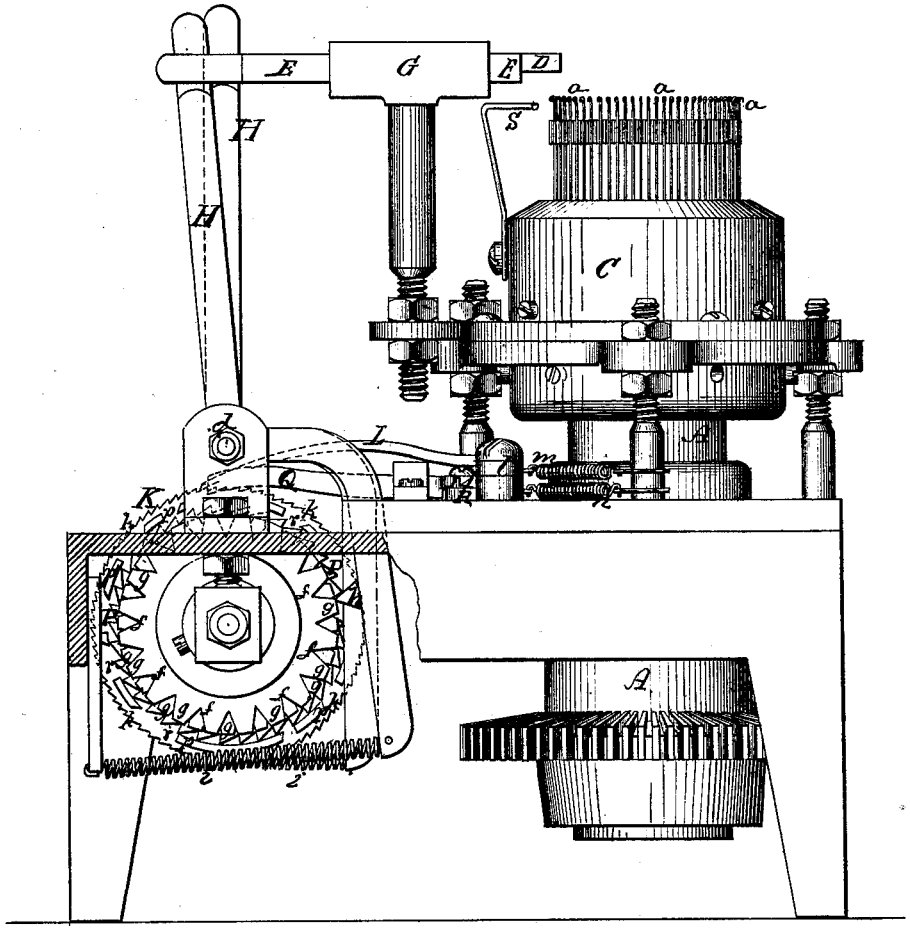
2 Sheets—Sheet 1.

J. M. SLACK.

KNITTING-MACHINE.

No. 190,694. Patented May 15, 1877.

Fig. 1.



Witnesses.

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D. P. Lowe.

Inventor,

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By his atty.,

Jas. Brown

2 Sheets—Sheet 2.

J. M. SLACK.

KNITTING-MACHINE.

No. 190,694. Patented May 15, 1877.

Fig. 2.

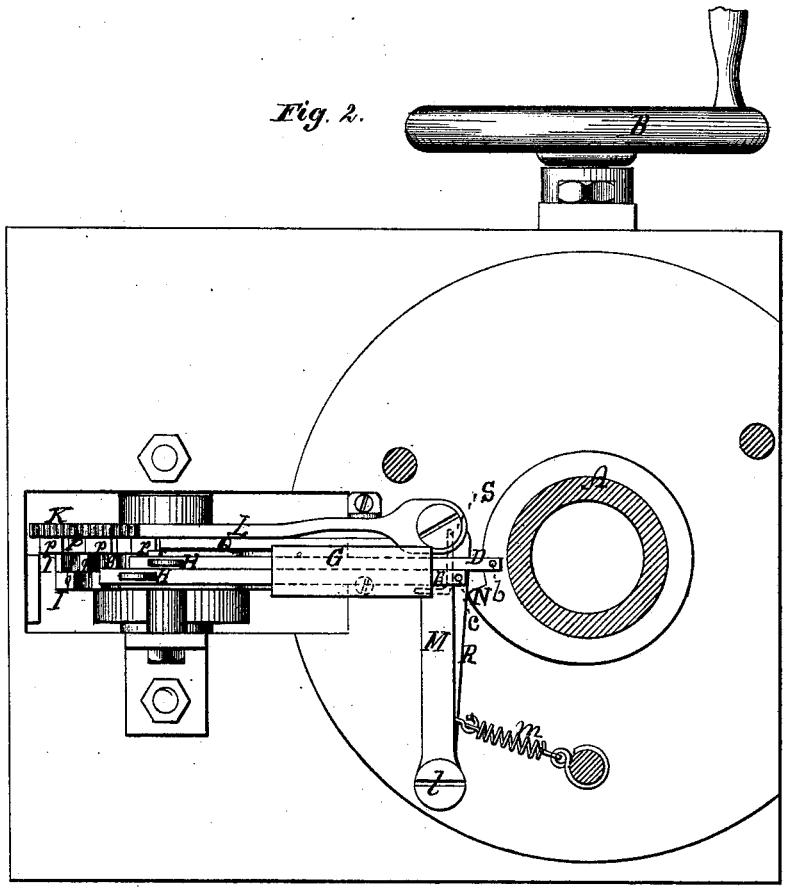
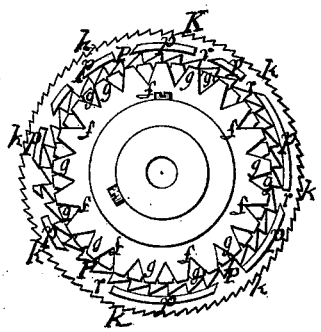


Fig. 3.



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UNITED STATES PATENT OFFICE.

JAMES M. SLACK, OF BRISTOL, PENNSYLVANIA, ASSIGNOR TO JULIA M. SLACK, OF SAME PLACE.

IMPROVEMENT IN KNITTING-MACHINES.

Specification forming part of Letters Patent No. **190,694**, dated May 15, 1877; application filed December 21, 1876.

To all whom it may concern:

Be it known that I, JAMES M. SLACK, of Bristol, in the county of Bucks and State of Pennsylvania, have invented an Improved Knitting-Machine; and I do hereby declare that the following is a full and exact description thereof, reference being had to the accompanying drawings, making part of this specification—

Figure 1 being a side elevation of a circular knitting machine provided with improvements, a part of the frame being removed by section to show the operative parts within; Fig. 2, a top view of the same, a part being removed by section to show parts of the mechanism otherwise hidden; Fig. 3, a view of certain parts in detail.

Like letters designate corresponding parts in all of the figures.

The purpose of my improvements in knitting-machines is to knit fabrics in alternate stripes of different colors, and to automatically effect the change from one to another color of yarn without stopping the machine or breaking the yarns, as also to produce stripes of varying widths according to a previously-determined pattern or design.

The nature of my invention consists, first, in the employment of shifting yarn-carriers, one for each color of yarn used, in combination with a stationary yarn-guide arranged to hold the yarns successively in proper position for the needles to take the same, the said yarn-carriers being alternately moved to pass the yarn between the needles from the front to the back of the same, and hold it for the time in that position, so as not to knit with that yarn, while at the same time the other or another yarn carrier is moved from back to the front of the needles, so as to pass the yarn into position for knitting as long as required to knit with that color of yarn before the next shifting of the said yarn-carriers in reverse directions; second, in combining with the levers or equivalent means by which the yarn-carriers are moved, cam and pattern wheels operated automatically by the revolving needle-cylinder, or in unison therewith, whereby the different yarns are brought successively into position for knitting them according to a predetermined pattern or style of stripes, the construction and operation of parts conducing to my invention being substantially as hereinafter specified.

The drawings represent a circular latch-needle knitting-machine making a tubular fabric, my improvements being applied thereto for producing a striped fabric of two colors, A being the revolving needle-cylinder, B the driving-wheel, and C the stationary needle-cam cylinder. Two yarn or thread carriers, D E, are employed, one for one color and the other for another color of yarn or thread.

These yarn-carriers are represented as mounted in a support, G, wherein each can slide independently toward and from the needle-cylinder, over the needles *a a*, so as to carry their yarn-eyes *b c* alternately behind the needles and to the front of them, one always being behind while the other is in front of the needles; thus the yarn-carrier that is moved to present the yarn-eye back of the needles, while in that position holds the yarn so that the needles cannot seize it, and the yarn-carrier which is moved to present the yarn-eye at the front of the needles; holds the yarn so that the needles catch it and knit therewith. This is effected by the assistance of a stationary yarn-guide, S, arranged substantially as shown, so that as either yarn or thread is brought forward to position it is held by this guide always in the right position to be seized by the needles; at the same time it does not interfere with the shifting of the yarns by the yarn-carriers. In making the change of position of the carriers they are so operated as to cause both yarns to lap together over one or more needles, as the change from one to another color is being made, so that the yarns are interlocked, and no stitch is dropped, the yarn never being broken, but floating on the inside of the fabric from one stripe to the next stripe of its own color.

The means which I have adopted for giving the said alternating movements to the yarn-carriers, and guiding their movements automatically, according to a predetermined pattern or design, I have represented in the accompanying drawings, and describe as follows:

With each yarn-carrier, in a convenient position, is connected a lever, H, through which to impart the requisite intermittent reciprocating movements to the said yarn-carriers. The levers are pivoted at a suitable point, *d*, to the frame or a fixed part of the machine, and the other arms of the levers curve or bend around the periphery of a pair of cam-wheels, I I, one opposite to each lever. These cam-wheels are connected together, or turn simultaneously, each having alternate notches and projections *f f* and *g g*, at uniform distances apart, and the two are so arranged that the notches *f f* of one wheel are opposite to, or side by side with, the projections *g g* of the other. A cam-point or projection, *h*, is formed on each lever H adjacent to its cam-wheel, and so formed and arranged that it can enter the notches *f f* thereof, or can simply bear against the outer surface of the projections *g g*, as shown. Springs *i i* draw and hold the levers against the respective cam-wheels, the cam-point of one lever always being drawn into a notch of its cam-wheel at the same movement of it and its shaft as that by which the cam-point of the other lever is brought to bear against a projection of its cam-wheel. When a cam-point is drawn into a notch, *f*, the carrier, as D of its lever, is moved to a position to pass its yarn back of the needles, and not to be knit; but when the cam-point of a lever is forced outward by the partial revolution of its cam-wheel, so that it bears against the surface of a projection, *g*, the carrier, as E, with which the said lever is connected, is moved forward or outward, so as to hold its yarn in front of the needles, and in position to be knit thereby. The projections *g g* operate as cams to force the cam-points of the levers outward by the partial revolution of the cam-wheels.

This construction of the cam-wheels requires that an intermittent motion be imparted to them on their axis equal in extent at each movement to the angular radial distance between the center of a notch, *f*, and the center of a projection, *g*, adjacent or to half the distance between the centers of two successive notches or projections, whenever the yarn-carriers are to be shifted, since, by such a movement, whichever cam-point is in a notch, *f*, is forced outward upon a projection, *g*, and the other cam-point is moved from a projection to a notch, whereby both yarn-carriers are shifted at the same time. But the lever, whose cam-point is moved from a notch to a projection begins, and has so far completed its movement, when the other cam-point is moved from a projection to a notch, that the yarn-carrier of the former shall supply yarn over the guide S to the needles before that of the latter leaves them. The lead of the outgoing lever is produced by giving a little breadth to the faces of the projections *g g*, whereby the outgoing movement of the cam-point is slightly hastened, and the ingoing movement thereof is slightly retarded. Hence, the two threads lap over each other one or two needles in making the change, so that there is no loss of stitches and consequent imperfect work produced thereby. To effect this movement of the cam-wheels, there is located on the same shaft as, and turning with the said cam-wheels, a ratchet-wheel, P, having twice as many ratchet-teeth thereon as there are projections or notches on either cam-wheel. To move this ratchet-wheel a notch at a time, a pawl, Q, takes into the same, and the said pawl is moved by being attached to a vibratory arm, R, pivoted at *l* to the frame of the machine in a position to be struck by a cam, N, on the needle-cylinder or the hollow shaft thereof. The cam moves the said arm in passing at each revolution of the needle-cylinder, to cause the pawl to move the ratchet-wheel one notch. The pawl-arm B is retracted by a spring, *n*.

As thus far constructed, the mechanism is not complete, since the ratchet-wheel P, and consequently the cam-wheels I I, would be moved, and the yarn-carriers shifted, at each revolution of the needle-cylinder, thus changing the yarn at each round of stitches. But it is ordinarily desired to make stripes of several rounds in breadth, of each color, and to vary the width of the stripes, so as to produce special and varied designs of goods. To effect this purpose automatically a ratchet-wheel or "shell-wheel," K, is mounted so as to turn freely on the same shaft as, or concentrically in line with, the ratchet-wheel P. This ratchet-wheel is also driven by a pawl, L, attached to a vibratory lever, M, on the same pivot *l*, or on a pivot adjacent to it, so as to be vibrated by the same cam N on the needle-cylinder as the lever B, being also retracted by a spring, *m*. Thus the ratchet-wheel K is moved to the extent of one of its notches at each revolution of the needle-cylinder.

Upon the face of it is a series of pattern-flanges, *p p*, all arranged in one circle, and projecting far enough to so far cover the teeth of the ratchet-wheel P that they will for the time hold the pawl Q, which rests and rides on them successively, up away from the said ratchet-teeth and prevent its turning the cam-wheels. The several pattern-flanges are of varied lengths according to the design of fabric required, each extending as many ratchet-notches of the ratchet-wheel K, on which they are secured or formed, as there are rounds or corners of stitches to be knit in the stripe then formed.

Between the several adjacent pattern-flanges there are spaces *r r* just long enough to allow the pawl Q to drop through and act once on its ratchet-wheel, and then be raised therefrom by the next flange in order. Thus it will be seen that the yarn-carriers are shifted every time when the pawl Q falls into a space, *r*, and a succeeding stripe of the other color is then produced alternately, while the pattern-flange is passing along under the pawl

Q. The entire number of pattern-flanges *p p* occupying the circuit of the ratchet-wheel K determines the number of stripes in the entire pattern of the fabric, which is repeated at every revolution of the said ratchet-wheel. To change the pattern the pattern-wheel is replaced by another producing the new pattern; or one pattern-wheel may be continually employed, and simply the several pattern-flanges *p p* be changed or replaced thereon, being attachable, removable, and adjustable at will.

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

1. In a circular knitting machine, the combination of two or more shifting yarn-carriers, D E, actuating-levers H H, cam-wheels I I, flanged pattern-wheel K, ratchet-wheel P, and pawl Q, for automatically knitting goods in colors according to a predetermined pattern, substantially as and for the purpose herein specified.

2. In combination with the cam-wheels I I and a ratchet-wheel, P, and pawl Q, actuated by a cam on the revolving needle-cylinder, a flanged ratchet pattern-wheel, K, and pawl L, constructed and operating to actuate the shifting yarn-carriers, substantially as and for the purpose herein specified.

JAMES M. SLACK.

Witnesses:

ELLWOOD DORON,

C. S. BAILEY.