No. 805,612. PATENTED NOV. 28, 1905.

F. B. WILDMAN.

CIRCULAR KNITTING MACHINE.

APPLICATION FILED AUG. 3, 1904.

4 SHEETS—SHEET 1.

Fig. 1.

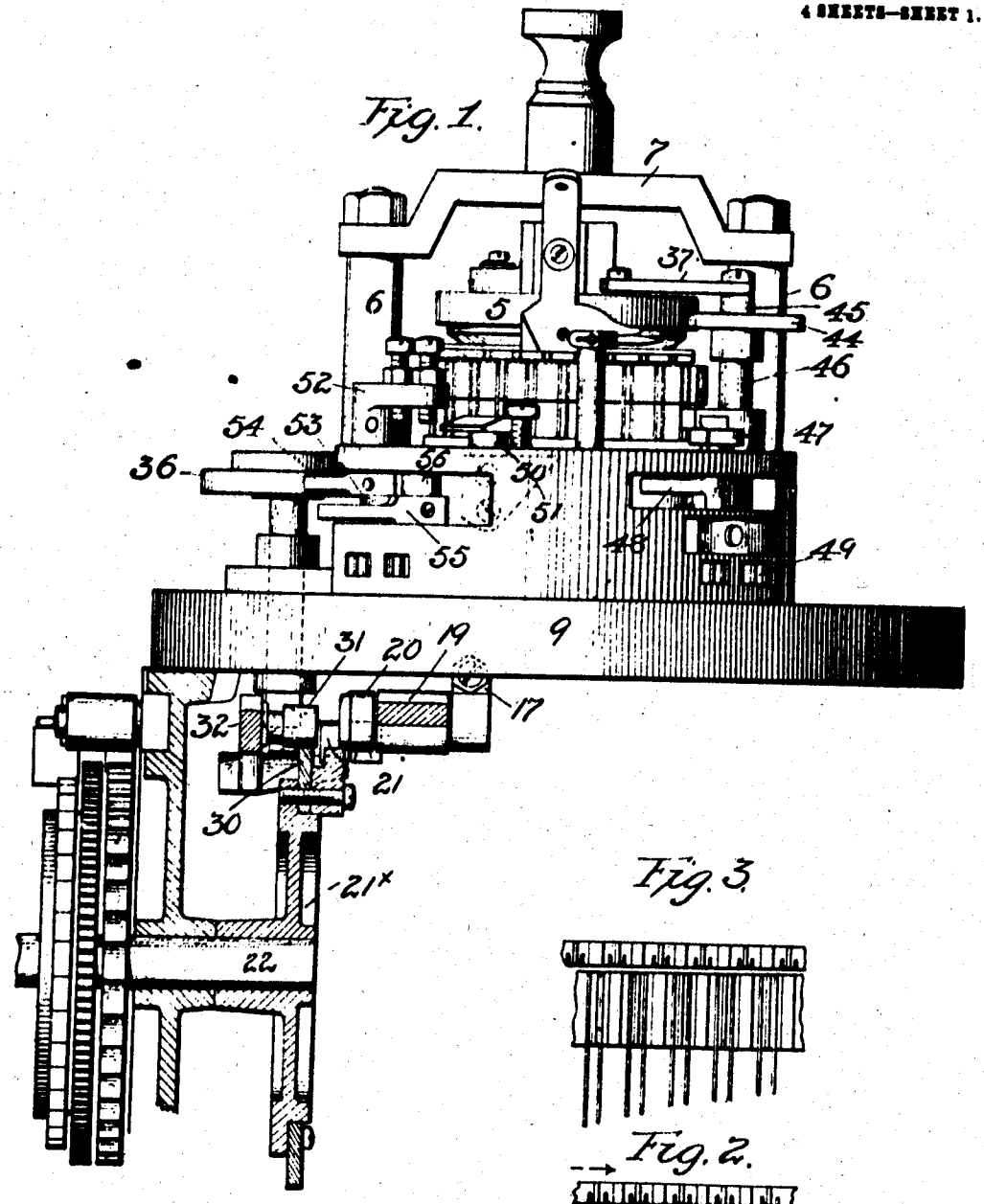
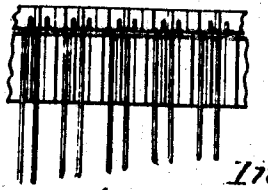


Fig. 3.

Fig. 2.



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No. 805,612. PATENTED NOV. 28, 1905.

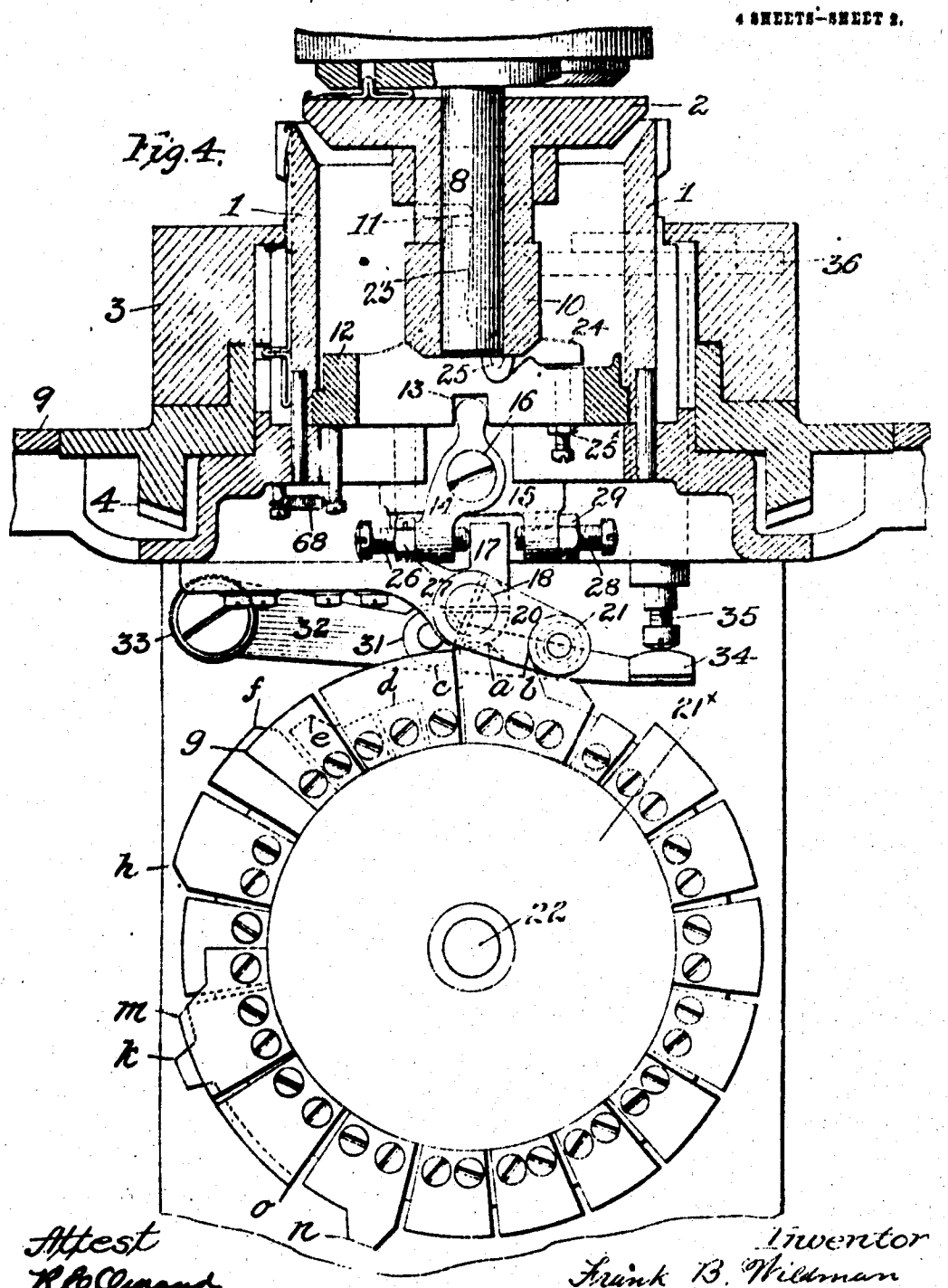
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4 SHEETS—SHEET 2.

Fig. 4.



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4 SHEETS—SHEET 3.

Fig. 5.

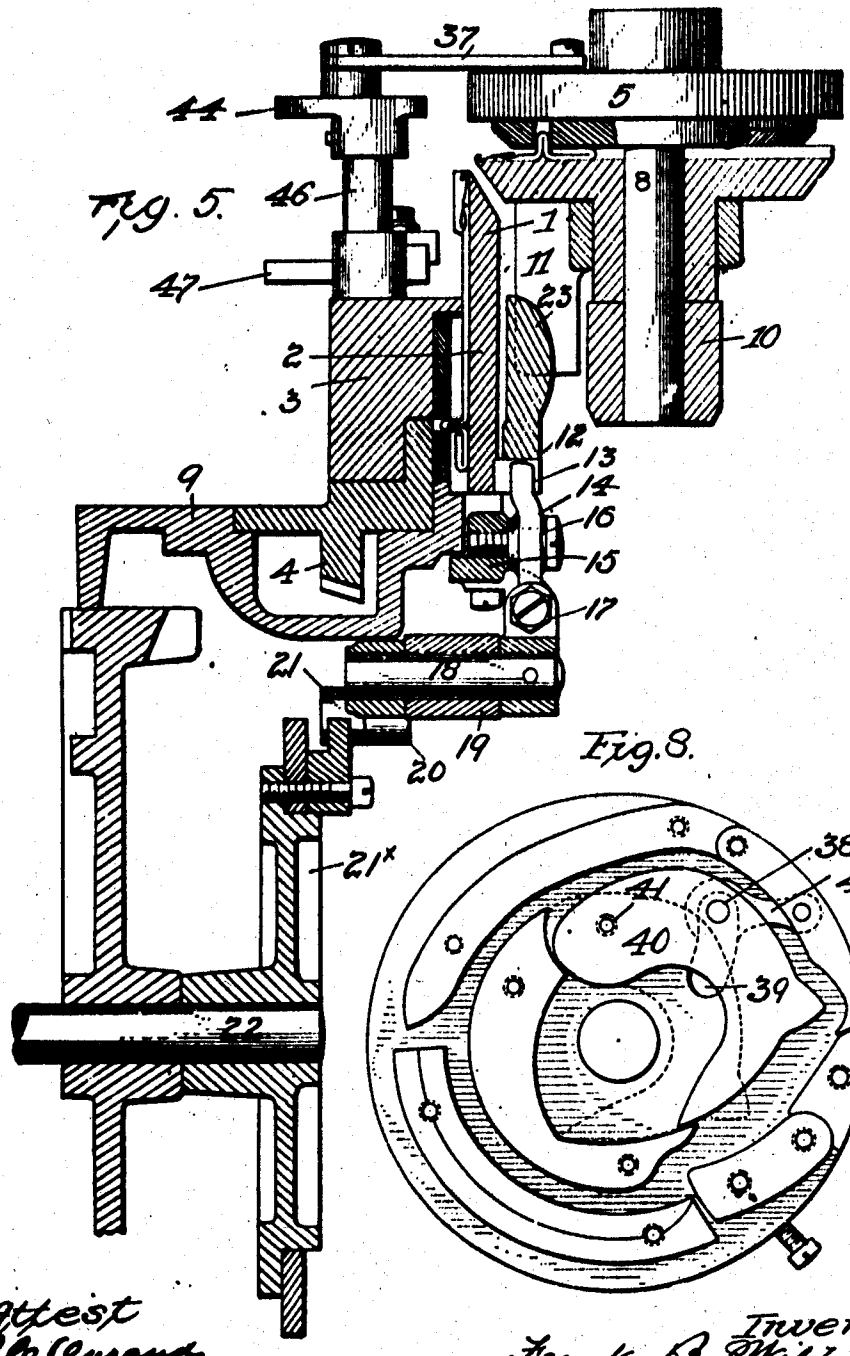


Fig. 8.

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4 SHEETS—SHEET 4.

Fig. 6.

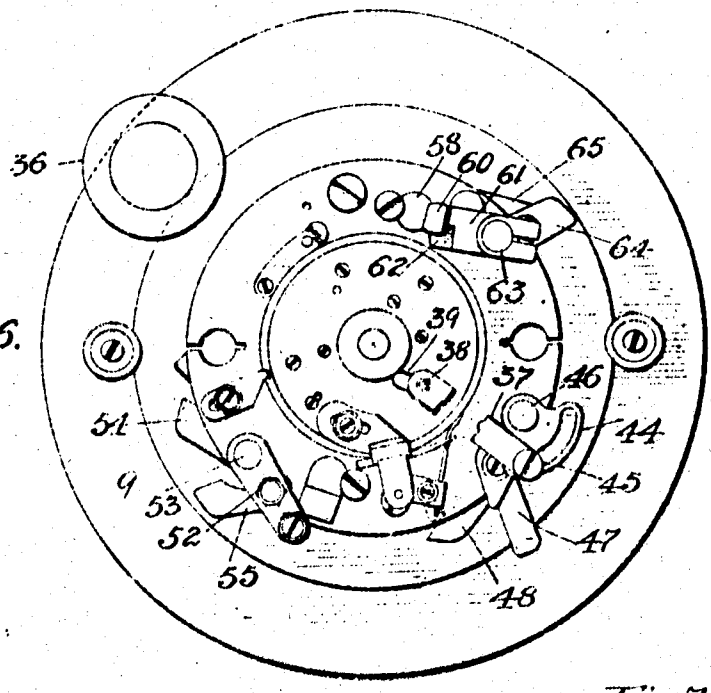


Fig. 7.

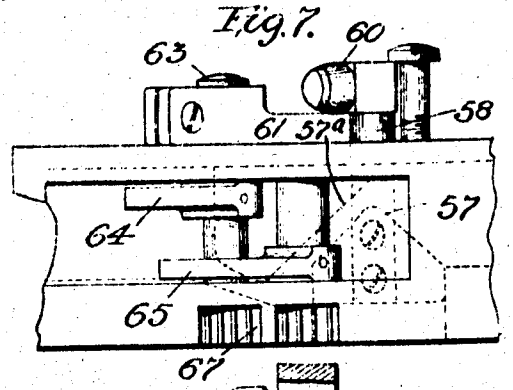


Fig. 10.

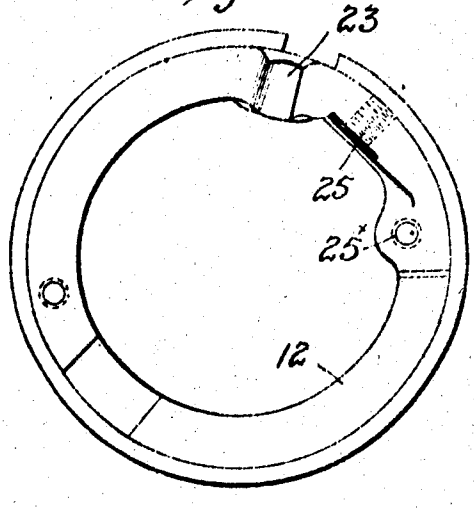
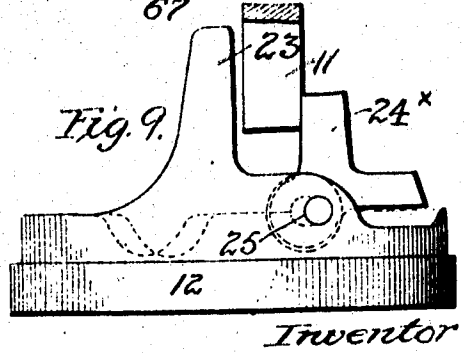


Fig. 9.



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UNITED STATES PATENT OFFICE.

FRANK B. WILDMAN, OF NORRISTOWN, PENNSYLVANIA.

CIRCULAR-KNITTING MACHINE.

No. 805,612. Specification of Letters Patent. Patented Nov. 28, 1905.

Application filed August 3, 1904. Serial No. 218,872.

To all whom it may concern:

Be it known that I, FRANK B. WILDMAN, a citizen of the United States, residing at Norristown, Pennsylvania, have invented certain new and useful Improvements in Circular-Knitting Machines, of which the following is a specification.

It is the object of my invention to provide a circular-rib-knitting machine in which the relation between the two sets of needles may be automatically changed for the purpose of producing different effects in the fabric.

In carrying out my invention I employ a cylinder and dial, and in order to get different relative arrangements—as between the cylinder and dial needles—means are provided whereby the dial may be automatically shifted circumferentially, so that the needles of the dial and cylinder are changed from a one-and-one to a two-and-two relation, or the reverse—that is, from an arrangement in which the needles of the dial and cylinder alternate singly with each other to one in which pairs of the dial-needles alternate with pairs of the cylinder-needles, the former arrangement producing in the fabric ribs alternating singly or one and one and the latter producing ribs alternating in pairs. In producing a stocking with a welt at the top I provide means for altering the relation between the needles for the formation of the welt, while the loops are held on the dial and cylinder needles in one-and-one relation. In producing such a stocking certain changes are made in the knitting—for instance, to provide a series of long loops knit on one set of needles for the purpose of making a division between the portions of the fabric to be separated, the said long loops being adapted to be raveled out—and my machine is organized to automatically control the knitting devices to secure the necessary changes in the character of the knitting.

The invention consists in the features and combination and arrangement of parts hereinafter described, and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 is a front view of a knitting-machine embodying my invention. Fig. 2 is a view in the nature of a diagram, showing a portion of the dial and cylinder with the needles of these beds arranged in one-and-one relation—*i. e.*, with the needles of the dial alternating singly in position with those of the cylinder. Fig. 3 is a view similar to Fig. 2, but with the needle-beds altered in position, so as to make the needles of the dial stand in pairs alternating with pairs of the cylinder-needles. Fig. 4 is a vertical sectional view of the invention with parts in elevation, the view being taken from the right of Fig. 1. Fig. 5 is a vertical sectional view at right angles to Fig. 4. Fig. 6 is a plan view of the dial-cap and cylinder-cam ring with parts associated therewith. Fig. 7 is a side view of the means for controlling one of the cylinder-cams intended to cause stitches to be dropped from the cylinder-needles. Fig. 8 is a bottom plan view of the dial-cap showing the dial-cams. Fig. 9 is a detail view of the ring for shifting the dial, and Fig. 10 is a plan view of the ring of Fig. 9.

In the drawings, 1 is the cylinder, and 2 the dial of substantially ordinary construction. The cam-ring 3 of the cylinder is rotated through a gear 4, and the dial-cap 5, carrying the cams for the dial-needles, is rotated in the ordinary manner by connections with the cylinder-cam ring, including the vertical posts 6 and the cross-piece 7, suitably connected to the shaft 8, which carries the said dial-cap with its cams. The cylinder is stationary and is supported upon the base ring or plate 9 of the machine, and the dial is supported on the shaft 8 by means of the collar 10 and is held stationary or against rotation by a lug 11, projecting from its side in a manner hereinafter described.

Figs. 2 and 3 illustrate the two positions of the dial and cylinder which the present embodiment of my invention is capable of making them assume. From these figures it will be seen that the needles of either the dial or cylinders are unequally spaced apart, or, in other words, they are arranged in pairs. In Fig. 2 the dial and cylinder are in the position assumed by them when it is desired to knit one-and-one—*i. e.*, with the needles of the dial alternating singly in position with those of the cylinder. Now by shifting the dial in the direction of the arrow in Fig. 2 the two needle-beds will assume the position shown in Fig. 3, in which the needles of the cylinder and dial alternate in pairs in relative position, a pair of needles of one row standing opposite the space between pairs of needles of the other row. This latter arrangement will give a two-and-two arrangement of the ribs in the knitted fabric. In order to secure this change in the relation between the needle-beds, means are provided for shifting the dial, with its needles, circumferentially in one direction to change from one-and-one knit-

ting to two-and-two and in the other direction to change from two-and-two to one-and-one knitting. This means comprises a ring 12, arranged within the cylinder and supported on the base-ring of the machine, where it is adapted to be turned circumferentially. The ring has a notch 13 in its under edge engaged by a lever 14, pivoted at 16 to a bracket 15, secured to the base of the machine. This lever is operated from an arm 17, pinned on a shaft 18, supported in a bracket 19, said bracket being secured to the base-ring of the machine. This shaft has pinned thereon an arm 20, carrying a roller 21, bearing on the blocks or pattern-pieces of a pattern-wheel $21^{\times}$, which is fixed on a shaft 22, journaled in the frame and operated from any suitable form of pattern mechanism. The ring 12 has a finger 23 extending up therefrom, which lies on one side of the lug 11, and a lever 24, pivoted at 25 to the ring, has one arm $24^{\times}$ extending up on the other side of the said lug. This lever 24 has its horizontal arm borne upon by a screw $25^{\times}$, extending through the ring, and by this screw the position of the lever in relation to the lug 11 may be changed to suit different gages of fabric, it being understood that in this class of machines the fabric passes down between the lug 11 and the part or lug which coacts therewith to hold the dial in place. Contact between the lever 14 and the lever 17 is obtained by a screw 26 passing through the lever 14 and bearing upon the lever 17. By this arrangement accuracy may be obtained in the action of these parts, and the screw may be set in any desired position by the lock-nut 27. A stop-screw 28 passes through a part of the bracket 15, and this may be locked in any position to which it may be adjusted by the nut 29.

Whenever the dial is adjusted circumferentially in relation to the cylinder, it is necessary to retract the needle-cams of the dial, so that the needles may be drawn in to their full extent for the purpose of allowing the shifting action to take place without conflict between the dial and cylinder needles. In addition to this certain other adjustments of the knitting devices must be effected, and for this purpose the pattern-wheel 21 carries another set of pattern blocks or pieces in addition to the set mentioned above. This set (indicated generally at 30) acts upon the roller 31 of a lever 32, pivoted to the machine-frame at 33 and having a broadened end 34 for operating vertically a stem 35, carrying on its upper end a disk 36, which is adapted to operate arms disposed in various positions about the machine and connected with the knitting devices for operating the same.

For operating the dial-cams inwardly in order to retract all the dial-needles preparatory to the operation of shifting the dial with its needles in relation to the cylinder and its needles a link 37 is used, having a pin 38 extending through a slot 39 in the dial-cap and connecting with the wing-cam 40, Fig. 8, of the dial-needles, said wing-cam being pivoted at 41 and having connected with it an outer cam-section 42 by means of a link 43, so that the outer section will move in unison with the wing-cam and maintain at all times the cam-path for the needles of the same shape and width to exert a perfect control over said needles. The link referred to connects with an arm 44 at 45 adjustably, said arm being on a shaft 46, journaled in the rotary cam-ring and having rigidly connected therewith an arm 47, projecting into the path of the disk 36 when said disk is adjusted into the horizontal plane of the arm. When the arm 47 is struck by the disk in the revolution of the machine, the dial-cam will be shifted inwardly, and the dial-needles will then all be retracted, so that the shifting of the dial circumferentially may take place without causing the needles of one set to engage those of the other set. The arm 48 on the shaft 46 is for returning the connections and the dial-cam to their former position when the disk 36 is lowered into the horizontal plane of this arm. This arm is on a shaft which is geared, as indicated at 49, to the shaft 46, this connection and the general action of these parts being well known in the art.

Mechanism is also provided for forming loose courses in the fabric, this being generally of known construction and consisting of the post 50, connected with the cam 51 and adapted to be depressed by a screw or pin on an arm 52, which arm is on a shaft 53, journaled in the rotary casing or cam-cylinder, said shaft having an arm 54 fixed thereon to be operated by the disk 36 and a second arm 55 on a shaft 56, journaled in said casing and geared to the shaft 53. These arms move the arm 52 in and out, according to which one of them is operated by the disk 36.

At a certain point in the knitting between where one garment is finished and another one started it is the function of the machine to knit several courses of long loops on the dial-needles to make a clear line of division between the two garments for the purpose of raveling out and separating the garments. The means for accomplishing this consists partly of the cam 57 of the cylinder-needles connected with a post 58, extending up through the cam-ring and having a laterally-arranged roller 60 at its upper end, said post being lifted at certain times by an arm 61, having an incline 62 thereon to work against the roller 60 and under the same. This arm 61 is fixed on a shaft 63, journaled in the cylinder-cam ring. The shaft is operated one way by the arm 64, fixed thereon, and in the other direction by an arm 65 on a shaft 66, journaled in the cam-ring, the two shafts being geared together at 67, Fig. 7. When this cam is in its uppermost position, it raises the cylinder-

needles to such a height that the threads thereon get beyond their latches, so that when the needle retracts immediately thereafter without taking thread under action of cam 57ª the long loop lengths measured by these needles across the stems of the dial-needles are cast off, leaving long dial-loops in the fabric for raveling and separating the garments.

In the operation of the machine we will suppose the needles are arranged two and two, as in Fig. 3, and when shifting or racking of the dial is to be performed to change the arrangement of the needles to one and one (whether to continue knitting one and one or to form the welt) the first action which takes place is the raising of the disk 36 to its highest position, to be in line with the upper one 47 of the pair of levers 47 48 for operating the dial-cam, so that the dial-cam will be operated inwardly and the dial-needles will be retracted throughout the whole circuit of the machine, in order that the racking may take place without interference on the part of the needles which would otherwise occur by the projected dial-needles striking the cylinder-needles. This elevation of the disk 36 takes place by the roller 31 on lever 32 being lifted by the block *a* on the pattern-wheel. After the dial-cam is shifted inwardly and the dial-needles are all retracted the dial is "racked" or shifted circumferentially by the roller 21 on the lever 20 being lifted by the pattern-block *b*, said lever acting through the connections 14 12 23, described, to shift the dial, so that its needles will alternate singly with the cylinder-needles, giving them a one-and-one arrangement. A course is now knit on the cylinder-needles with the needles in this position. The roller of the disk-lever 32 now falls to block *c*, which brings the disk 36 into line with the lower lever 48 of the dial-cam, so that the dial-cam is restored to operative position, and the dial-needles begin knitting again. The next action desired is the knitting of long loops on the dial-needles for separating the garments by raveling out these long loops, and for this action the stitches are dropped from the cylinder-needles, and these needles then simply measure off the long loop lengths on the dial-needle for the formation of the long dial-loops on the dial-needle. For this effect of dropping the stitches from the cylinder-needles the roller 31 of disk-lever 32 next drops to block *d*, which lowers disk 36 into line with lever 65, which lever when moved inward raises the cam 57 of the cylinder, so that the stitches will be dropped from the cylinder-needles because these needles are raised so high that the stitches get below their latches, and when the needle retracts under action of cam 57ª the stitch is dropped, no thread is taken as this needle retracts. The cam 57 is a special cam and is independent of the stitch-cam of the cylinder, which is located adjacent the thread-guide, as in ordinary practice. The needles of the cylinder which take the thread from the thread-guide serve to measure off long lengths of thread across the dial-needles for the course or courses to be raveled out. Several of these long loop courses are now knit on the dial-needles, the stripping-cam 57 in its action following the cylinder stitch-cam and dropping the thread from the cylinder-needles. When pattern-block *e* strikes the roller 31 of the disk-lever, said disk 36 is raised into line with lever 64 of the cam 57 of the cylinder, thus lowering the said cam so that the cylinder-needles after receiving the thread will hold it, and thus begin to knit again in conjunction with the dial-needles; but as the relation between the dial and cylinder has been changed circumferentially, as above described, the knitting or the order of the loops on the dial and cylinder-needles will now be one and one. This knitting by both sets of needles immediately precedes the knitting of the welt on the cylinder-needles. Only one course is knit by both sets of needles jointly, and then the parts are set for forming the welt as follows: When block *f* strikes the roller 31 of the disk-lever, the disk 36 will be raised again into line with the upper lever 47, controlling the dial-cam, and the dial-cam will again be shifted inwardly, so that all the dial-needles will be retracted to knit the welt on the cylinder-needles, and also in order that the dial may be racked or shogged circumferentially to change the relation between the dial and cylinder needles, and the pattern-wheel continuing to rotate brings the point *g* from under the roller 21 of the racking connections 17 14 12, allowing a spring 68 to rotate the ring 12, and thus shift the dial in relation to the cylinder. From the time the dial-needles were thrown out of operation by the inclined edge of the block *f* until the point *h* is reached by the roller of the disk-lever 31, the machine is knitting welt courses on the cylinder-needles, the arrangement of the needles remaining one and one, the dial-needles, however, remaining inactive all this time. The next change is the racking of the dial back to the two-and-two relation, which takes place when the roller 21 drops off of point *g*. The machine continues knitting the welt until the roller 31 of the disk-lever drops off of point *h* and shifts the disk 36, so as to cause the dial-needles to be again thrown into operation to knit the rib fabric two and two. This two-and-two relation is now maintained until the cuff at the top of the stocking-leg is completed, and then the throwing inwardly of all the dial-needles and the racking takes place when the disk-roller 31 and the roller 21 arrive, respectively, at the points *k* and *m*. The knitting now changes to one and one and continues until points *n* and *o* arrive at the disk-roller 31 and the roller 21, respectively, when the two-and-two position will be resumed.

Briefly stated, the actions through which the machine goes, as above described, are as follows: Starting with the needle-beds having their needles in two-and-two relation operate the dial-cam inwardly to withdraw needles. Rack the dial circumferentially, so that the needles of the dial and cylinder are in one-and-one order. Knit a course with the parts in this relation. Restore knitting on the dial-needles in conjunction with the knitting on the cylinder-needles. Drop stitches from the cylinder-needles and knit several courses of long loops on the dial-needles. Restore cylinder-knitting in conjunction with dial-knitting. Retract all dial-needles to permit the cylinder-needles to knit the welt. Rack back to the two-and-two relation of the needles and continue knitting the welt. Then throw the dial-needles into operation, and thus complete the selvage-welt. It is immaterial just at what period in the formation of the welt the racking back takes place to the two-and-two relation of the needles, as the welt will continue to be knit on the cylinder-needles whether the relation be one and one or two and two, as the loops will be held on the needles in one-and-one relation though the needles may actually be in two-and-two position.

The mechanism herein described can be applied to a regular one-and-one arrangement, leaving the two-and-two feature out entirely and having a cylinder and dial cut regular—that is, all needles equal distances apart and racking the dial-needle from its position between one pair of cylinder-needles to the central position of the next pair of cylinder-needles, thus producing a selvage-welt in the same manner as it is produced on a two-and-two fabric—and, further, the mechanism can be used for producing a zigzag or fancy rib by racking forward and backward step by step at every second or third revolution of the machine the distance of two or more needles. For example, the dial-needles are thrown in, the dial racked forward, and the next revolution the dial-needles thrown out, the next revolution the dial-needles thrown in and racked forward, this operation being repeated two or more times, and then racked back a needle at a time until the normal position or starting-point is reached.

I claim as my invention—

1. In combination, in a circular-knitting machine, a dial and cylinder with the needles and needle-cams, means for retracting the needle-cam of the dial, means for automatically changing the relation between the dial and cylinder from a two-and-two order of the needles to a one-and-one order, means for restoring the needle-cam of the dial to knitting position, means for causing the cylinder-needles to drop the thread and to aid the dial-needles in the formation of long loops, means for causing the resumption of knitting on the cylinder-needles, and the retraction and throwing out of action of the dial-needles and the knitting of the welt on the cylinder-needles, means for shifting the dial back to the two-and-two relation of the needles, and means for bringing the dial-needles into action to resume rib-knitting in two-and-two order, substantially as described.

2. In combination, in a circular-knitting machine, a dial and cylinder with the needle-cams, means extending within the cylinder from below for engaging a part of the dial for turning the same circumferentially, and automatically-operating means for moving the said means consisting of pattern mechanism, substantially as described.

3. In combination in a circular-knitting machine, a cylinder and dial, pattern mechanism and a ring having a portion extending within the cylinder and engaging a part of the dial for turning the same, substantially as described.

4. In combination in a circular-knitting machine, a cylinder and dial, a ring within the cylinder having engagement with a part of the dial, and pattern mechanism for turning the ring, substantially as described.

5. In combination with a dial, a cylinder, a ring within the cylinder having engagement with a portion of the dial, a lever engaging the ring and pattern mechanism for operating the lever, substantially as described.

6. In combination with a dial and cylinder, a ring adjustable circumferentially and having an arm, and an adjustable lever for engaging a part of the dial, and means for turning the ring automatically for changing the position of the dial, substantially as described.

7. In combination, the dial and cylinder, a ring within the cylinder having engagement with a part of the dial, a lever for operating the ring, an arm for operating the lever, a rock-shaft carrying the said arm, a pattern-wheel and an arm on the rock-shaft operated by the said pattern-wheel, substantially as described.

8. In combination in a circular-knitting machine, a dial, a cylinder, needle-cams, means for adjusting the said needle-cams, consisting of a vertically-movable disk, a vertical shaft having arms to be operated thereby and a link connection from the shaft to the dial needle-cam, a pattern-wheel with connections to the said adjusting means, and connections from the said pattern-wheel to the dial for adjusting the same circumferentially, substantially as described.

9. In combination, in a circular-knitting machine, a dial, a cylinder, the knitting-cams, a cam for one circular row of needles adapted to operate the same to throw off the stitches of all the needles of that row, and means for automatically controlling the said cam, substantially as described.

10. In combination in a circular-knitting machine, a cylinder, a dial, needles and cams

therefor, a lug on the dial, a pattern-wheel, a rock-shaft operated by the said pattern-wheel, a connection extending from the said rock-shaft within the needle-cylinder to engage the lug on the dial, a vertically-arranged shaft connected with the dial-cam and means adjustable vertically and controlled by the pattern-wheel for turning the said vertical shaft; substantially as described.

11. In combination in a circular-knitting machine, a dial a cylinder, the knitting-cams, a cam for one circular row of needles adapted to operate the same to throw off the stitches of all the needles of that row means for automatically controlling the said cam and means for automatically changing the relation circumferentially between the cylinder and dial, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

FRANK B. WILDMAN.

Witnesses:
CARRIE LANDIS,
AVONIA FRICK.