

(No Model.)

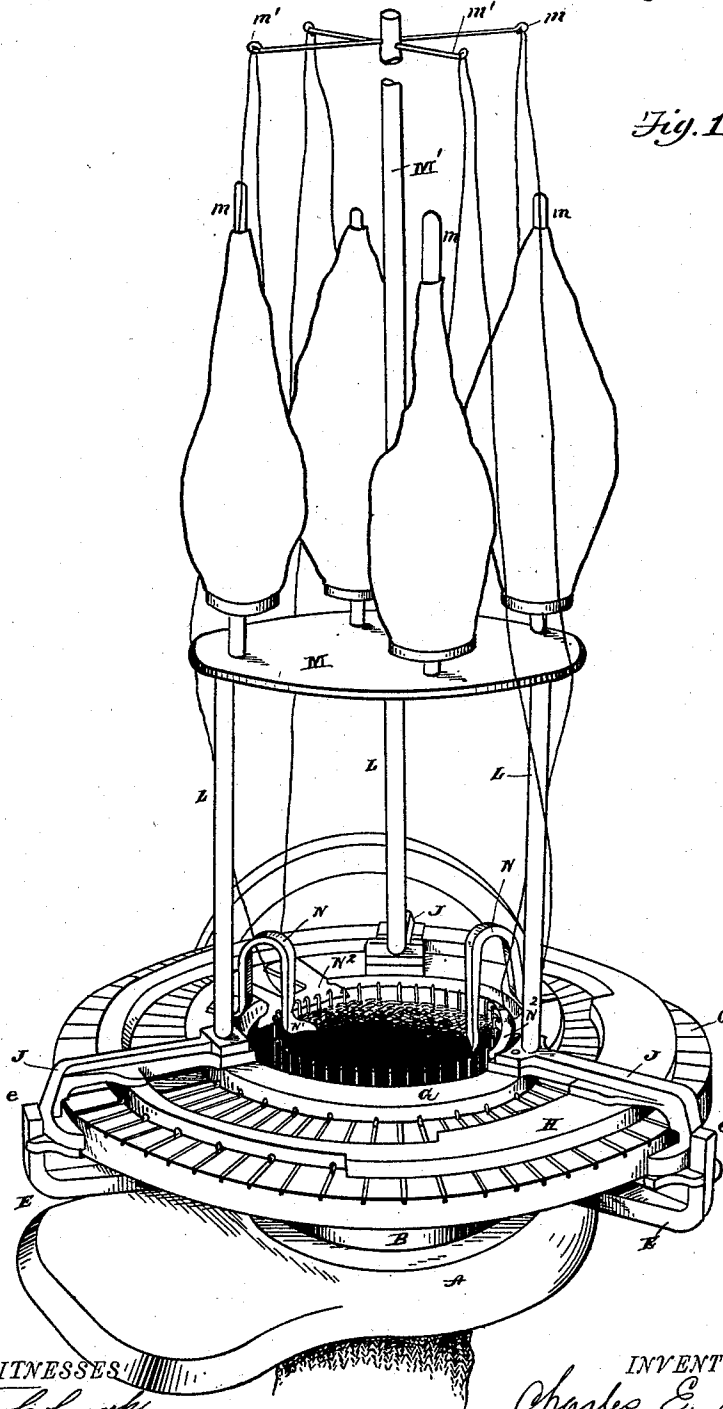
8 Sheets—Sheet 1.

C. E. WAKEMAN.  
ROUND KNITTING MACHINE.

No. 580,833.

Patented Apr. 13, 1897.

*Fig. 1.*



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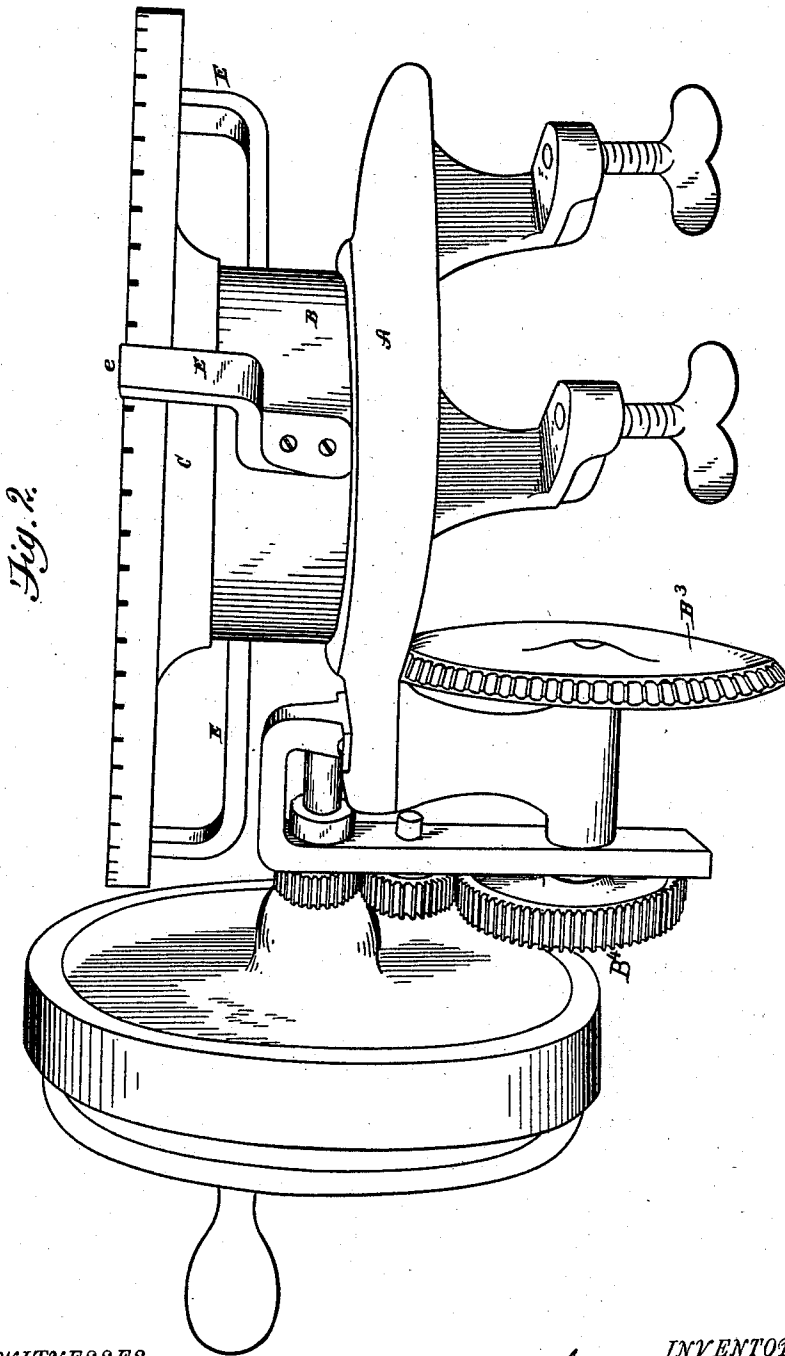
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8 Sheets—Sheet 2.

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(No Model.)

8 Sheets—Sheet 3.

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Fig. 3.

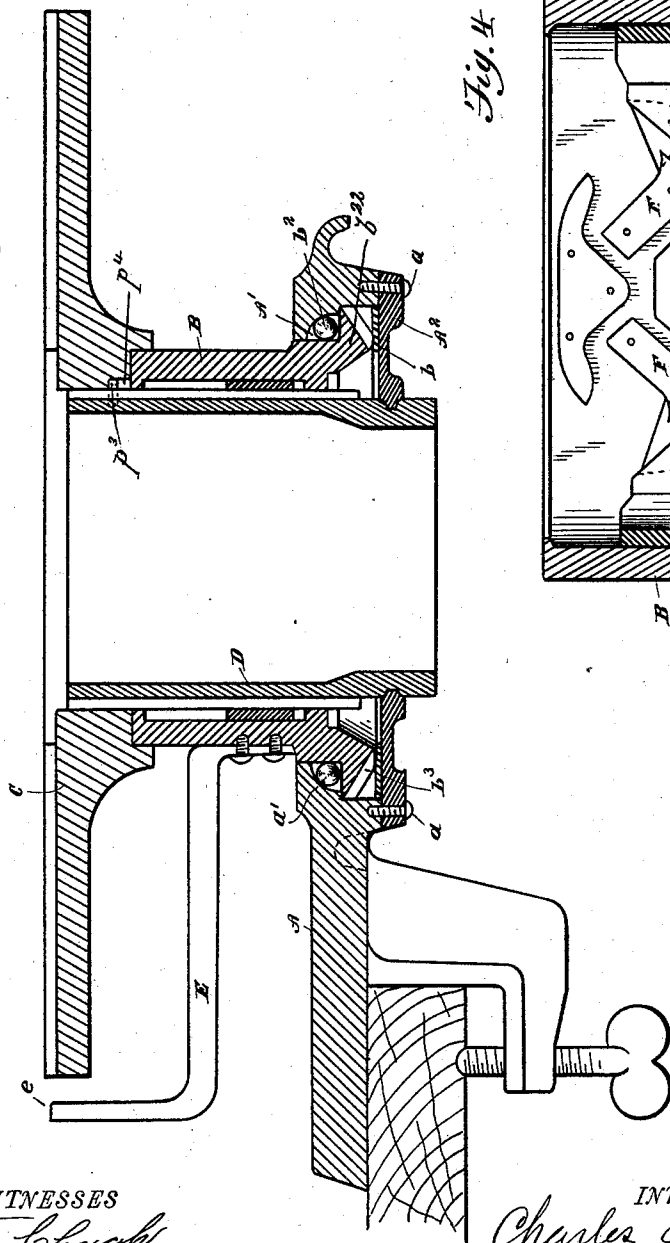
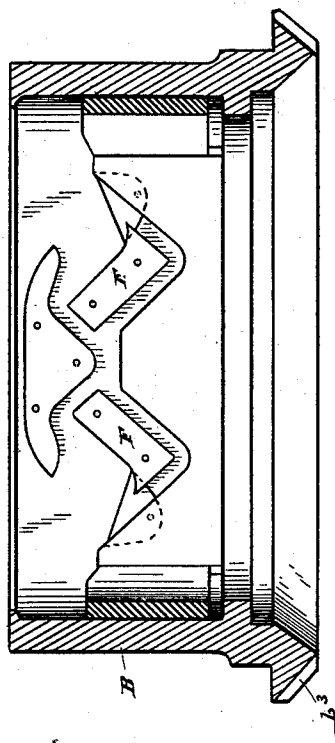


Fig. 4.



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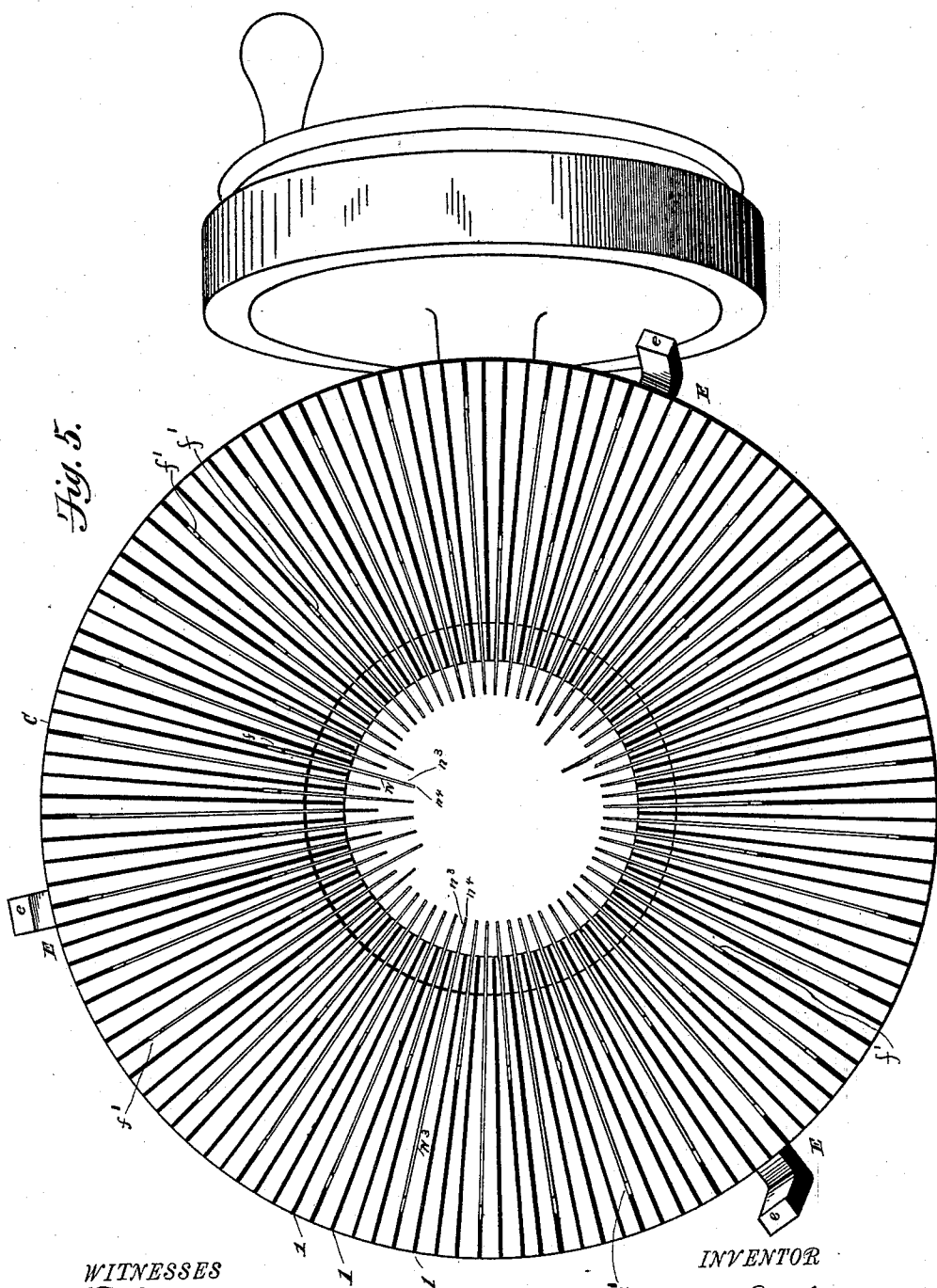
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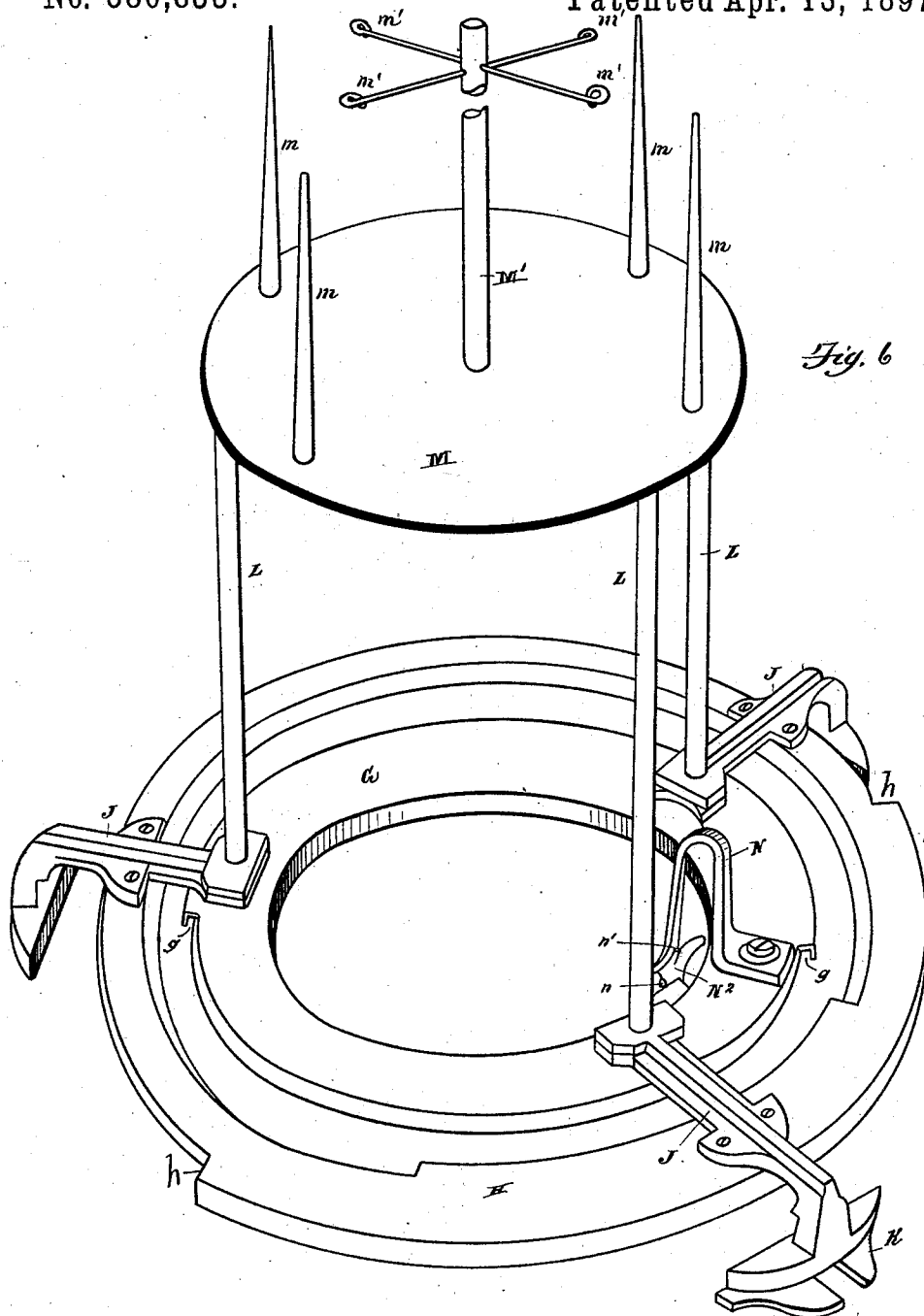
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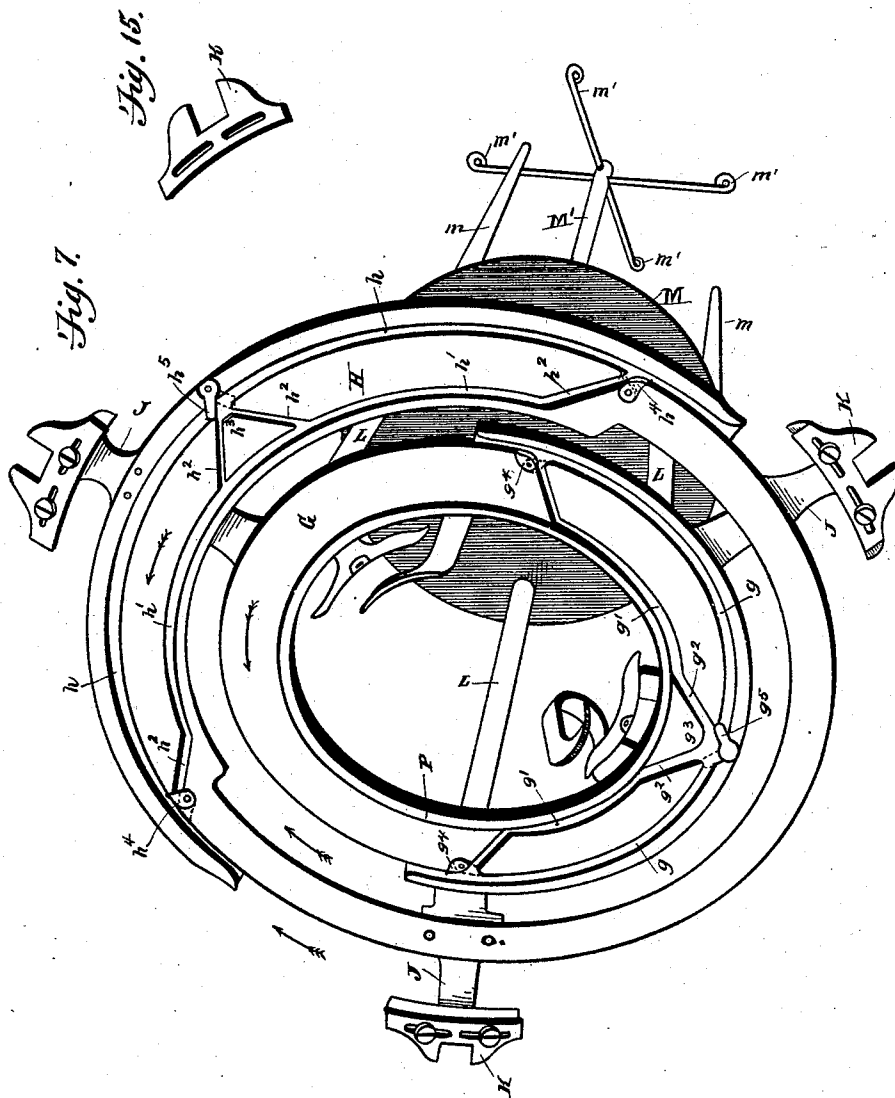
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8 Sheets—Sheet 6.

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8 Sheets—Sheet 7.

C. E. WAKEMAN.  
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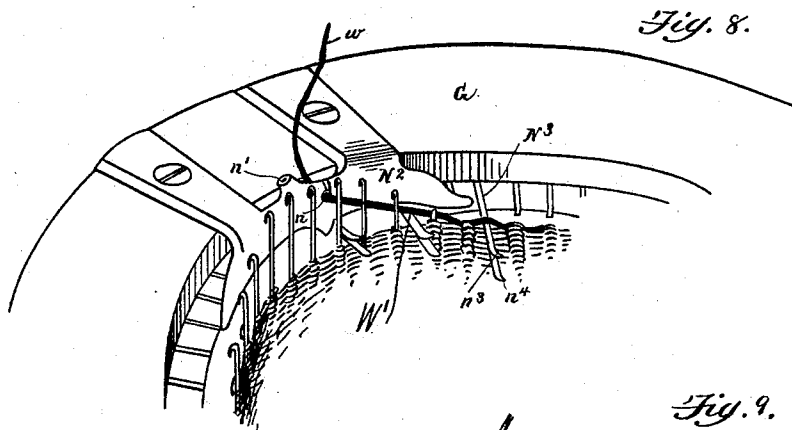


Fig. 8.

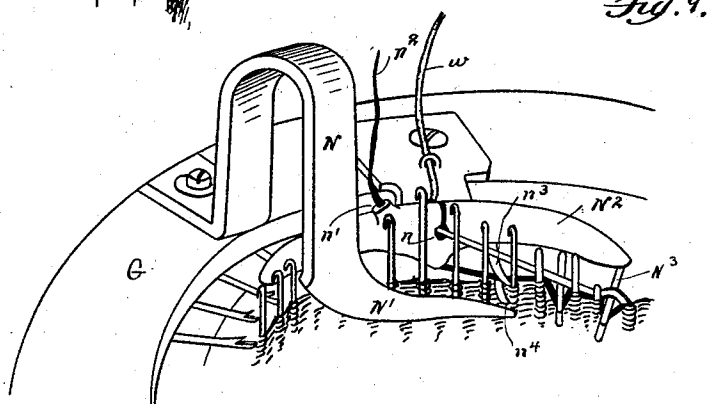


Fig. 9.

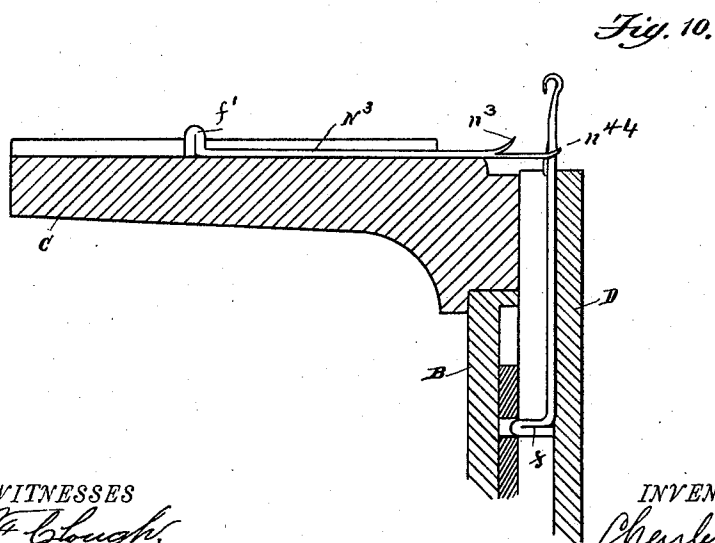


Fig. 10.

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(No Model.)

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C. E. WAKEMAN.  
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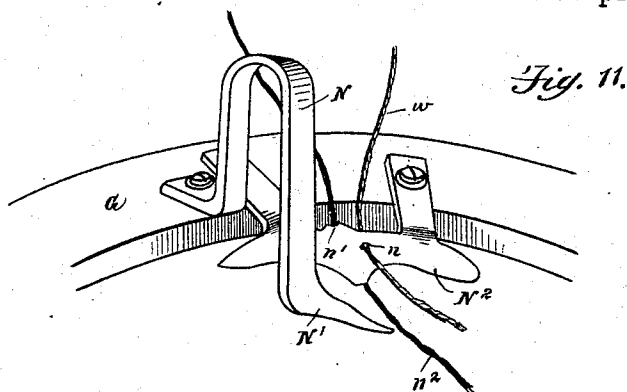


Fig. 11.

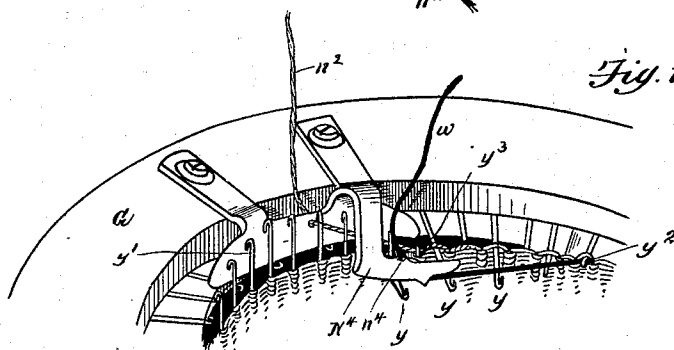


Fig. 12.

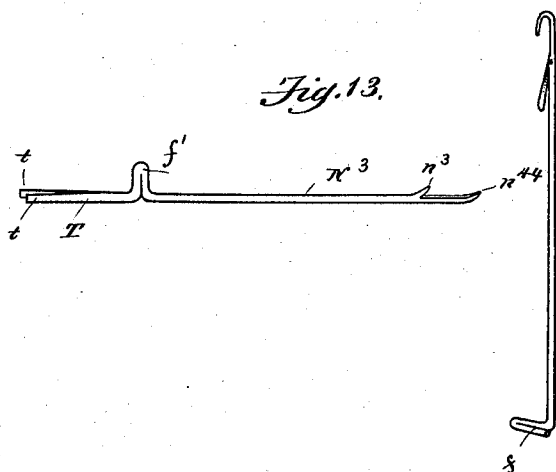


Fig. 13.

Fig. 14.

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# UNITED STATES PATENT OFFICE.

CHARLES E. WAKEMAN, OF PONTIAC, MICHIGAN.

## ROUND-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 580,833, dated April 13, 1897.

Application filed March 2, 1894. Serial No. 502,087. (No model.)

*To all whom it may concern:*

Be it known that I, CHARLES E. WAKEMAN, a citizen of the United States, residing at Pontiac, county of Oakland, State of Michigan, have invented a certain new and useful Improvement in Round-Knitting Machines; and I declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates to round-knitting machines; and it consists in various arrangements and combinations of mechanism whereby the operator is enabled to make a great number of different designs and grades of fabric with looped linings without altering the form of the stitches.

In the drawings, Figure 1 is a perspective of the machine arranged for operation. Fig. 2 is an elevation in perspective of the lower portion of the same, showing the gear by which it is operated. Figs. 3 and 4 are sectional views through the cam-cylinder and needle-table. Fig. 5 is a plan view of the needle-table with the cam-rings removed. Fig. 6 is a perspective of cam-rings and attachments for holding the cam-rings to the needle-table and for holding the spools from which the yarn is derived. Fig. 7 is a perspective of the under side of the cam-rings, showing the cams. Fig. 8 shows a fragment of the inner cam-ring, the yarn-guide seen at the left in Fig. 1, and one kind of fabric in process of formation, the presser-foot being omitted. Fig. 9 is a similar view, the yarn-guard, however, being of the form seen at the right in Fig. 1 and another kind of fabric being in process of formation. Fig. 10 shows a section of the cylinder and table with needles in position. Fig. 11 shows the same yarn-guide as Fig. 8, but with the presser-foot in position. Fig. 12 shows a combined yarn-guide and presser-foot being used in connection with ordinary knitting-needles in the table for the purpose of making a third kind of fabric. Fig. 13 is a detail figure of my forked looping-needle employed in this device. Fig. 14 is an ordinary needle. Fig. 15 is a detail view of the locking device.

Similar letters refer to similar parts.

In the drawings, A represents the framework or base, within which is located the lower portion of the cam-cylinder B.

C is the looping-needle table.

The bed A has a circular undercut groove A'. The lower portion of the bed A is closed off by a ring A<sup>2</sup>, which is held in place by screws *a a*. The lower edge of the cam-cylinder B at *b* impinges upon the upper face of this ring. The forcing of the ring A<sup>2</sup> upwardly while it is being secured in place carries the lower part of the cam-cylinder to a close bearing in the undercut groove A' in the bed A. The upper portion of this groove at *a'* is concaved, and interposed between it and an angle formed by a flange *b*<sup>22</sup> upon the lower portion of the cam-cylinder are a number of balls *b*<sup>2</sup>, thereby forming at this point a ball-bearing. Bevel-gear *b*<sup>3</sup> upon the lower end of the cam-cylinder engages a bevel-wheel B<sup>3</sup>, (shown in Fig. 2,) which when operated by means of appropriate gearing at B<sup>4</sup> creates a tendency by the resistance to raise, or rather tilt, the cam-cylinder B, and this is resisted by the ball-bearings hereinbefore mentioned, which thereby reduce the friction due to such tilting to a minimum and very much facilitate the operation of the machine. This is important in this class of machines.

D is the needle-cylinder, which is rigidly held by the ring A<sup>2</sup>, which, as above stated, is secured to the bed-plate by means of the screws *a a*. This is of the ordinary construction, having longitudinal grooves surrounding its periphery, in which are located the needles, as shown in Figs. 8 and 10.

The ring A<sup>2</sup> is made in two halves, each being provided with an inner flange which is arranged to engage in a horizontal groove formed in the periphery of the needle-cylinder. These two halves of the plate are made to fit the groove snugly and are then secured to the frame by means of the screws *a*.

Attached to the cam-cylinder B are preferably three radial arms E. These arms extend outwardly beyond the edge of the needle-table C and from thence rise upwardly to a point *e*. The cam-cylinder has located within its inner surface the usual cams for operating the needles, and the needles are formed with a shank, as shown in Fig. 14 at *f*, for the pur-

pose of engaging these cams, all of which is in the usual form and about which there is nothing new. A face view of one of these cams is shown in Fig. 4 at F F. The rotation of the cam-cylinder around the needle-cylinder therefore compels the needles located in the slots in the needle-cylinder D to reciprocate in the usual manner. The needle-table, as shown by Fig. 5, contains a number of radial slots  $l l l$ , corresponding in number to the number of slots in the periphery of the needle-cylinder and so located that these slots are interposed between the extensions of the slots in the needle-cylinder. The needle-table C is detachably fixed to the needle-cylinder D by means of pins  $p^3$ , fixed in the needle-cylinder, and slots  $p^4$ , formed in the table and arranged to engage over the protruding end of the pins, as seen in Fig. 3. Located above the needle-table are two or more cam-rings. In the device in question two are shown, termed the "inner" cam-ring G and the "outer" cam-ring H. These cam-rings are connected together by means of the radial arms J J J. The outer ends of these radial arms have adjustable bifurcated extensions K K K, a detail of which is shown in Fig. 15. These bifurcations extend downwardly below the top of the needle-table and are adapted to engage in the upper and outer ends  $e e$  of the arms E E and constitute an adjustable engagement between the cam-cylinder B and the cam-rings, which compels the cam-rings to rotate simultaneously with the rotation of the cam-cylinder B, as they are thus locked to it, and by means of the cams, to be hereinafter described, underneath the cam-rings, they simultaneously operate the needles in the slots  $l l l$  of the needle-table C. The simultaneous action of the needles in the needle-cylinder and the needle-table is very plainly shown in Figs. 9 and 10.

As the slots in the needle-table extend to the periphery, any portion of the needles located therein may be drawn outwardly, so that their shanks  $f' f'$  will not engage the cams located underneath the outer cam-ring or cannot engage in the cams located in the inner cam-ring G, and thus such needles will not be operated. Also, needles can be taken out of the needle-slots in the needle-cylinder, and by this means almost an infinite variety of combinations of stitches and corresponding fabric can be made. A framework is erected upon the top of the cam-rings, consisting of the standards L L L, held by the disk M, and upon which are located spindles  $m m$  for the reception of spools carrying yarn, which may be of different varieties or colors. A central standard M' is provided, carrying at its upper extremity yarn-guides  $m'$ .

Upon the inner cam-ring G is attached a loop-presser N, (shown in Fig. 9,) having a foot N' extending concentrically inside of the needle-cylinder, the object of which is to press downward and outward closely to the needles the loops formed by the knitting. Also upon

the inner cam-ring is attached a yarn-guide N<sup>2</sup>, it being, in the form shown in Figs. 8 and 9, perforated with two holes, one of which,  $n$ , is in the ordinary form and the other,  $n'$ , is designed by me. The object of the second,  $n'$ , is to carry into the fabric a second yarn  $n^2$ , which is shown as being knit into the fabric in Fig. 9. There is a guide N<sup>2</sup> and presser-foot N for each ring G H of said cams, as shown in Figs. 1 and 7, and corresponding cams in cylinder B; that is, one feed for each set of cams. The needles located in the needle-table are of the form shown in Figs. 8, 9, 10, and 13 at N<sup>3</sup>. In this form the needles N<sup>3</sup> have a barb located upon them at  $n^3$  a short distance from the extreme end  $n^4$ , and the barbs catch the second yarn  $n^2$  and push it inward above the latches of the cylinder-needles, thus forming the loops, as shown in Fig. 9. These loops are then held by their respective forked looping-needles until the adjacent hooked needles in the needle-cylinder have engaged both yarns and drawn them down through the loops carried by the vertical hooked needles, when the first-named loop, or the one formed by the forked looping-needle, is firmly tied with the stitch of the fabric. The forked looping-needles are then withdrawn for the next operation, which may be repeated several times during a single revolution of the cam-ring.

The forked looping-needles are held in position upon their needle-table by means of an inner ring P, which occupies a rabbet cut in the inner edge of the needle-table, as shown in Fig. 3. The ring, being sprung into place, holds the forked looping-needles so that they reciprocate underneath it and are prevented from rising at their inner extremities during such reciprocations. The ring can be integral with the cam-ring and rotate with it, as shown in Fig. 7.

In Fig. 7 are shown the cams in the inner and outer cam-rings, the arrows on the rings showing the direction in which the rings may move and the arrows outside of the rings showing the direction in which the needle-shanks enter the cams. These cams in ring H consist of grooves in the under face of the ring, the grooves being marked  $h$ . Interior concentric grooves are formed in the body of the ring at  $h'$ . These interior grooves  $h' h'$  lead outwardly at each end at  $h^2$ , the interior angular outward grooves meeting and forming an apex at  $h^3$ . Located at the extremity of the grooves  $h' h'$  are dogs  $h^4$ , which are adapted to shift, as shown by the dotted lines, and guard the entrances into the grooves  $h^2$ . Located at the apex or meeting-point of the grooves  $h^2 h^2$  at  $h^3 h^3$ , is also a dog  $h^5$ , which is adapted to swing from side to side. These dogs are adapted to enable the cam-rings to be turned in either direction. On the forked looping-needle entering from the opposite point to that indicated by the arrow it strikes the dog  $h^4$  and reverses the position shown to that of the dotted line. Passing into the groove  $h$ , it is deflected by the

dog  $h^5$  over and beyond the apex of the cam  $h^3$  into the groove  $h^2$ , and thence onward to the opposite dog  $h^4$ , which is thrust from the position shown into that of the dotted line, and thence outward. This reversal is necessary in knitting heels and toes. The inner cam-ring G has also therein cams similarly constructed, which may be located at any point in the circle desired, the only limitation upon the location being their relation to the cams in the cam-cylinder and the yarn-guides. It will readily be understood from this that any number of cams in a single ring and guides consistent with the space may be employed, although I have thought it sufficient to show a single set in the relation indicated in Fig. 7, and which are so arranged as to operate the horizontal forked looping-needles at the proper time with relation to the hooked needles in the needle-cylinder. The grooves and dogs in the inner cam-ring are marked, respectively,  $g$   $g'$   $g^2$ , with an apex  $g^3$ , and the dogs  $g^4$  and  $g^5$ , and as the mode of operation is precisely the same it will not need to be repeated.

It is obvious that while I have shown and described two cam-rings one, or even three or more, might be employed without departing from my invention, and the cams carried by these rings may be arranged in any convenient relation around the center. Of course in the use of one cam-ring the needles, unless some of them are withdrawn, will all be operated by each cam, and will consequently produce a fleece-surface of loops in a much thicker and different arrangement than the needles would as at present shown; but it would not be as desirable for producing many varieties of fabric. This is apparent from the fact that in the use of two rings, as illustrated in the drawings, the needles  $N^3$  have lugs  $f'$  arranged to be engaged by the cams of the outer ring, while the short needles have lugs  $f'$  in position to be engaged by the cams of the inner ring and that the second cam does not operate the same set of needles as the first. It will thus be seen that while I may employ one or more cam-rings, and also one or more feeders, I rather prefer the number shown, as I am then able to operate the long forked looping-needles independent of the shorter ones, and thus secure a greater variety of designs.

I have shown in Fig. 14 a common needle for the purpose of illustrating certain differences between it and my forked looping-needle, (shown in Fig. 13,) in which the outer end, or the end opposite the hook, is split in the plane of the shank and the two extremities of the split ends are sprung outwardly, as shown at T, the ends being  $t$   $t$ . When the needles are placed in the grooves and have split ends, the split ends expand slightly and produce a spring tension against the sides of the grooves, thereby keeping the needles in place and preventing their jumping, as is too often the fault with the common needles.

In Figs. 8, 9, and 12 are illustrated various modes of operation depending upon different arrangements and which will result in the formation of different sorts of fabric due to variations in the treatment of the looping-yarn  $n^2$ .

In Fig. 8 the yarn-guide  $N^2$  carries but one thread  $w$ , instead of two, as shown in Figs. 9 and 12. In this Fig. 8 the needles  $N^3$  extend under the yarn  $w$ , as shown at  $W'$ , without the barb  $n^3$  engaging it, so that when the yarn  $w$  is drawn into the fabric by the cylinder-needles the needle  $N^3$  is in the position shown in Fig. 8, holding the yarn above it, and thus making the open-work fabric.

In Fig. 9 the yarn  $w$  is shown as also lying over the needles  $N^3$  and not being engaged by the barb  $n^3$ , but in this case the fabric is constructed with an additional yarn  $n^2$ , which is engaged by the barbs of the needles  $N^3$ , and both are knitted or drawn into the work by the cylinder hook-needles, as in Fig. 8.

In Fig. 11 I have shown the presser-foot, yarn-guide, and yarn in position, omitting the needles and fabric to more clearly illustrate the relation of the parts.

In Fig. 12 I have shown two yarns  $n^2$  and  $w$  being knit into the fabric; but instead of using the barbed needles  $N^3$  in the table I use the ordinary hook-needle, as shown in Fig. 14, and the yarn  $w$  is drawn into the fabric by the hooks  $y$   $y$  of the needles, as represented at  $y^2$ . The yarn  $w$  is not guided by a yarn-guide similar to that shown in the other figures, but instead a presser-foot  $N^4$  has a perforation therein, through which the yarn  $w$  is carried, as shown at  $n^4$ . This presser-foot differs from the one shown in Fig. 11 in that it is designed to act as a yarn-guide as well as a presser-foot; but I do not deem it necessary to limit myself in the construction of this quality of fabric to this combined yarn-guide and presser-foot, as two separate devices might be readily employed with the same results. The use of this guide brings the yarn  $w$  a little distance inwardly from the face of the fabric and does not permit of its being worked therein simultaneously with the yarn  $n^2$ .

What I claim is—

1. In a round-knitting machine, the combination of a needle-cylinder having needle-holding slots in its periphery and parallel with its axis, a surrounding cam-cylinder adapted to reciprocate the needles held in the needle-cylinder, a needle-table detachably fixed to the upper portion of the needle-cylinder and having an upper surface at right angles to the axis of the needle-cylinder, and containing in said surface radial slots extending from the upper edge of the needle-cylinder outwardly, cam-rings superimposed upon the needle-table, means for causing the rings to rotate with the cam-cylinder, said cam-rings carrying on their under surfaces cams, forked looping-needles held in the radial slots in the needle-table and adapted to engage

with said cams whereby they are reciprocated in said slots simultaneously with the reciprocations of the needles in the needle-cylinder, substantially as described.

2. In a round-knitting machine, the combination of a needle-cylinder having needle-holding slots in its periphery and parallel with its axis, a surrounding cam-cylinder adapted to reciprocate the needles held in the needle-cylinder, a needle-table detachably fixed to the upper portion of the needle-cylinder and having an upper surface at right angles to the axis of the needle-cylinder, and containing in said surface radial slots extending from the upper edge of the needle-cylinder outwardly, cam-rings superimposed upon the needle-table, means for causing the rings to rotate with the cam-cylinder, said cam-rings carrying on their under surfaces cams, forked looping-needles held in the radial slots in the needle-table and adapted to engage with said cams whereby they are reciprocated in said slots simultaneously with the reciprocations of the needles in the needle-cylinder, and a superimposed frame carried by the cam-rings, and having thereon spindles adapted to receive spools on which is wound the yarn to be knit, substantially as described.

3. In a round-knitting machine, the combination of a needle-cylinder having needle-holding slots in its periphery and parallel with its axis, a surrounding cam-cylinder adapted to reciprocate the needles held in the needle-cylinder, a needle-table detachably fixed to the upper portion of the needle-cylinder and having an upper surface at right angles to the axis of the needle-cylinder, and containing in said surface radial slots extending from the upper edge of the needle-cylinder outwardly, cam-rings superimposed upon the needle-table, means for causing the rings to rotate with the cam-cylinder, said cam-rings carrying on their under surfaces cams, forked looping-needles held in the radial slots in the needle-table and adapted to engage with said cams whereby they are reciprocated in said slots simultaneously with the reciprocations of the needles in the needle-cylinder, and a yarn-guide adapted to receive the strands of yarn from the spools and to guide the same into the needles, substantially as described.

4. In a round-knitting machine, the combination of a needle-cylinder having needle-holding slots in its periphery and parallel with its axis, a surrounding cam-cylinder adapted to reciprocate the needles held in the needle-cylinder, a needle-table detachably fixed to the upper portion of the needle-cylinder and having an upper surface at right angles to the axis of the needle-cylinder, and containing in said surface radial slots extending from the upper edge of the needle-cylinder outwardly, cam-rings superimposed upon the needle-table, means for causing the

rings to rotate with the cam-cylinder, said cam-rings carrying on their under surface cams, forked looping-needles held in the radial slots in the needle-table and adapted to engage with said cams whereby they are reciprocated in said slots simultaneously with the reciprocations of the needles in the needle-cylinder, and means whereby power is applied to rotate synchronously the cam-rings and cam-cylinder, substantially as described.

5. In a round-knitting machine, a fixed horizontal table carrying forked looping-needles reciprocating in radial lines from a common center, in combination with cam-rings adapted to rotate about a common center superimposed upon the table, said cam-rings adapted to operate different sets of forked looping-needles, substantially as described and for the purpose set forth.

6. In a round-knitting machine a fixed horizontal table carrying forked looping-needles reciprocating in radial lines from a common center, in combination with cam-rings adapted to rotate about a common center superimposed upon the table, said cam-rings adapted to operate different sets of forked looping-needles, and means for operating said cams, substantially as described.

7. As an article of manufacture, a needle designed to be mechanically operated, and having a shank at one end adapted to be engaged by cams, a raised nose  $n^{44}$  upon the same side as the shank, and a raised barb or point  $n^3$  located also upon the same side as the shank and between the raised nose  $n^{44}$  and the shank, substantially as described.

8. In a knitting-machine, the combination of a needle-cylinder, a needle-plate, a hooked needle mechanically reciprocated in one of the two, and a pushing-needle  $N^3$  mechanically operated at substantially right angles to the hook-needle in the other of the two, and means for reciprocating the needles respectively, substantially as and for the purpose described.

9. In a knitting-machine, the combination of a needle-cylinder, a needle-plate, slots formed in said needle-plate and needle-cylinder, hooked needles adapted to operate in the slots formed in said needle-cylinder, forked looping-needles adapted to operate in the slots in said needle-plate, said needle-cylinder and needle-plate so adjusted with respect to each other as to support the hooked needles at right angles to the forked looping-needles, cams adapted to operate said forked looping-needles and means for operating said hooked needles, substantially as described.

In testimony whereof I sign this specification in the presence of two witnesses.

CHARLES E. WAKEMAN.

Witnesses:

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LEONARD LANHAM.