginning of the formation of the heel and instep, whereby the last courses knitted on the legger are at substantially the narrowest width of the flat fabric blank preceding the foot; and thereupon bodily removing the knitted leg fabric from the legger and topping it upon the needles of the footer; and therefrom upon the footer flat knitting the entire fabric of the foot, with full fashioning thereof to the required shape.

17. The method as in claim 16 and wherein the foot is shaped by full fashioning, first to widen the fabric and later to narrow it, thereby to form round heel projections at the two sides of the blank, with later narrowings of the foot toward the toe end of the blank.

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