

(Model.)

2 Sheets—Sheet 1.

H. E. EMERSON.

Now by marriage H. E. HINCHLIFF.

TUBULAR KNIT FABRIC.

No. 550,874.

Patented Dec. 3, 1895.

Fig. 1.

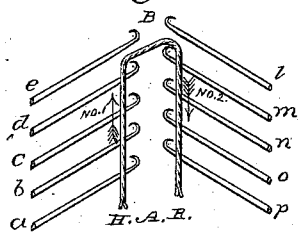


Fig. 2.

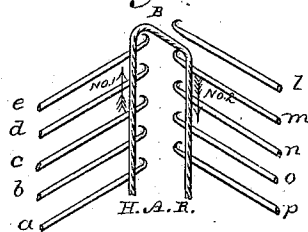


Fig. 5.

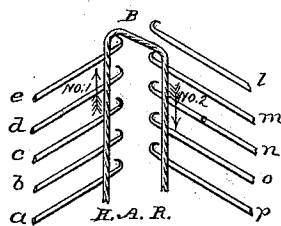


Fig. 3.

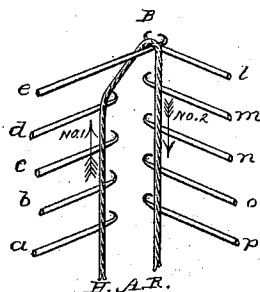


Fig. 4.

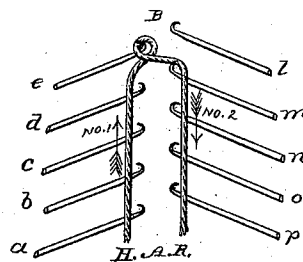


Fig. 6.

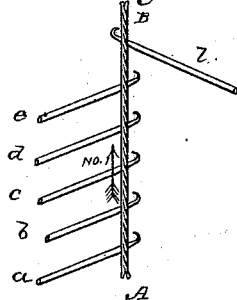
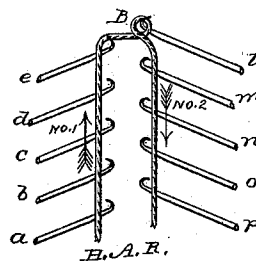


Fig. 7.



WITNESSES

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Fig. 8.

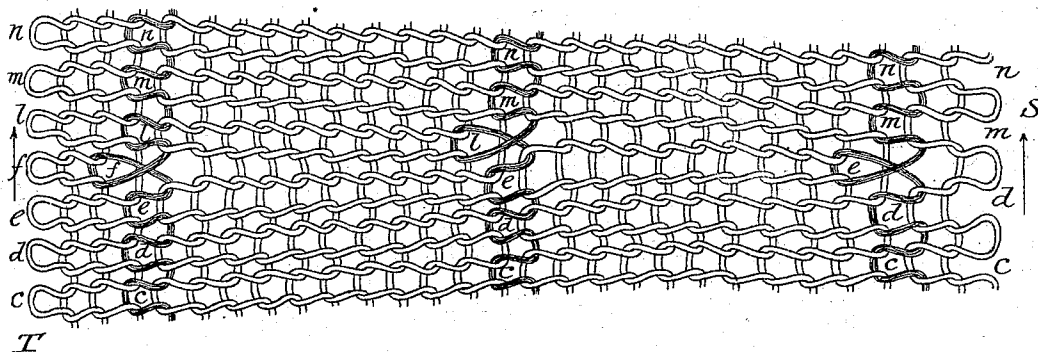


Fig. 9.

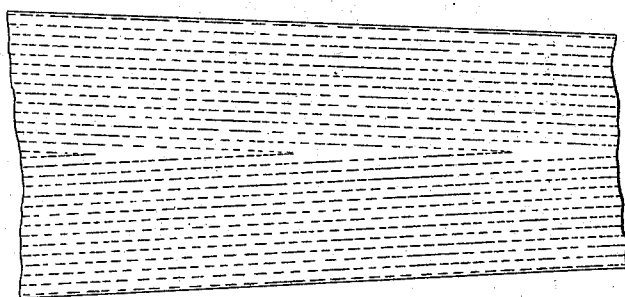
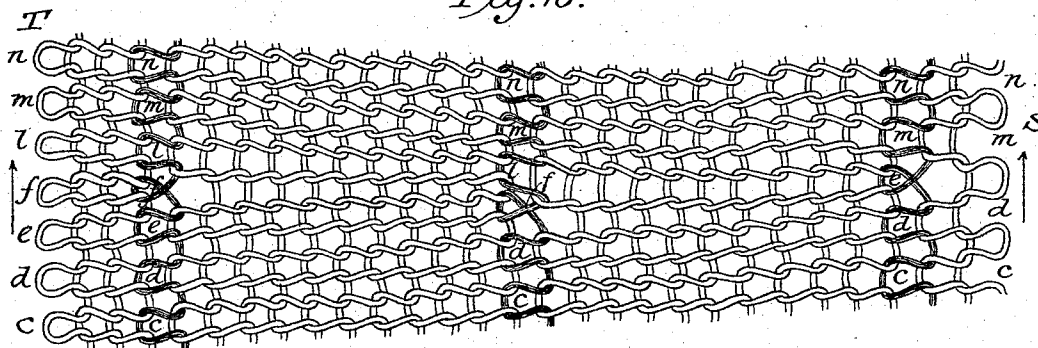


Fig. 10.



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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. 550,874, dated December 3, 1895.

Application filed November 13, 1884. Serial No. 147,860. (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 fabric or knit-fabric articles—such as stockings, mittens, shirts, drawers, &c.—in the formation of which fabric 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. 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 “Nel-

son” 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 controlling 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 7, 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 method of laying the yarn in the additional needle while advanced across the line of knitting with the cams moving in one direction after the additional needle has been advanced and before it is retracted. Fig. 4 shows the form of the twisted loop on the additional needle when it is retracted by the cam. Fig. 5 represents the relation of the parts in ordinary tubular knitting after the first additional needle has been brought into full action. Fig. 6 shows the relation of

the parts when the second additional needle is first advanced with the cams moving in a direction the reverse of that shown in Figs. 3 and 4 and the needle advancing from the opposite side of the line of knitting. Fig. 7 shows the relation of the parts under the conditions last mentioned with the additional needle drawn back, as in Fig. 4. It will be observed that in Fig. 4 the first additional needle is shown drawing the yarn over and across the yarn from the side in which the knitting is being done. In Fig. 7 the crossing yarn is shown as drawn so as to lie under instead of over the other, but still to the side opposite to the knitting. This is necessary in order to do successful work. Fig. 8 represents, on an enlarged scale, a view of a fabric formed by catching a twisted loop at the point of widening and holding it for one round before knitting in the loop. Fig. 9 represents a portion of a tube embodying my invention and suitable for shirt-sleeves and drawers-legs. Fig. 10 is a view on an enlarged scale, the loops being exaggerated, showing the peculiarities of the fabric whereby the eyelet-holes are closed by the twisted loops.

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 to complete a round of knitting.

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 instead of laying the yarn in the additional needle *e*, in the manner above described, as shown in Figs. 1 and 2, I lay the yarn in and knit stitches on the needles *a b c d*, while the additional needle *e* is still kept out of action until the yarn-carrier pauses at the end of a stroke at the point B. At this moment the additional needle *e* is so placed as to be acted upon by the cam on the advancing side H, while the needles *a b c d* are thrown out of action and the cam on the advancing side H is arranged so as to operate simultaneously with that on the reverse side R during the reverse stroke. As the reverse movement begins the additional needle *e* is thrown across the line of knitting and the yarn laid in it, as shown in Fig. 3, as it passes to the needles *m n o p* during the continuance of this movement. As soon as the yarn is engaged with the needle *m* the additional needle *e* retracts to its normal position, forming a twisted loop, as shown in Fig. 4, and remains quiescent, holding the loop until the yarn-carrier returns on the next forward stroke or succeeding round of knitting, the needles *m n o p* knitting in the usual way on the reverse stroke, while the needles *a, b, c*, and *d* on the opposite side, having been thrown out of action, do not act. When the yarn-carrier pauses at the initial point A, the needles *a b c d* are again thrown into action and the cams arranged so that they will act alternately, as at first described. The additional needle *e* being in position is actuated at the end of the forward stroke and knits regularly thereafter, the eyelet-hole which ordinarily would be left in the fabric being closed by the twisted loop above described. With some kinds of yarn, however, I have produced better results by suspending the action of the additional needle *e* after it has caught its loop until several rounds are knit on the old needles, when said needle *e* is brought into full action of knitting on the second or third course and thus the hole is more effectually closed.

When still further widening of the fabric is desired, an additional needle *l* on the reverse side or that opposite the additional needle *e* is in like manner brought into action, excepting that in this case, in order to produce a twisted loop, it is necessary to proceed in a somewhat different order from that previously described. Figs. 6 and 7 illustrate this order of procedure, a tube being supposed to be knit with the additional needle *e* in operation, as in Fig. 5. Under this condition of things, while the yarn-carrier and cams are resting at A, the reverse needles *m n o p* are thrown out of position and the additional widening-needle *l* is brought into position, so that it can be acted upon by the cam on the reverse side R during the forward movement, and this cam is arranged to act simultaneously with the one on the opposite or advancing side H. The effect of this arrangement is that the needles *a b c d e* knit the

fabric in the usual manner. Between the time when the yarn-carrier passes needle *e* and comes to rest at B the reverse additional needle *l* is thrown forward by its cam across the line of knitting, catches the yarn, as shown in Fig. 6, and retracts to its original position. Then on the reverse movement of the yarn-carrier a twisted loop is formed in a position reverse to that shown in Fig. 4, by the passage of the yarn over the yarn held by the retracted needle, as shown in Fig. 7. Previous to this reverse movement, however, the reverse needles *m n o p* are returned to their normal position, so as to be acted upon by their cam, and needle *l* is put out of position, so that it may hold the yarn and form the twisted loop. The cams are then arranged to act successively or alternately, as heretofore described. The knitting then progresses regularly, as before described, for any desired number of rounds, or until it is desired still further to widen the fabric by repetition of the widening operations.

Referring to Fig. 10 it will be seen that the knitting progresses in the direction 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.) The stitches are lettered to correspond with the needles by which they are supposed to have been knit. The first two rounds or courses, so far as shown, were knit by needles *c d m n*, and on the third round the twisted loop knit by the first widening-needle *e* is represented as closing the eyelet-hole at the point of widening. After this, the work having progressed regularly as far as desired on needles *c d e m n*, then by the operation of a second widening-needle *l* a further widening and closing of an eyelet-hole takes place. At the next point of widening a twisted loop *f* is represented. The needle for knitting this obviously would be on the advance side or in the same rank as the first widening-needle. The work is continued and widened at intervals to the extent desired.

I am aware that it has heretofore been proposed to fill up the eyelet-holes in fabrics,

when knitting with two yarns at the same time, by simultaneously projecting two additional needles, one each side of the line of knitting, so as to stand crossing each other, and then simultaneously retracting them in opposite directions, each carrying the yarn with it. This method is described in the United States Patent No. 302,119, which also shows the dropping of the additional or widening-needles for one or more courses after being thrown into action; but so far as I am aware I am the first to avoid eyelet-holes in knitting widened tubular fabrics by traversing a single needle at the commencement of each widening across the line of knitting from the side opposite that where the knitting is being done, retracting said needle to form a twisted loop, and holding said loop until a succeeding round of knitting. In fact, so far as I am aware, I am the first to produce a machine-knit widened tube knit from a single yarn with eyelet-holes closed at points of widening by portions of said yarn knit into the fabric.

I have demonstrated practically that the mode of operation employed produces a superior fabric and obviates difficulties incident to the method above disclaimed, which are well known to those skilled in the art.

What I claim herein as new and as of my own invention is—

1. The hereinbefore described machine-knit widened tube, knit from a single yarn with eyelet holes closed at the points of widening by portions of said yarn knit into the fabric.

2. The hereinbefore described knit-fabric, having its widened tube knit from a single yarn, with the eyelet-holes formed at the points of widening closed during the operation of knitting by twisted loops knit integrally with the fabric, substantially as hereinbefore set forth.

In testimony whereof I have hereunto subscribed my name.

HARRIET ELIZABETH EMERSON.

Witnesses:

RALPH EMERSON,
S. G. BRONSON.