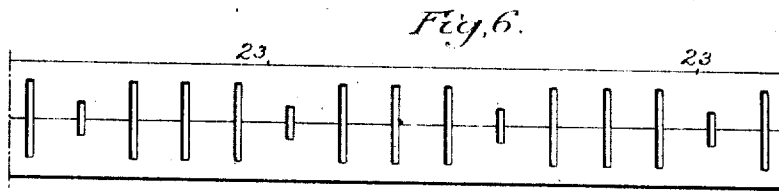
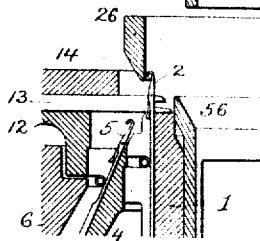
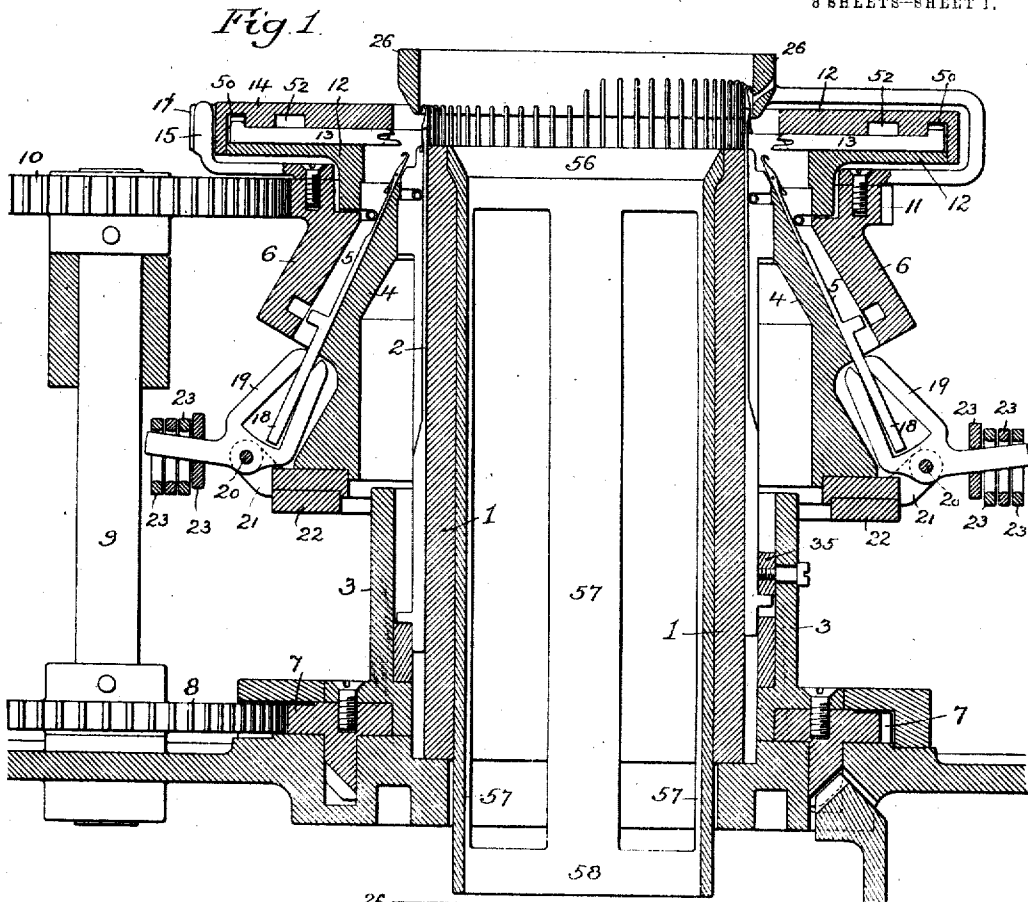


1,007,494.

R. W. SCOTT.  
CIRCULAR KNITTING MACHINE.  
APPLICATION FILED JAN. 25, 1907.

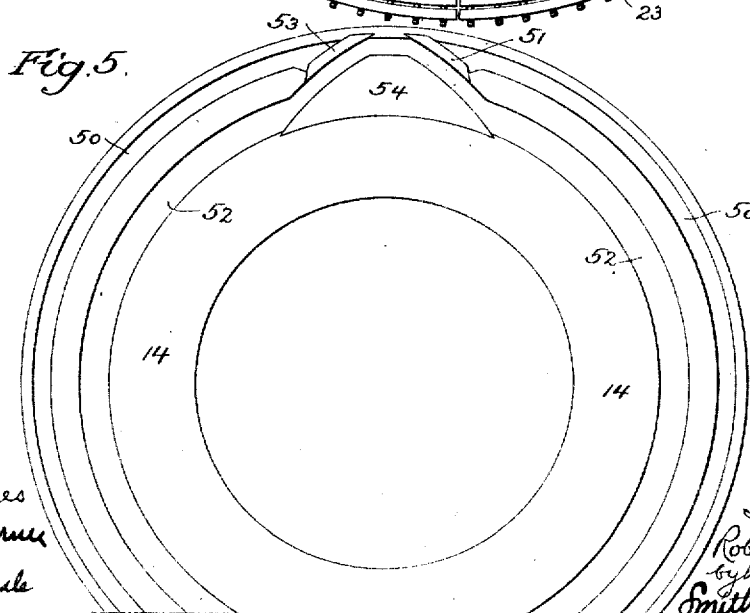
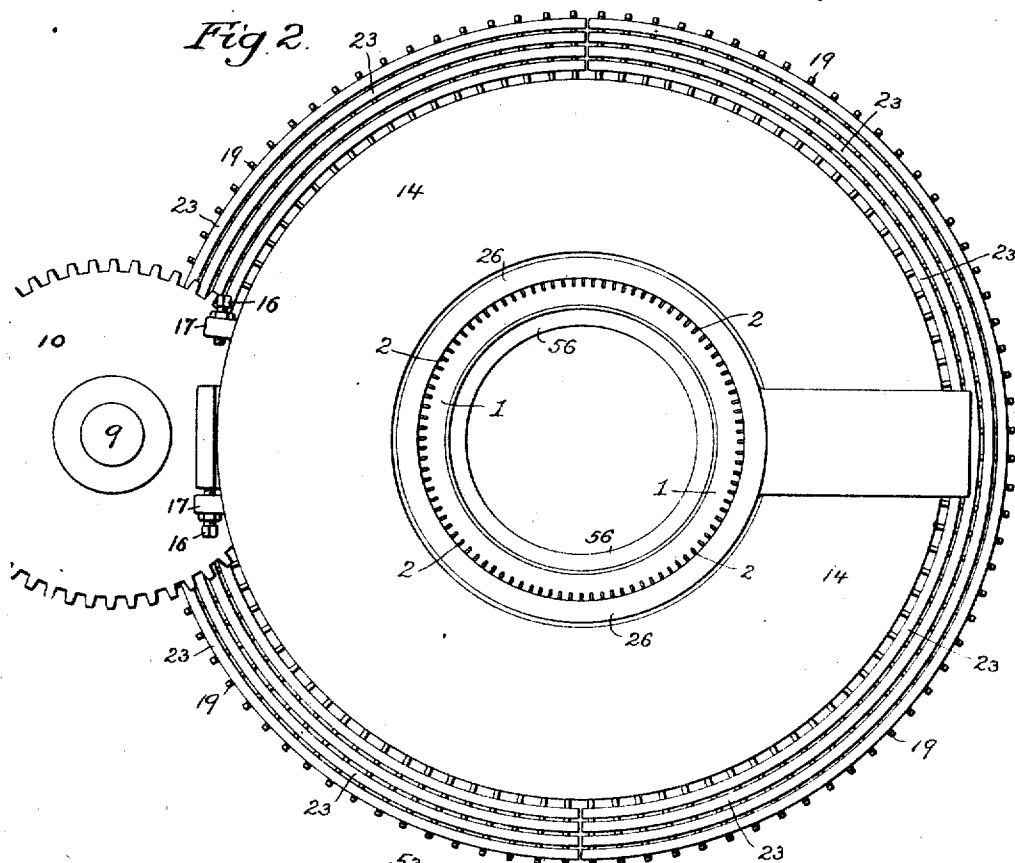
Patented Oct. 31, 1911.

8 SHEETS—SHEET 1.



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 T. D. Turner  
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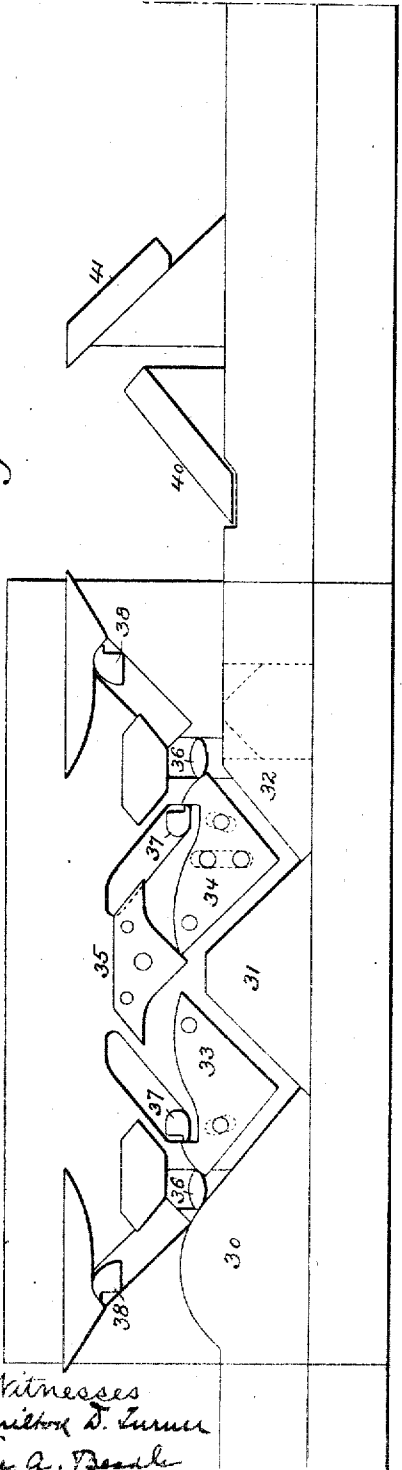
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1,007,494.

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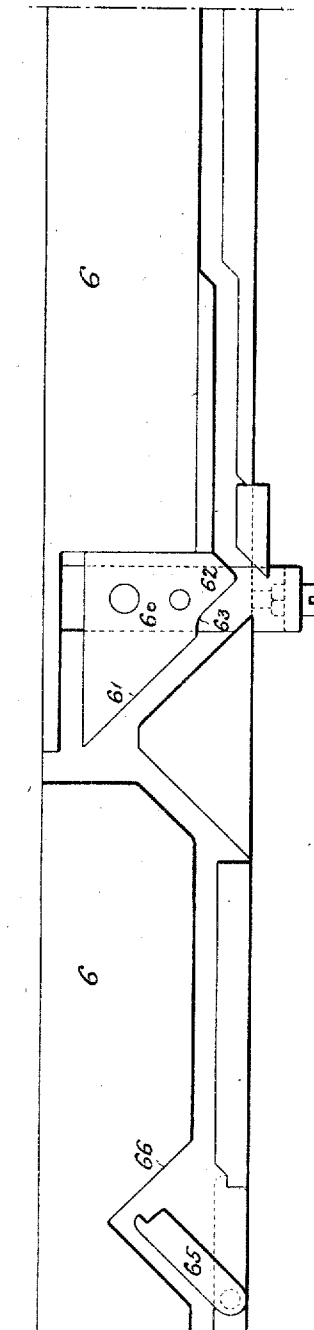
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Fig. 3.



Witnesses  
Hamilton D. Turner  
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Fig. 4.



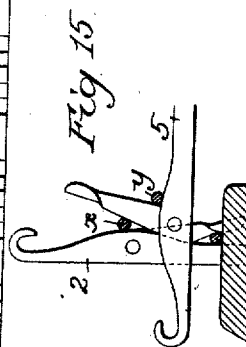
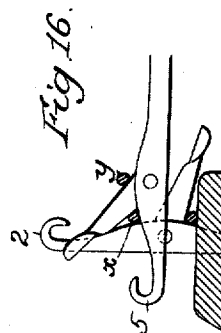
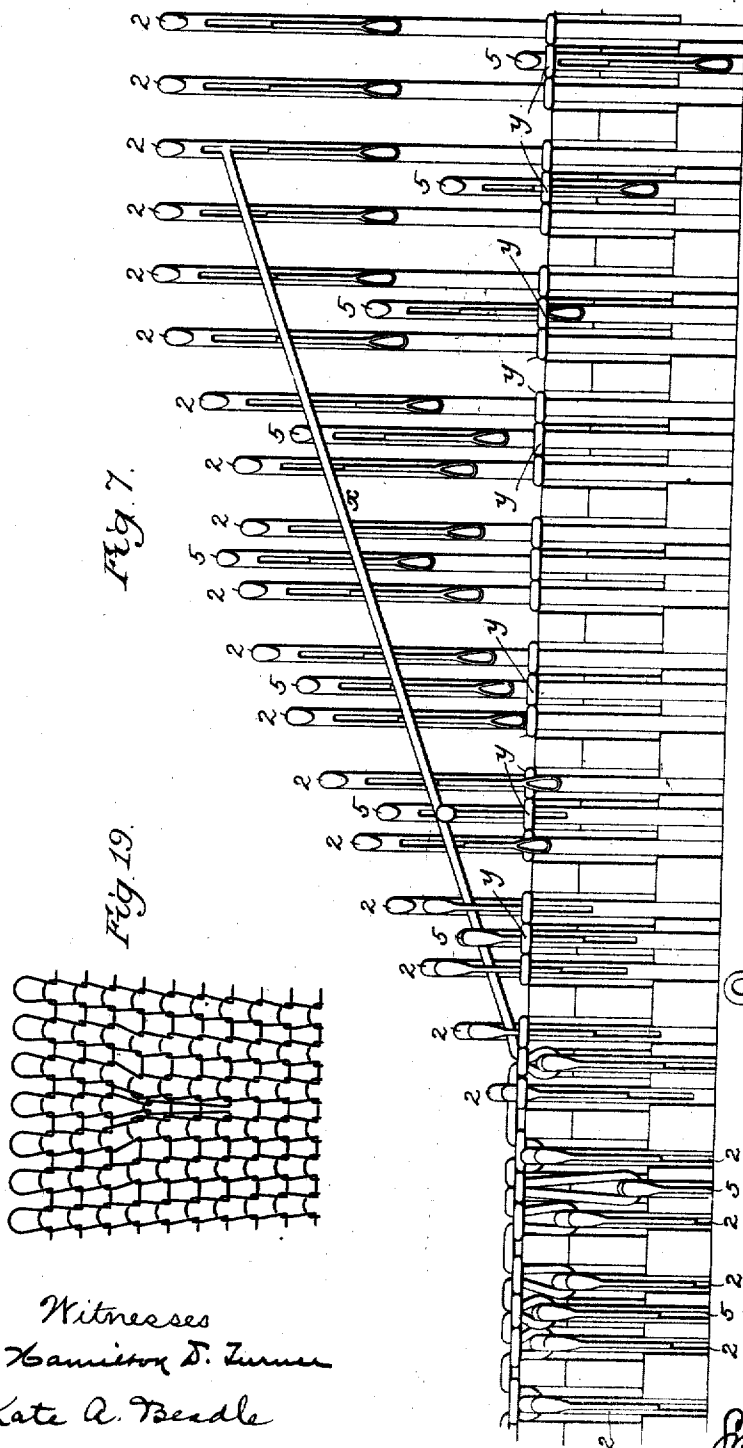
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APPLICATION FILED JAN. 25, 1907.

1,007,494.

Patented Oct. 31, 1911.

8 SHEETS—SHEET 4.



Witnesses  
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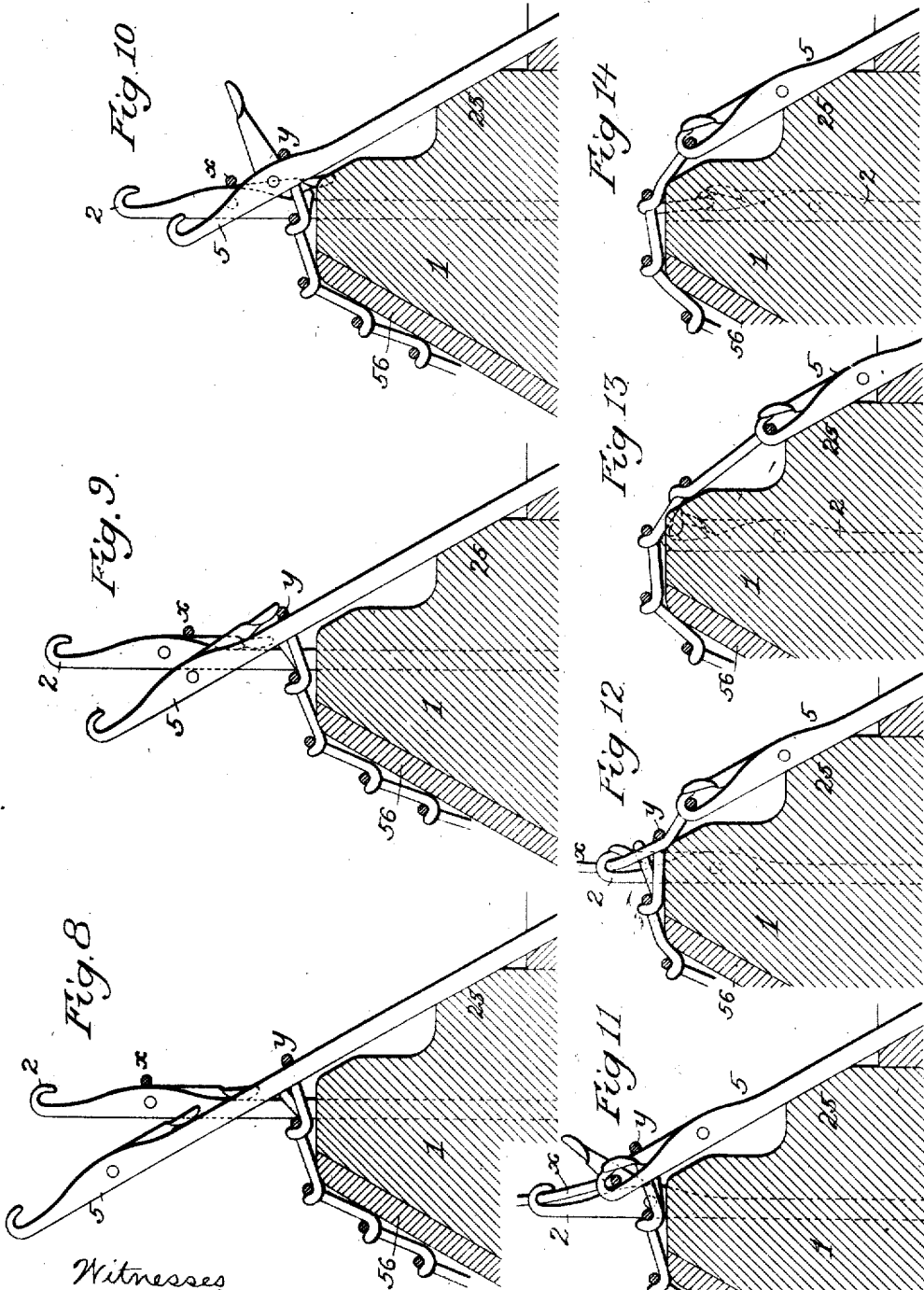
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CIRCULAR KNITTING MACHINE.  
APPLICATION FILED JAN. 25, 1907.

1,007,494.

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8 SHEETS—SHEET 5.



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APPLICATION FILED JAN. 25, 1907.

1,007,494.

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8 SHEETS—SHEET 6.

Fig. 17.

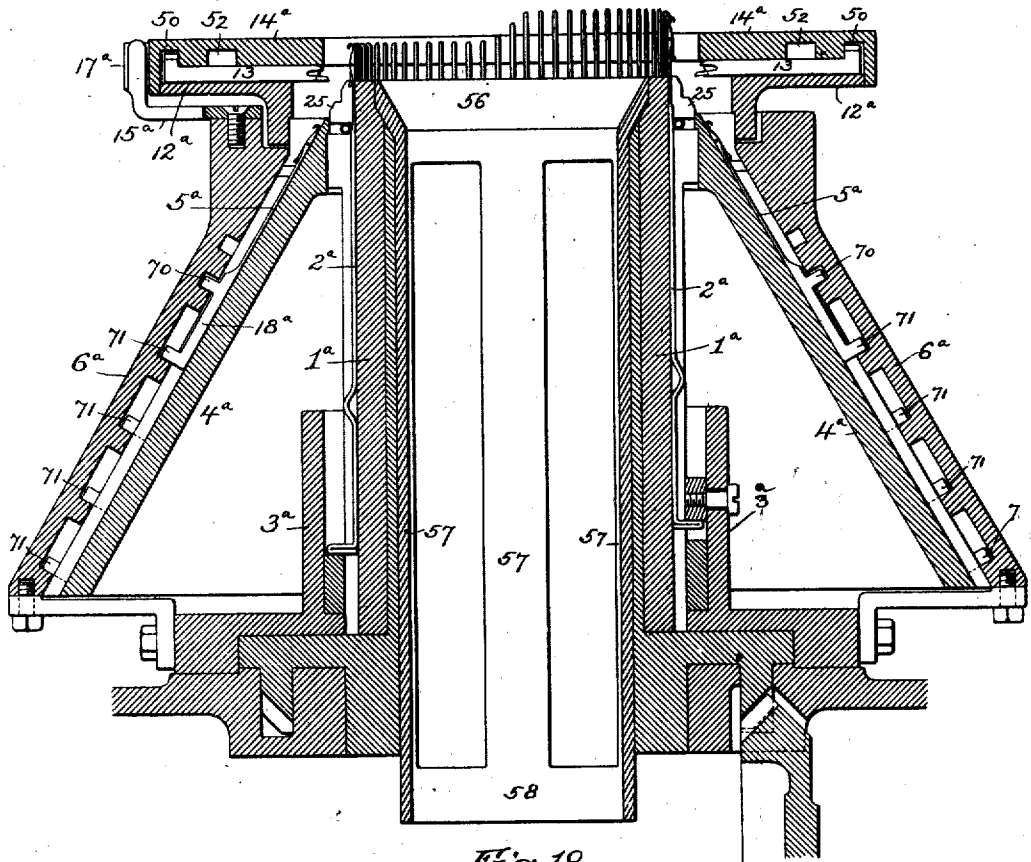
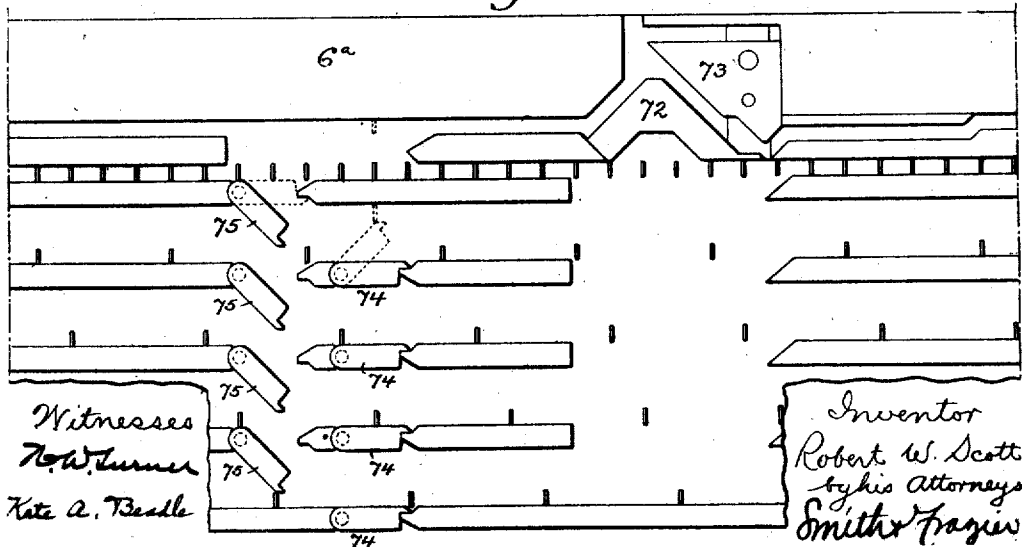


Fig. 18.



Witnesses  
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1,007,494.

Fig. 21.

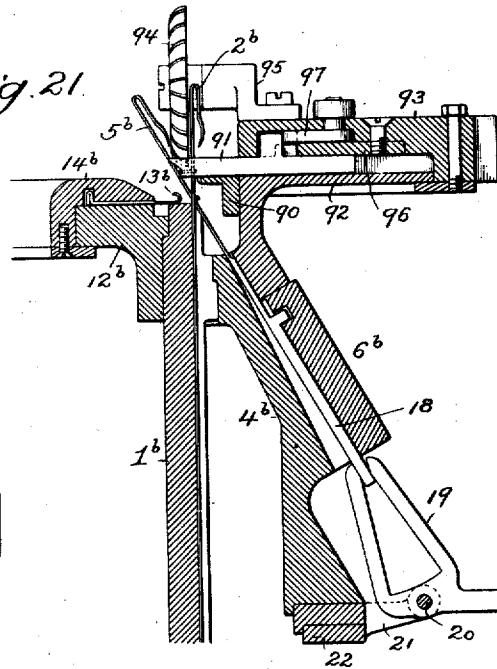


Fig. 23.

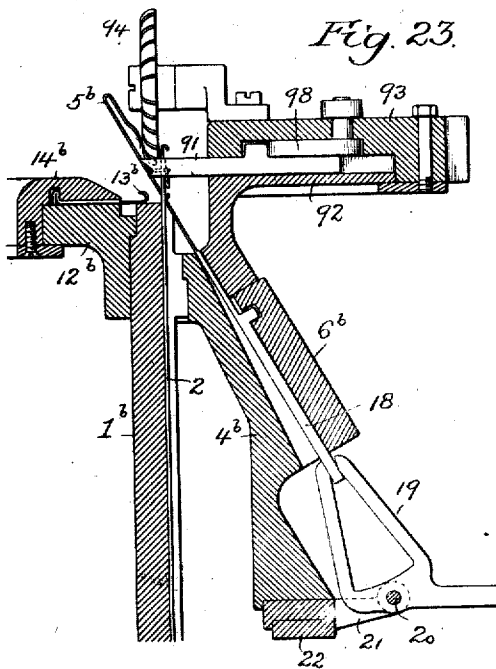
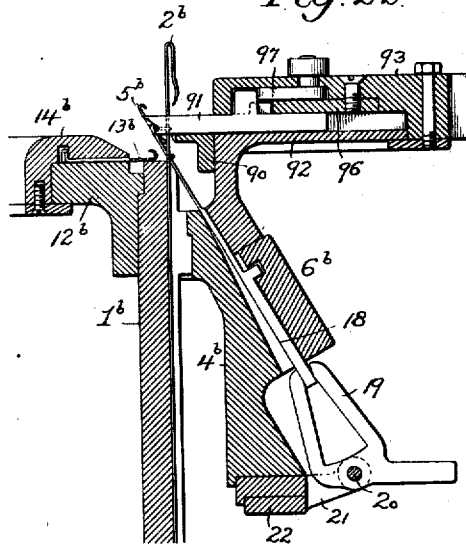


Fig. 22.



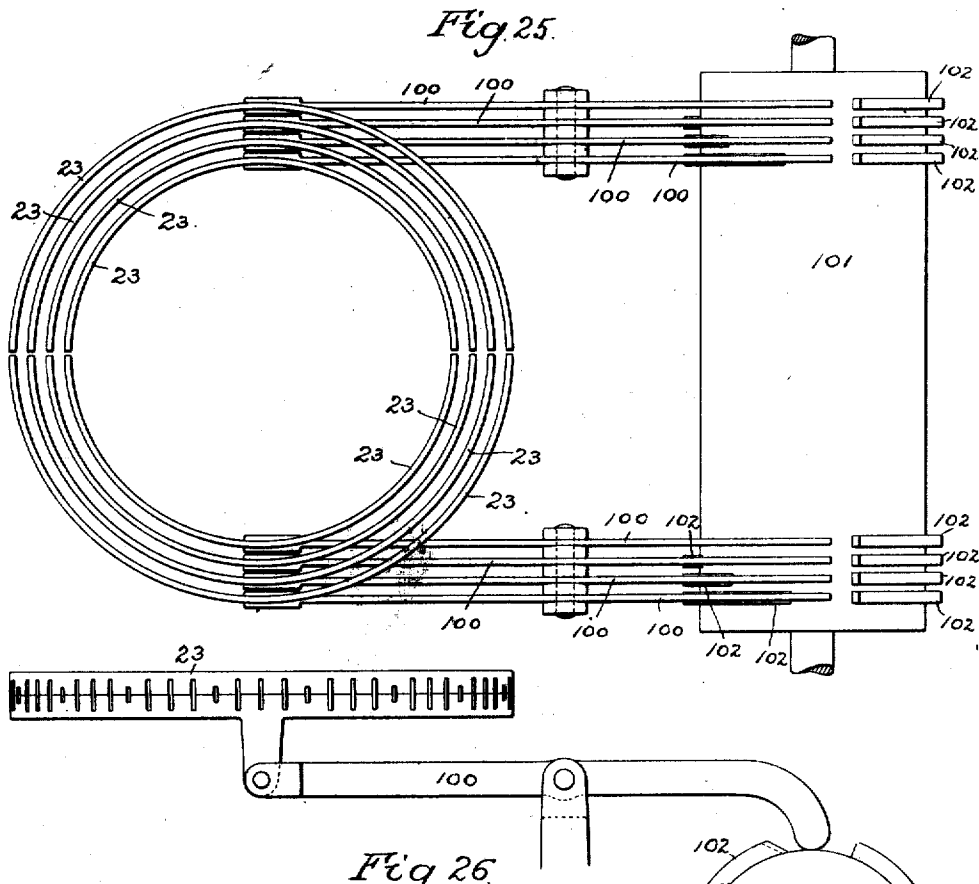
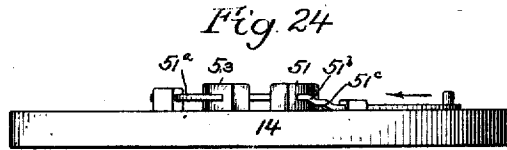
Witnesses  
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Smith & Taylor

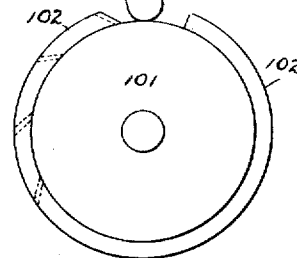
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R. W. SCOTT.  
CIRCULAR KNITTING MACHINE.  
APPLICATION FILED JAN. 26, 1907.

Patented Oct. 31, 1911  
8 SHEETS—SHEET 8.



*Fig. 26*



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# UNITED STATES PATENT OFFICE.

ROBERT W. SCOTT, OF LEEDS POINT, NEW JERSEY, ASSIGNOR OF ONE-HALF TO LOUIS N. D. WILLIAMS, OF OGONTZ, PENNSYLVANIA.

## CIRCULAR-KNITTING MACHINE.

1,007,494.

Specification of Letters Patent.

Patented Oct. 31, 1911.

Application filed January 25, 1907. Serial No. 354,098.

*To all whom it may concern:*

Be it known that I, ROBERT W. SCOTT, a citizen of the United States, residing in Leeds Point, New Jersey, have invented certain Improvements in Circular-Knitting Machines, of which the following is a specification.

The object of my invention is to provide a knitting machine for the rapid and economical production of stockings having shaped, seamless legs, and also, if desired, seamless heel and toe pockets.

In the accompanying drawings:—Figure 1 is a longitudinal section of sufficient of a circular knitting machine to illustrate my present invention; Fig. 2 is a plan view of the same; Fig. 3 is a view of the cams of the cam cylinder, developed in a flat plane; Fig. 4 is a similar view of the cams for operating the needles of a supplementary needle carrier which is employed in connection with the needle cylinder of the machine; Fig. 5 is an inverted plan view of the cam ring for operating the web holders of the machine; Fig. 6 is a view, developed in a flat plane, of part of one of the rings which serve to render operative or inoperative the needles of the supplementary needle carrier; Figs. 7 to 14, inclusive, are views illustrating the relation of the needles to one another at various stages in the operation of the machine; Figs. 15 and 16 are views illustrating a defect which my invention has been designed to overcome; Fig. 17 is a longitudinal section of a machine in which certain modifications of some of the features of my invention have been embodied; Fig. 18 is a view of certain cams employed in said machine; Fig. 19 is an exaggerated view of a piece of knitted web produced upon a machine made in accordance with my invention; Fig. 20 is a view of part of the machine shown in Fig. 1, with a different disposition of parts from that there represented; Figs. 21, 22, and 23, are sectional views of parts of machines, illustrating other modifications of my invention. Fig. 24 is a view illustrating means for operating the web holder cams, and Figs. 25 and 26 are views illustrating certain means for operating the rings or ring segments which control the supplementary needles.

In Fig. 1 of the drawing, 1 represents a

stationary needle cylinder and 2 the needles vertically guided therein, these needles being operated by cams in a rotating cam cylinder 3 which surrounds the lower portion of the needle cylinder.

Rigidly mounted upon the upper portion of the cylinder 1 is an exterior annular needle carrier 4, which, for convenience, I call a "dial," this carrier having needles 5, which alternate with cylinder needles, are disposed at an acute angle in respect to the latter, and are reciprocated by cams in a ring 6, the latter surrounding the dial and being driven in unison with the cam cylinder 3 in any desired manner. The means adopted for this purpose in the present instance are a circular flange 7 secured to or formed on the cam cylinder 3 and having a toothed periphery which engages a toothed wheel 8 at the lower end of a vertical shaft 9, the upper end of said shaft being provided with a toothed wheel 10 which meshes with teeth on the periphery of a circular flange 11 formed on or secured to the annular dial cam ring 6.

In operating a machine having the two sets of needles thus disposed, narrow web of a width appropriate for the foot and ankle portions of the stocking is produced upon one set of needles, and wider web, suitable for the calf portion of the stocking is produced upon said needles in conjunction with those of the other set. The needles of one set may therefore, for convenience, be termed "narrow web" needles, and may be those of either carrier, those of the other set being termed "wide web" needles.

In the present instance, the narrow web needles are those carried by the cylinder and the wide web needles are those carried by the dial, and as, in most cases, seamless heel and toe pockets will be formed upon the foot of the stocking the cam cylinder 3 is provided with cams appropriate for this purpose, and is susceptible of either continuous rotating movement for the production of tubular web, or of reciprocating, or to-and-fro movement for the production of such pockets.

There may be one dial needle for each cylinder needle, or only one dial needle for every two, three or more cylinder needles, depending upon the number of widening

wales desired and these widening wales may extend entirely around the machine or only part way around the same, as required, or some of the dial needles may be in action at all times, and thus constitute part of the narrow web needles, the remaining dial constituting the wide web needles. In such case the dial needles which are continuously in action will, by preference, alternate with cylinder needles other than those upon which the heel and toe pockets are produced.

The dial cam ring 6 carries the yarn feed ring 26, and rigidly mounted upon the upper portion of said dial is an annular bed 12 for the reception and guidance of a series of radially guided web holders 13, which may extend completely around the machine or only part way around the same, these web holders, in the latter case, acting only upon that portion of the circular web in which the heel and toe pockets are formed.

In the machine shown in the drawing there are one-half as many needles in the dial as there are in the cylinder, successive dial needles alternating with successive pairs of cylinder needles, around the machine. If there is a web holder 13 for each of the spaces between the cylinder needles throughout either the entire cylinder or part of the same every alternate one of these web holders will occupy the same plane as one of the dial needles, in a fine gage machine, in which there is not space enough between successive cylinder needles for the reception and operation of both a dial needle and a web holder, side by side. As the web holders are, however, needed only in making the heel and toe pockets and the dial needles are only used in shaping the calf portion of the leg of the stocking, neither will interfere with the proper action of the others, the dial needles being out of operation when the web holders are in action, and the latter being retracted so as to be out of the way of the dial needles when the latter are to be used.

In a machine of the character shown in the drawing, only those web holders which are in the same planes as the dial needles need be put out of operation, but, for convenience, all of the web holders are put into and out of action, in the manner hereinafter described. Even in a machine in which the dial needles and web holders could operate side by side, between the cylinder needles, it would be inadvisable to keep both the web holders and dial needles in operation at the same time, and means for rendering the web holders inoperative when the dial needles were in action would, by preference, be adopted in such a machine. Surmounting the web holder ring or bed 12 is a ring 14 carrying the cams for operating the web holders, this ring being operated from the dial cam ring 6 through the medium of a

dog 15 whose outer end projects between set screws 16 carried by lugs 17 on the periphery of said cam ring 14.

The dial needles 5 are movable so as to carry their butts into and out of range of the cams of the dial cam ring 6, this result being attained in any desired manner. In the machine shown in Fig. 1 it is effected by raising and lowering the needles in the grooves of the dial, said grooves being deeper at the bottom of the dial than at the top of the same in order to permit such movement. Each dial needle has a stem or jack 18 projecting below the dial cam ring and engaged by the jaws of the forked upper arm of a lever 19 whose fulcrum pin 20 is carried by lugs 21 on a ring 22 secured to the bottom of the dial, the lower arm of each lever 19 projecting radially and being acted upon by a ring 23 which is susceptible of vertical movement, whereby, when it is lifted, the levers 19, under control of the same, will be caused to lower the stems or jacks of the needles engaged thereby so as to withdraw their butts from the range of the cams of the dial cam ring 6, reverse movement of the ring effecting movement of the butts of the dial needles into range of said cams. The dial needles 5 are introduced into action when the wider portion of the tube is to be produced, and if all of the dial needles are to be introduced at one time but a single ring 23 will be needed in order to operate them. It is advisable, however, in order to properly shape or taper the knitted tube from the portion of least diameter to that of greatest diameter, to introduce the dial needles in groups or sets and to knit a number of courses of web after the introduction of each group of the dial needles. For this reason a number of rings 23 are used and the dial needles are divided into groups, each controlled by its special ring. In the present instance there are four rings and consequently four different groups of dial needles.

Supposing that the cylinder has one hundred and seventy-six needles and that the dial contains eighty-eight needles, or one for each pair of needles of the cylinder, said dial needles may be divided into four groups of twenty-two needles each, the needles of each group being, by preference, evenly distributed throughout the dial, thus the first group of needles may comprise the first, fifth, ninth, etc., the second group may comprise the second, sixth, tenth, etc., the third group may comprise the third, seventh, eleventh, etc., and the fourth group may comprise the fourth, eighth, twelfth, etc. Each ring 23 is divided horizontally, the meeting faces of each half of the ring being slotted in order to form openings for the reception of the radially projecting arms of the levers 19, these openings being shallow,

if the ring is to control the lever arm, or deep, if the lever arm has to pass through the ring in order to be controlled by a ring outside of the same. (See Fig. 6.) The rings 23 are also composed of independently operable semi-circular segments, in order that the needles around each half of the dial may be moved into or out of position to engage the dial cams when said cams are at the opposite half of the dial, whereby the presence of the cams will not interfere with the movement of the butts of the needles into or out of range of the same.

The partitions between the grooves of the needle cylinder, have their upper outer corners rounded or beveled, as shown in Figs. 8 to 14, in order to permit the loops or stitches to pass freely over the same without cutting or abrading the yarn, and, to avoid burring or roughening of these rounded or beveled corners, the dial needles 5 are free from contact with the same, each of said dial needles having a broad bearing upon the beveled face of a lug or flange 25, which projects from the outer face of each partition below the top of the same, thereby providing the desired rigid bearing for the upper portion of each dial needle.

The cylinder cam ring 3, is, as shown in Fig. 3, provided with cams 30, 31, 32, 33, 34, 35 and 36 of the ordinary character for operating the cylinder needles either in round-and-round or to-and-fro knitting, and with a cam 40 for throwing a certain number of the cylinder needles out of action when it is desired to form a heel or toe pocket upon the remaining needles and a cam 41 for bringing these temporarily retired needles into action again after the formation of the said heel or toe pocket has been completed, and it is also provided with lifting pickers 37 for putting out of action successively needle after needle at each end of the fashioning set in narrowing the web, and with depressing pickers 38 for bringing these needles into operation again successively but in reverse order for widening the web, as is usual in machines for making seamless heel and toe pockets upon a knitted tube.

The disposal of the dial needles at an acute angle in respect to the cylinder needles is for the purpose of preventing the trapping and cutting of the freshly inserted yarn by the closing of the latches of the dial needles upon the same which would take place if the two sets of needles were disposed at a right angle to each other with the dial needles outside of the cylinder needles, in order to draw stitches to the same face of the web as said cylinder needles and thus produce a plain web instead of a ribbed web. Such right-angled arrangement of the needles is shown in Figs. 15 and 16, and on reference to the same it will be noted that the freshly inserted yarn  $x$  is

almost directly above the stitch  $y$  upon the dial needle, and there is consequently little or no space between the two in the direction of movement of the dial needle, the result being either that the latch of said dial needle will close before the new yarn  $x$  comes into range of the same, and will thus cause the dial needle to drop its stitch, or, if the latch, when it reaches the vertical position, as shown in Fig. 15, is brought into contact with the fresh yarn  $x$ , the latter will be forced down into the angle between the stem and latch, as shown in Fig. 16, and, being thereby trapped, will be either directly severed or held so as to be incapable of movement, in which case the strain upon the yarn will cause the same to break. When, however, the dial needles are disposed at an acute angle in respect to the cylinder needles, this tendency to trap and sever the yarn is overcome, for the sharper the angle of the needles the more nearly the action of the dial needles approaches that of the cylinder needles, and the less tendency is there to trap the yarn. This will be understood on reference to Figs. 7 to 14, which represent successive positions assumed by the dial and cylinder needles in the operation of the machine.

As shown in Fig. 8 the dial needle has been fully projected so as to clear its stitch  $y$  and it is about to return, Fig. 9 showing that stage of the return movement where the stitch  $y$  has begun to close the latch, and Fig. 10 showing the latch moved by the action of the stitch until it is at a right angle to the stem of the needle, this position corresponding to that shown in Fig. 15. The fresh yarn  $x$ , however, instead of being in position to contact with the latch is considerably in advance of the same, so that, by the time the latch is fully closed, as in Fig. 11, the fresh yarn is well up into the throat of the needle, and all risk of said yarn being trapped between the latch and stem of the needle is effectually obviated. To better insure this result it is advisable to close the latch of each dial needle as soon as possible after the new yarn has been laid across said needle, in order that the closing of the latch will be completed while the yarn is still high upon the needle, for, as shown in Fig. 7, the course of the new yarn is a constantly descending one, and the longer the closing of the latch is delayed, the more likelihood there is for it to be trapped by the closing latch. In order therefore that the latch-closing portion 61 of the draft cam 60 of the dial cam ring 6 may be advanced as much as possible in respect to the knocking-over portion or nose 62 of said cam, I provide the cam with an offset 63 between the two inclines 61 and 62, (see Fig. 4) whereby, while still preserving the proper angle of draft for the dial needle,

dles I advance the earlier portion of said draft in respect to the later portion to the extent of the offset 63, as compared with a cam having a uniform draft or single incline.

6 The offset 63 may, as shown, be such as to cause a dwell in the movement of the needles, or it may be merely a lessening of the angle of the cam so as to effect a decrease  
10 in the speed of such movement without actually arresting the same, but in either case it results in a non-uniform draft of the needles. As a still further aid in preventing trapping of the new yarn by the latches  
15 of the dial needles the latter are, preferably, so actuated as to draw their stitches in advance of the cylinder needles, said dial needles acting as the primary stitch-forming members, and the cylinder needles as  
20 secondary members, and each dial needle draws an abnormally long stitch and is then slightly retracted in order to slacken said stitch, and supply yarn to the following cylinder needle in its draft.

25 The abnormally long dial needle stitch is shown in Fig. 13, the yarn to supply said stitch having been drawn through the hook of the following cylinder needle, and the outward pull of the yarn being exerted upon  
30 the hook or upon the upper portion of the closed latch of said needle. The position of the dial and cylinder needles after said dial needle has been slackened off and the cylinder needle has been fully retracted is  
35 shown in Fig. 14.

When the dial needles 5 are in action, the web holders 13 are retracted and the butts of said web holders travel in the outer groove 50 of the web holder cam ring 14.  
40 One half of the web holders have long butts and the other half have short butts, and when it is desired to put said web holders into action a vertically movable cam 51 on the ring 14 is first partially depressed so as  
45 to engage with the long butts, and, after the cam is in full engagement with said long butts, it is further depressed so as to be in position to engage with the short butts, all of the butts being thereby directed to the inner-  
50 most or active groove 52 of the ring 14, after which another cam 53 similar to the cam 51 is depressed into operative position.

The operative movement of the web holders is effected by a retracting cam 54, and the projecting cams 51 and 53, and such operation continues during the formation of a heel or toe pocket upon the knitted tube, at which time the dial needles 5 are out of action.  
60 When it is desired to again put the web holders out of action the cams 51 and 53 are raised, thus permitting the butts of the web holders, which have been retracted by the cam 54, to continue their course in the outer groove 50 of the web holder cam ring.  
65 Any desired means for effecting the rais-

ing and lowering of the cams 51 and 53 may be adopted, and in Fig. 24 I have shown for this purpose a cam bar 51<sup>a</sup>, slidably mounted on the web holder cam ring 14, passing through openings in projecting portions of the cams 51 and 53 and having two cam portions 51<sup>b</sup> and 51<sup>c</sup>. When this cam bar is partially moved in the direction of the arrow the cam 51<sup>b</sup> serves to partially depress the cam 51, and when the cam bar is further moved the cam 51<sup>c</sup> serves to fully depress said cam 51, a final movement serving to depress the cam 53 by a succession of steps immediately following each other. In order to raise the cams the cam bar 51<sup>a</sup> is moved in the opposite direction by a single movement of full extent.

When the web holders are out of action the tops of the partitions between the cylinder needle grooves act as knocking-over bits for the stitches, but when the web holders are projected they rest upon the tops of these partitions and act as knocking-over bits, and as they are in a higher plane than the tops of the partitions correspondingly longer stitches would be drawn in the absence of some means for preventing such a result. One means of prevention is to lower the needle cylinder, and another means is to slack off the draw-down cams of the cam cylinder, the latter plan being adopted in the present case, the draw-down cams 33 and 34 (Fig. 3) being adjustable for the purpose.

In order to insure engagement of the knitted web by the web holders, when the latter are brought into operation, after being temporarily out of action, it is advisable to lift the web or support the same above the top of the cylinder, otherwise the web holders might be projected above the top course of stitches of the web. For this purpose, I provide, just below the top of the cylinder an internal ring 56, which is connected by rods or bars 57 to a ring 58 at the base of the cylinder, whereby, when said ring 58 is raised, there will be corresponding upward movement of the ring 56, as shown in Fig. 20, and consequent lift of the upper portion of the knitted web above the top of the cylinder. The ring 58 may be raised and lowered by means similar to those employed for raising and lowering the needle cylinder supporting ring shown in Letters Patent No. 670,828, March 26, 1901, or by other means available for the purpose. The means for imparting either rotating or to-and-fro movement to the cam cylinder 3 may be similar to any of the known means now employed for this purpose, Letters Patent No. 743,398, dated November 3, 1903, being cited as showing means available for the purpose, and the Letters Patent No. 774,124, dated November 1, 1904, illustrate means which may be employed for throwing the

needle pickers 36 and 38 into and out of operative position. When the web holders extend only part way around the machine, a ring segment can, of course, be employed in place of the full ring 56 which I have shown in the drawing.

Although I have described the machine as designed for effecting the widening of a knitted web by introducing the dial needles it will be evident that a reverse method may be adopted without departing from the essential principles of my invention, that is to say, the machine may be designed for narrowing a wide web by transferring stitches from the dial needles to the cylinder needles.

My previous Patent, No. 834,768, dated October 30, 1906, so fully illustrates and describes such means for effecting transfer of stitches from one set of needles to another that illustration of such means in my present application is believed to be unnecessary.

When the shaping of the tube is effected by introducing the dial needles, the latter first draw an open loop of yarn, and these open loops would, in the absence of any provision for closing them, form a row of eyelet holes around the knitted tube. For this reason, therefore, the dial needles, after having first been moved so that their butts engage with the cams of the dial cam ring and after having been permitted to remain in engagement with said cams during the formation of a single course of the knitted web, are removed from engagement with the cams and permitted to remain out of operation while one or more courses of stitches are being formed upon the cylinder needles only, after which the dial needles are restored to the control of their cams and the knitting operation proceeds with the dial needles in action. By this means the sinker wales of the courses of stitches formed by the cylinder needles while the dial needles are temporarily out of action, after having drawn their initial loops, will extend as bars across said loops, as shown in Fig. 19, and thus close the eyelet holes.

In the machine shown in Fig. 1 the needle cylinder, dial, and web holder ring are stationary, and the various cam rings have rotating or reciprocating movement imparted to them, but it will be evident that a reverse construction can be adopted without departing from the essential features of my invention, and in Figs. 17 and 18 I have illustrated such a modification along with other modifications of my invention. In the machine shown in these figures of the drawing, 1<sup>a</sup> represents the movable needle cylinder, which carries the dial 4<sup>a</sup>, and to the latter is secured the web holder ring 12<sup>a</sup>, the cylinder cam ring 3<sup>a</sup> and dial cam ring 6<sup>a</sup> being fixedly secured to the bed or other immovable member of the machine, and the web

holder cam ring 14<sup>a</sup> being mounted upon the web holder ring 12<sup>a</sup>, and controlled by means of a dog 15<sup>a</sup> projecting between lugs 17<sup>a</sup> on the said cam ring 14<sup>a</sup>, so that the latter can only have such movement as is necessary in order to properly time the action of the web holders in respect to the needles, in reciprocating or to-and-fro knitting, as usual. In this machine, also, the dial needles are put into and out of action in a manner different from that represented in Fig. 1. Each dial needle 5<sup>a</sup> has two butts 70 and 71, the upper butt 70 being adapted to be acted upon by the knitting cams 72 and 73, and the lower butt 71 being under control of lower cams 74 and 75 on the cam ring 6<sup>a</sup>. There are as many of these cams 74 and 75 as there are sets or groups of needles in the dial, the jacks 18<sup>a</sup> of each group of needles being of a different length from those of the other groups, whereby the butts 71 are in different planes, one below another, and the sets of cams 74 and 75 are in like different planes, in order that each set of such cams will act only upon its selected group of needles. The cams 74 are lifting cams and the cams 75 are depressing cams, and each of them is pivoted or otherwise mounted, so that it can be readily moved into or out of operative position.

Normally, that is to say when the dial needles are all out of action, the cams 74 and 75 are all in the position shown by full lines in Fig. 18, but when it becomes necessary to put a group of dial needles into action, the cam 74 corresponding to said group is raised as shown by dotted lines, thereby acting upon the lower butts 71 of the corresponding needles to raise the same and bring their upper butts 70 into range of the knitting cams 72 and 73, thereby forming upon these needles the initial loops of the widening wales. As soon as all of the group of needles have been thus raised, however, the cam 74 is restored to inoperative position, whereby the needles, put out of action by the depressing cam 75, can remain out of action during the formation of the barring courses by the cylinder needles, both cams 74 and 75 being then raised to the positions shown by dotted lines, in order to restore the needles to action, and permit them to remain in action, one group of needles after another being thus acted upon until all of the widening needles have been rendered operative. In order to put the widening needles out of action again, both cams 74 and 75 of each set are lowered to the positions shown by full lines, and permitted to remain in such position until another widening operation has to be performed.

Fig. 16 illustrates in full lines the butts of the dial needles when the latter are out of action, and also shows by dotted lines the position assumed by the butts when the

needles are being put into action. In this machine, as in the machine of Fig. 1, the dial cam ring will be equipped with a lifting cam 65 and a depressing cam 66, independent of the knitting cams, and located at a point so remote therefrom that the dial needles can be raised and depressed without engaging the new yarn, and can therefore cast the stitches therefrom preparatory to being put out of action, the lifting cam 65 being movable into and out of operative position, so as to have no effect upon the dial needles except immediately before the retirement of the same. Ribbing needles may, if desired, be combined with either of the machines which I have described, and the machines will, of course, be provided with devices under control of a pattern wheel or chain for operating the various cams and the rings 23, and with take-up mechanism, latch openers, and other appurtenances common to ordinary knitting machines.

As an instance of means which may be used to operate the ring segments 23 I may refer to Figs. 25 and 26, in which each of the ring segments is shown as pivotally hung to one arm of a lever 100, the other arm of which projects over a pattern drum 101 having a suitable raised lug 102 for each lever. When the lever arm rests upon the drum the ring segment hung thereto is raised and the needles controlled thereby are out of action, but when the lever arm is raised by its corresponding lug 102 on the drum the ring segment is lowered and the needles 5 controlled thereby are put into action.

It will be manifest that many changes in the structural character of the machine may be made by those skilled in the art without departing from the essential features of my invention, for instance I have thus far described my invention as applied to a machine having latch needles in both cylinder and dial, but, so far as the main features of my invention are concerned, the character of the needles is immaterial, as both or either of the sets of needles may be spring beard needles, if desired, and in Figs. 21, 22 and 23 I have shown the essential parts of three machines using such needles, the machine of Fig. 21 having spring beard needles 2<sup>b</sup> in the cylinder and like needles 5<sup>b</sup> in the dial, the machine of Fig. 22 having spring beard needles 2<sup>b</sup> in the cylinder and latch needles 5 in the dial, and the machine of Fig. 23 having spring beard needles 5<sup>b</sup> in the dial and latch needles 2 in the cylinder. In the machines illustrated the web holders are disposed in a ring 12<sup>b</sup> on the inner side of the cylinder and are operated by cams in a ring 14<sup>b</sup>, and may be put into and out of action by means similar to those employed for operating the web holders in the other machines shown and described.

A presser ring 90 is employed in connection with the spring beard needles of the cylinder for the purpose of closing the beards of said needles after the new yarn has passed under the same and before the ends of the beards reach the old stitches, and in each of the machines shown there are reciprocating sinkers 91, carried by a ring 92 and operated by cams in a ring 93 for sinking the loops between the cylinder needles, these loops in the case of the machine having spring beard needles in the dial lying on said dial needles so far in advance of the old loops or stitches on the latter that time is afforded by means of a presser wheel or cam 94, after the ends of the beards have passed over the new yarn and before they reach the old stitches. It is preferable to employ two sets of these sinkers 91, each set operated by its own projecting cam, in order that the sinkers which operate between cylinder and dial needles may be projected farther and form longer loops than those which operate between cylinder needles only, the projecting cam, which operates such long-throw sinkers, being slacked off when the dial needles are retired, so that it then forms loops of the same length as the other sinkers.

In the machines shown in Figs. 21 and 22, one set of sinkers has low butts actuated by a fixed cam 96, and the other set has high butts operated by a swinging or other adjustable cam 97. In the machine of Fig. 23, however, only one set of sinkers is used, these sinkers being actuated by an adjustable cam 98, which can be retracted so as to retire the sinkers when the dial needles are removed from action, and the latch needles of the cylinder are the only needles in operation.

Of course, a machine having its dial equipped with spring beard needles is not subject to the objection of trapping the new yarn, as in the case of a machine having latch needles in the dial, but on the other hand, the disposition of the two sets of needles at an acute angle, when the dial is equipped with spring beard needles, insures a greater distance between the new yarn and the old stitch than if the needles were at right angles to one another, and hence provides ample time for the closing of the beard after it has passed the new yarn and before it reaches the old stitch.

I claim:—

1. A circular knitting machine having, in combination, a cylinder and dial, each equipped with a set of needles, those of one set being disposed at an acute angle in respect to those of the other set, and both sets drawing stitches to the same face of the web, a yarn guide, means for actuating the needles to cause them to knit, and a series of groups of levers, each controlling certain of the needles of one set, and serving to

move the latter into and out of control of said knitting devices.

2. A circular knitting machine having, in combination a cylinder and dial, each equipped, with a set of needles, those of one set being disposed at an acute angle in respect to those of the other set, and both sets drawing stitches to the same face of the web, a yarn guide, means for actuating the needles to cause them to knit, a series of groups of levers, each controlling certain of the needles of one set to move them into and out of control of said knitting devices, and a plurality of rings each adapted to operate one of the groups of levers.

3. A circular knitting machine having, in combination, a cylinder and dial, each equipped with a set of needles, those of one set being disposed at an acute angle in respect to those of the other set, a yarn guide, means for actuating the needles to cause them to knit, and means for operating needles of one set to place them under or out of control of said knitting devices, said operating means having, as an element, a ring composed of independently operable segments movable in the same direction as the parts upon which they act.

4. A circular knitting machine having, in combination, a cylinder and dial, each equipped with a set of needles, those of one set being disposed at an acute angle in respect to those of the other set, a yarn guide, means for operating the needles to cause them to knit, and means whereby groups of needles of one set are operated to place them under or out of control of said knitting devices, said operating means having, as elements, needle controlling levers and a plurality of rings, each constructed to operate certain of the levers and to permit passage of the other levers without operating them.

5. A circular knitting machine having in combination a cylinder and dial, each equipped with a set of needles, those of one set being disposed at an acute angle in respect to those of the other set and both sets drawing stitches to the same face of the web, a yarn guide, cams for actuating the needles to cause them to knit, and means for operating the needles of one set to place them under or out of control of their knitting cams, said means comprising a ring or ring segment having slots, some shallow and some deep, for the reception of the elements upon which the rings act, and means for moving the rings to cause them to act upon said elements.

6. A circular knitting machine having in combination a cylinder and dial, each equipped with a set of needles, those of one set being disposed at an acute angle in respect to those of the other set and both sets drawing stitches to the same face of the

web, a yarn guide, cams for actuating the needles to cause them to knit, and means for operating the needles of one set to place them under or out of control of their knitting cams, said means comprising a ring or ring segment divided longitudinally and having, in each of its meeting faces, slots some shallow and some deep, whereby openings of different depths are formed for the reception of the elements upon which the rings act, and means for moving the rings to cause them to act upon such elements.

7. A circular knitting machine having, in combination, a cylinder and dial, each equipped with a set of needles, those of one set being disposed at an acute angle in respect to those of the other set, and both sets drawing stitches to the same face of the web, and means for knitting upon said needles to produce a shaped, seamless, tubular web, the needle-actuating devices being so disposed that the wide web needles act as the primary stitch-forming members of the machine.

8. A circular knitting machine having, in combination, a cylinder and dial, each equipped with a set of needles, those of one set being disposed at an acute angle in respect to those of the other set and both sets drawing stitches to the same face of the web, and means for knitting upon said needles to produce a shaped, seamless, tubular web, said knitting devices having a retracting cam for the wide web needles in advance of the retracting cam for the narrow web needles, and combined with a following lift cam, whereby the wide web needles act as the primary stitch-forming members of the machine, draw abnormally long stitches and afterward slacken the same.

9. A circular knitting machine having, in combination, a cylinder and dial, each equipped with a set of needles and both sets drawing stitches to the same face of the fabric, and web holders cooperating with needles of one set, and susceptible of being retired from action.

10. A circular knitting machine having, in combination, a cylinder and dial, each equipped with a set of needles, and both sets drawing stitches to the same face of the fabric, and web holders cooperating with needles of one set and working in the same planes as certain of the needles of the other set, and susceptible of being retired from action.

11. A circular knitting machine having, in combination, a needle carrier and its needles, means for knitting upon the latter including web holders and devices for moving the latter into and out of action, and means for moving the web into position for engagement of the web holders therewith.

12. A circular knitting machine having, in combination, a grooved needle carrier,

needles operating in said grooves, means for knitting upon the needles, web holders operating above the partitions between the needle grooves, and means for moving said web holders into and out of said operative position, whereby the knocking over of the stitches upon the needles is sometimes effected by the web holders and at other times by the tops of said partitions.

- 10 13. A circular knitting machine having, in combination, a cylinder and a dial each equipped with a set of needles, those of one set being disposed at an acute angle in respect to those of the other set, and means  
15 for knitting upon said needles to produce shaped, seamless, tubular web, the means for operating the wide web needles being constructed to impart to the latter a non-uniform draft which effects early closing of the  
20 latches.

14. A circular knitting machine having, in combination, a cylinder and dial each equipped with a set of needles, those of one set being disposed at an acute angle in respect to those of the other set, and means  
25 for knitting upon said needles to produce shaped, seamless, tubular web, the means for operating the wide web needles being constructed to impart to the latter a quick latch-closing movement and a quick knocking-over movement with intervening pause.

15. A circular knitting machine having a cylinder provided with needles, and a dial likewise provided with needles disposed to  
35 draw stitches to the same face of the fabric as the cylinder needles and occupying an acute angle in respect thereto, said cylinder

having grooves with intervening partitions whose upper corners are beveled or rounded.

16. A circular knitting machine having a cylinder provided with needles, means for knitting upon said needles to produce either a continuous tube or seamless heel and toe pockets, a dial provided with needles disposed to draw stitches to the same face of the fabric as the cylinder needles and occupying an acute angle in respect thereto, means for knitting upon said dial needles in conjunction with the cylinder needles, means for arresting such knitting operation upon the dial needles at intervals, and web holders operating in conjunction with cylinder needles, and susceptible of being retired from action.

17. A circular knitting machine in which are combined narrow web needles and wide web needles disposed at an acute angle in respect to one another and both drawing stitches to the same face of the web, and means for acting upon said needles, the retracting cam for the wide web needles being in advance of the retracting cam for the narrow web needles, whereby the yarn for the stitches on the wide web needles is drawn against the inner sides of the latches or hooks of the narrow web needles.

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

ROBERT W. SCOTT.

Witnesses:

HAMILTON D. TURNER,  
KATE A. BEADLE.