

Dec. 3, 1940.

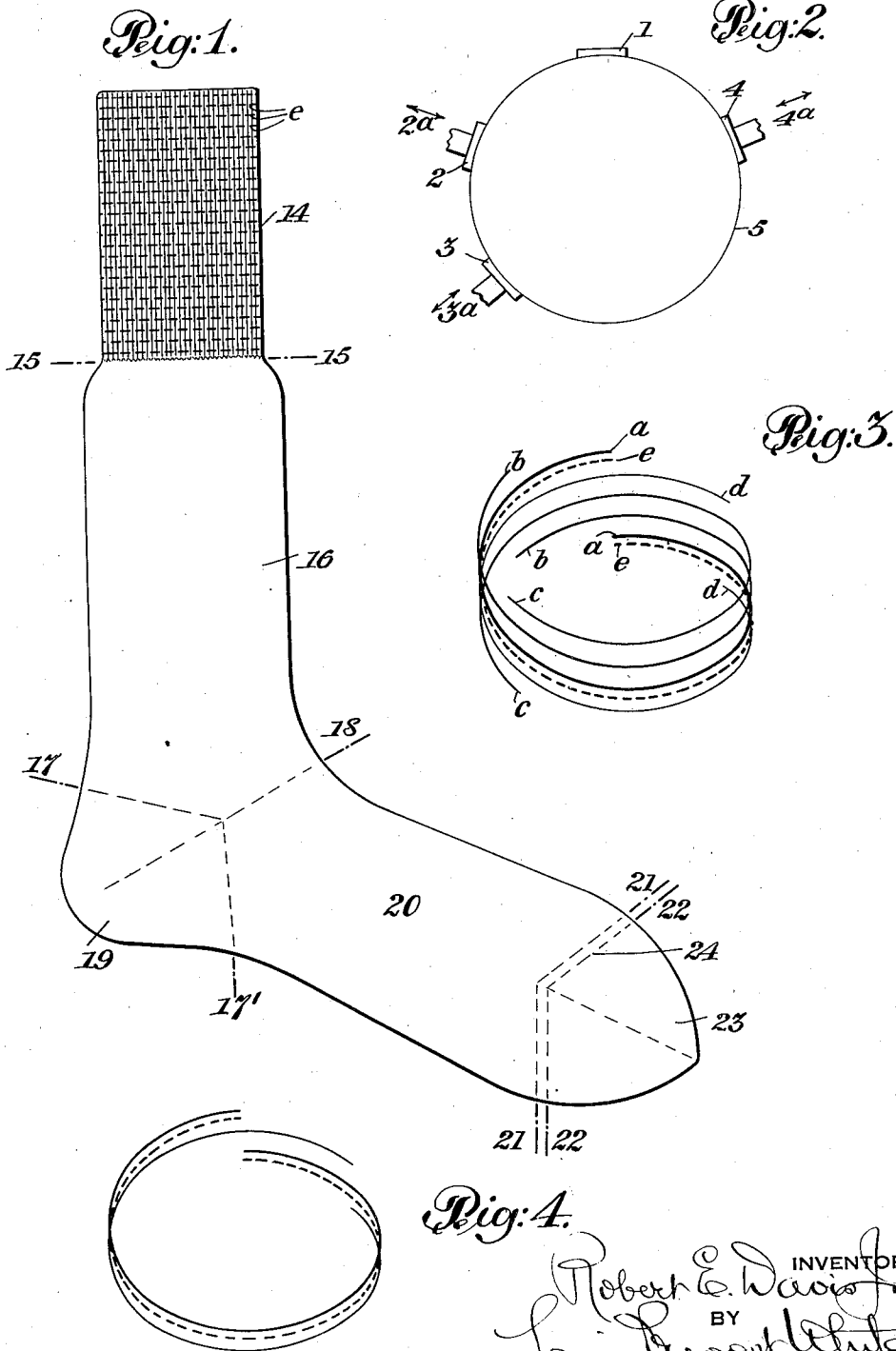
R. E. DAVIS, JR

2,223,719

HOSIERY

Filed Jan. 15, 1938

3 Sheets-Sheet 1



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HOSIERY

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3 Sheets-Sheet 2

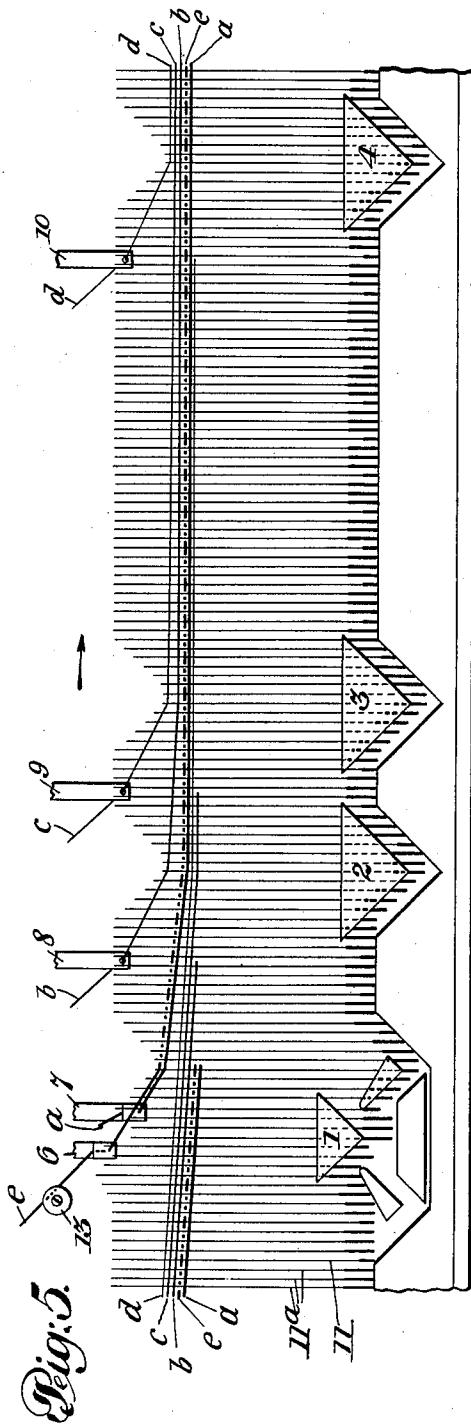


Fig. 7a



Fig. 7

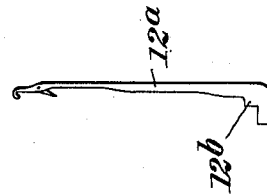


Fig. 6a

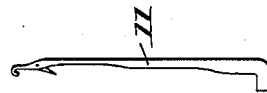
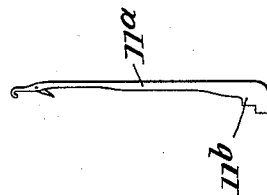


Fig. 6



Robert E. Davis, Jr. INVENTOR
BY Louis Newell Whitaker ATTORNEY

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Fig. 8.

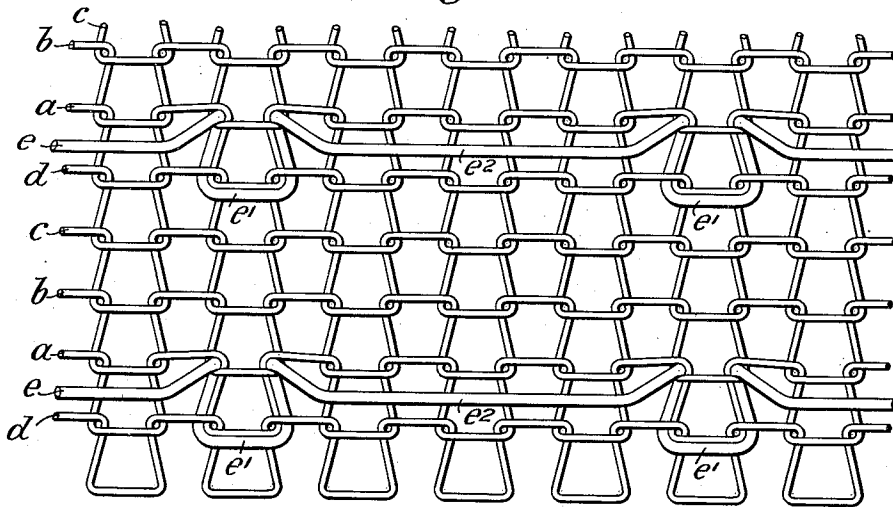
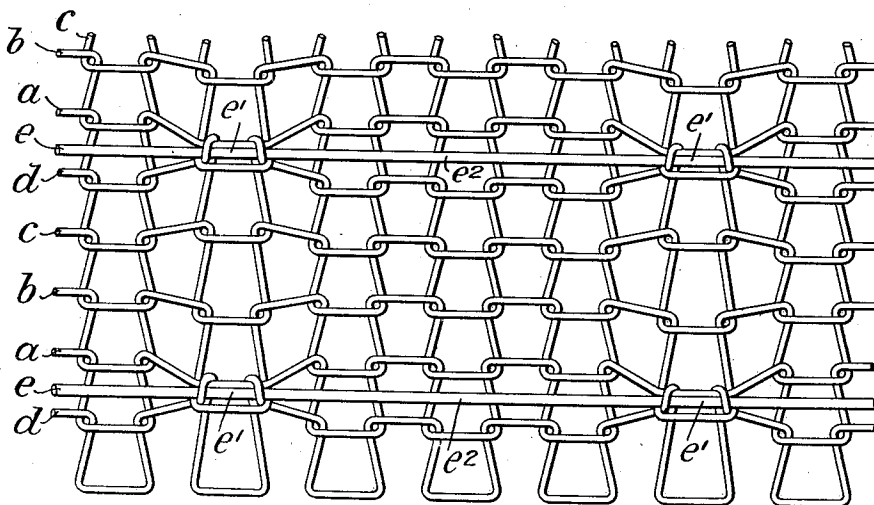


Fig. 9.



Robert E. Davis, Jr. INVENTOR
BY Louis Brewster Whitaker
ATTORNEY

UNITED STATES PATENT OFFICE

2,223,719

HOSIERY

Robert Evan Davis, Jr., Fort Payne, Ala., assignor
to Interwoven Stocking Company, New Brunswick, N. J., a corporation of New Jersey

Application January 15, 1938, Serial No. 185,122

2 Claims. (Cl. 66—172)

My invention consists in the novel features hereinafter described, reference being had to the accompanying drawings, which illustrate an embodiment of my invention and one method of producing the same, selected by me for purposes of illustration, and the said invention is fully disclosed in the following description and claims.

In the manufacture of hosiery, and particularly men's half hose and anklets, it has been customary for many years to knit the top or upper portion of the leg by rib knitting on a rib knitting machine which produces a tubular fabric of much smaller diameter than a plain knit fabric containing the same number of stitches or wales in each course, the fabric being also more elastic than plain knit fabric, so that while it may be stretched to permit the passage of the foot therethrough, it will contract by the inherent character of rib knitting to enable it to conform to the shape and size of the leg. These tops were subsequently transferred, in a well-known way, to a plain knitting machine, and the leg of the stocking was knit by plain knitting into the last course of the rib knit top. Obviously, this necessitated two sets of machines and a transfer step requiring skilled labor. I am aware that it has been proposed to knit the top of a stocking by plain knitting with a single inelastic thread, or threads, knitting continuously in every course and to incorporate in that portion of the plain knitting which conforms to the top of the stocking, an elastic thread of rubber or Lastex which is preferably connected to the fabric formed by the inelastic thread in the process of knitting, at spaced wales in the elastic bearing courses, the elastic thread being floated on the inner face of the fabric, and fed under a sufficiently high tension so that it will draw together the wales of the plain knit fabric and produce an elastic section or top of reduced diameter as compared with the other portions of the leg. The points of the different courses at which the elastic thread is united to the fabric are usually vertically aligned, thereby producing throughout the rubber incorporated fabric, vertical rib-like ridges closely approximating the appearance of a rib top and producing the same form-fitting effect, with the additional supporting effect. This supporting effect is accomplished by portions of the elastic thread on the inner face of the fabric which form horizontally disposed beads, slightly indenting the skin of the wearer, and supporting the sock on the leg. To insure sufficient separation between the elastic bearing courses, the elastic thread is withdrawn

at the completion of knitting each elastic bearing course and one or more courses are knit of inelastic thread only. This results in a series of longitudinally spaced elastic bearing courses connected by floats of elastic thread extending longitudinally of the fabric from one elastic bearing course to the next. To provide room for introducing the cams for manipulating the needles to incorporate the elastic thread in the elastic bearing courses of the fabric, the space between the last wale at which the elastic thread is caught in one of said courses and the first wale at which it is caught in the next, is greater than the space between the wales at which the elastic thread is caught throughout the rest of the circumference of the fabric. This results in long floats of elastic thread at the point where the elastic thread is carried over between the elastic bearing courses. Upon completion of the top portion of the sock, the leg is then knit on the same machine by simply discontinuing the feed of the elastic thread, thus avoiding the previously necessary transfer step.

My invention is an improvement on the elastic incorporated fabric above referred to, whereby the long floats of elastic thread connecting successive elastic bearing courses are avoided and both the top and leg and foot of the sock can be knit more rapidly, thus increasing the capacity of the knitting machine and cheapening the cost of manufacture. According to my invention, the top portion of the sock is knit by plain knitting, but with multiple feeds and multiple knitting cams, so that a plurality of courses are knit at every revolution of the machine, there being at least three such feeds and associated cams so that the thread forming each course is different from that of the two preceding and two succeeding courses. In saying that the courses are formed of different threads, it is meant that the threads are separate and distinct from one another, although they may be of the same color and character. In association with one of the multiple knitting threads, an elastic thread is fed to certain of the needles, preferably in plating relation with one of the multiple threads, so that it is incorporated in every course of knitting with that particular thread, thereby effectively spacing the courses containing the elastic thread without the necessity of introducing the elastic thread in the desired courses and withdrawing it while knitting the courses within which it is not desired, as in the case of knitting the top with a single thread. The elastic thread is united to the fabric at uniformly spaced wales separated

by at least two intervening wales and is otherwise floated on the inner surface of the fabric. The elastic thread thus forms on the inner surface of the top portion of the sock an inwardly projecting body engaging bead extending along the inner face of the fabric in the form of a continuous, smooth and uniform spiral, with at least two courses of inelastic thread between successive convolutions of the spiral. The elastic thread is incorporated under sufficient tension to contract the fabric into vertically extending ribs. When the knitting of the top is completed, the feed of the elastic thread is discontinued, and the knitting of the leg of the sock proceeds preferably with multiple feeds and multiple cams, either the same multiple used in the top, or a different multiple, as desired, and the foot portion between the heel and toe pockets is preferably knit in the same manner, thus greatly expediting the production of the sock, increasing the output of the machine, and cheapening the cost of manufacture. The heel and toe pockets are knit with a single thread feed by reciprocating work and narrowing and widening in the usual manner using one of the threads knit in the leg and foot portions or a separate thread with or without a reinforcing thread or threads. In some instances the leg and foot portions may also be knit with a single feed if desired, after knitting the multiple feed top as previously described.

My invention also contemplates certain other novel features hereinafter fully described, and pointed out in the claims.

In the accompanying drawings, which illustrate an embodiment of my invention in a sock and the process of knitting the same, selected by me for purposes of illustration.

Fig. 1 represents a side elevation of a completed sock embodying my invention.

Fig. 2 is a diagrammatic horizontal plan view of a circular series of needles of a knitting machine showing one arrangement of the main and auxiliary cams.

Fig. 3 is a diagrammatic view illustrating one arrangement for feeding separate yarns for the simultaneous formation of multiple courses of plain knitting in carrying my invention into effect, in which four yarns are simultaneously fed.

Fig. 4 is a similar view showing an arrangement for carrying out my invention, in which two yarns are simultaneously fed.

Fig. 5 represents a layout of the needle cylinder and cam ring of a knitting machine for carrying out my invention, showing it arranged to effect the simultaneous feeding of from two to four separate threads, or the feeding of a single thread as desired.

Fig. 6 is a detail view of one of the short nib needles provided with a selecting shoulder.

Fig. 6a represents a short nib needle without the selecting shoulder.

Fig. 7 represents one of the long nib needles, provided with a selecting shoulder.

Fig. 7a represents a long nib needle without the selecting shoulder.

Fig. 8 is a diagrammatic representation of a portion of the fabric showing it as it would appear if it remained as knit.

Fig. 9 is a similar view showing the fabric as it actually appears, due to the tendency of the elastic thread under tension to straighten out in the fabric.

My invention can be carried out, and my im-

proved fabric or stocking made, either by hand or by means of a knitting machine, and in the present instance I will describe my process as carried out on a well known Banner machine, manufactured by the Hemphill Company, which can be readily adapted for the purpose by the addition of certain additional knitting cams, yarn feeds and pattern controlling mechanism therefor. The improvements in the knitting machine, however, form no part of my present invention and will form the subject matter of a separate application.

In carrying out my invention by the aid of a knitting machine of the kind described, I employ, in addition to the main knitting cam two or more additional cams. In the present instance, as shown particularly in Figs. 2 and 5, I have shown the machine provided with a main knitting cam, indicated at 1, such as is usual in the Banner machine for example, and in addition thereto I have provided three auxiliary cams, indicated at 2, 3 and 4, arranged at convenient positions around the needle circle, indicated diagrammatically at 5 in Fig. 2, for example, the machine being provided with the usual thread guides at the throat of any desired number, two of such thread guides being indicated at 6 and 7 respectively in Fig. 5, and additional thread guides, indicated at 8, 9 and 10 being provided, one in advance of each of the auxiliary cams 2, 3 and 4. The auxiliary cams 2, 3 and 4 are preferably arranged in such manner that each one of them can be moved into and out of operative relation, which is conveniently accomplished by mounting them so that they may be moved radially with respect to the cylinder, as indicated by the reversed arrows at 2a, 3a and 4a in Fig. 2, all of the thread guides being movable into and out of operative position. With this arrangement it is obvious that it would be possible to feed one single thread, or more, such as two or three, according to the adjustment of the auxiliary cams and thread guides, thereby knitting either a single course or multiple courses of two, three and four in a single revolution of the machine, as may be desired.

The elastic thread is preferably introduced in plating relation with one of the multiple threads and is fed to the needles in such a manner that it will be united to the fabric at certain wales only of the successive courses continuously knitted by that thread. By reason of the multiple knitting, the elastic bearing courses will be separated by the continuous courses knit by the other body threads fed by the other separate thread guides.

For convenience of description, let it be assumed that a tubular plain knit fabric is to be formed by four feed knitting to constitute the top or upper portion of the sock, or other form fitting garment section, in which case the arrangement would be as indicated in Fig. 5, and let it be further assumed that the elastic thread is to be fed in plating relation with the body thread delivered by one of the thread guides of the throat, as the thread guide 7 for example, and is to be knit into the fabric at every fourth wale of the continuous courses formed by that thread, which will obviously be separated from each other by three intervening courses formed by the other body threads, the knitting machine will be provided as usual with short butt needles, one of which is indicated at 11 in Fig. 6a, and long butt needles, one of which is indicated at 12 in Fig. 7a, the short butt needles 75

cooperating in the usual manner with the narrowing and widening mechanism to produce the heel and toe pockets under the control of suitable pattern mechanism forming part of the machine. In carrying out my invention, I provide a series of short butt needles, one of which is indicated at 11a in Fig. 6, which are provided above the butt with a shoulder, indicated at 11b, and a series of long butt needles, one of which is indicated at 12a in Fig. 7, and which is provided with a similar shoulder 12b. In setting up the machine, every fourth needle of both short butt and long butt series will be of ordinary type without shoulder, while the three intervening needles in both series between these plain needles will be provided with the shoulder 11b or 12b, as the case may be. The main knitting cam 1 is so arranged that it will engage the shoulders 11b or 12b, and thereby draw down all the shouldered needles to a greater extent than the needles 11 and 12, which are therefore left in a higher position at the throat. A main body thread, indicated at a, is fed by one of the throat feed fingers, as 7, at the proper height to deliver it to all of the needles, while the elastic thread, indicated at e, will be fed by another of the throat feed fingers, 6, for example, at a higher position, and therefore will be fed only to the raised needles 11 and 12, or in other words, every fourth needle in the arrangement assumed. The auxiliary knitting cams 2, 3 and 4 are preferably so arranged that when in their innermost or operative positions they will engage the ribs of the needles only, that is to say they will engage the ribs of the plain needles and will engage the ribs of the shouldered needles forward of the shoulder thereof, so that all of the needles will be drawn down to the same extent. A second body thread, indicated at b, will be fed by the auxiliary feed finger 8 in advance of the auxiliary cam 2. A third body thread, or inelastic thread, c, will be fed by the feed finger 9 in advance of the auxiliary cam 3. A fourth body thread, d, is fed by the feed finger 10 in advance of the auxiliary cam 4. It will be understood that the body threads a, b, c and d are inelastic threads, and that the elastic thread e is of rubber or Lastex, or other suitable elastic material.

As the cylinder rotates, it will now be understood that as the needles engage the main knitting cam 1, the shouldered needles will be drawn down to a lower level than the non-shouldered needles, which will be left in position to receive the elastic thread e, while all of the needles including both the shouldered needles and the non-shouldered needles will take the body thread a, commencing the knitting of a course of stitches in which the elastic thread is fed in plating relation with the body thread a, and will be knit in every fourth wale with the body thread a, and floated between said spaced wales on the inner face of the fabric. As these same needles arrive at the auxiliary cam 2, all the needles will take the second body thread b, knitting it into the course of stitches previously formed by the thread a, and forming a second course, the said needles taking the third body thread c from the thread guide 9 at the auxiliary cam 3 and knitting a third course into the stitches formed by the thread b, and then taking the fourth body thread d from the thread guide 10 at the auxiliary cam 4, and knitting a fourth course into the stitches of the previous course formed by the thread c.

As the cylinder continues to revolve, bringing the

same needles again to the main knitting cam 1, the elastic thread will be fed to the elevated non-shouldered needles, in plating relation with the thread a, and will then be knit in the same manner into the stitches of the preceding course formed by the thread d, and the operation will be repeated.

It will thus be seen that a plurality of courses of the fabric are knit at each revolution of the machine, and that as the elastic thread is fed along with one of the multiple threads it will be continuously knit at spaced wales in every course formed by that thread throughout the fabric, so that the feed of each thread, including the elastic thread, is continuous throughout the formation of the fabric, for example, throughout the formation of the top of a stocking, and at no time during the knitting of this fabric is the feed of the elastic thread or of any of the body threads interrupted.

It will be understood that my invention is not limited to four feed knitting and the fabric may be formed in the manner above described with three threads, four threads, or more as desired, according to the desired separation between the courses carrying the elastic thread. I wish it also understood that I do not limit myself to any particular spacing of the wales in the courses carrying the elastic thread at which it is united to the fabric, either by knitting in as above described, or in any other manner by which it is made to engage with the inelastic thread so as to hold it in the fabric. For example, the shouldered needles and non-shouldered needles could be alternated throughout the needle circle, and the shoulders and thread guide 6 arranged to feed the elastic thread below the latches of the non-shouldered needles, thereby "laying in" the elastic thread as it is sometimes termed, in analogy to the laying in of an extra thread in rib knitting, without feeding it directly to the hooks of the needles.

I also wish it to be understood that the elastic thread is fed under considerable tension by passing it through a tension device, indicated diagrammatically at 13 in Fig. 5, for example, so that as the knitted fabric leaves the needles it will be contracted by the tension of the elastic thread to a much smaller diameter than it would have without the presence of the elastic thread, and as the elastic thread is united to the fabric in one of the ways mentioned by the same needles throughout the several courses containing the elastic thread, the fabric will be gathered into vertically disposed ribs or ridges resembling more or less rib knitting, according to the spacing of the non-shouldered needles, thus constituting the fabric form fitting while at the same time portions of the elastic thread on the inner surface of the fabric will constitute an inwardly projecting spiral bead capable of slightly indenting the skin of the wearer, with the convolutions of the spiral bead distributed over such a large area as to render the sock self-supporting with a relatively small amount of pressure on the leg and without any inconvenience to the wearer.

As indicated in Fig. 1 for example, I have shown a stocking provided with a top portion, 14, formed in the manner just described, the elastic thread in the continuous spaced courses containing the same, being indicated at e. When the desired length of the top is attained, as indicated by the dotted line 15-15, it is only necessary to throw out of operation the feed finger 6 for the elastic thread, when the leg of the stock-

ing, indicated at 16, can be knit integrally with the top by multiple knitting with the four feeds, as previously described. Obviously the leg of the stocking could be knit with a lesser number of body threads by simply withdrawing one or more of the auxiliary cams from operative position and throwing out of operation the feeding fingers cooperating therewith. In some instances it may be desirable, for example, to knit the leg of the stocking with two body threads simultaneously, in which case at the same time that the feed finger 6 is thrown out of operation, the feed fingers 8 and 9 and the auxiliary cams 2 and 3 can also be moved to inoperative position, so that the leg of the stocking would in such case be knit by the body threads *a* and *d*, fed to all of the needles and knit in by the knitting cams 1 and 4.

The relation of the threads in the four course feed is diagrammatically illustrated in Fig. 3, the body threads and elastic thread being indicated by the reference characters previously referred to, and the multiple feed with two threads, and an incorporated elastic thread is indicated in Fig. 4. Obviously other arrangements of plurality knitting in combination with the introduction of an elastic thread in one of the plurality courses can be made.

In carrying out the knitting of the entire sock, which can be done on the same machine and as an integral fabric, when the leg has been completed down to a course just above the heel, indicated for example at 17, 18, the circular knitting stops and reciprocating knitting for the formation of the heel pocket begins. As only one feed finger and one knitting cam is used in knitting the heel pocket, the auxiliary cam or cams used in knitting the leg 16 and also the auxiliary feed fingers therefore are thrown out of action when the point just above the heel, indicated by the dotted line 17—18 is reached and the knitting of the heel pocket proceeds with the main knitting cam 1 and with a non-elastic thread fed by one of the feed fingers at the throat. This thread may be the same thread used in the leg or a heavier thread or threads as may be desired. Obviously the first course of the heel pocket will be knit into the stitches of the immediately preceding course or courses if more than one course is held upon the needles used in reciprocating work, as will ordinarily be the case.

In some instances I may, when reaching the point indicated by the line 17, 18, throw out of operation such of the auxiliary knitting cams and their feed fingers as may have been used in knitting the leg, and knit one or more complete circular courses with the knitting thread *a*, by means of the main knitting cam 1, and feed finger 7, if this is found desirable, but it is not necessary.

After the knitting of the heel pocket, which is indicated at 19, in the usual manner, circular knitting again commences from the line 17—18, preferably by throwing in one or more of the auxiliary cams and their feed fingers and knitting the foot of the sock, indicated at 20, by multiple feed plain knitting with either two, three or four threads, as desired.

Immediately before the commencement of the knitting of the toe pocket, at a point indicated by the dotted line 21, 21, I prefer to throw out of operation the auxiliary cams and their feed fingers used in the knitting of the foot, and knit a few looping courses, indicated at 22, of plain knitting, using only the main knitting cam 1 and thread *a*, down to the position occupied by

the dotted line 22, 22, after which the toe pocket 23 is knit in the usual manner with a single thread by reciprocating work, as described with reference to the heel pocket, and the stocking is completed by looping on the upper half of the meeting edges of the toe pocket and foot portion, in the usual manner, as indicated at 24. The toe pocket also may be made of the thread *a*, or of a heavier thread or threads, fed by another feed finger at the throat, if that is desired.

The entire stocking is therefore knit as a unitary fabric including the four feed plain knit top portion 14 with the incorporated elastic thread, in the manner previously described, which forms an elastic form fitting and self-supporting top for the stocking, and holds it in position on the leg when in use without the necessity for a garter.

In Fig. 8 of the drawings I have shown diagrammatically and on an enlarged scale, the arrangement of the four courses of stitches simultaneously formed in a single revolution of the machine with the elastic thread knit into the fabric at spaced wales in the particular courses formed by one thread only, the stitches containing the elastic thread being represented theoretically as they would be formed in the fabric. Bearing in mind, however, that the elastic thread *e* is fed under considerable tension, it will naturally straighten out in the fabric, very much as indicated in Fig. 9, so that actually it extends in a substantially straight horizontal line around the fabric, being incorporated in the spaced wales at the points indicated at *e'*, *e'*, and floated on the inner face of the fabric as indicated at *e2*, *e2*. At the points *e'* the elastic thread will be frictionally held in the fabric by frictional engagement with the portions of the inelastic thread of the same and adjacent courses which come in contact with it and hold it in the fabric at these points, it being understood that while the elastic thread is firmly united with the fabric at the points indicated, it can slide longitudinally through the embracing portions of the inelastic thread or threads which confine it so as to accommodate and distribute any stretching force which is applied to it at any point around the fabric, thus keeping the tension of each elastic thread substantially uniform throughout each convolution thereof.

In addition to the advantage of plurality course knitting in the formation of the stocking top and also in the leg and sole portions thereof, which do not have the elastic thread ordinarily incorporated therein, although it could be introduced at any desired point in either the leg or foot if desired, my invention is admirably adapted for the formation of horizontal striping and other effects by the use of threads of different colors. For example, each of the plural inelastic threads employed may be of a different color if desired, or they may all be of the same color, or alternately of different colors, and may be varied after the production of stripes by employing an additional thread guide or thread guides in connection with each of the knitting cams, in a well known way, it being understood that when each of the auxiliary knitting cams is thrown out of operation all of the thread feed fingers cooperating therewith will likewise be thrown out of operation, under the control of suitable pattern mechanism, which will also control the pattern of the color scheme to be carried out in knitting the fabric or stocking.

As previously stated, after the completion of the top of the sock by plain knitting and multiple feeds so that a plurality of courses are simultaneously and continuously knitted and the elastic thread is incorporated continuously in the spaced courses formed by one of said threads, as previously described the feed of the elastic thread is discontinued and the leg portion of the sock and the foot portion between the heel and toe pockets may be knit with the single thread, which may be one of the threads previously used in knitting the top or a separate thread fed to all of the needles by a feed finger at the throat, the knitting being accomplished by the main knitting cam 1, and the auxiliary knitting cams being withdrawn together with their feed fingers from operative position. The first course of the leg will in either case be knitted into the stitches of the last course or courses of the termination of the top. I prefer, however, to knit the leg portion and the foot portion between the heel and toe pockets by multiple feed plain knitting as previously described, using the main knitting cam in conjunction with one of the throat feed fingers and one or more of the auxiliary knitting cams with the feed finger or fingers associated therewith.

What I claim and desire to secure by Letters Patent is:

1. In an article of hosiery, a form-fitting and self-supporting seamless top portion comprising a plurality of courses of plain knit stitches, the stitches of each of said courses being formed by an inelastic thread different from that of the stitches of the two preceding and two succeeding courses, said top portion having on its inner

surface an inwardly projecting body engaging bead formed by an elastic thread extending along the inner surface of the fabric in the form of a continuous, smooth and uniform spiral, with at least two courses of inelastic thread only between successive convolutions of the spiral, the elastic thread being united to the fabric at uniformly spaced wales around the circumference of the article, the wales at which the elastic is located being separated by at least two intervening wales, and the elastic being incorporated under sufficient tension to contract the fabric into vertically extending ribs.

2. In an article of hosiery, a form fitting and self supporting seamless top portion comprising a plurality of courses of plain knit stitches, all of the stitches of each of said courses being formed by an inelastic thread different from that of the stitches of the two preceding and two succeeding courses, said top portion having on its inner surface an inwardly projecting body engaging bead formed by an elastic thread extending along the inner surface of the fabric in the form of a continuous smooth and uniform spiral, with at least two courses of inelastic thread only between successive convolutions of the spiral, the elastic thread being united to the fabric by being knitted in plated relation with one of said inelastic threads at uniformly spaced wales around the circumference of the article, the wales at which the elastic is locked being separated by at least two intervening wales, and the elastic being incorporated under sufficient tension to contract the fabric into vertically extending ribs.

ROBERT EVAN DAVIS, JR.