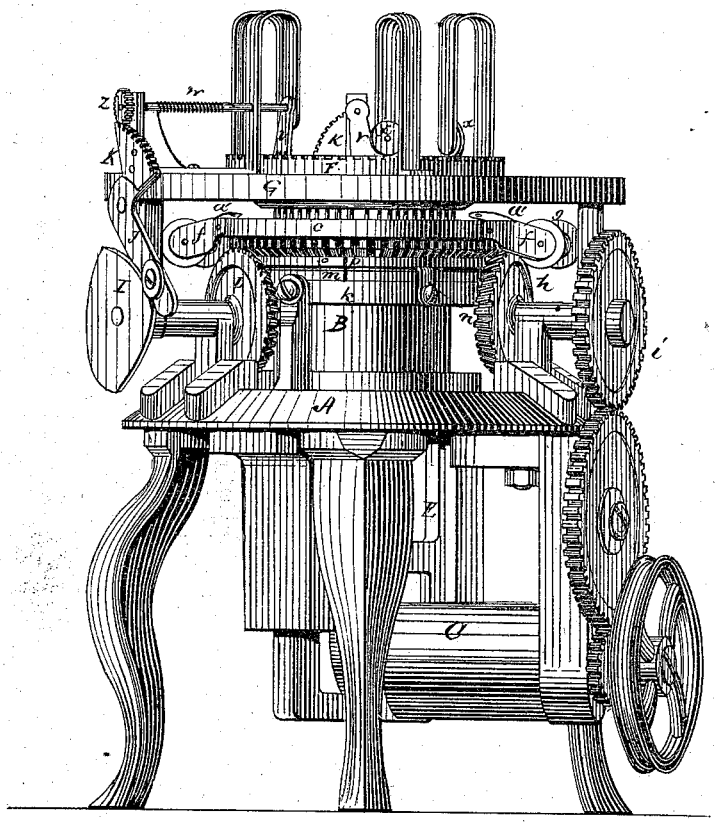
2 Sheets--Sheet 1.

E. P. CURTISS.

Circular Knitting-Machine.

No. 161,009. Patented March 23, 1875.

Fig. 1.



Attest:

W. H. Curtiss

W. E. Chaffee

Inventor:

Edward P. Curtiss

by Wm. H. Kinnear

Atty.

THE GRAPHIC CO. PHOTO-LITH. 39 & 41 PARK PLACE, N.Y.

2 Sheets--Sheet 2.

E. P. CURTISS.

Circular Knitting-Machine.

No. 161,009. Patented March 23, 1875.

Fig. 2

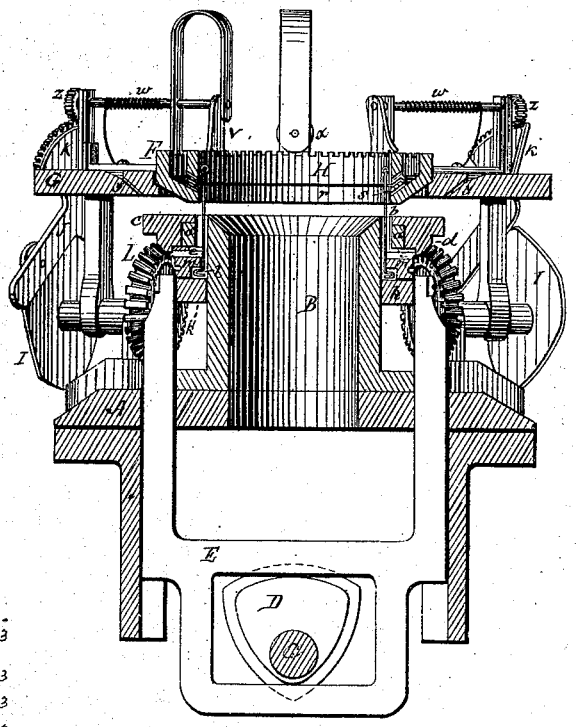


Fig. 4

Fig. 6.

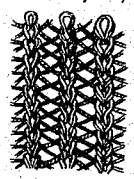
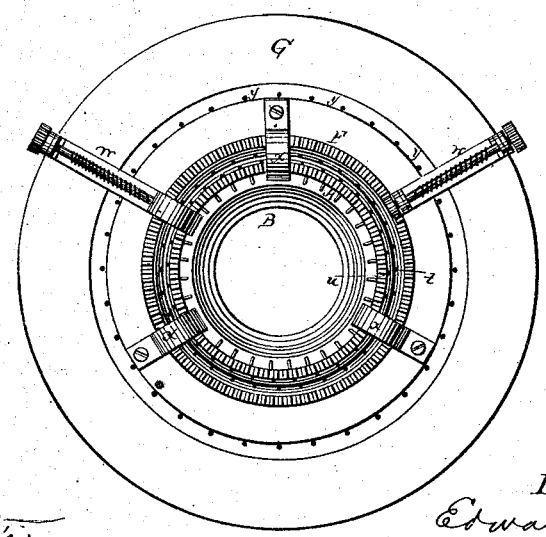


Fig. 5

Fig. 3



Attest:

W. J. Curtiss

W. E. Shaffer

Inventor:

Edward P. Curtiss

by Wm. K. Vincent

Atty.

THE GRAPHIC CO. PHOTO-LITH. 39 & 41 PARK PLACE, N.Y.

UNITED STATES PATENT OFFICE.

EDWARD P. CURTISS, OF NORWALK, ASSIGNOR OF ONE-HALF HIS RIGHT TO THEODORE C. FOOTE, OF CLEVELAND, OHIO.

IMPROVEMENT IN CIRCULAR-KNITTING MACHINES,

Specification forming part of Letters Patent No. **161,009**, dated March 23, 1875; application filed February 11, 1875.

To all whom it may concern:

Be it known that I, EDWARD P. CURTISS, of Norwalk, in the county of Huron and State of Ohio, have invented certain new and useful Improvements in Circular-Knitting Machines, of which the following is a specification:

The invention consists in a machine for knitting a circular or tubular seamless fabric with or without warp and weft threads, wherein are employed one or more annular reciprocating yarn-carriers; a needle-carrier, in which the needles are secured so that any one of them may be removed without displacing the others or disturbing the work; a rotating weft-carrier, which also serves as a means for imparting motion to the yarn-carriers; and also a bed-plate for receiving the yarn-carriers, and serving as a warp-guide, these several elements being constructed and arranged as hereinafter more fully set forth.

In the accompanying drawings illustrating my invention, Figure 1 is a front elevation; Fig. 2, a central vertical section; Fig. 3, a top plan view, and Figs. 4, 5, and 6, views of fabrics.

Similar letters of reference indicate like parts in the several figures.

The letter A may represent a bed-plate suitably supported, from which rises a cylinder, B, the upper inner edge of which is beveled, and the outer edge extended into a flange, *a*, in which a number of deep grooves, *b*, are cut, which serve as needle-ways. The flange *a* is rabbeted to receive a ring, *c*, the lower edge *d* of which is provided with beveled teeth. This ring is further secured on the flange, so that it may freely move thereon, by a ring, *e*, of thin metal screwed to said ring and extending partly under the flange. This ring *c* is further provided with a number of hangers, *f*, to receive the filling or weft-thread spools *g*, and is rotated by means of suitable gearing *h i*, connected with the driving-shaft C. On the end of said shaft is a cam, D, which operates a pitman, E, the upper end whereof is forked, the arms extending through openings in the bed-plate, and supporting a ring, *k*, that encircles and slides on the cylinder B. This ring has a number of grooves or recesses, *l*, made in it, in which the needles are set, such needles being preferably made with large butts. The ring *k* is rabbeted to receive a rotating annulus, *m*, which is secured to said ring *k* by tongues *n* on said ring fitting in a groove, *o*, in the annulus. A slot, *p*, is made in the annulus, of such width as to allow the passage through it of one of the needles. This ring and annulus constitute the needle-carrier, and its motion causes a simultaneous operation of all the needles. F is a yarn-carrier, supported by a shoulder on a bed-plate, G, and provided with an inclined inwardly-projecting flange, *r*, on the edge of which is a seat, *s*, that supports a second yarn-carrier, H. Both of these yarn-carriers or guides are made in the form of rings or cylinders, and each is composed of a single piece of metal, having the thread-eyes *t u*, and spurs or teeth on their upper surface. These carriers are reciprocated in their beds to the requisite degree by a toothed lever, *v*, secured on a rock-shaft, *w*, to which motion is imparted by a cam, I, through the lever J, having a toothed segment, K, engaging with a pinion, *z*, on the rock-shaft. Friction-rollers *x*, or other means, may be employed to insure the proper working of the carriers in their beds. Through the plate G a number of diagonal holes, *y*, are made, through which the warp-threads are passed into the cylinder. The cams I receive their motion from spur-wheels L engaging with the weft-carrier *c*.

My knitting-machine being constructed in the above manner, its operation is as follows: The knitting-threads are inserted through the eyes in the yarn-carriers, two threads for each needle, one thread passing through carrier F, and another through carrier H; but I do not wish to limit myself to the use of two threads, as only one may be employed. The warp-threads are fed into the cylinder through the eyes *y* in the bed-plate; and the filling-spools are placed in position on the weft-carrier, and the threads led into the cylinder also.

Motion is imparted to the driving-shaft C, the cam on which moves the pitman, and it the needle-carrier. When the pitman completes its upward stroke the needle-carrier is at rest during the time required by the cam D to make about a quarter revolution. During this time the yarn-carriers will have been re-

ciprocated—in opposite directions—so as to cross the threads, when the downward stroke begins and the knitted row is released. At the completion of the downward stroke the needle-carrier is again at rest and the yarn-carriers again moved, so as to change the positions of the yarns—that is, so that they shall not be crossed—and thus allowing the needles to come up between the yarns, so as to form the next stitch, which is completed when the yarn-carriers are moved at the end of the upstroke. By this backward and forward movement of the yarns a fabric is formed that may be cut at any place and a selvage obtained.

The warp-threads are fed to the fabric as it is formed and regularly bound therein by the weft-threads, these latter being carried around the cylinder as the weft-carrier is revolved, and passing over the warp and under the horizontal rows of knitting, as clearly shown in Fig. 4, 1 being the warp, 2 the knitting, and 3 the weft.

It will be understood that the greater the number of weft-spools on the carrier the more rapid the operation of the machine, and, too, that any number of such spools and any number of warp-threads may be used. It will also be seen that at each revolution of the driving-shaft a complete row of stitches is formed; hence the fabric can be produced with great expedition.

A tongue, *a'*, extends upwardly from the spool-hangers, has an eye in it, and serves as a guide for the weft.

In Fig. 4 I have shown the warp and weft knit fabric. This is produced in tubes of any length, which are cut up into proper lengths for forming grain-bags, and it will be found that bags made of this material will not stretch, and are very strong, besides being very cheaply and quickly made. Leaving out the warp and filling a fabric is produced, from which stockings and other under wear can be made. This fabric may be cut any where between the rows of knitting and a selvage obtained, which enables the goods to be closed up without any apparent seam.

In Fig. 5 is illustrated a fabric made of a single thread to each needle—that is employing only one yarn-carrier, the warp and weft being left out. This fabric is designed for stockings, scarfs, and the like; and by employing a variety of colors and different-shaped cams, I, various designs or figures may be made in the fabric. The ring *m* rotates freely around the ring *k*, and when it is desired to remove any one of the needles the slot *p* is brought opposite such needle, and it may then be removed without disturbing the other needles or the work.

In Fig. 6 the fabric without the warp and weft is shown, and this fabric is produced in the manner already described.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a circular-knitting machine, annular yarn-carriers F H, set in a bed-plate, G, and reciprocated simultaneously in reverse or opposite directions, substantially as shown and described.

2. In combination with the grooved needle-carrier *k*, the independent annulus *m*, having slot *p*, whereby the needles are held rigidly in place, and whereby any needle in said carrier may be removed and replaced at pleasure without disturbing the other needles or other parts of the machine, substantially as shown and described.

3. The within-described knit fabric formed of two threads crossed back and forth, as shown, so that such fabric may be cut lengthwise at any point, and form or leave selvages on both sides, substantially as specified.

4. The combination, with the yarn-carriers, of the cams I, levers J and *v*, and connecting mechanism, whereby said carriers are reciprocated, substantially as and for the purpose described.

5. The toothed weft-carrier *c*, rotated by pinion *h*, and meshing with pinions L, for the purpose of transmitting motion to the cams I, substantially as described.

E. P. CURTISS.

Witnesses:

W. J. CURTISS,

WM. H. FINCKEL.