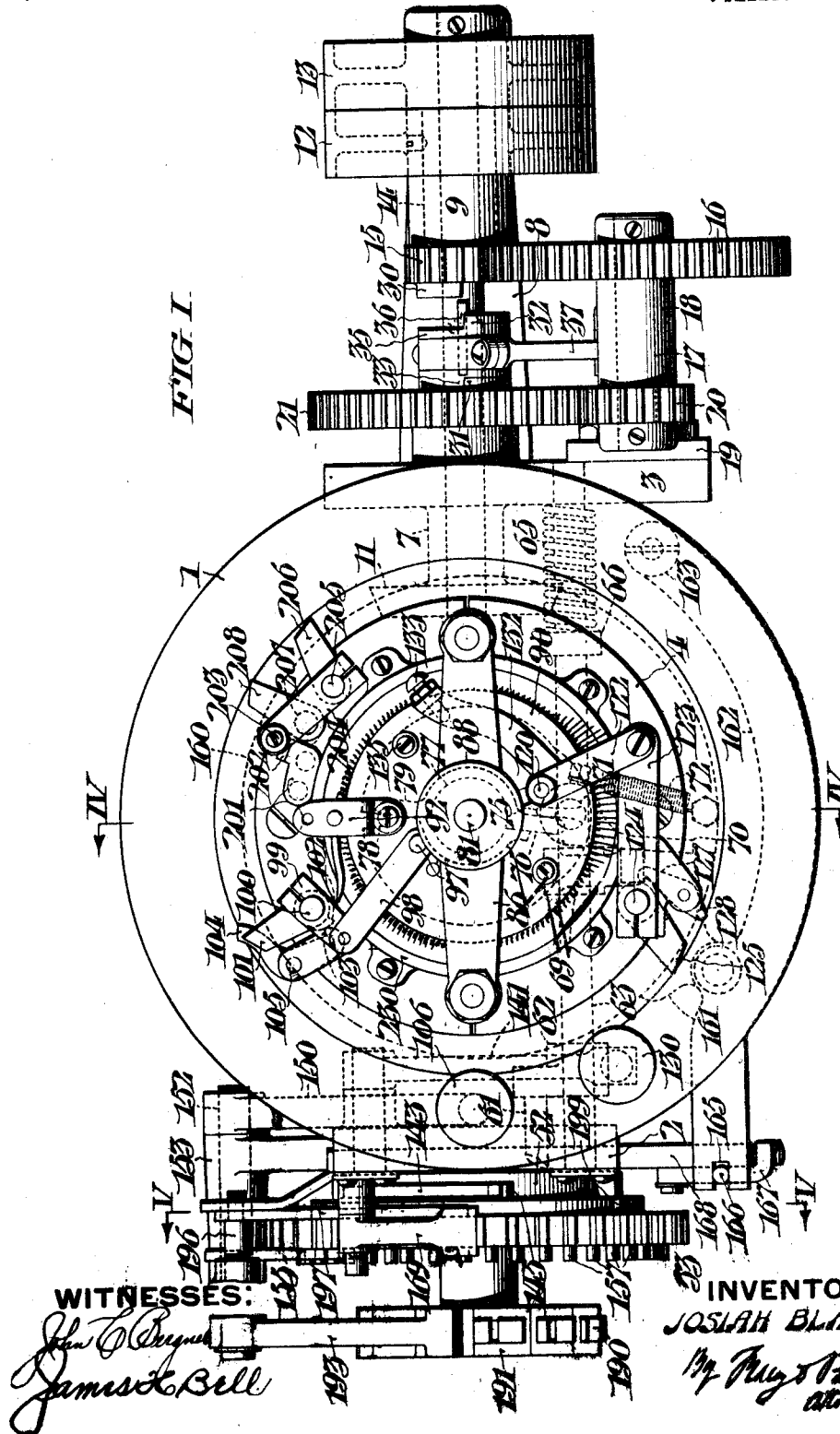


J. BLACK.
CIRCULAR KNITTING MACHINE.
APPLICATION FILED DEC. 3, 1908.

Patented May 27, 1913

8 SHEETS—SHEET 1.

1,062,875.

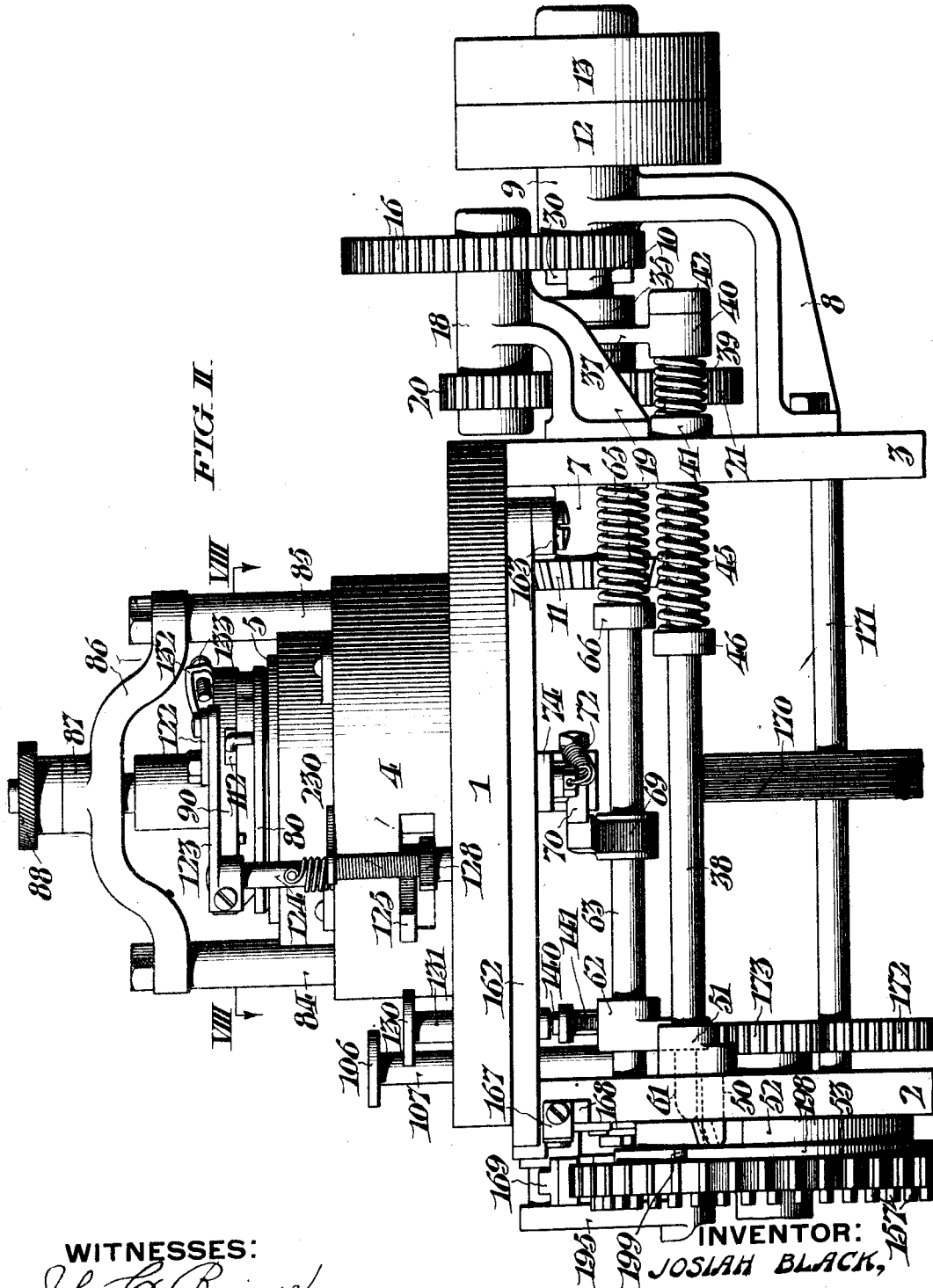


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6 SHEETS—SHEET 2.

1,062,875.



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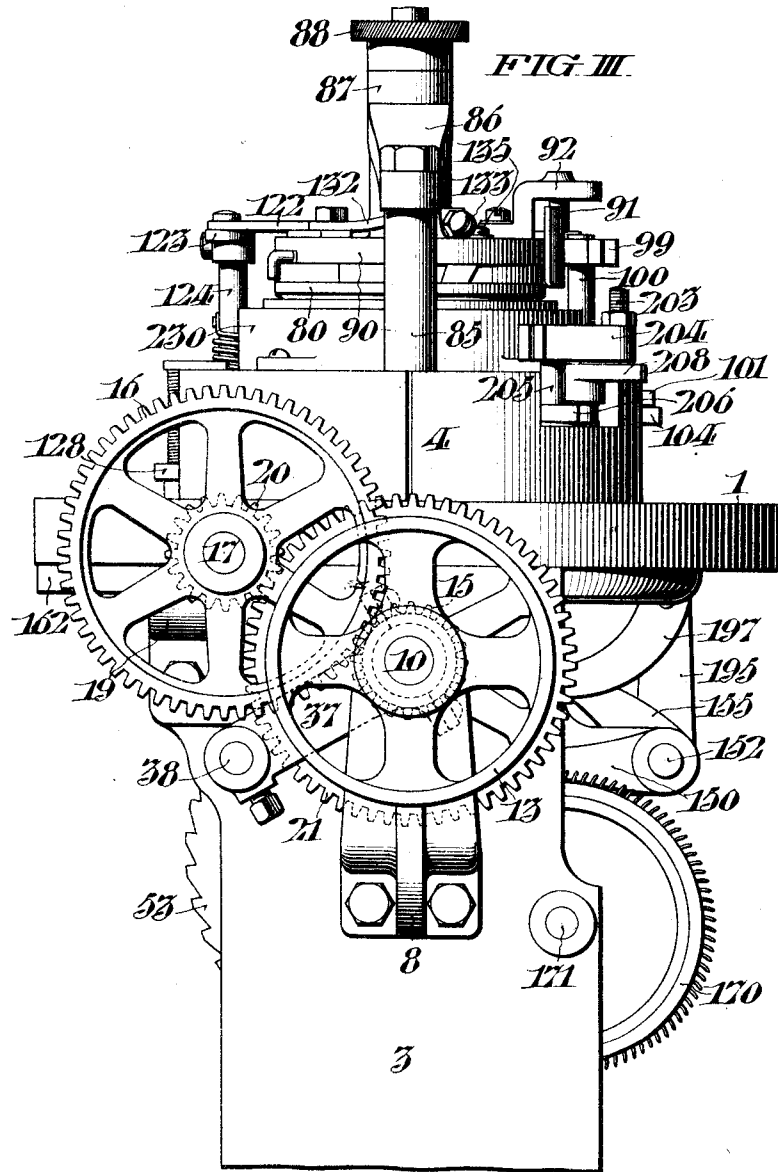
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6 SHEETS—SHEET 3.



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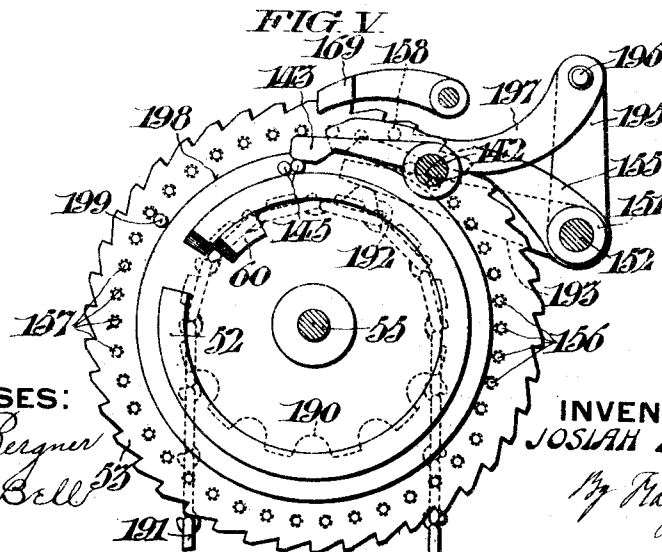
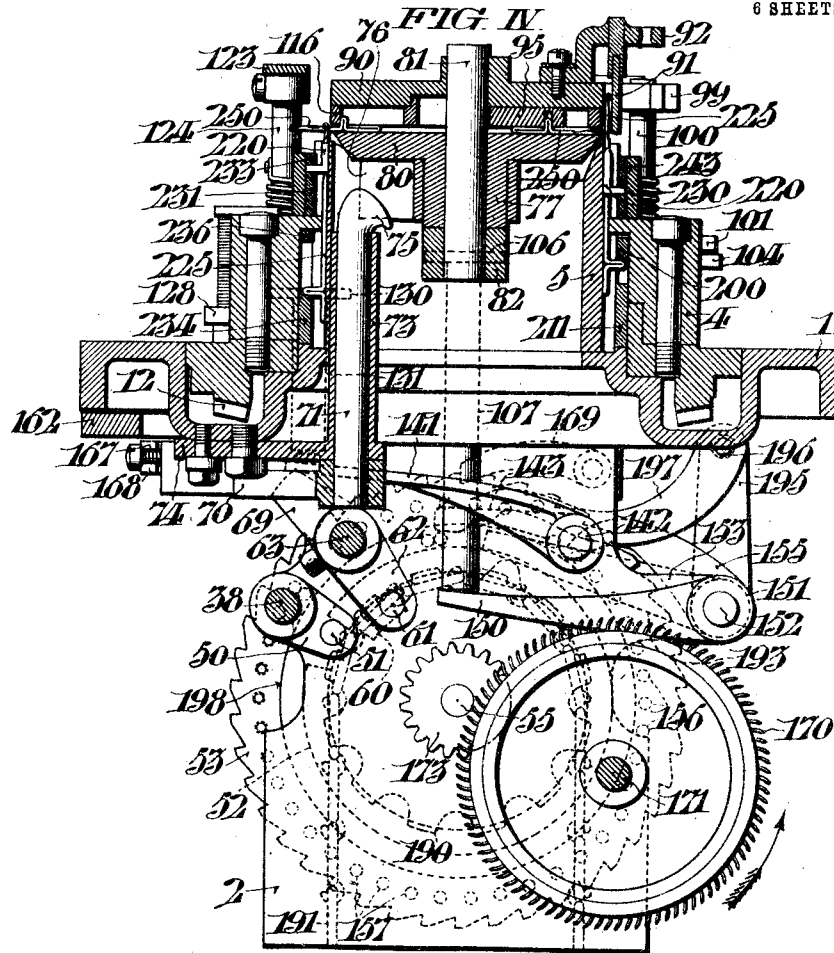
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1,062,875.

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6 SHEETS—SHEET 4.



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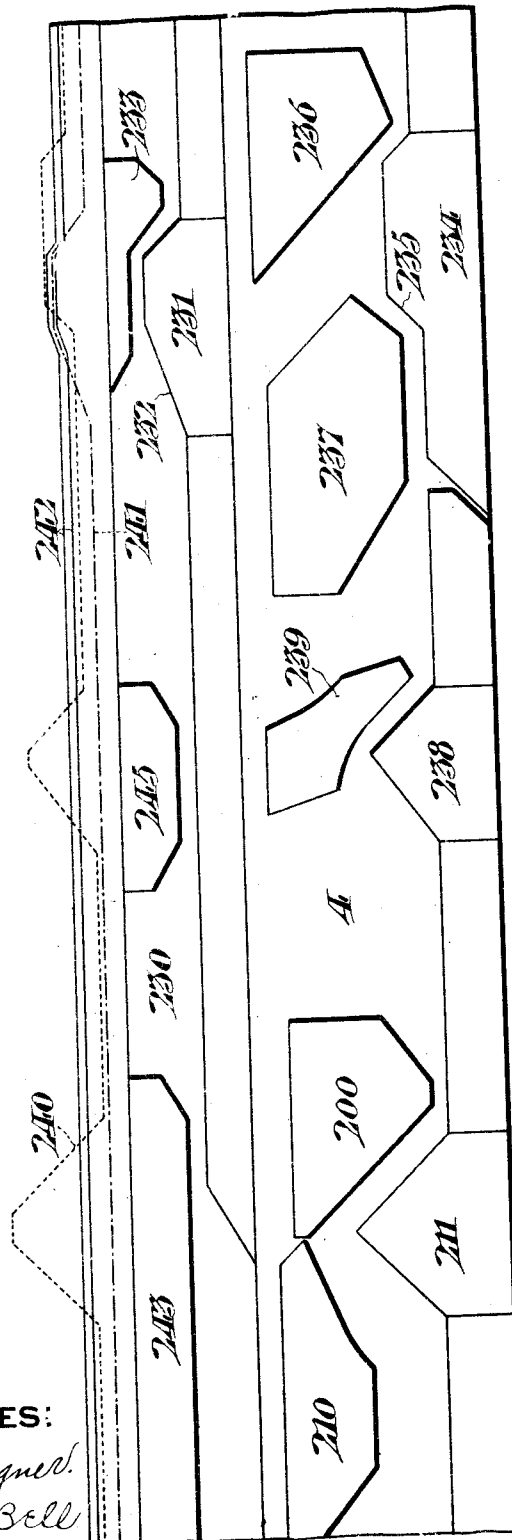
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1,062,875.

6 SHEETS—SHEET 5.



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APPLICATION FILED DEC. 3, 1908.

Patented May 27, 1913.

6 SHEETS—SHEET 6.

1,062,875.

FIG. VII.

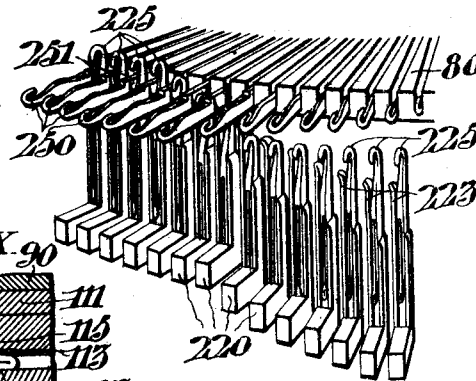


FIG. IX.

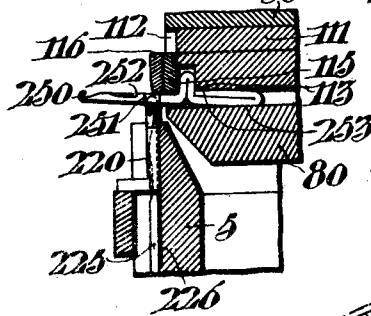


FIG. VIII.

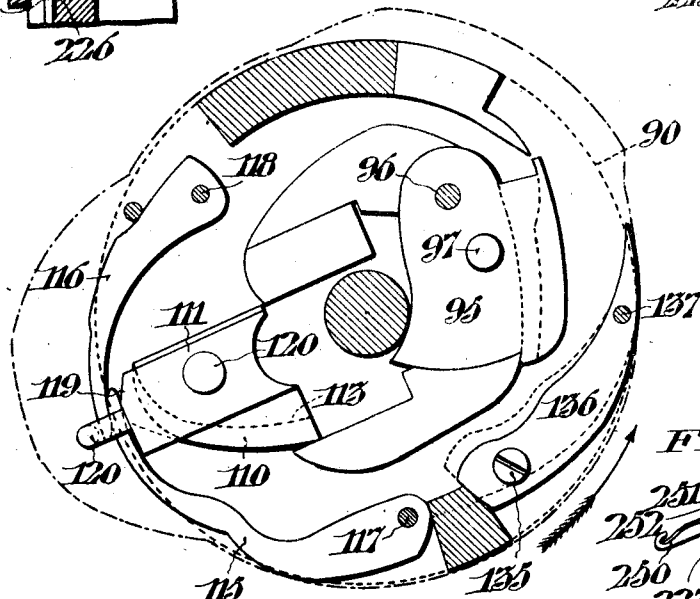


FIG. X.

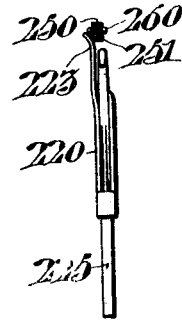


FIG. XII.

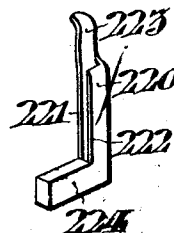
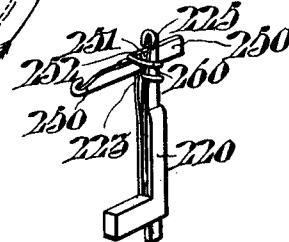


FIG. XI.



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UNITED STATES PATENT OFFICE.

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CIRCULAR-KNITTING MACHINE.

1,062,875.

Specification of Letters Patent.

Patented May 27, 1913.

Application filed December 3, 1908. Serial No. 465,776.

To all whom it may concern:

Be it known that I, JOSIAH BLACK, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Circular-Knitting Machines, whereof the following is a specification, reference being had to the accompanying drawings.

My invention relates to the employment in circular rib knitters of a transferring device, whereby the alternate loops carried by the dial needles may be automatically transferred, each to an adjacent cylinder needle; and also to devices for affecting the stitch length and the speed of rotation of the machine which may be conveniently used in conjunction with such transferring devices.

Transferring mechanism for accomplishing the purpose which I have thus indicated has heretofore been devised and used for the purpose of enabling a knitting machine to knit as a continuous web first rib knitting and then plain knitting; and more specifically stocking knitting machines have been devised involving the use of such transferring mechanism for the purpose of enabling the same machine to knit both the rib top of a stocking and also the body and foot portion. The transferring devices which I have invented and will describe are capable of being used in machines of this class and such use is within the scope of my present invention. But I have illustrated and will describe for the purpose of making clear and claiming my invention, a machine of a different type from that just referred to, and intended to carry out somewhat different purposes, and in connection with which in addition to the transferring devices, there are utilized certain adjunctive agencies in order to adapt it to the specific use for which it is intended; and my invention in the present case, includes the combination of devices which will be found embodied in this mechanism, whereby it is adapted to perform the particular functions now to be described, which combination of functions I believe to be wholly new.

Certain parts of the machine herein shown and described have been disclosed by me and claimed in Letters Patent of the United States No. 933,016, granted to me under date of August 31st, 1909. In an application filed by me under date of October 28th, 1908, Serial Number 459,833, co-pend-

ing herewith, and subsequently issued under date of February 16th, 1909, as Letters Patent No. 912,934, I have described and claimed my process of knitting stockings to the accomplishment of which the machine about to be described is particularly adapted.

According to my method I do not knit the body of the stocking upon the same machine upon which the rib top is knit, my process contemplating the manual transfer of the work from the ribber to the stocking knitter at the proper point, as has long been practised, but as heretofore practised, the manual transfer operation has been rendered difficult and tedious by reason of a factor which my invention eliminates. This results from the fact that in order that the rib top shall bear a proper relation in size and elasticity to the body of the stocking knit of plain knitting, it is necessary for the rib work to comprise in each course a considerably larger number of loops than the plain knitting. Accordingly, when by a manual transfer operation a rib top is transferred to a stocking knitter for the purpose of completing the body of the stocking of plain knitting, it has heretofore not only been necessary to transfer one loop of the rib knitting to each needle of the stocking, (an operation which is easily and rapidly performed), but also to place a number of additional loops upon the needles which have already received one loop of the rib fabric, and this process of doubling the loops is a tedious and difficult one. It is to eliminate this latter and tedious step that the machine shown in the drawings and about to be described is devised with the result of saving much time and labor. According to my invention I so organize a rib knitter that at the proper point the doubling of the loops required to permit the knitting of a stocking of plain knitting in continuation of a tubular ribbed web is automatically effected by the transfer of the dial loops to the cylinder needles. Thereafter, a few courses of plain knitting are made upon the cylinder needles, which courses may be subsequently discarded as ravel courses, and then a further length of rib knitting is produced, and so on in indefinite succession. The string-work of rib knitting, alternating with short ravel courses of plain knitting, is then severed in the ravel courses, and each rib top manually

transferred to a stocking knitter. But by reason of the doubling of the loops, this operation is a very easy one, since the fabric at the point where the transfer takes place now contains the precise number of loops required to place one loop on each needle of the stocking knitter. The transfer may take place at any of the courses of plain knitting, but I prefer, as explained in my process application to which I have referred, to effect the transfer along the line between the last course of rib knitting and the first course of plain knitting, where the doubling of the loop occurs. This is because it results in a neater union between the rib work and the body of the stocking which is subsequently to be knit. To this end, the machine employs automatic transferring devices, for the purpose of effecting this doubling of the loops, and also the other automatic mechanism required to produce continuously a tube of rib knitting alternating with short ravel courses of plain knitting involving half as many loops to the course as are found in the rib knitting.

In order to facilitate the manual transfer operation which is to take place after the sections of rib knitting have been severed, the particular course along which the manual transfer is to occur should be knit as a loose course, and my invention accordingly comprises automatic mechanism for so affecting the stitch length as to accomplish this. As the machine now to be described is organized this involves the production of this loose course as the particular course along which the doubling of the loops, and therefore, the change from rib knitting to plain knitting occurs. I have also found that in order to properly accomplish this doubling of the loops, by the automatic transferring mechanism, it is desirable that during the knitting of the doubled course, the machine should be run much more slowly than during the rest of the work, and my machine is therefore adapted to automatically slow down at the proper time in order to facilitate this operation. Other details, all cooperating to the end which I have described, will be found embodied in this machine which is specially organized with this purpose in view, and accomplishes a result different from what has heretofore been accomplished, and accordingly my claims in the present case include combinations of mechanism coordinated to produce this new result.

In the accompanying drawings, Figure I, is a plan view of a machine conveniently embodying my invention. Fig. II, is an elevation of the same looking from the bottom of Fig. I. Fig. III, is an end elevation looking from the right of Fig. I. Fig. IV, is a sectional view taken on line IV, IV, of Fig. I.

Fig. V, is a sectional view taken on line V, V, in Fig. I. Fig. VI, is a development of the cam cylinder showing the relative positions of the sheaths with respect to the needles during the transferring of the stitches from the dial to the cylinder needles. Fig. VII, is a partial perspective view showing the relative positions of the dial and cylinder needles and the sheaths at the region where the transfer is accomplished. Fig. VIII, is a plan section through the dial cam plate taken on line VIII, VIII, in Fig. II. Fig. IX, is a fragmentary sectional view through the dial and needle cylinder, showing how the dial needles are tilted by means of the sheaths for the purpose of disengaging their loops. Fig. X, shows the combination of a sheath and a dial and cylinder needle. Fig. XI, is a perspective view showing a cylinder needle in position ready to receive the dial loop after having been advanced therethrough. Fig. XII, is a perspective view of one of the sheaths.

In said drawings, the bed plate 1, is supported on suitable standards 2, and 3, and carries the rotatable cam cylinder 4, and stationary needle cylinder 5. The standard 3, comprises a bearing 7, and supports a bracket 8, provided with a bearing 9, in which the driving shaft 10, is suitably journaled. At the inner end of shaft 10, is secured the bevel pinion 11, which engages the circular rack 12, formed on the lower portion of cam cylinder 4. At its outer end said shaft 10, carries the driving pulley 12, and the loose pulley 13. The pulley 12, is secured to the sleeve 14, which freely surrounds the shaft 10, within the bearing 9. A pinion 15, integral with said sleeve 14, meshes with a gear wheel 16, secured to a shaft 17, which is journaled within the bearing 18, on a bracket 19. Secured to the other end of shaft 17, is a pinion 20, which meshes with a gear wheel 21, which is mounted freely on shaft 10, directly adjacent to the standard 3.

Pinion 15, and gear wheel 21, are provided with segments 30, and 31, which are adapted to be respectively engaged by the segments 32, and 33, on the coupling ring 35, which is slidably secured to the shaft 10, by means of the spline 36. Said coupling ring 35, is rotatably mounted in the free end of an arm 37, and arranged to be shifted thereby to engage by means of its segments either pinion 15, or gear 21. The pinions 15, and 20, and gear wheels 16, and 21, are respectively in the ratio of 1 to 3 in the present instance. In the position shown in the drawings, the gear wheel 21, is coupled to shaft 10, by means of ring 35, and the speed of said shaft is reduced to one-ninth of that of the driving pulley 12. It has been found that a perfect transfer is more readily obtained at a much reduced speed, hence the

reason for the above described mechanism. When shaft 10, is coupled to pinion 15, it is thereby directly connected to the driving pulley 12, and the train of wheels 16, 20, and 21, run idle.

5 The arm 37, is yielding supported on the slide rod 38, under compression of a spring 39, which is interposed between a boss 40, on said arm 37, and a collar 41, and which tends to force said arm 37, 10 against the collar 42, on the free end of said rod 38. The slide rod 38, is guided within the standards 2, and 3, and is subject to the compressive force of a spring 45, which 15 abuts against the standard 3, and acts against a collar 46, on said rod 38. Said spring 45, serves to keep the chamfered pin 50, (which extends through frame 2, and is supported in the arm 51, secured on the 20 slide rod 38), in engagement with the cam ring 52, on the ratchet wheel 53, which is freely mounted for rotation on shaft 55. It will be observed that spring 45, also serves to allow the arm 37, to yield in an opposite 25 direction to that allowed by spring 39. A cam 60, is also secured to ratchet wheel 53, within the cam ring 52, (Figs. II, IV, and V), and is adapted to engage the chamfered end of pin 61, which extends through the 30 standard 2, and is supported in the arm 62. Said arm 62, is secured to a slide rod 63, which is guided within the standards 2, and 3, similar to the rod 38. The slide rod 63, is also subject to action of a compression 35 spring 65, which is interposed between the standards 3, and a collar 66, on said rod 63. By the action of the spring 65, the chamfered pin 61, is maintained within the path of the cam 60, on the ratchet wheel 53. 40 The slide rod 63, carries the arm 69, which is adapted to engage the lever 70, secured to the lower end of the vertical shaft 71, and subject to the tension of a spring 72. Said shaft 71, is mounted within the sleeve 45 73, whose lateral extension 74, is bolted to the bed 1. The flattened head 75, of shaft 71, is adapted to engage the wing 76, on the boss 77, of the dial needle plate 80, best shown in Fig. 1. When the vertical shaft 50 71, is set in motion by the arm 69, it causes a slight rotary movement of the dial needle plate 80, so that its needles are in position to come in contact with those of the needle cylinder 4, during the transferring in which 55 position the machine is shown in the drawings. Normally however, the dial needle plate 80, is held in stationary relation with the needle cylinder 5, by means of the engagement of the lug 78, formed on said needle cylinder 5, and the wing 79, which is 60 diametrically opposite to wing 76, on the boss 77, of said dial plate 80. When in the latter position the dial needles are evenly spaced with respect to the cylinder needles. 65 The dial needle plate 80, is loosely mount-

ed on the vertical rod 81, and its boss 77, is supported on the collar 82, which is secured to said rod 81. Mounted on the cam cylinder 4, are the standards 84, and 85, which are spanned by a yoke 86, having a boss 87, 70 in which the rod 81, is adjustably secured by means of the thumb screw 88.

The dial cam plate 90, is secured to the rod 81, directly above the needle plate 80, and is therefore rotated with cam cylinder 4, 75 and carries the thread guide 91, which is adjustably mounted within the bracket 92. Said cam plate 90, is provided with the retractable stitch cam 95, which is pivoted at 96, and is provided with a pin 97, arranged to operate within a slot in said cam plate 90, (see Fig. VIII). A link 98, connects the pin 97, with the outer end of the arm 99, which is secured to the upper end of the 80 vertical spring pressed rocking shaft 100, having a cam finger 101. The said cam finger 101, is provided with a notch 102, which is adapted to be engaged by the hook 103, on spring pressed cam finger 104, pivoted on pin 105. The cam fingers 101, and 104, are at different levels, and are engaged 85 by a roller cam 106, having a stem 107, which is mounted for vertical movement within the bed plate 1. By this means the dial stitch cam 95, is operated to extend or withdraw the dial needles. In the drawings, the roller cam 106, has been raised to the level of the finger 104, to engage it to 90 cause the withdrawal of the dial needles to prevent any stitches being formed by them 100 during the transferring.

Diametrically opposite the stitch cam 95, the dial plate 90, is provided with extending cam 110, having a guide block 111, 105 which is adapted to slide within a radial slot 112, in said dial plate 90. The guard and retracting cams 115, and 116, are pivoted at 117, and 118, respectively and overlap at their free ends which are interposed between the ledges 119, on block 111, and 110 the depending portion of the pin 120, which projects from said cam 110. By this means the cams 115, and 116, are contemporaneously moved outward with cam 110, as 115 shown in Fig. VIII, for the purpose of protruding the dial needles into the path of the cylinder needles during transferring as will be more definitely hereinafter explained.

The cam 110, is provided with a pin 120, 120 which moves in a radial slot in plate 90, and is connected by the link 122, with the free end of the lever arm 123, on the upper end of the vertical spring pressed rock shaft 124. Said rock shaft carries a cam finger 125, 125 which is provided with a notch adapted to be engaged by the hook 127, on the spring pressed finger 128, which is pivoted about the pin 129. Cam fingers 125, and 128, are also at different levels and are adapted to be 130

engaged by the roller cam 130, in a manner similar to that described above, with respect to the cam fingers 101, and 104. In the position shown in the drawings, the finger 125, has been engaged by the roller cam 130, and caused the transfer set of cams 100, 115, and 116, to be shifted outwardly to project the dial needles into the path of the cylinder needles (see Fig. I).

The link 122, which is connected to the pin 120, on the cam 110, is provided with a lateral arm 132, supporting at its outer end a set screw 133. During rib knitting the said screw 133, constantly engages the head of a screw 135, which extends through a slot in the dial plate 90, and terminates in the drawback cam 136, which is pivoted at 137, and coöperates with the cam 95, to produce dial stitches. During the transferring, the screw 135, is released from engagement with the screw 133, in the arm 132, and the dial needles force cam 136, outwardly to the extent allowed by the slot in which screw 135, plays, and therefore said needles are allowed to remain projected slightly beyond the periphery of their dial plate 80, as indicated by the dot and dash line in Fig. VIII. In case the dial stitches are not all transferred to the cylinder needles on the first transfer revolution, those that remain on the dial needles are therefore not cast off, but retained on them until taken by the said cylinder needles on the next revolution, thus obviating any imperfection in the fabric which might otherwise occur.

The stem 131, on the roller cam 130, is supported for vertical movement within the bed plate 1, and is provided at its lower end with an adjusting screw 140, which rests upon the free end of the lever 141, which is secured to the rock shaft 142. Said rock shaft 142, is supported within and extends through the standard 2, and at its outer end supports the finger 143, which normally rests upon the ledge of the ring cam 52, on ratchet wheel 53, in which position the roller cam 130, is on the level of cam finger 128, and is also adapted to engage the pins 145, on the inner face of said ratchet wheel 53, and when so engaged, the roller cam 130, is raised into the path of the cam finger 125.

The lower end of stem 107, on roller cam 106, rests upon the free end of the arm 150, which is secured to a sleeve 151, loosely supported on a rock shaft 152, which is mounted within a bracket 153, which projects laterally from the standard 2. Secured to the other end of the sleeve 151, is a finger 155, which rides upon a series of pins 156, and 157, concentrically located on the outer face of the ratchet wheel 53, in proximity to its periphery, the series 157, being farther remote from its center than the series 156. The series 157, terminates in a pin 158, which is located beyond its fellows and its purpose,

together with that of the others will be explained later, in connection with the operation of the machine.

Upon the lower portion of the cam cylinder 4, is formed an eccentric 160, upon which rides the shoe 161, which is pivoted upon a curved spring pulled lever 162. Said lever 162, is fulcrumed at 163, to the bed plate 1, and is provided at its free end with a notch 165, which engages the pin 166, on the adjustable plate 167, attached to the slide bar 168, which is guided in a horizontal slot near the top of standard 2.

The pawl 169, is pivoted to the slide bar 168, which by reason of its connection with lever 162, and eccentric 160, is reciprocated and causes the pawling of the ratchet wheel 53. The pawling of the ratchet wheel 53, is however, under the control of the mechanism about to be described. The brush wheel 170, is rotated by the fabric produced by the machine in the direction indicated by the arrow in Fig. IV. Said brush wheel 170, is mounted on the horizontal shaft 171, which carries the toothed wheel 172, directly adjacent to the standard 2, in which it is journaled at that end, the other end being supported in standard 3. Said wheel 172, meshes with and thereby imparts motion to the pinion 173, on the shaft 55, upon which the ratchet wheel 53, is mounted. To the outer end of said shaft 55, is secured the sprocket wheel 190, having a measuring chain 191, provided with a high link 192, which is adapted to engage the arm 193, on the rock shaft 152. To said rock shaft 152, is also secured the vertical lever 195, provided at its free end with a stud 196, on which is fulcrumed the cam arm 197, whose free extremity rides upon the peripheral shoulder 198, formed on the ratchet wheel 53. When the high link 192, disengages the arm 193, the cam arm 197, slides forward on the shoulder 198, and under the pawl 169, which projects beyond the face of the ratchet 53. Said ratchet wheel 53, will be pawled until the pin 199, thereon, engages the end of the arm 197, and thereby raises the pawl 169, to prevent it from turning said ratchet 53.

The cam cylinder 4, is shown developed in Fig. VI. It is provided with a stitch cam 200, which is spring pressed and connected with a plate 201 (Fig. I), having a beveled extension 202, adapted to be engaged by the set screw 203, in the arm 204, which is secured to the vertical rock shaft 205, supported in said cam cylinder 4. The shaft 205, carries the cam finger 206, and is in geared relation at its lower end, with a second rock shaft 207, also having a cam finger 208, and mounted for oscillation in said cam cylinder 4. The fingers 206, and 208, are also engaged by the roller cam 106, to cause the raising or lowering of the stitch

cam 200, to produce tight or loose knitting on the cylinder needles. Cam finger 206, is on the same level with cam finger 104, so that they are both engaged by the roller cam 106, in the same revolution of the machine. The parts just described are old in machines of this class, and have not therefore been shown in detail. The guard cam 210, and raising cam 211, which coöperate with the stitch cam 200, constitute the stitch forming set.

The sheaths 220, (Fig. XII), constructed according to my invention have two parallel sides 221, and 222, which are joined at their inner edges, one of said sides having an extension or lateral blade 223. Said sheaths 220, are also provided with butts 224, so pierced as to continue the channels formed by the parallel sides 221, and 222, to receive the cylinder needles 225. The cylinder needles are all provided with sheaths 220, which are slidably supported in the needle grooves 226, of the cylinder 5. Said grooves 226, are enlarged at their upper ends to accommodate the said sheaths 220, as clearly shown in Fig. IX.

Mounted on the cam cylinder 4, is the ring 230, which supports the sheath actuating cams, and which is also shown developed in Fig. VI. This set consists of a raising cam 231, and a coacting guard and lowering cam 233. Directly below the sheath raising cam 231, the cam cylinder 4, is provided with a raising cam 234, a lowering cam 236, and a guard cam 237. These cams actuate the cylinder needles, when the latter take the stitches from the dial needles. By reference to Fig. VI, it will be seen that the incline 232, on the sheath raising set is slightly in advance of the incline 235, on the needle raising cam 234, so that the sheaths 220, are raised before the cylinder needles.

The paths of the upper ends of the needles and sheaths are shown by the dotted, and dotted and dashed lines 240, and 241, respectively, the full lines 242, showing the corresponding behavior of the dial needles 250, when acted upon by said sheaths 220, as will now be explained. The cam 110, protrudes the dial needles 250, so that their notches 251, are in the path of the cylinder needles 225 (see Figs. VII, and IX). The dial needles are also provided with shoulders 252, which distend their stitches to assist in the ready insertion of the cylinder needles through the distended stitch as shown in Fig. XI. After the dial needles 250, have been extended the full amount by the cam 110, the blades of the sheaths 220, encounter the dial needles 225, and raise them as shown in Figs. VII, IX, and X, and as is indicated by the wave in the full line 242, shown in Fig. VI, which represent the behavior of the dial needles 250, during transferring. This raising or tipping of

the dial needles 250, is permitted by their cut-away portions 253, and by the compensating bevel 113, on the dial cam 110, shown in Fig. IX, and indicated by a dotted line in Fig. VIII. By raising the dial needles 225, their loops are further distended and are also placed in a position more nearly parallel to the dial needles, all of which facilitates the proper reception of the cylinder needles by the distended loops. This stretching is permissible since only a few needles are acted upon at a time.

By reference to Fig. X, it will be seen that the notches 251, are provided with a beveled or inclined side so that when the cylinder needles 225, are raised they are by this inclination, guided into the stretched loops indicated by the numeral 260, in Figs. X, and XI. It will also be observed from Figs. VII, and X, that the blades of the sheaths 220, are so formed with an outward curve, that in addition to raising the dial needles 250, they steady or brace them while the cylinder needles 225, pass up through the dial loops, since during this piercing process, each dial needle is firmly embraced by a sheath blade on one side and a cylinder needle on the other. After the cylinder has taken the loop of the dial needle the sheaths 220, are again withdrawn from their contact with the dial needles by means of the cam 233.

Referring again to Fig. VI, it will be seen that as the cylinder needles are drawn down to their stitch forming level, by means of cam 200, their latches will be closed, within their sheaths. It will also be remembered that at the transfer point, the sheaths rise in advance of the needles, hence their latches must be opened before this point is reached. In order to affect this, end I provide a raising cam 238, which elevates the needles, so that their latches just clear the tops of the sheaths thereby allowing them to be opened by the last formed loops. The needles are not however, elevated by cam 238, to an extent which will throw their loops beneath the latches, as is done by stitch cam 211. After being elevated by the cam 238, the needles are then again depressed by a co-acting cam 239, to their idle level. The tops of the needles are thus drawn into their sheaths with their latches open, in readiness to receive the dial loops, when they are again elevated at the transfer point by the cylinder cam 234.

To prevent the cylinder needles 225, when they are raised from carrying their sheaths with them, the sheath cam ring 230, is provided with the guard cams 243, and 245.

The operation of the machine is as follows:—The fabric causes the rotation of the brush wheel 170, and in turn the sprocket wheel 190. Normally the arm 193, is not in engagement with the high link 192, on the

chain 191, therefore the cam arm 197, is in its forward position and when engaged by the pin 199, raises the pawl 169, and therefore renders the ratchet wheel 53, idle. The chamfered pin 51, then rides on the high portion of the cam ring 52, on the ratchet wheel 53, and the driving shaft 10, is coupled to the pinion 15, and therefore to the driving pulley 12, so that the machine runs at full speed. The chamfered pin 61, is out of engagement with its cam 60, so that the dial needle plate is held by the contact of its wing 79, with the lug 78, on the needle cylinder 5, by means of which the dial needles are located centrally with respect to the cylinder needles. At this time the screw 203, on arm 204, is out of contact with the spring pressed plate 202, so that the stitches produced by the cylinder are of normal size, and the dial stitch cam 95, is extended to produce knitting by the dial needles and the dial transfer cams are set in inactive position.

According to my invention it is desirable to have certain special adjustments which have reference to the transfer from the dial to the cylinder needles, occur for three successive courses, and for convenience I will term these the three special courses. In the first of these courses, after the ratchet wheel 53, is started, it is pawled until the pin 158, engages the finger 155, whereupon, the roller cam 106, is raised to engage the cam finger 208, and thereby lower the cylinder stitch cam 200, to produce a loose course of rib knitting. This is the first special course preparatory for the transfer operation. At the next revolution of the machine (corresponding to the second special course), the ratchet wheel 53, is advanced one tooth and the pins on the ratchet wheel at this point are so related to each other in position as to simultaneously reduce the speed of the machine, shift the dial needles into position to contact with the cylinder needles, retract the dial stitch cam to discontinue dial knitting, and then throw the dial transfer set of cams into operation and relieve the dial draw back cam 136, so that the transfer operation takes place, the transferred loops being the loose loops formed during the preceding course. In the finished product, the loose doubled stitches of the transfer course are readily seen, so that the said transfer stitches may be subsequently placed by hand, on the needles of a machine commonly known as a footer, whereby the stocking is completed. In the third special course, the machine remains in the same condition as described for the second course, as the pawling of another tooth on the ratchet wheel 53, involves no change as will be seen by reference to Figs. IV, and V, and if there has been any failure to transfer every dial loop during the preceding course, the transfer will inevitably occur during this course. The condition of affairs

during this course is illustrated in the drawings, and the movements just described are accomplished in a manner already hereinbefore explained. At the next rotation the ratchet wheel 53, is advanced so that the chamfered pin 51, rises upon the high portion of ring cam 52, whereupon, the machine will again resume full speed, and simultaneously with this movement, the cam 60, on said wheel 53, disengages the pin 71, so that the wing 76, on the dial needle plate 80, is released thereby allowing the wing 79, to contact with lug 78, on needle cylinder 4, whereupon the dial needles will again resume their normal position with respect to the cylinder needles. In the last described revolution, the pins 145, are advanced from under the finger 143, whereby the roller cam 130, is dropped to the level of cam finger 128, whereupon the set of dial transfer cams is again withdrawn. After this the machine knits say eight or ten courses of plain knitting at full speed, since the cam finger 155, rides upon the series of pins 156, until the first pin of the series 157, encounters finger 155, whereby the roller cam 106, is raised to engage the cam finger 101, to again throw the dial stitch cam into action, whereupon rib knitting is resumed. Thereafter the ratchet wheel is pawled until the pin, encounters the cam arm 197, to raise the pawl 169, whereupon the ratchet wheel remains idle, for a length of time depending on the length of the chain 191, which is set according to the length of rib knitting which it is desired to produce.

Having thus described my invention, I claim:—

1. In a circular knitting machine provided with cylinder needles and dial needles, a device for transferring loops from one set of needles to the other, which comprises a series of movable blades; means whereby a blade is temporarily moved into contact with one side of a needle from which a loop is to be transferred; and means whereby the needle to which the loop is to be transferred is advanced against the opposite side of said needle to that which is in contact with the blade in order to engage the loop on such needle.

2. In a circular knitting machine, provided with cylinder needles and rocking dial needles, a device for transferring loops from dial needles to cylinder needles, which comprises a series of movable blades; and means whereby a blade is temporarily moved into contact with a loop-carrying dial needle so as to tip up its end, and means whereby a cylinder needle is advanced along side of the dial needles while thus tipped and caused to engage its loop.

3. In a circular rib knitting machine, the combination of dial needles and cylinder needles, said dial needles being provided

with loop distending shoulders on their upper surfaces and also with beveled notches on one side; means whereby the two series of needles are so adjusted in relation to each other that while a dial needle is advanced with its loop distended by contact with the shoulder on its upper surface, the corresponding cylinder needle is advanced through said distended loop, its entry therein being facilitated by contact with the above recited beveled surface, all cooperating to accomplish the transfer of dial loops to their adjacent cylinder needles.

4. In a circular rib knitting machine the combination of dial needles with capacity for a rocking motion and with loop-distending shoulders; sheaths surrounding the cylinder needles, with blades on each sheath; means for successively advancing first the dial needles to distend their loops, second the sheaths until their blades tip up the ends of the dial needles; and third the cylinder needles until each has passed through the adjacent distended loop held by a tipped up dial needle.

5. In a circular rib knitting machine, the combination of dial needles with loop-distending shoulders; sheaths with lateral blades for each cylinder needle; means for successively advancing the dial needles to distend their loops, the sheath blades to brace one side of the dial needle, and the cylinder needle to pass up through the distended loop of the dial needle on the side of that needle opposite to that one braced by its protruded sheath.

6. The combination of grooved dial plate containing a set of needles; a grooved cylinder containing a set of needles; individual means for tilting and bracing said dial needles when advanced in their grooves in order to stretch the loops held by them; and means for moving said cylinder needles into engagement with the dial needles to receive their stretched loops while thus braced.

7. The combination of a set of dial needles; a set of cylinder needles; means for abnormally protruding said dial needles; means for shifting said dial needles, relatively to said cylinder needles; means for individually bracing each of said dial needles when in the state of abnormal protrusion against the expected contact of a cylinder needle; and means for moving said cylinder needles to engage said dial needles.

8. In a knitting machine, the combination

with a set of dial needles; of a set of cylinder needles; an extending cam for the dial needles; means for protruding said cam and simultaneously relieving the dial stitch cam whereby the dial needles are allowed to project slightly beyond their plate after one complete rotation of the extending cam.

9. In a rib knitter, loop transferring mechanism comprising dial needles having lateral recesses; cylinder needles having separately movable surrounding sheaths; terminal blades on one side of each sheath; and means for so spacing the needles of one set with relation to the needles of the other set at the time of transferring, that each sheath when advanced prior to the advance of its needle for the transferring operation, places its blade on the side of the dial needle opposite to the recess thereby raising said dial needle to stretch its loop, and steadying it, to permit the advance of said cylinder needle, within the recess for the purposes of transferring the dial loop to the cylinder needle.

10. In a circular rib knitting machine the combination of automatic means for producing a course of loose knitting, and automatic means whereby all the dial loops of that course of knitting are transferred to an adjacent cylinder needle.

11. In a circular knitting machine, the combination of a dial plate and a cylinder provided with needles; means for actuating said needles; means for transferring the dial loops to the cylinder loops; means for producing loose courses on the cylinder needles during the transfer; and means for reducing the speed of said machine during the said transfer.

12. In a circular knitting machine, the combination of a dial plate and a cylinder provided with needles; means for actuating said needles; means arranged to relatively shift said dial and cylinder needles, whereby the needles of one set are shifted to laterally contact with the needles of the other set; individual means for each needle of the dial set to brace said needles and to simultaneously guide the needles of the cylinder set into the loops held by the dial set.

In testimony whereof, I have hereunto signed my name, at Philadelphia, Pennsylvania, this first day of December 1908.

JOSIAH BLACK

Witnesses:

JAMES H. BELL,

E. L. FULLERTON.