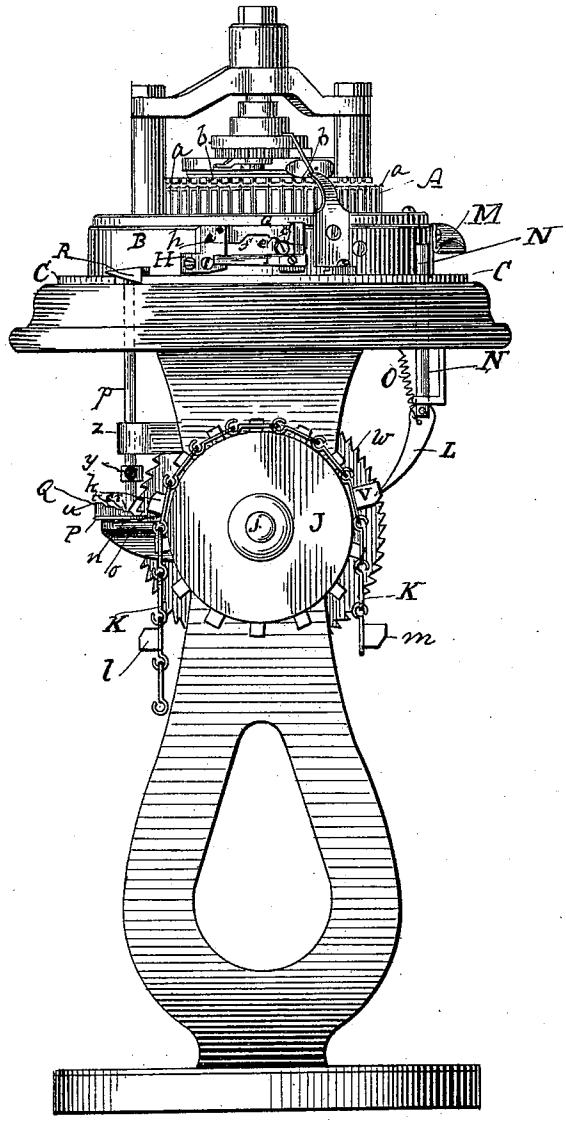
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W. H. PEPPER & A. T. L. DAVIS.

CIRCULAR KNITTING MACHINE.

No. 404,930. Patented June 11, 1889.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2.

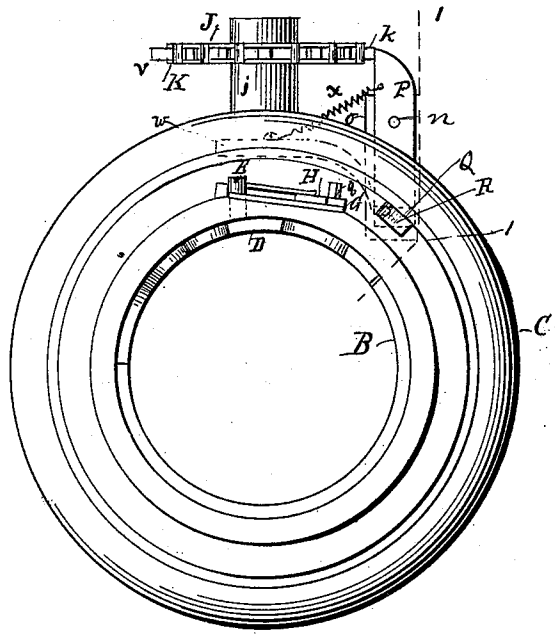


Fig. 3.

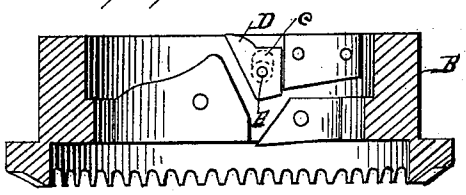


Fig. 4.

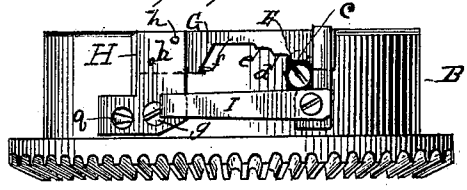
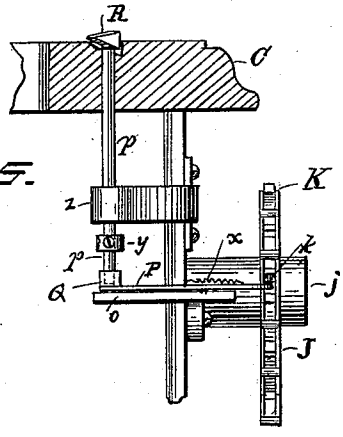


Fig. 5.



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UNITED STATES PATENT OFFICE.

WILLIAM H. PEPPER AND ALBERT T. L. DAVIS, OF LAKE VILLAGE, NEW HAMPSHIRE.

CIRCULAR-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 404,930, dated June 11, 1889.

Application filed December 12, 1887. Serial No. 257,705. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM H. PEPPER and ALBERT T. L. DAVIS, citizens of the United States, residing in Lake Village, in the county of Belknap and State of New Hampshire, have invented an Improvement in Circular-Knitting Machines; and we do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawings, making part of this specification.

The purpose of this invention is to give permanent fashion or shape to tubular-knit stockings or hose, particularly to the legs of the stockings, by varying the length of the stitches in the act of knitting, so as to knit "loose" or "close," according to the portion of the stocking being knit, it being understood that long or loose stitches produce a larger or wider web, and short or close stitches produce a smaller or narrower web. By the mechanism invented by us and hereinafter specified we are enabled to automatically grade the length of the stitches, so as to give permanent enlargement to the upper end of the stocking-leg, gradually diminish it downward toward the ankle, and make it smallest at the ankle, and when the machine is adapted or employed to knit a tubular foot portion to make that portion of the web as small or narrow as required.

We now proceed to describe our mechanism for accomplishing the aforesaid purpose by reference to the annexed drawings, in which—

Figure 1 represents a side view of a circular-knitting machine provided with our present improvements; Fig. 2, a top view of the cam-ring, its supporting-rim, and parts mounted upon the said portions of the machine pertaining to our present invention; Fig. 3, a central vertical section of the cam-ring, showing the needle-depressing movable cam employed in the present invention mounted in the cam-ring; Fig. 4, an outside view of the cam-ring, showing the parts thereon appertaining to our invention; Fig. 5, a partial section and elevation taken in a plane indicated by the line 1 1, Fig. 2.

Like letters designate corresponding parts in all of the figures.

In the drawings, A represents the needle-cylinder of the machine with needles *a a* therein; B, the cam-ring; C, the stationary rim in which the cam-ring revolves. We show also in Fig. 1 a dial-plate and a set of dial-needles *b b*, and operating cam-plate therefor, for knitting ribbed work on the machine; but these comprise no part of our present invention, which may be equally well applied to a simple cylinder knitting-machine.

It being well understood that the length of the stitch-loops is determined by the depth to which the depressing-cam sinks the needles in the grooves of the needle-cylinder—that is, that the farther the needles are sunk in the grooves the longer will be the loops, and vice versa, and therefore that the looseness or closeness of the stitches is determined by the depth of this depression—it follows that the position of the depressing-cam D, Fig. 3, on the inner surface of the cam-ring and acting on the butts of the needles is the ruling element in devising our invention. We therefore employ, first, a means for moving this cam up or down and for producing and controlling that movement from the outside and in a regular manner. We represent in the drawings such a means, and describe it as follows:

The needle-depressing cam D, Fig. 3, on the inside of the cam-ring B, under which cam the butts of the needles pass, has an up-and-down adjusting movement within the required limits. For this purpose it is affixed to a stud E, projecting outward through a vertical or upright slot *c* in the cam-ring, as shown by dotted lines in Figs. 1 and 3, the said slot being just wide enough to allow the stud to move up and down freely therein and long enough to allow as much up-and-down movement of the stud as may be desired for lengthening and shortening the stitch-loops of the thread. The stud projects outwardly beyond the outside periphery of the cam-ring far enough to enable it to be acted upon by the contiguous parts of the operating and controlling mechanism. The tension of the web drawing up on the needles is always sufficient to lift the cam D by the butts of the needles at any time passing under the cam. Therefore it is only necessary to apply means for de-

pressing the cam and for controlling both its upward and downward movement. For depressing the cam we employ a cam-bar G which bears at all times on the top of the projecting stud E, (or it may be on the cam itself,) and has a nearly-horizontal sliding movement over the same. On the under edge of this cam-bar are several steps or surfaces of different heights or degrees of projection. There are to be as many steps or heights of cam-surface as required for the purpose of this invention. We show four of these steps *c d e f*, sufficient in number to fully illustrate our invention. The surface of the cam-bar might be regularly increased by a continued inclination; but since the movement of the cam-bar is made at intervals and to stated distances it is preferable to have the surface in steps, so that it will bear securely upon the cam-stud. When the cam-bar is in the position shown by full lines in Fig. 4 and the step *c* bears upon the cam-stud, the cam D is then depressed to its lowest position, the needles are sunk farthest into their grooves, and the stitch-loops are made longest, thus knitting the loosest and largest web; and when the cam-bar is in such position that the step *f* bears upon the cam-stud the said cam is then raised to its highest position, the needles are sunk least in their grooves, and the stitch-loops are made shortest, thus knitting the closest and smallest web. These two positions illustrate the whole movement.

The cam-bar G is mounted for sliding and moving over the cam-stud E by means of a bell-crank lever H, pivoted at *g* to the cam-ring C, and rigidly attached to the cam-bar at *h*. The other end of the cam-bar may move back of and beneath a guide *i*, attached to the cam-ring, and a spring friction-plate I is or may be employed to press lightly on the lever H, as shown, to retain it and the cam-bar in any position to which they are moved; or the spring-plate might press directly upon the cam-bar. The cam and cam-bar are actuated and controlled in their movements by a pattern chain or wheel, by which the cam may be automatically shifted to the several positions required for this purpose.

We have represented in the drawings a suitable pattern-chain and connecting mechanism for the purpose, and now describe it as follows: Upon a pivot *j*, projecting from the frame of the machine, is mounted a sprocket-wheel J, which carries a pattern-chain K. The sprocket-wheel is moved one step or distance at a time around its pivot by means of a ratchet-wheel *w*, attached to the sprocket-wheel or its tubular hub, and a pawl L, which takes into the ratchet-wheel, being moved downward at every revolution of the cam-ring by means of a cam M, attached to the said cam-ring, and a vertical slide N, connected with the pawl and having its way in the rim or frame of the machine, the said slide being alternately depressed by the cam M and again raised by a counter-spring O. This mechanism is shown in Fig. 1, and represents one means for giving a regular movement to the pattern-chain. At the proper intervals upon the pattern-chain are secured as many different cam projections as there are required positions of the cam-bar E. Thus we have shown three cam projections *k l m* of different degrees of projection or throw thereon, corresponding with the three steps *d e f* on the cam-bar. These cam projections, when they successively come round to the proper positions, act upon a step-lever P, which turns on a vertical pivot *n*, secured upon a suitable bracket or projection *o* of the frame. This step-lever is thus made to swing in a horizontal plane into different positions by the said cam projections of the pattern-chain. Upon this step-lever are located a series of steps Q, upon which rests the vertical standard *p* of a fixed tappet R, against which a pin or projection *q* on the bell-crank lever H strikes as the cam-ring C rotates. The said tappet-standard *p* has a sliding movement in the rim or frame of the machine, but is held therein steadily, so as to cause the tappet to present an unyielding surface to the lever-pin *q* striking it, and thereby cause the lever to be moved and the cam-bar to be shifted in position. The action of the several cam projections on the pattern-chain against the lever P is such as to successively push the several steps of the series Q thereon beneath the tappet-standard, as indicated in Fig. 5. These steps, as *r s t*, hold the tappet respectively at such heights as to cause the lever H to move the cam-bar E into positions where the respective projections *d e f* will rest on the cam-stud D, and the cam projections *k l m*, respectively, move the said steps correspondingly under the tappet-standard, and thus the pattern-chain transmits the proper movements to the needle-depressing cam. Another movement is required for making the entire pattern movement automatic. This is to return the cam-bar to its first position. We effect this by using another step *u* on the step-lever *p* and another projection *v* on the pattern-chain, in order to lift the tappet R high enough to allow the pin *q* on the lever H to pass under it, and the lower side of the tappet is made inclined or wedge-shaped to a sufficient degree to cause the return of the lever to its first-named position by the pin *q* bearing against the said under side of the tappet. In order to hold the tappet from rising out of position during this returning operation, a suitable stop *y* on the tappet-standard may be used and adapted to bear upward against any fixed bearing or part, as *z*, on the frame of the machine. The pin *q* is properly made wedge-shaped, as shown, as well as the tappet R. A spring *x* serves to bring back the step-lever P after each movement of the same by a projection on the pattern-chain.

We claim as our invention—

1. The combination, with the needle-cylinder and needles, the cam-ring, and the needle-depressing cam, of a cam-bar having a series of depressing cam-faces, a pattern chain or wheel having a series of cam projections corresponding with the cam-faces on the cam-bar, and means, as the step-lever P, tappet R, and lever H, for connecting the movements of the said pattern chain-wheel and the cam-bar, substantially as and for the purpose herein set forth.

2. The combination, with the needle-cylinder and needles, the cam-ring, and the needle-depressing cam, of a cam-bar having a series of depressing cam-faces, a pattern chain or wheel having a series of cam projections, a step-lever having a series of steps thereon, a fixed tappet resting on one of the series of steps for adjusting its height, and a lever H, provided with a pin or projection *q*, arranged to strike the tappet as the cam-ring revolves, the said lever being attached to and adapted to move the cam-bar into its various positions as the cam-ring revolves, for the purpose herein specified.

In witness whereof we have hereunto signed our names in the presence of two subscribing witnesses.

WILLIAM H. PEPPER.
ALBERT T. L. DAVIS.

Witnesses:
G. A. SANDERS,
A. W. RUSSELL.