

(Model.)

2 Sheets—Sheet 1

H. E. EMERSON.
Now by marriage H. E. HINCHLIFF.
TUBULAR KNIT FABRIC.

No. 550,875.

Patented Dec. 3, 1895.

Fig. 1.

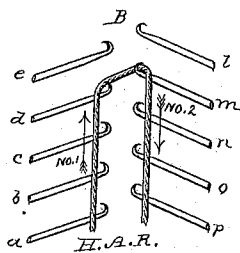


Fig. 2.

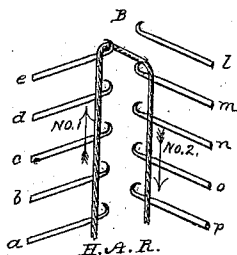


Fig. 6.

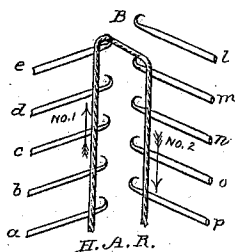


Fig. 3.

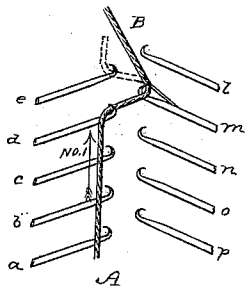


Fig. 4.

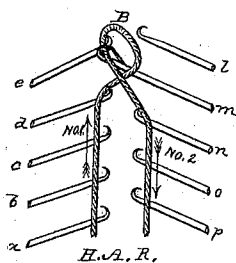


Fig. 5.

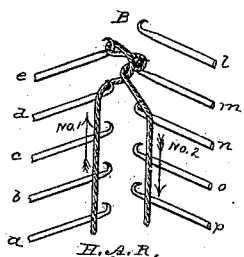


Fig. 7.

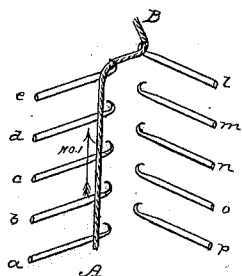


Fig. 8.

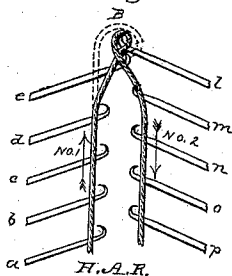
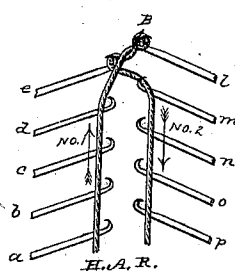


Fig. 9.



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Fig. 10.

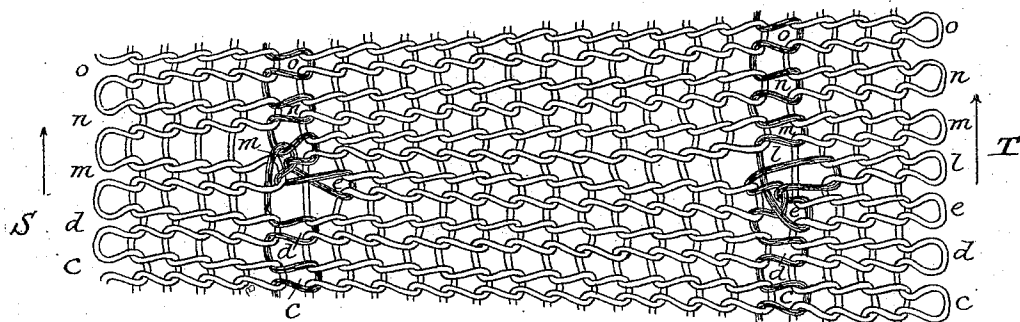


Fig. 11.

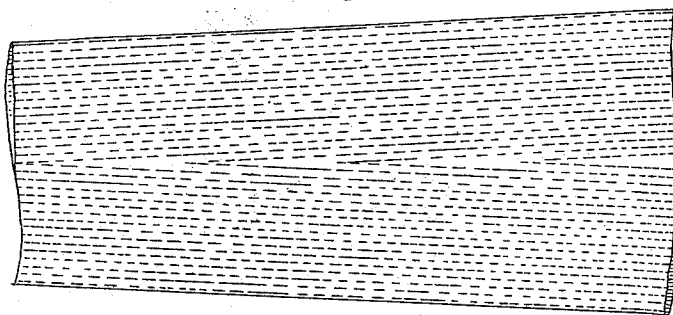
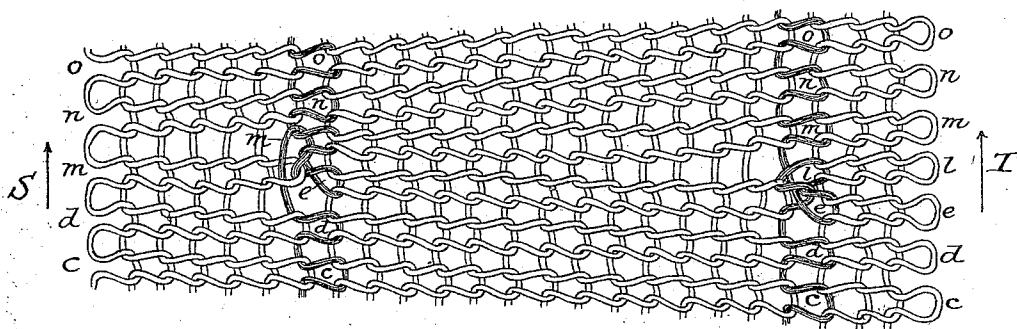


Fig. 12.



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UNITED STATES PATENT OFFICE.

HARRIET ELIZABETH EMERSON, (NOW BY MARRIAGE HARRIET ELIZABETH HINCHLIFF,) OF ROCKFORD, ILLINOIS.

TUBULAR-KNIT FABRIC.

SPECIFICATION forming part of Letters Patent No. 550,875, dated December 3, 1895.

Application filed November 13, 1884. Serial No. 147,861. (Specimens.)

To all whom it may concern:

Be it known that I, HARRIET ELIZABETH EMERSON, (now by marriage HARRIET ELIZABETH HINCHLIFF,) a citizen of the United States, residing at Rockford, in the county of Winnebago and State of Illinois, have invented a new and useful Improvement in Tubular-Knit Fabrics, of which the following is a specification.

My invention relates to the manufacture of tubular-knit fabrics or knit-fabric articles—such as stockings, mittens, shirts, drawers, &c.—in the formation of which fabrics or articles tubes are knit of varying widths or diameters for different portions of their lengths.

The dimensions of the tubes or tubular portions of such articles as those above enumerated have heretofore been varied during the process of knitting by throwing in additional needles in a common well-known way to widen the fabric. The result of such manipulations usually has been to leave openings or “eyelet-holes,” so called, at the points where the additional needles were thrown in. This defect is ordinarily remedied by taking up stitches by hand, which close these openings, this manner of proceeding being well known, and consisting in taking up by means of a hand-pick the last stitch which has been knit off by the needle next to the widening-needle to be thrown into action and in the same rank of needles therewith and putting this cast-off stitch as a loop with which to continue knitting on the widening-needle. Attempts have also heretofore been made to remedy this defect when knitting with two yarns at the same time by automatically throwing in two needles simultaneously, one on each side of the line of knitting.

The object of my invention is to produce with a single continuous yarn the knit tubular portion of the desired article or tubular-knit fabric of a varying diameter with a continuous unbroken surface or one free from eyelet-holes. This end I attain by the employment of what is known as the “parallel-row” knitting-machine—that is to say, one having the needles arranged in two parallel ranks or rows inclined at an angle to each other and working across a central opening—

the needles being actuated when in operation in any desired order or succession by suitable cams or guides. One well-known type of such machine is what is called the “New Lamb Knitting-Machine,” now being manufactured at Jackson, Michigan. In this machine the needles are thrown into and out of action by hand, as desired. The work may also be done automatically by what is known as the “Nelson” machine, one form of which is exemplified in Letters Patent of the United States, No. 214,308, granted April 15, 1879, as now made at Rockford, Illinois. In machines of this class the needles are thrown into and out of connection with the cams by means of a pattern guide or wheel. Proper automatic appliances also control the throwing into and out of operation of either one or the other, or both, of said cams at proper intervals. The construction and operation of these machines being well known need not be described in detail here.

In order to carry out my invention, the machine employed must possess the capacity of having each needle capable of being separately thrown into and out of action at any particular stage of the process, and must also be so arranged that the cams which actuate the needles may operate alternately on one side or the other or on both sides simultaneously at the will of the operator—that is, each cam can act separately from and alternately or simultaneously with the other on its respective needles.

A proper understanding of the manner in which I produce the fabric will be facilitated by reference to the accompanying drawings, of which Figures 1 to 9, inclusive, are diagrams representing theoretical skeleton plan views showing the relations of the needles and yarn at various stages of the operation, it being understood that the needles are the well-known latch-needles ordinarily used in the machines above mentioned with a single yarn laid thereon.

Fig. 1 represents the relation of the parts in ordinary tubular knitting. Fig. 2 is a similar view with an additional needle thrown into action in the old way to widen the fabric. Fig. 3 shows the order in which the yarn is

laid into the needles and knit previous to laying the yarn in the widening-needle, the full lines showing the yarn as knit by the working needles, while the dotted line shows the method of laying the yarn in the widening-needle when only a plain stitch is to be knit. Fig. 4 represents the formation of a loop by laying the yarn in the widening-needle on the reverse movement of the yarn-carrier, thus forming, when finished, a twisted loop. Fig. 5 shows the twisted loop as completed by the retraction of the needle *m*. Fig. 6 represents the relation of the parts in ordinary tubular knitting after the first additional needle has been brought into full action. Fig. 7 shows the relation of the parts when the second additional needle is first advanced from the opposite side of the line of knitting. Fig. 8 shows the relation of the parts when the second additional needle has been thrown forward, as above mentioned, and the order in which the needles thereafter knit. The dotted lines show the manner of proceeding if the straight loop is desired. Fig. 9 shows the completion of the formation of the twisted loop by the retraction of the first additional or widening needle, which has been since the last widening a working needle. Fig. 10 is a view of the fabric on an enlarged scale, showing the relation of the loops when a twisted stitch has been caught and held on an additional needle for one round of knitting before knitting in the loop. Fig. 11 represents a portion of a tube embodying my invention and suitable for shirt-sleeves and drawers-legs. Fig. 12 is a view, on an enlarged scale, considerably exaggerated, showing the peculiarities or structural characteristics of the fabric.

The arrows in the drawings show the direction in which the yarn traverses in being laid in the needles.

A represents the end at which the traverse begins, and B the point at which the yarn-carrier and accompanying cams stop before commencing the reverse movement.

H represents what I call the "advancing" side of the movement, and R the "reverse." *a b c d e* represent the needles on the advancing side, and *l m n o p* represent the needles on the reverse side, of the movement.

It will be understood that the cam on the advancing side H ordinarily acts on the needles on that side when the yarn-carrier and its accompanying cams are advancing from A to B, as shown by arrow No. 1 in the drawings, thus successively operating needles *a*, *b*, *c*, and *d*, while the cam on the reverse side R ordinarily only operates on the reverse stroke, actuating the needles *m n o p* when the yarn-carrier and its accompanying cams are moving from B to A.

In order to widen the fabric when operating in the old way, as illustrated in Figs. 1 and 2, the additional needle *e* would be thrown into action to receive the yarn while the yarn-carrier was advancing from A to B. Then the yarn would be carried from the additional

needle *e* directly across the line of knitting to the needles *m n o p* on the opposite side of the line of knitting, as shown in Fig. 2, the ultimate effect of which operation is to leave an eyelet-hole in the triangular space formed by the points of the needles *d e m*, Fig. 2.

In forming my fabric I set up the work in well-known ways common to the machines above mentioned, and knit the tube in the ordinary manner until it is desired to widen it. Then while the yarn-carrier and its attendant cams are at rest at the initial point A needles *n o p* are thrown out of action and the cam on the reverse side R so arranged as to act simultaneously with the cam on the advancing side H. Now as the yarn-carrier and cams advance from A to B stitches will be successively knit on the needles *a*, *b*, *c*, *d*, and *m*, as shown in Fig. 3. Then while the yarn-carrier and cams are at rest at B the needles *n o p* and the additional needle *e* are thrown into action, while the needles *a*, *b*, *c*, and *d* are thrown out of action, and the cam on the advancing side H is so arranged that it will act simultaneously with the cam on the reverse side R. When now the yarn-carrier and its attendant cams move from B to A, the yarn is caught on the additional needle *e* in the form of a twisted loop, as shown in Fig. 4, partially completed, Fig. 5 showing the loop as completed by the retraction of the needles *e* and *m*. It will thus be seen that while needles *a b c d n o p* have each knit one stitch needle *m* has knit two successive stitches, thus drawing two extra courses of yarn across the place where the eyelet-hole would naturally be formed, and between the knitting of these two stitches on *m* a loop has been caught on the additional or widening needle *e*, which is so bound between these two stitches knit by *m* that it is obviously impossible to leave an eyelet-hole at this point. While the yarn-carrier and cams are resting at the initial point A, needles *a b c d* are thrown into action, the cams arranged for their normal alternate action, and regular tubular knitting progresses as at first, as shown at Fig. 6, until widening is again desired. I find, however, that with certain yarns simpler work can be done by putting needle *e* (still holding its loop) out of action and knitting an additional course or courses on needles *a b c d m n o p* before bringing needle *e* into permanent action. Fig. 10 shows the course of the yarn when needle *e*, having caught the twisted loop and been put out of action while a round was knit on the needles *a b c d m n o p*, previously in action, is again put in action and the yarn again passes over it and continuous knitting is resumed.

It is obvious that instead of bringing forward needle *e* to catch the loop on the reverse movement of the yarn-carrier it could sooner be thrown into action, so as to catch the loop during the forward movement of the yarn-carrier, as shown by dotted lines in Fig. 3; but I prefer the form of loop heretofore de-

scribed, as when fully knit it will be a twisted loop, while the one formed as in dotted lines will be a plain loop.

When additional widening is desired, I proceed as follows: With the yarn-carrier and its cams at A, the second additional needle *l* is thrown into action, while the needles *m n o p* are put out of action, the cam on the side R being so arranged as to act simultaneously with the cam on the opposite side H. Under this arrangement the yarn-carrier as it advances knits regularly on *a b c d e*, leaving a loop on the new additional needle *l*. (See Fig. 7.) During the pause of the yarn-carrier with its cams at B this new additional needle *l*, with its loop, is put out of action, and the needles *m n o p* are thrown into action, while the needles *a b c d* are thrown out, the cam on the side H, however, being arranged to knit simultaneously with the cam on the opposite side R. The yarn-carrier then moves from B to A, which results in knitting first an extra stitch on the needle *e* and knitting regularly on needles *m n o p*, Figs. 8 and 9, thus knitting two stitches on needle *e* to one knit on the needles *a b c d m n o p* and catching a loop on the second additional needle *l* between these two stitches, thus effectually preventing the formation of an eyelet-hole while introducing a new needle on the reverse side R, as has previously been done while introducing a new needle on the advancing side H. While the yarn-carrier is at its initial point A, needles *a, b, c, d*, and *l* are returned to action, the cams arranged for alternate operation, and regular tubular knitting continued, as before.

Fig. 9 shows a loop caught on needle *l*, and that needle *e* has caught the yarn as it returned from *l* and knit an extra stitch, thus knitting and casting off the yarn which came to it from needle *d*.

The dotted lines in Fig. 8 show how a straight instead of a twisted loop could be caught on the needle *l*, which is done by throwing *l* into action at the commencement of the reverse movement instead of at the

beginning of the advancing movement. With most yarns the twisted form of loop is preferable.

Referring to Figs. 10 and 12, it will be seen that the knitting progresses in the direction of from S to T and that the traverse of the yarn is in the direction indicated by the arrows or from left to right, (bottom to top in said figure.) So far as represented the stitches are lettered correspondingly with the needles by which they are supposed to have been knit. The first six rounds or courses were knit on needles *c d m n o*. The result of the first widening is represented in the seventh course, the two stitches knit by needle *m* in that course, as well as the widening-loop from the first additional or widening needle *e*, being clearly shown, the widening-loop being interposed between the two stitches knit by *m*. Knitting having continued on needles *c d e m n o* until the next point of widening, the second widening-needle *l* knits a widening-loop, which is interposed between the two stitches knit by needle *e*. Further knitting and widening at intervals may be continued to the extent desired.

What I claim as my invention is—

1. The described machine-knit widened tube composed of a single yarn with the eyelet-holes closed by extra stitches knit in at the points of introduction of the widening-needles.

2. An article of knit fabric, such as described, having the tube without eyelet-holes, composed of a single yarn and widened by loops knit in at the points of introduction of the widening-needles, with the yarn of the widening loop passing twice across what otherwise would be the eyelet-hole at each place of widening, substantially as set forth.

In testimony whereof I have hereunto subscribed my name.

HARRIET ELIZABETH EMERSON.

Witnesses:

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S. G. BRONSON.