(No Model.) 3 Sheets—Sheet 1.

B. F. SHAW, Dec'd.

J. BUTLER, Executor.

CIRCULAR KNITTING MACHINE.

No. 460,039. Patented Sept. 22, 1891.

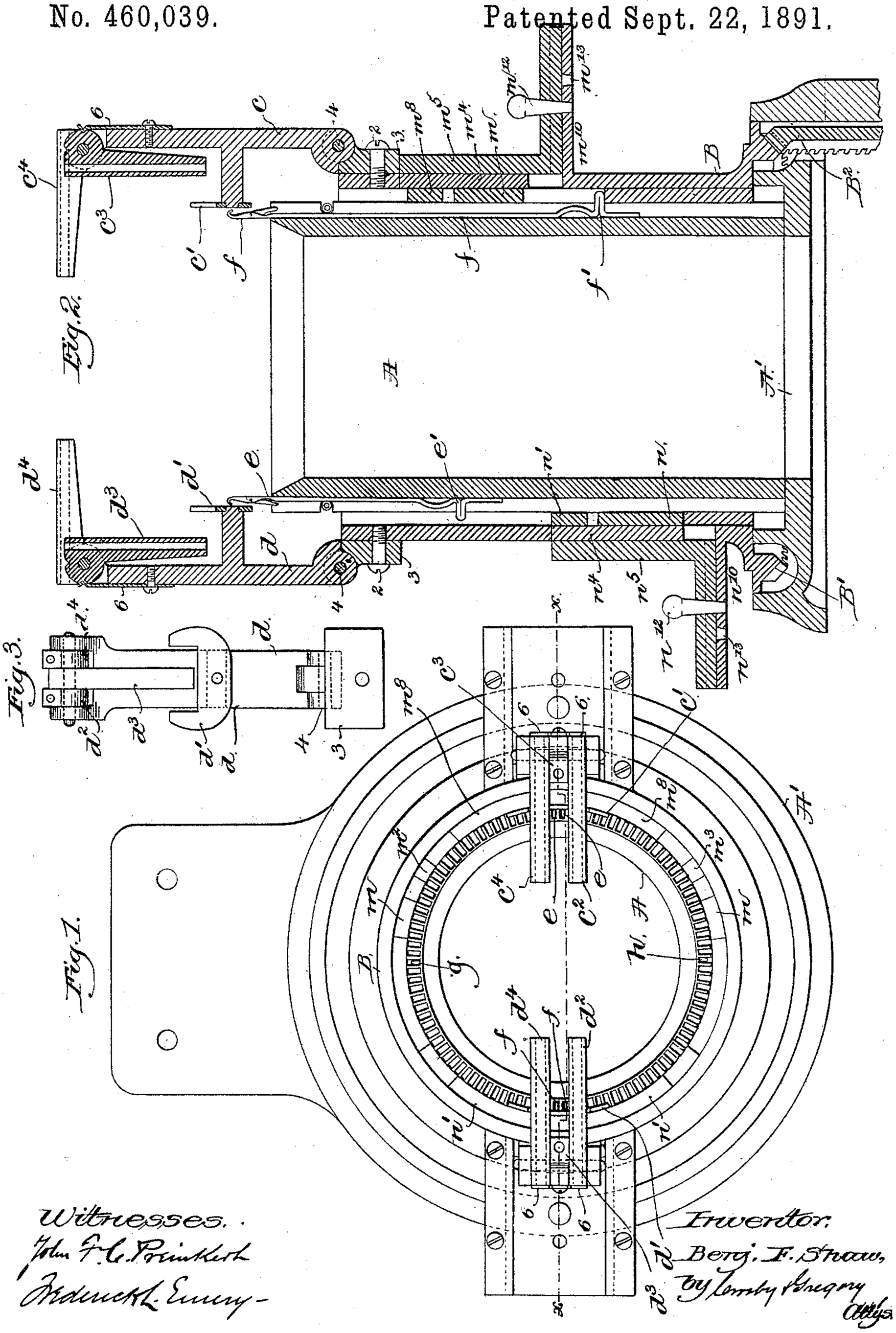

Fig. 1.

Fig. 2.

Fig. 3.

Witnesses.
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(No Model.) 3 Sheets—Sheet 2.

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CIRCULAR KNITTING MACHINE.

No. 460,039. Patented Sept. 22, 1891.

Fig. 4.

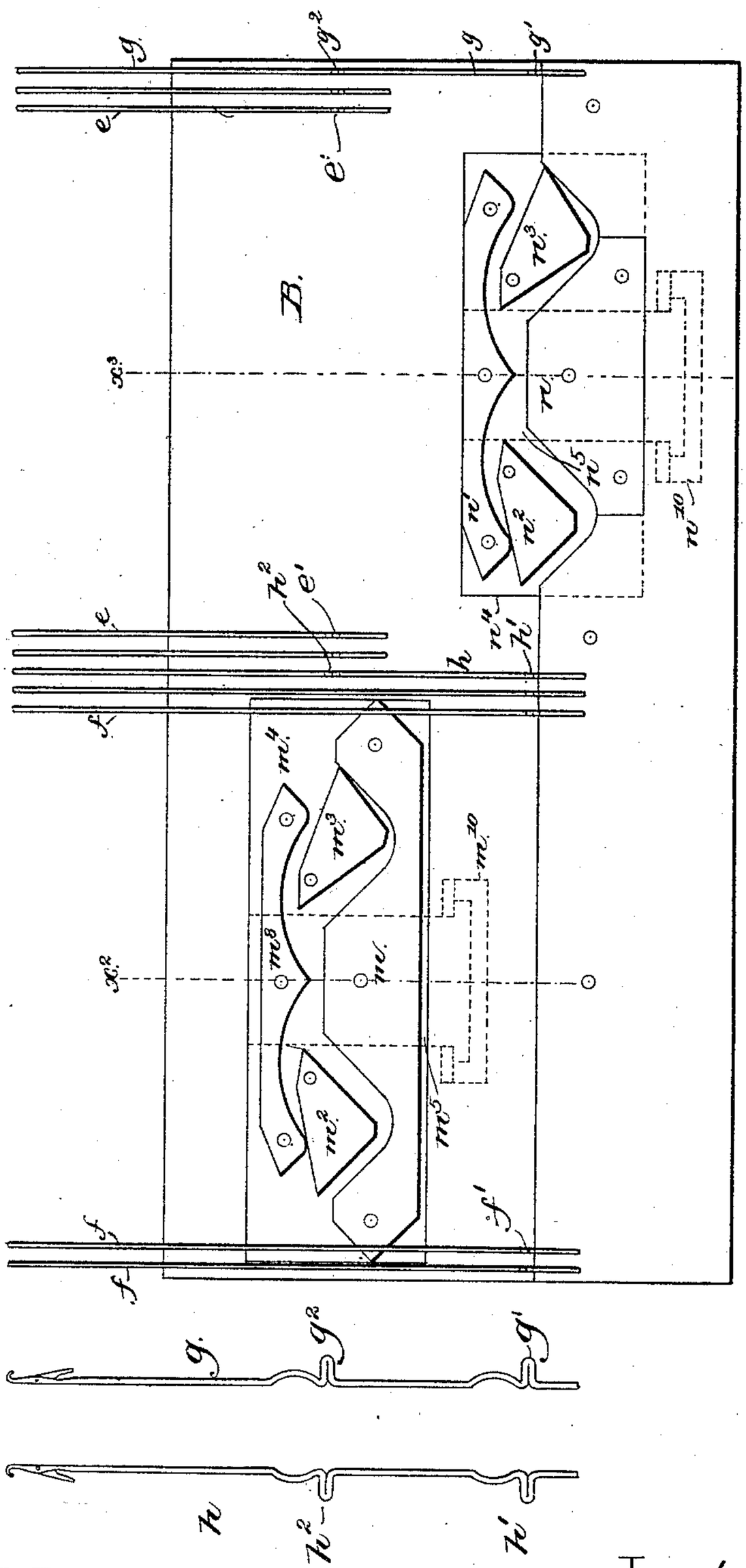

Fig. 4a.

Witnesses

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CIRCULAR KNITTING MACHINE.

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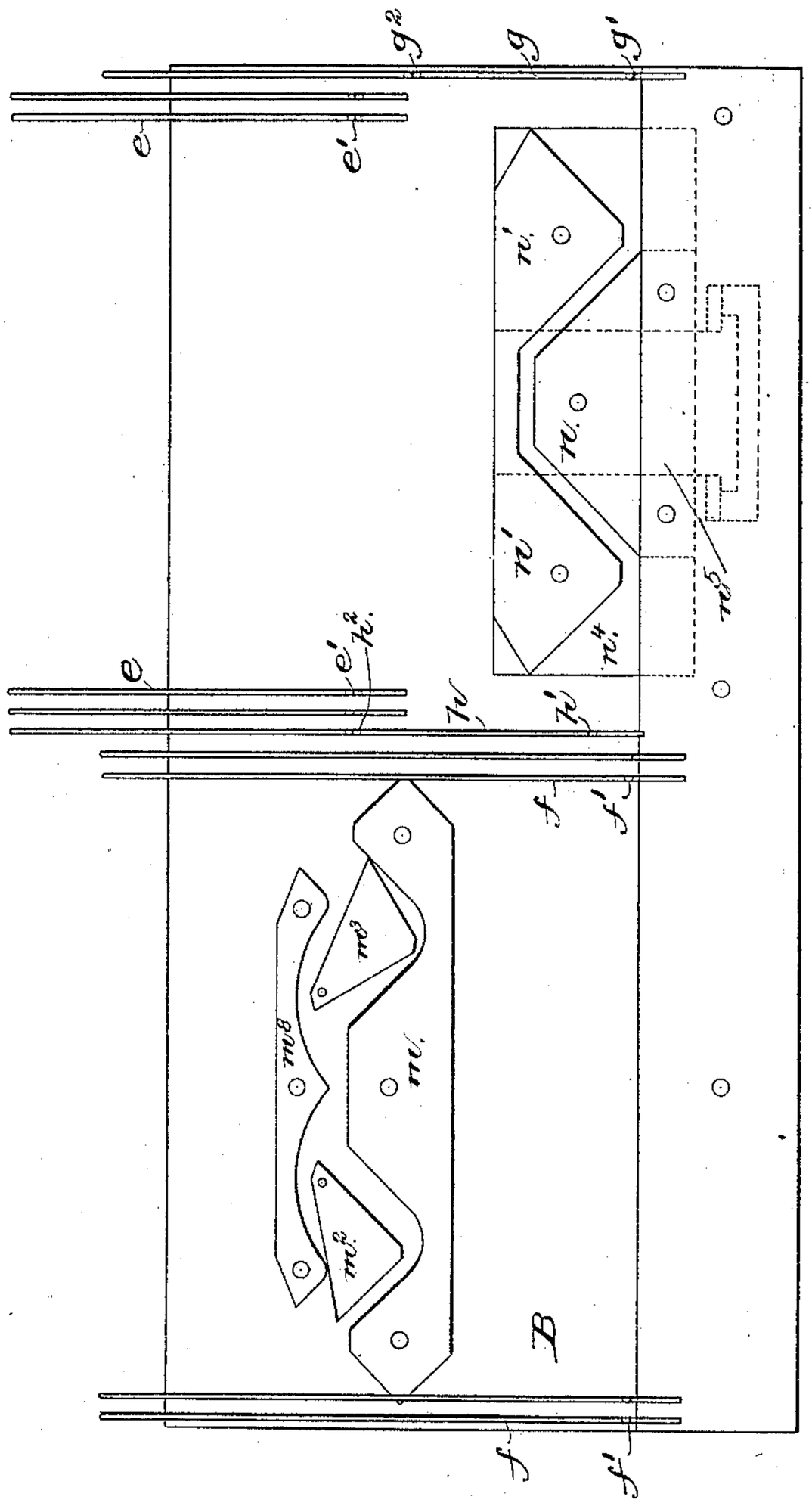
Fig. 5.



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UNITED STATES PATENT OFFICE.

BENJAMIN F. SHAW, OF LOWELL, MASSACHUSETTS; JOSIAH BUTLER, EXECUTOR OF SAID BENJAMIN F. SHAW, DECEASED, ASSIGNOR TO THE SHAW STOCKING COMPANY, OF SAME PLACE.

CIRCULAR-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 460,039, dated September 22, 1891.

Application filed March 7, 1890. Serial No. 342,960. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN F. SHAW, of Lowell, county of Middlesex, State of Massachusetts, have invented an Improvement in Circular-Knitting Machines, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention has for its object the production of a novel knitting-machine for knitting stockings wherein the leg is tubular and without seam, the said machine containing provisions whereby the stocking may, if desired, be striped or made party-colored, the machine being capable of being actuated to narrow and widen the stocking at desired points, as in the production of heels and toes for stockings.

My machine is provided with means whereby one or more independent yarns may be added to the stocking fabric at desired points to thicken the fabric.

My invention is embodied in a machine containing two series of needles the hooks of which are so arranged in the grooves of an annular bed, in conjunction with certain "suture-needles," as to enable the production of a tubular web, the said two series of needles being of different lengths or having their butts located at different distances from their hooks, and herein I denominate these series needles "longer needles" and "shorter needles." I have in this present embodiment of my invention arranged the two series of needles in grooves of an annular bed, so that the needles of one of the said series are disposed opposite the needles of the other series, the two series being in concentric arcs of a circle; but I desire to have it understood that the bed in which the said two series of needles are placed to be reciprocated, instead of being of the exact shape and style shown, may be of any other annular shape common to knitting-machines wherein the hooks of the needles are arranged in circular arcs and capable of making a tubular fabric. Each series of needles has its own cam or actuator and one or more yarn-guides, and the cam or actuator carrier—in this instance shown as cylindrical—is moved in one and then in the opposite direction, so that by the movement of the said cam-carrier in either direction each of the cams carried by it traverses the butts of all of and actuates only its own series of needles. In addition to the two series of longer and shorter needles, the machine is provided with two suture-needles, which are placed between the opposing ends of the two series of needles, and these two suture-needles, as herein shown, have each two butts so located that they are actuated alternately by the longer and shorter needle cams or actuators both when the said cams or actuators start to engage the butts of the longer and shorter needles and when the said cams pass off from the butts of the said longer and shorter needles, the said suture-needles thus forming two loops, while the longer and shorter needles form one loop, the wales thus made by the suture-needles being more prominent than the other wales. These suture-needles located as described between the opposing ends of the two series of needles, so as with them to form a complete circle of needles, co-operate with the said two series of needles in such manner as to receive the yarns being fed to the said two series of needles and effect the interloopment successively of the two half-circular courses of loops knitted on the two series of needles; or, in other words, the suture-needles take the yarns fed to both sets of needles and make simultaneously at each side of the needle-bed loops to join at their edges and make a single tubular fabric of what but for their interaction would be two separate flat fabrics. The machine may have a number of yarn-guides to each series of needles, so that yarns of different colors or characters may be fed to the needles as desired, one or more at a time. It will preferably be so constructed as to enable one series of needles to be used in knitting heels and toes while the other series is left inactive. The needle-bed (herein shown as a hollow cylinder) will be removable to facilitate the running on of cuffs or rib-tops, to which the stocking may be knitted. The cams or actuators will preferably be so mount-

ed, as will be described, as to enable them to be withdrawn from and returned into operative position in the cam-carrier whenever desired.

My invention is embodied in a knitting-machine having an annular needle-bed, two series of needles therein, one series being of one length and the other of another length, the two series being arranged in concentric arcs, and intermediary suture-needles between the opposing ends or sides of the two series of needles and constituting with them a complete circle, the suture-needles having two butts each, one of the butts being in rank with the butts of the series of shorter needles and the other in rank with the butts of the series of longer needles, and a needle-actuator to actuate the needles whose butts are in one rank, including the suture-needles, and a needle-actuator to actuate the needles whose butts are in the other rank, including the suture-needles, and a yarn-guide to each needle-actuator and acting in connection therewith, combined with means for reciprocating the needle-actuators, substantially as will be hereinafter described.

Other features in which my invention consists will be hereinafter pointed out in the claims at the end of this specification.

Figure 1 is a top view or plan of a knitting-machine embodying my invention, all but two of the series of longer and shorter needles and the two suture-needles being omitted, the butts of the longer needles being supposed to be located below the shorter-needle cams or actuators and the butts of the shorter needles as above the longer-needle cams or actuators; Fig. 2, a vertical section in the irregular dotted line x of the machine shown shown in Fig. 1; Fig. 3, an inner side view of one of the arms and yarn-guides, to be described; Fig. 4, a detail of the inner side of the cam-carrier, its cams or actuators, and some of the longer and some of the shorter needles, and the suture-needles in the positions they will occupy with relation to the shown cams when each series of needles is disengaged from the cam which actuates the said series; Fig. 4^a, details showing the suture-needles separately, and Fig. 5 a modification to be described.

The annular needle-bed A is herein shown as a hollow cylinder; but instead of the particular form of annular needle-bed represented I may use any other form of annular bed commonly employed in knitting-machines for the production of tubular fabrics. The needle-bed is set upon a foot-plate A′, which also supports the cam-carrier B, herein shown as a hollow cylinder provided at its lower end with a suitable gear B′ of usual construction, which is engaged and driven by any usual bevel-gear B^2, as partially shown in Fig. 2, mounted on a suitable driving-shaft. (Not shown.) The cam-carrier has attached to it, as herein shown, by like screws 2 the feet 3 of two like arms c d, each jointed or hinged in suitable manner, as at 4, to its own foot, so that the said arms may stand upright, as in Figs. 1 and 2, or be turned on the joints 4 into substantially horizontal positions when desired. The arm c has a yarn-delivery guide c' and three auxiliary feeders c^2 c^3 c^4, each being herein represented as hinged and provided with a suitable spring, as 6, by which to retain it either in elevated position, as indicated by the feeders c^2 c^4 d^2 d^4, or down in working position, as indicated by the feeders c^3 d^3. The yarn or yarns from the feeders c^2 c^3 c^4, each of which when down, will be led therefrom to the yarn-delivery guide c', which latter will present the said yarn or yarns, whatever may be their color, size, or number, to the hooks of the series needles e, designated as "shorter needles," when in elevated position. The arm d has a yarn-delivery guide d' and a series of auxiliary feeders, as d^2 d^3 d^4, like those described on arm c, the yarn-delivery guide d' supplying the yarn or yarns delivered to it to the hooks of the series needles f, denominated the "longer needles." The needles e, termed "shorter needles," have their butts e' located at such a distance from their hooks as to enable them to be acted upon by the shorter-needle cam or actuator, (shown at the left in Figs. 4 and 5 and at the right in Figs. 1 and 2,) while the series of needles f, having their butts f, at a greater distance from their hooks, and consequently called "longer needles," are actuated by the longer-needle cam or actuator. (Shown in detail at the right of Figs. 4 and 5 and at the left, Figs. 1 and 2.) In the drawings the longer-needle cams are shown as having passed the series of longer needles and as having been stopped under the series of shorter needles, and the shorter-needle cams are shown as having passed the series of shorter needles and as having been stopped opposite the series of longer needles, but above their butts.

The two series of needles called "longer" and "shorter" needles are arranged in concentric arcs and so as to co-operate in the production of a tubular fabric by means of certain intermediary needles g h, which I designate "suture-needles," the said needles being placed between the opposing ends of the said series of longer and shorter needles, so as to form with them a complete circle of needles. Each of these suture-needles is made to operate in conjunction with both of the said series of needles, first with one and then with the other, and so on alternately, to effect the interloopment of the two sides of the work as fast as their half-circular courses are successively laid. The wale or wales made by these suture-needles consist of stitches formed out of the yarns knitted on the adjacent needles on each side of them. For example, if a red yarn be fed to one series and a white yarn to the other series, the first series will make red wales and the second series white wales, while the suture-needles will make wales having both red and white stitches. Each series

of longer and shorter needles has its own set of cams or actuators and yarn guides or feeders, which latter are moved back and forth during the process of knitting, and the cams and guides of one set do not interfere with the cams, guides, or needles of the other set. The butts of the longer needles are out of range of the cam or actuator for the shorter needles, and vice versa.

The suture-needles *g h*, as herein shown, have, respectively, two butts g' g^2 h' h^2, the butts g' h' being in line with the butts of the series of longer needles *f*, and the butts g^2 h^2 being in line with the butts of the series of shorter needles *e*.

In Fig. 4, which shows clearly the different cams or actuators used in the machine represented in Figs. 1 and 2, the shorter-needle cam or actuator at the left is represented as composed of a notched plate *m*, a top plate m^8, and two pivoted blocks or tumblers m^2 m^3. The longer-needle cam or actuator shown at the right in Fig. 4 is composed of a notched plate *n*, a top plate n', and two pivoted blocks or tumblers n^2 n^3. When the cam-carrier B is given a movement in one direction and then in a reverse direction, the shorter-needle cam passes the set of shorter needles, acts on their butts, and reciprocates them, and when completing its movement passes over some of the longer needles above their butts without actuating them, and at the same time the longer-needle cam crosses the series of longer needles and, engaging their butts, actuates the said longer needles, and in its further movement to complete its stroke passes under the butts of some of the shorter needles without actuating them.

Instead of the longer-needle cam and the shorter-needle cam being provided with tumbler parts, as in Fig. 4, either or both may be made rigid, as at the right of Fig. 5.

The longer and shorter needle cams shown in Fig. 4 are all of usual shape or construction, and when in action they operate on the butts of the needles to reciprocate the needles as in other earlier knitting-machines; but instead of the particular longer-needle cams or actuators and the particular shorter-needle cams or actuators herein shown I desire it to be understood that I may employ any other suitable cams or actuators commonly employed in machines for knitting a tubular web and capable of being reciprocated at times for shaping heels and toes. The particular form of the said longer-needle cams and shorter-needle cams are not of my invention, and there is a great variety of such cams in United States patents, any of which may be employed, and the longer-needle cams and the shorter-needle cams may be alike or be different from each other.

The drawings Figs. 1, 2, and 4 show the longer-needle cam as secured to a segment n^4, while the shorter-needle cam is secured to a segment m^4, both segments fitting openings made in the cylindrical cam-carrier. I, however, desire it to be understood that instead of securing the said longer-needle cam and the said shorter-needle cam to the said segments, which constitute supports, the said cam or cams may be fixed in any usual manner to the inner side of the cam-carrier, as shown at the left of Fig. 5; but I prefer to fix the said cams to segments, as shown in Fig. 4, so that the longer-needle cam may be moved out of operative position when the shorter needles are to be used in knitting heels and toes by narrowing and widening, and so that the shorter-needle cam may be moved out of the way to facilitate the removal of the needle-bed with the needles therein for the application to the needles of the loops of a rib-top or cuff.

In the arrangement of Fig. 4 the two series of cams are alike, and they are tumbler-cams, adapted to leave all the needles with their hooks somewhat beyond or clear of the needle-bed, so as to be readily moved by hand out of and into the cam-paths, as is the usual practice in knitting heels and toes of seamless stockings.

In Fig. 5 the longer-needle cam $n\,n'$ is rigid and leaves the needles at the points of farthest descent or with their hooks slightly below the top of the needle-bed. This longer-needle cam $n\,n'$ is, however, shown as secured to a segment n^4 and adapted to be moved out of and into operative position when the knitting of heels and toes is being done on the shorter needles and when it is desired to remove the cylinder from the cam-carrier.

The L-shaped slides m^5 n^5, Fig. 2, to which the segments m^4 n^4 are secured, have their feet fitted to slide in guideways m^{10} n^{10}, projecting from the cam-carrier horizontally, the said slides having locking devices m^{12} n^{12}, (shown as pins,) which enter holes in the bottom plates of the said guideways, as shown in Fig. 2, the said bottom plates having other openings m^{13} or n^{13} to receive the pins m^{12} or n^{12} and prevent the withdrawal of said slides farther than necessary.

To remove the needle-bed for the application to the needles of a rib-top or cuff in the construction shown in Fig. 4, wherein the cams are movable from their actuating positions, the cam-carrier will be stopped in position where the buts of the shorter needles will be over the longer-needle cam and the butts of the longer needles under the shorter-needle cam, and, the shorter needle cam or actuator next being moved out of actuating position, the needle-bed and the needles therein may be lifted out. After applying the rib-top to the needles in usual way the needle-bed will be returned to position in the machine and the shorter-needle cam or actuator will be returned to its working position, whereupon, yarn being supplied to the needles, knitting may be proceeded with.

In the modification, Fig. 5, to remove the needle-bed for applying ribbed tops the following is the best method: With the cam-car-

rier in such position that the longer-needle cam is on the opposite side of the cylinder from the longer needles, (under the shorter needles,) the shorter needles are drawn up out of range of the shorter-needle cam, the longer-needle cam is withdrawn, and the cam-carrier given half a revolution, whereupon the needle-bed and its needles may be lifted out. After applying the ribbed top to the needles in the usual manner the needle-bed will be so held that the shorter needles will be over the shorter-needle cam and the longer needles over the longer-needle cam, and then the needle-bed will be lowered into its place on the machine-bed, the cam-carrier will be turned one half-revolution, the longer-needle cam will be returned to its actuating position, and the shorter needles be pushed down into operative position, whereupon, yarn being supplied to the needles, knitting may be proceeded with. After a sufficient length of tubular fabric, composed of half-circular courses interlooped, as described, has been knitted to form a leg, a heel may be knitted on either series of needles in the construction shown in Fig. 4 or on the shorter series in the construction shown in Fig. 5, all of these series being actuated by tumbler-cams, the series of needles not to be used in making the heel in construction Fig. 4 being rendered inoperative by moving their cam or actuator out of operative position; but if the said cam or actuator were not attached to a movable segment, as described, then the needles not to be used would have to be lifted by hand until their butts would be out of range of the series of cams for operating them, the needles not to be used in making the heel in construction Fig. 5 being rendered inoperative by withdrawing the longer-needle cam. The heel, if the ordinary seamless one, is knitted by raising the needles one at a time out of range of the knitting-cams in narrowing and returning them one at a time to the proper position to be engaged by the cams when widening, this being done by hand in the usual way. At the completion of the heel in the construction Fig. 4 the cam or actuator that was withdrawn to render one series of needles inoperative will be returned; but if the said cam or actuator had been fixed to the cam-carrier and the needles had been raised, as described, to commence a heel the said series of needles not used during the making of the heel would be returned into proper position to be engaged by its cam. The foot will be knitted by reciprocating the cam-carrier, as in knitting the leg.

In construction Fig. 5 that series of needles not used in making the heel becomes operative through the return of the longer-needle cam to its working position. At the completion of the foot the needles not to be used for the production of the toe are made inoperative in the same manner as described for the knitting of the heel, and the toe is knitted in any usual way.

In the construction Fig. 4 it will be understood that the heel or toe may be made on either series of needles, or that the heel may be made on one series and the toe on the other series, should it be desired to make them in that way; but in the construction Fig. 5 the heel and toe will be knitted on the shorter needles.

If it is desired to make a stocking with a leg and upper half of foot striped—say red and drab yarn—and the heel, toe, and sole of a different color—say of brown yarn—the auxiliary feeders c^3 d^3 on arms c and d will be supplied with drab, the feeders c^4 and d^4 with red, and the feeders c^2 and d^2 with brown yarn. The auxiliary feeders which are turned down, as shown, by the feeders c^3 d^3 feed the yarn to the needles through the main delivery-guides c' and d', while those feeders which are turned up, as the feeders c^2 c^4 d^2 d^4, do not supply yarn to the said delivery-guides. After, say, eight half-circular courses have been knitted from the drab yarn supplied by the feeders c^3 d^3 and it is desired to change the color to red the feeders c^4 and d^4 are swung down into position and the feeders c^3 and d^3 are swung up out of position. If two courses of red are desired, the cam-carrier is moved back and forth to knit that number of courses, when the feeders c^4 d^4 are swung out of operative position and the feeders c^3 d^3 are again swung into operative position and the drab yarn is used to knit, as before, for the desired number of courses. This may be repeated until the point is reached at which it is desired to make the heel. If this is to be made of the brown yarn, the feeder c^2, co-operating with the delivery-guide c' for supplying yarn to the shorter needles, will be turned down into operative position and all the other auxiliary feeders will be swung up out of position. One series of needles, either the longer or shorter, is then to be rendered inoperative in the manner described and the heel is to be knitted on the other series. At the completion of the heel both series of needles are to be made operative for the knitting of the foot. If the sole of the foot is to be of the same color as the heel, then the feeder that was used in knitting the heel can remain in position during the knitting of the foot, it only being necessary to alternate the feeders for supplying yarn to the needles on which the instep or top of the foot is knitted, as in the operation of knitting the leg. The tubular fabric for the foot having been knitted of suitable length, the toe is knitted in the manner described for the heel.

The machine described may be used to knit the heel and toe of a stocking, as in United States Letters Patent No. 64,154, dated April 23, 1867, or it may be made to knit other usual heels and toes.

Application Serial No. 332,426, filed by me December 3, 1889, shows the manner of interloopment of the half-circular courses of loops, as herein provided for, by the suture-needles, as shown in Fig. 4 of the said application.

It will be noticed from the foregoing description and from the drawings that the butts on the suture-needles are far enough apart to allow the passage between them of the shorter-needle cams or actuators, and that there are spaces between the ends of the semicircular series of shorter and longer needles, respectively, wherein the cams are wholly disengaged by the needles, this disengagement enabling the reversal of motion of the knitting-cams without casting off the work.

I claim—

1. A knitting-machine containing the following specified instrumentalities, viz: an annular needle-bed, two series of needles therein, one series being of one length and the other of another length, arranged in two series in the arc of a circle, and intermediary suture-needles between the opposing ends or sides of the two series of needles and constituting with them a complete circle, suture-needles having two butts each, one of the butts being in rank with the butts of the series of shorter needles and the other in rank with the butts of the series of longer needles, and a needle-actuator to actuate the needles whose butts are in one rank, including the suture-needles, and a needle-actuator to actuate the needles whose butts are in the other rank, including the suture-needles, and a yarn-guide to each needle-actuator and acting in connection therewith, and with a radially-movable slide or stand to support one of the said needle-actuators, whereby it may be moved radially toward and from the needle-cylinder, combined with means for reciprocating the needle-actuators, substantially as described.

2. A knitting-machine containing the following specified instrumentalities, viz: an annular needle-bed, two series or ranks of needles having their hooks disposed in different arcs of the same circle, two yarn-delivery guides, one for each series of needles, two series of feeders for the said yarn-delivery guides, and intermediary suture-needles interacting between said two series or ranks of needles, substantially as and to the effect described, combined with needle-actuators to operate said two series of needles and the said suture-needles and means for the application of motive power, substantially as described.

3. A knitting-machine containing the following instrumentalities, viz: an annular needle-bed, a series of shorter needles and a series of longer needles disposed in substantially-circular arcs, suture-needles having two butts located far enough apart to admit of the passage between them of the shorter-needle cam or actuator, and a yarn-delivery guide for each series of shorter and longer needles, a cam-carrier having a shorter-needle cam or actuator and a longer-needle cam or actuator, and means to reciprocate said cam-carrier to operate the said longer and shorter needles and the suture-needles, one of the cams or actuators being mounted on a radially-movable slide or carriage, whereby the said cam may be withdrawn from operative position, as and for the purposes set forth.

4. A knitting-machine containing the following instrumentalities, viz: a needle-bed, a series of shorter needles and a series of longer needles, two suture-needles having each two butts far enough apart to admit of the passage between them of the shorter-needle cam or actuator, a yarn-delivery guide for each series of longer and shorter needles, and a cam-carrier having shorter and longer needle cams or actuators, the said cams or actuators each having tumbler portions, as described, and an outwardly-movable plate carrying one of the said sets of cams or actuators, whereby one of the said sets of cams or actuators may be moved outwardly away from the needles which they are adapted to actuate, as and for the purpose set forth, substantially as described.

5. A needle-bed, a series of shorter needles, a series of longer needles, two suture-needles having each two butts and located, respectively, between the opposing ends of the two series of shorter and longer needles, and a yarn-delivery guide for each series of longer and shorter needles, combined with a cam-carrier having a shorter-needle cam or actuator and a longer-needle cam or actuator, a radially-movable slide to support the longer-needle cam in order that it may be withdrawn from the cam-cylinder from operative position, as described, and means to reciprocate the said cam-carrier, substantially as described.

6. A needle-bed, a series of shorter needles, a series of longer needles, suture-needles having each two butts and located between the opposing ends of the two series of shorter and longer needles, and a yarn-delivery guide for each series of longer and shorter needles, combined with a cam-carrier, means to reciprocate it, a longer-needle cam or actuator, a shorter-needle cam or actuator, and a radially-movable slide to support the said shorter-needle cam or actuator, whereby it may be withdrawn when desired, as and for the purposes set forth.

7. A needle-bed, a series of shorter needles, a series of longer needles, suture-needles having each two butts and located between the opposing ends of the two series of shorter and longer needles, and a yarn-delivery guide for each series of longer and shorter needles, combined with a cam-carrier, the shorter and longer needle cams or actuators, and radially-movable slides to support the said cams or actuators, whereby they may be withdrawn from their operative positions, substantially as described.

8. A needle-bed, a series of shorter needles and a series of longer needles, suture-needles each having two butts, the two butts being

far enough apart to admit of the passage between them of the shorter-needle cam or actuator, a cam-carrier having a shorter-needle cam or actuator and a longer-needle cam or actuator, and means to reciprocate said cam-carrier, combined with two yarn-delivery guides, one for each of the said two series of needles, and with a series of auxiliary feeders co-operating with the said yarn-delivery guides and adapted to be used interchangeably for striping or in the production of color effects, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

BENJAMIN F. SHAW.

Witnesses:
MARTIN L. HAMBLET,
CHAS. F. LIBBY.