Sheet 1, 2 Sheets.

Burson & Nelson.

Circular Knitting.

No. 108,003. Patented Oct. 4, 1870.

Fig. 1.

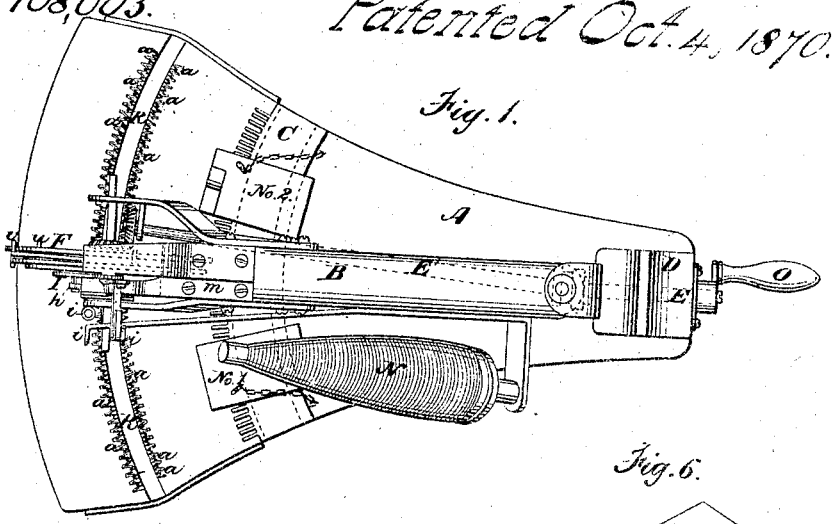


Fig. 6.

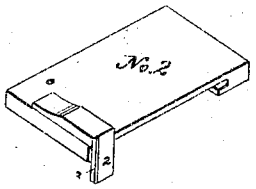


Fig. 2.

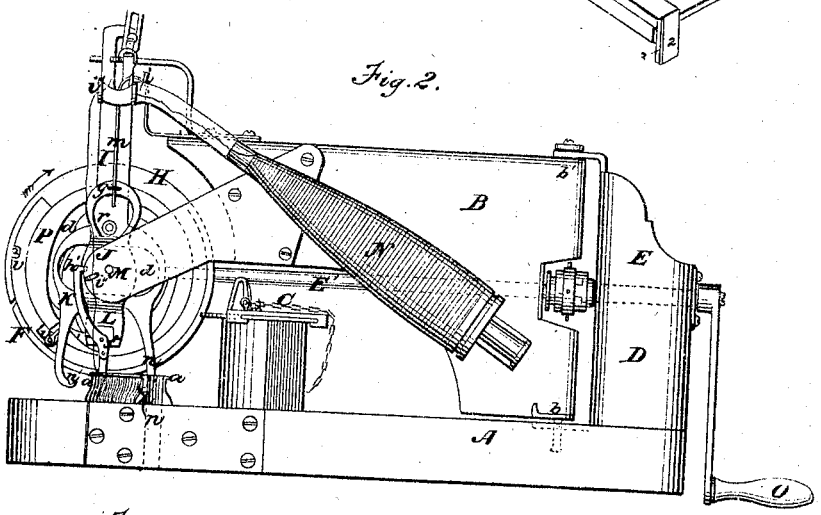


Fig. 5.

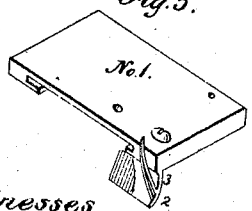


Fig. 7.

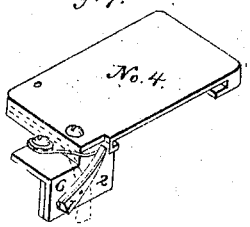
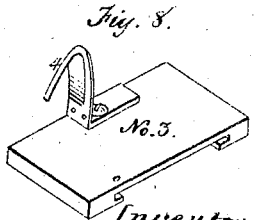


Fig. 8.



Witnesses.
A. P. Boynton
Thomas S. Burnett

Inventor:
W. W. Burson
per John Nelson
W. W. Burson his Atty.

Sheet 2, 2 Sheets.

Burson & Nelson.

Circular Knitting.

No. 108,003. Patented Oct. 4, 1870.

Fig. 4.

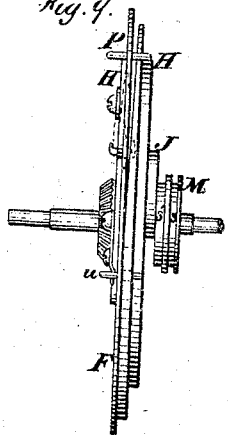


Fig. 3.

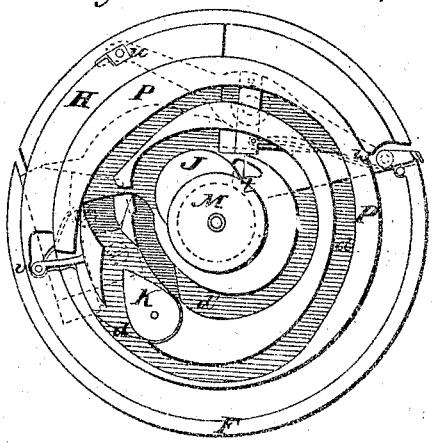
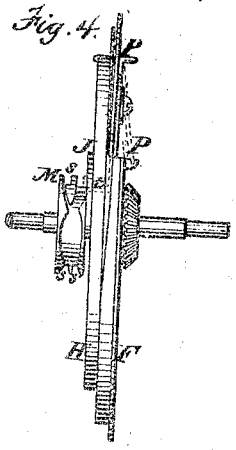
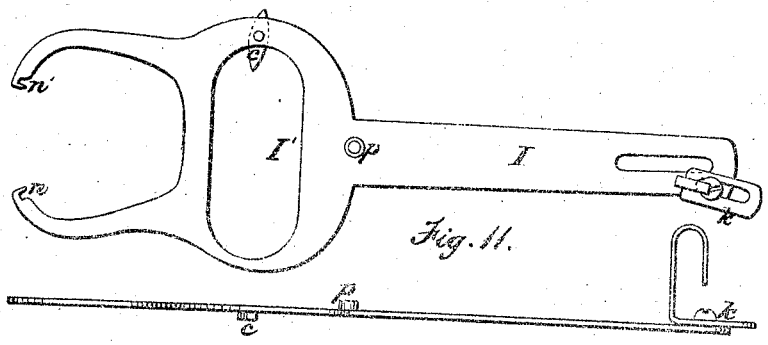


Fig. 4.





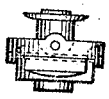
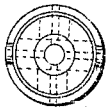


Fig. 12.



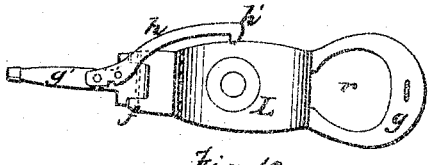
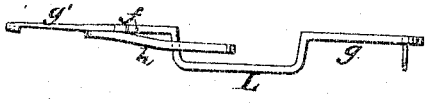


Fig. 10.



Witnesses.
A. P. Boynton
[illegible]

Inventor.
W. Burson,
John Nelson,
per W. Burson his
Attorney in fact

United States Patent Office.

W. W. BURSON AND JOHN NELSON, OF ROCKFORD, ILLINOIS.

Letters Patent No. 108,003, dated October 4, 1870; antedated September 30, 1870.

IMPROVEMENT IN KNITTING-MACHINES.

The Schedule referred to in these Letters Patent and making part of the same.

We, W. W. BURSON and JOHN NELSON, of Rockford, in the county of Winnebago and State of Illinois, have invented certain Improvements in Knitting-Machines, of which the following is a specification.

Our invention relates to the knitting of fabrics from yarn or thread, and consists of certain combinations of devices hereinafter to be set forth.

In the drawings—

Figure 1 is a plan view of our machine.

Figure 2 is a side elevation of the same.

Figure 3 is a face view of driving-wheel F.

Figure 4 is the same viewed on its edge.

Figure 5 shows reversing-stop No. 1.

Figure 6 shows reversing-stop No. 2.

Figure 7 shows reversing stop No. 4.

Figure 8 shows reversing-stop No. 3.

Figure 9 shows an edge-view of wormer H on wheel F.

Figure 10 shows yarn-carrier L.

Figure 11 shows looper I.

In the drawings, figs. 1 and 2, A is the bed-piece, holding the loop-supporting hooks *a a a a*, the feed-rack C, and upright D.

The loop-holders *a a a a* are constructed of such form as to terminate in a hook at the upper end, below which is a stem, which, for a portion of its length at the lower end, must be grooved on the same side on which the hook is turned, and at its base two flanges extend outward, serving the double purpose of keeping the loop from descending lower than is desired, and also properly guiding the looper-hooks to the stitch. These hooks, constructed as described, are secured to the bed-piece A in two parallel rows, which are segments of two concentric circles, having sufficient space between them for the knitted fabric to pass down through, and the corresponding hooks of the two rows being on lines radial from the center, and the hooks of the two rows facing in opposite directions to each other.

The feed-rack C is constructed on a segment of a circle, concentric with the hooks *a a a*, the teeth of which correspond with the said hooks, and may be placed in any convenient position, so that the flange of wheel F and wormer H may mesh in the teeth of the rack for the purpose of giving motion to the knitting device.

The upright D supports shaft E and pivot *b'*.

The swinging arm B is hinged on the pivots *b'* and *b*, and supports the shaft E' and driving-wheel F, with their attachments.

The driving-wheel F receives its motion from the miter-gear on the shaft E', which is jointed to shaft E and turned by crank O, and is constructed so that its edge or flange shall mesh in the teeth of feed-rack C. A portion of its periphery is hinged, which makes it, when moved to either side of the right line of the wheel, a wormer, and, since it swings to both sides of the wheel, yet only acts during a portion of its revolution, we call it a reversible, irregular wormer.

The looper I, fig. 11, is constructed with the main stem I, in which is the opening I', and terminates in the hooks *n n'*.

It receives its upward and downward motion from the revolution of the eccentric J, which is secured to the shaft of wheel F, and moves in cam-opening I', and its lateral irregular movement, by the guide-tongue *c*, moving in grooves *d d'* of said wheel.

Guide-tongue *c* is changed from one groove to the other by the action of the double switch K, described further on.

To the looper I are attached stud *p*, guide-tongue *c*, and tension-hook *k*.

The yarn-carrier L, fig. 10, vibrates on the shaft of driving-wheel F.

It is hinged at *f*, and the part *g'*, through the hollow end of which the yarn passes, is guided by the stud *h'* of arm *h* moving in cam-grooves *i'* of pulley M, which is placed on the shaft of wheel F.

The bobbin N has a support on arm B, and hence retains the same relative position to the knitting device, whatever position the arm B may assume.

In operation, the end of the yarn is passed from the bobbin N, through the eyelet *i*, over the tension-hook *k*, through the eyelets *i' i''*, and through the end *g'* of the yarn-carrier, and the fabric being "set up" in any convenient manner on the hooks *a a a a*, and sufficient weight attached thereto to insure the loops being kept fully down, the crank O is turned so as to rotate the driving-wheel F in the direction indicated by the arrow, fig. 2.

For convenience of describing the operation of the machine, we shall assume that the guide *c* is in groove *d*, hook *n*, the "working hook," and the knitting device traveling to the right hand, looking from the crank.

The rotation of the driving-wheel F forces down hook *n* into the groove at the base of hook *a*, under the loop, which is to be raised by the continued action of the eccentric J, and, guided by tongue *c*, the hook passes up said groove, and is guided outward, so as to clear the hook *a*, and the new yarn held by the yarn-carrier below it; then it is drawn into space R and depressed, thus casting off the old loop, when it is guided outside of the hook, ready to repeat the operation.

When hook *n* is fully raised, wormer H enters another space of feed-rack C, and thus draws along the knitting device, so that the hook *n*, in passing downward and outward, shall move far enough to pass into and out of the space between two hooks *a a*, and, by

the continued action of the wormer, be brought outside the row, in line with the next hook, when the fixed flange of wheel F, entering the feed-rack, no further lateral movement is had until the wormer enters another space of the feed-rack.

It will be observed that the curve described by hook *n* is an irregular figure eight, (8,) the lines crossing below the middle, and the upper curve being much the largest.

While the hook *n* is making the above-mentioned movements, the yarn-carrier L, held at rest centrally over the space R by the spring *m*, is, by the action of stud *p* on the looper I, working in cam-opening *r* of yarn-carrier L, moved to follow hook *n* outward through the space between the hooks *a a*, keeping in line with said hook until it begins to rise, when stud *h'* of arm *h*, moving in cam-groove *s* of wheel M, is turned into the side groove *s'* by the switch *t*, which movement turns the extremity of the yarn-carrier from its position central with hook *a*, into the next space between the hooks, which leaves the yarn in the hook *a* traversed by hook *n*, the spring *m* throwing the yarn-carrier to the center of space R, thus forming a new loop on the hook from which the loop has just been thrown.

The continued rotation of wheel F brings the wormer H into another space of the feed-rack, and thus the knitting mechanism is fed or moved along, and the movements just described repeated until arriving at the reversing-stop No. 2 on the feed-rack, which requires a more careful explanation.

In regular tubular work, the reversing-stops No. 1 and No. 2 are used as shown in fig. 1. When the knitting device has reached stop No. 2, stud *u* of latch-lever P, on the wheel F, strikes the inclined track 2 of said stop, and the latch is raised thereby out of its safety-notch, and forced, together with wormer H, over to the other side of wheel F, where it catches in the other notch, and, being held there by spring *w*, will feed in the opposite direction.

Following the movements just described, stud *v* of the double switch K strikes the incline 3 of the reversing-stop, which draws it outward, and thereby throws the switch K across the cam-groove *d*, which turns the guide-tongue *c* of the looper I into groove *d'*, thus bringing hook *n'* into work, the yarn-carrier crossing over, also, at the same time, by the action of the stud *p* in cam-opening *r*, when the movements before described by hook *n* will be repeated by hook *n'* until reaching stop No. 1, which will repeat the movements made by stop No. 2, except that the stud *v* will be drawn toward the center of wheel F, which will throw switch K across cam-groove *d'*, and will thus turn the guide-tongue *c* into groove *d*, which was the place it occupied at the beginning.

The reversing-stops are moved outward on rack C to widen the fabric, and inward to narrow it.

When it is desired to knit heel-work or flat-work, stop No. 3 must take the place of No. 1, and No. 4 of No. 2. The particular operation of these stops will be described further on.

We place the loop-supporting hooks *a a a a* in two parallel rows, which are segments of two concentric circles, having a space between them of sufficient width to permit the fabric to pass down, the hooks of the rows being upon lines radial from the common center. This arrangement of the hooks *a a a a* enables us to use a knitting device which shall be pivoted at this common center, and will thereby traverse all the hooks equally, and with the least possible friction.

Having arranged the loop-supporting hooks as just described, we swing the arm B upon the conic points *b b'*, placed at the common center of the rows *a a a*, and upon this arm secure the knitting mechanism, which shall, of course, hold the same relative position to all parts of the rows.

The feed-rack C is made concentric with the rows of loop-supporting hooks the teeth of which agree with the radial lines upon which said hooks are placed, and the feeding mechanism of wheel F meshes into the said rack, and, by means of the reversible wormer H, feeds or moves the knitting mechanism in either direction, as desired.

We would call attention to the peculiar construction of the looper I, combining lightness, durability, and effectiveness of operation, when used in combination with two parallel rows of loop-supporting hooks.

The arrangement and combination of the loop-supporting hooks *a a a a*, driving-wheel F, and looper I, enable us to knit tubular work, such as is usually done on circular machines, having also the advantage of widening and narrowing with facility.

A proper arrangement of the knitting mechanism herein described, causes the hooks *n n'* to serve the double purpose of casting off the loops from hooks *a a a a*, and of depressing the loop next to be taken hold of, thereby dispensing with a separate depressing-device, as is usually employed with this kind of knitting-machines.

By constructing the looper-hooks *n n'* in one piece with the looper I, and rigid, the act of bringing one hook into working position, cannot fail to throw the other out, thereby accomplishing this specific purpose by the arrangement and construction of the parts described.

As a convenient manner of using a single guide, operated alternately by the two cam-grooves *d d'*, we employ the double switch K, which is moved by the stud *v* striking the reversing-stops. When this stud is thrown toward the centre of the wheel F, groove *d'* is closed, and when thrown outward, groove *d* is closed.

In each case an opening is made to connect with the other groove when one is closed, fig. 3.

The construction of the swinging guide-tongue *c*, enables us to use switch K in its least complicated form, as described, as the tongue will cross the openings thus formed without difficulty, which could not be done were looper I guided by a simple stud.

We construct the yarn-carrier L, fig. 10, of the parts *g* and *g'* hinged together, at *f*. To the part *g'* we fasten the arm *h*, on which is the stud *h'*. The lower part *g'* is tubular, and through it the yarn passes. The yarn-carrier vibrates upon the shaft of wheel F.

When the yarn-carrier is at rest, it is held centrally over the space R, between the loop-supporting rows, by the spring *m*. To the looper I, we secure the stud *p*, which works in the cam-opening *r*, in the yarn-carrier. It will be seen that, since the cam-opening *r* is above the vibrating point, the part *g'* will, when moved by stud *p*, move toward the working-hook. The shape of this cam-opening is such as to give the yarn-carrier the movement required.

The movements required to be given the yarn-carrier in forming the stitch, are obtained by the arm *h* of part *g'* of the yarn-carrier, guided by the groove S of wheel M, in combination with the vibrating movement given it, as heretofore explained.

It is necessary to so construct the devices that the yarn-carrier shall pass outside the rows of loop-supporting hooks, always in the same space that the "working-hook" does. This condition is provided for by the peculiar construction of groove S, in combination with the hinge *f* and arm *h* of the yarn-carrier; also, the peculiar form given to the cam-opening *r*, by which the yarn-carrier follows closely after the hook, insuring its passing out in the same space.

As a distinct characteristic of our machine from that heretofore explained, we would call attention to the construction of groove S, in combination with the parts of the yarn-carrier L, switch *t*, and the vibrating devices heretofore explained, whereby the movements of the yarn-carrier are equally effective and satisfac-

ory, no matter which way the feeding mechanism is working, or on which of the rows. The "crossing over" of the yarn-carrier from one side to the other is accomplished with certainty, and always at the right time, by the peculiar construction of the cam-opening *r*, stud *p*, and switch K.

By observing the operation of the machine in "heel" or flat work, it will be seen that the latch-lever P must be operated from its front end to reverse the wormer, so that the knitting devices shall return on the same row of hooks without crossing over, and from the back end when the looper-hooks cross over to knit on the opposite row. This latch-lever holds the wormer in whichever position it is placed by the reversing-stops.

We would ask attention to the arrangement of the adjustable reversing-stops No. 1 and No. 2, placed upon feed-rack C, when used in combination with a traversing knitting-device, operating upon two parallel rows of needles. These reversing-stops Nos. 1 and 2 both operate to reverse the wormer, and cross over the knitting devices. They are both adjustable upon feed-rack C, being held thereon by any convenient latch or pin. They are constructed so that the inclined track 2 shall always unlatch lever P and reverse wormer H.

The inclined track 3 of stop No. 1 moves stud *v*, and with it switch K, toward the center of driving-wheel F, while the inclined track 3 of stop No. 2 draws the same stud toward the circumference.

The combination of the stops No. 1 and No. 2 upon feed-rack C with the wormer H, switch K, and knitting mechanism, such as has been described, completes the arrangement for regular tubular work.

Reversing-stop No. 3 is constructed so as to reverse the wormer H without crossing over the knitting mechanism, and, in order that the yarn-carrier shall be moved far enough to lap its thread around the proper needle or hook for the selvage, it is necessary that the knitting devices be moved the length of one tooth of the feed-rack beyond the selvage-needle, and this we accomplish by means of the flexible reversing-stop 4, which operates against the forward end of the latch-lever P. In the necessary movements already described the latch lever has been operated from its rear end.

The forward end of the latch-lever forms the acting end of the flange of the wormer, and the side of this latch-lever, at its outer end, has a groove, which, as latch and wormer are about to enter a space of the feed-rack, engages with the edge of the flexible stop 4, but so near its lower extremity that the stop yields and does not reverse the latch; but, at the next revolution of the wheel, the groove or notch of the latch engages with the inclined edge of the spring-stop higher up, and said stop then acts with sufficient force to unlatch the lever, and shifts the wormer in its furthest opposite position, thus enabling the wheel to skip a notch or tooth of the feed-rack in its backward movement.

Reversing-stop No. 4 is constructed so as to reverse the wormer, and also to cross over the knitting devices. It differs from stops No. 1 and No. 2 in being capable of crossing over the knitting devices from either row of hooks, and is used with stop No. 3 in knitting heel or flat work.

The stop No. 4 has an inclined track, corresponding with the track 2 on stop No. 1, and it operates to reverse the wormer in like manner.

To adapt this stop for shifting the knitting devices alternately in opposite directions, we pivot to stop No. 4 a switch, 7.

When the hook *n'* is operating to cast the loop, the switch 7 is in the position represented by dotted lines in fig. 7, and, when the wheel F has reached the stop, the pin *v* passes down back of it, and strikes track 2, which turns switch K, to close groove *d'*, and open groove *d*, which shifts the position of the parts, and throws hook *n* in working position.

After pin *v* leaves the bottom of track 2, it strikes the lower end of switch 7, and turns it in the position represented in full lines in fig. 7, and so that the pin *v* on wheel F, when it again reaches the stop No. 4, will move down against the concave side of switch 7, and shift switch K, to open groove *d*, and throw hook *n'* in operative position.

We form the heel of hose by substituting stop No. 3 for No. 1, and No. 4 for No. 2. Stop No. 4 is placed on the feed-rack in position occupied by No. 2, but No. 3 is moved in about one-third the number of stitches on the rows to begin with; or the narrowing to form the heel may commence at the outer end of the stitch-rows. At each round, stop No. 3 is moved in one or more notches on the feed-rack, so as to narrow down the heel, to form the point, and then, at each round, the stop may be moved out again, to widen, thus forming a well-shaped heel, when these stops are removed, and Nos. 1 and 2 replaced.

Flat work is knit the same as heel work, except that stop No. 3 is kept all the time at the end of the stitch-rows.

It has been stated that, in heel work, when the feed is reversed at the end where the widening and narrowing are done, the yarn-carrier must pass the yarn about each hook traversed by the looper-hooks, whereas stops Nos. 1, 2, and 4 allow the last hook traversed to be without the yarn. By reversing the wormer just before it enters the feed-rack, as is done by stop No. 3, this point is gained, as switch *t* is changed in time to give the yarn-carrier the proper movement to insure this result.

The stops Nos. 1, 2, and 4 do not reverse the wormer until it has passed nearly through the feed-rack, and, with the wormer-switch *t*, is reversed, whereby the yarn-carrier is turned back, and passes out through the same space between the hooks *a a* by which it enters, and no loop is left on the last hook, *a*, traversed by the looper-hook.

In this knitting mechanism, it is not only necessary to cross the knitting devices over, but also to cross them at the proper time. The arrangement here shown crosses over the hooks, while free from loops, in time to act as depresser on the first stitch of the new row, and while the yarn-carrier is in position of rest.

We place the tension-hook *k* on the looper I, which, drawing upward on the yarn between the two eyelets *i i'*, when the yarn-carrier is in position of rest, will draw off an equal amount of yarn from the bobbin for each stitch, and thus insure uniformity of fabric.

This hook is adjustable by a slot and set-screw, so that the amount drawn off by it may be regulated at pleasure.

Having thus described our machine,

What we claim as our invention, and desire to secure by Letters Patent, is—

1. The arrangement of the loop-supporting hooks, constructed as described, in two parallel rows, which are segments of two concentric circles, substantially as set forth.

2. The combination of the swinging arm B, carrying a knitting mechanism, with the two parallel rows of loop-supporting hooks, the whole arranged to operate substantially as specified.

3. The combination of the curved feed-rack C, loop-supporting hooks *a a a*, and vibrating arm B, provided with knitting devices, operating substantially as described.

4. The looper I, constructed as described, in combination with the wheel F and the two parallel rows of loop-supporting hooks, substantially as specified.

5. The combination and arrangement of the cam-

grooves *d d'* in driving-wheel F, looper-hooks *n n'*, and two parallel rows of loop-supporting hooks, the whole arranged and operating substantially as described, and for the purpose set forth.

6. The combination, construction, and arrangement of the irregular wormer H, eccentric J, cam-groove *d*, and looper I, operating as a loop-depresser, substantially as specified.

7. The combination of the looper I, cam-grooves *d d'*, and switch K, constructed as shown, for the purpose of changing the working-hook, substantially as set forth.

8. The yarn-carrier L, composed of the parts *g g'*, arm *h*, stud *h'*, and having the opening *r*, the whole constructed and arranged to operate as described.

9. The combination of the yarn-carrier L with the stud *p* on the looper I, acting in the cam-opening *r* of the yarn-carrier, and the spring *m*, the whole arranged and operating substantially as set forth.

10. The combination and arrangement of the looper-hook *n*, hooks *a a a*, yarn-carrier L, and cam-grooves S, the whole arranged to operate substantially as specified.

11. The combination of the yarn-carrier L, the groove S, and switch *t*, constructed as described, and operating in such manner that the part *g'* shall follow out the looper-hook *n*, substantially as set forth.

12. The combination and arrangement of the cam-groove S, switch *t*, yarn-carrier L, looper I, and cam-grooves *d d'*, the whole constructed and operating substantially as described.

13. The combination and arrangement of the yarn-carrier L, having the cam-opening *r*, with the stud *p*, looper I, and switch K, the whole arranged and operating substantially as specified.

14. The combination of latch-lever P, reversible wormer H, and wheel F, constructed and operating substantially as set forth.

15. The combination and arrangement of reversing-stops No. 1 and No. 2 with the feed-rack C and a traversing knitting device, all constructed and operating substantially as specified.

16. The reversing-stops No. 1 and No. 2, constructed and operating substantially as and for the purpose described.

17. The combination and arrangement of the reversing-stops No. 1 and No. 2, feed-rack C, wormer H, looper I, and loop-supporting hooks *a a a a*, all constructed and operating substantially as described, and for the purpose set forth.

18. The reversing-stop No. 3, when constructed and operating substantially as set forth.

19. The reversing-stop No. 4, constructed and operating substantially as specified.

20. The combination of the reversing-stop No. 3, feed-rack C, latch-lever P, and wormer H, the whole constructed, arranged, and operating substantially as specified.

21. The combination and arrangement of the reversing-stops No. 3 and No. 4, feed-rack C, and a traversing knitting device, the whole arranged and operating as specified.

22. The combination of the reversing-stops No. 1, No. 2, or No. 4, with the feed-rack C, wormer H, switch *t*, groove S, and yarn-carrier L, the whole arranged to operate substantially as set forth.

23. The arrangement of the looper I, switch K, grooves *d d'*, and wormer H, as specified, and operating for the purpose set forth.

W. W. BURSON.
JOHN NELSON.

Witnesses:
CYRUS F. MILLER,
C. S. HORSMAN.