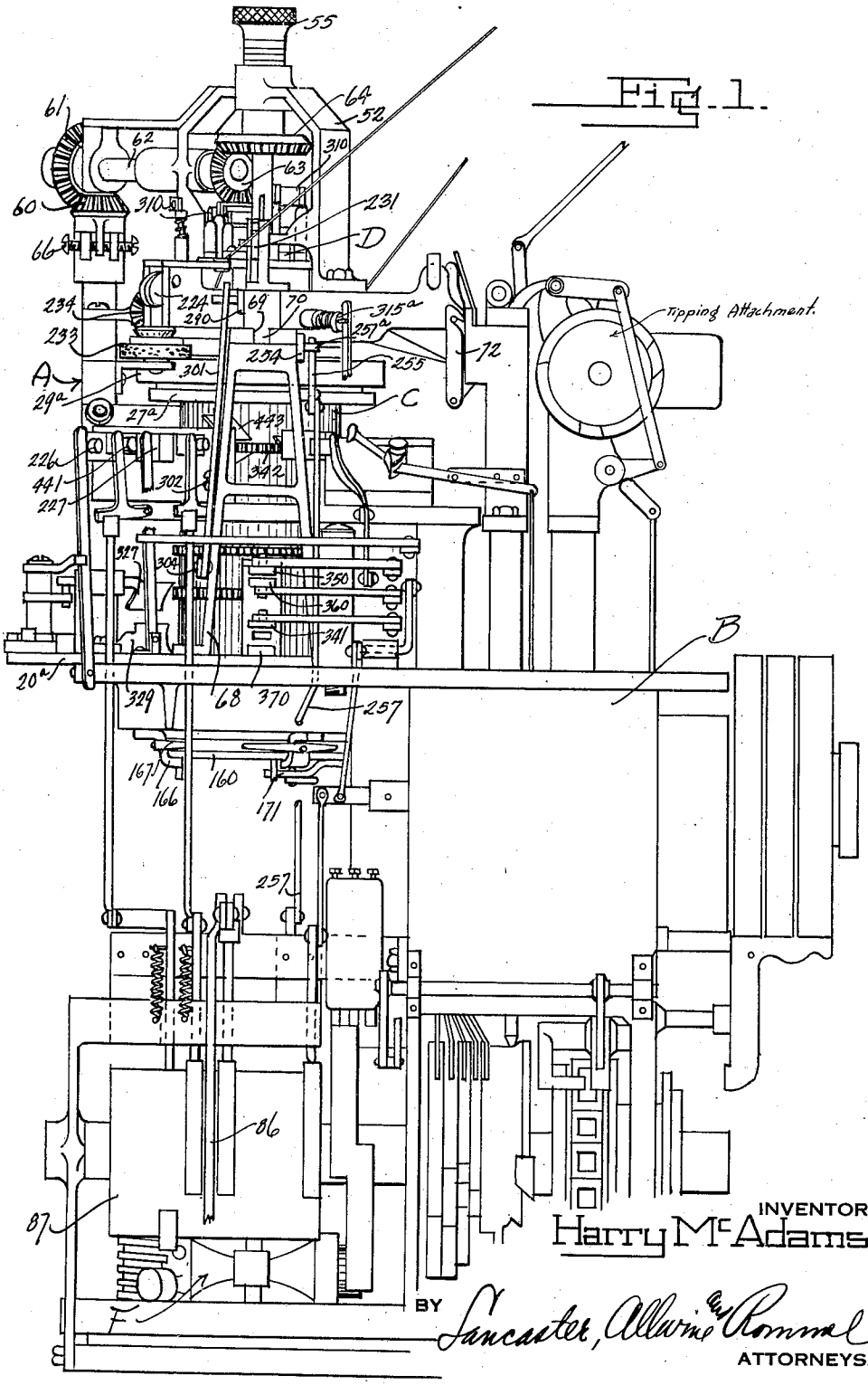
July 4, 1939. H. McADAMS 2,164,337

KNITTING MACHINE AND METHOD OF PRODUCING STOCKINGS THEREON

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Fig. 1.



INVENTOR.
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KNITTING MACHINE AND METHOD OF PRODUCING STOCKINGS THEREON

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Fig. 2.

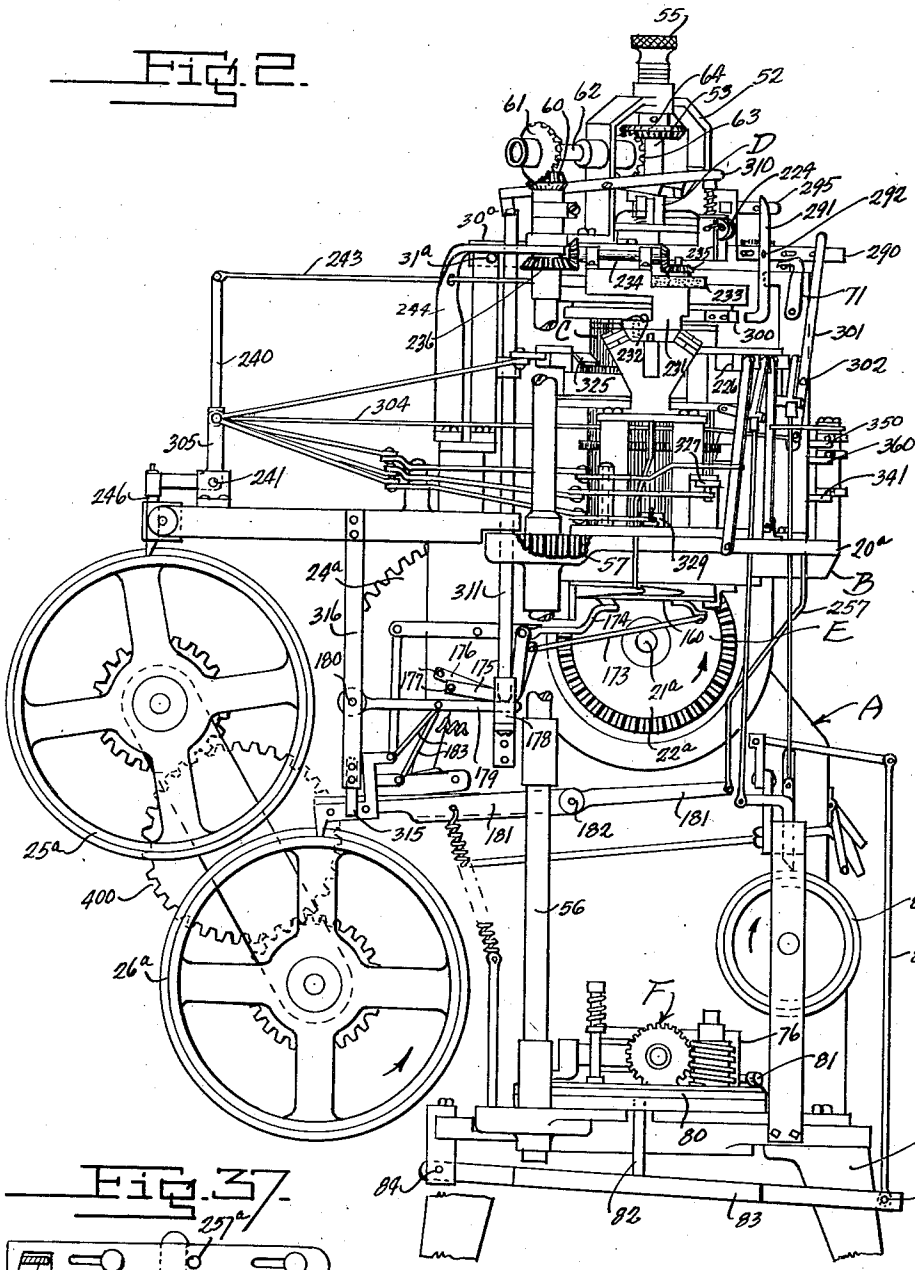
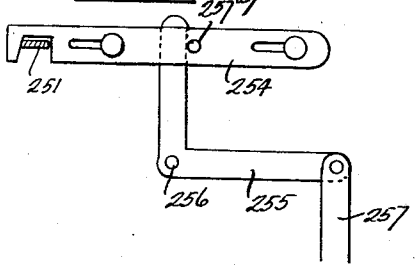


Fig. 3.



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KNITTING MACHINE AND METHOD OF PRODUCING STOCKINGS THEREON

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Fig. 3.

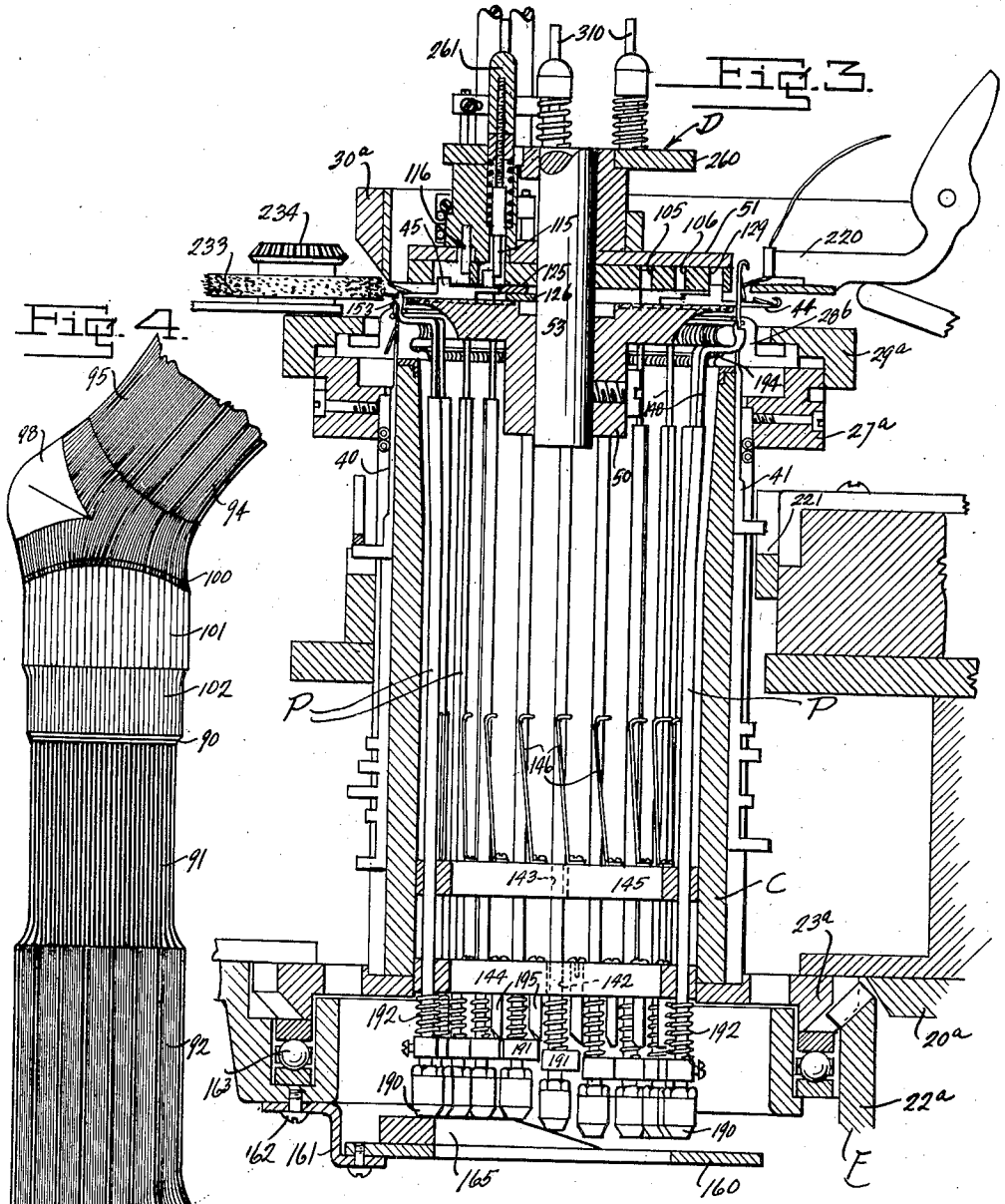


Fig. 4.

Harry McAdams.
INVENTOR.

BY Lancaster, Allwine & Rommel
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KNITTING MACHINE AND METHOD OF PRODUCING STOCKINGS THEREON

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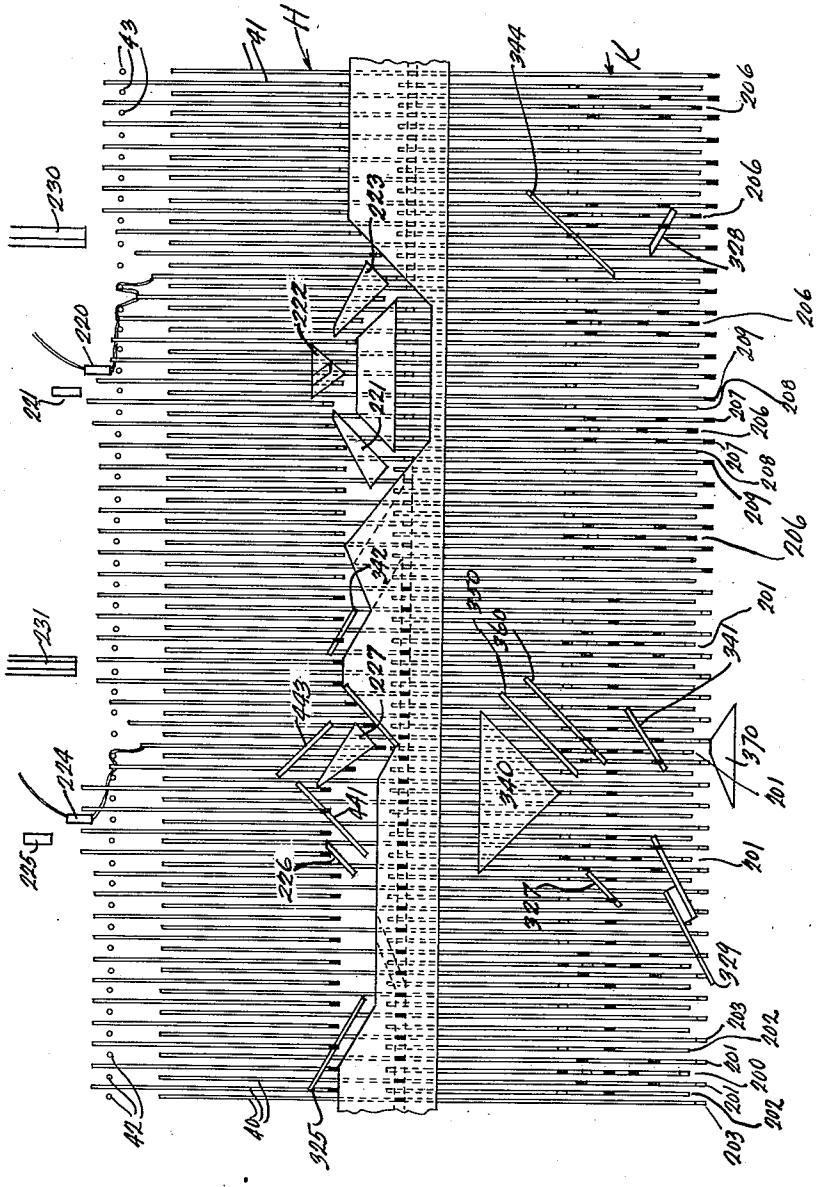


Fig. 5.

Harry McAdams.
INVENTOR.

BY Lancaster, Allwine and Rommel
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KNITTING MACHINE AND METHOD OF PRODUCING STOCKINGS THEREON

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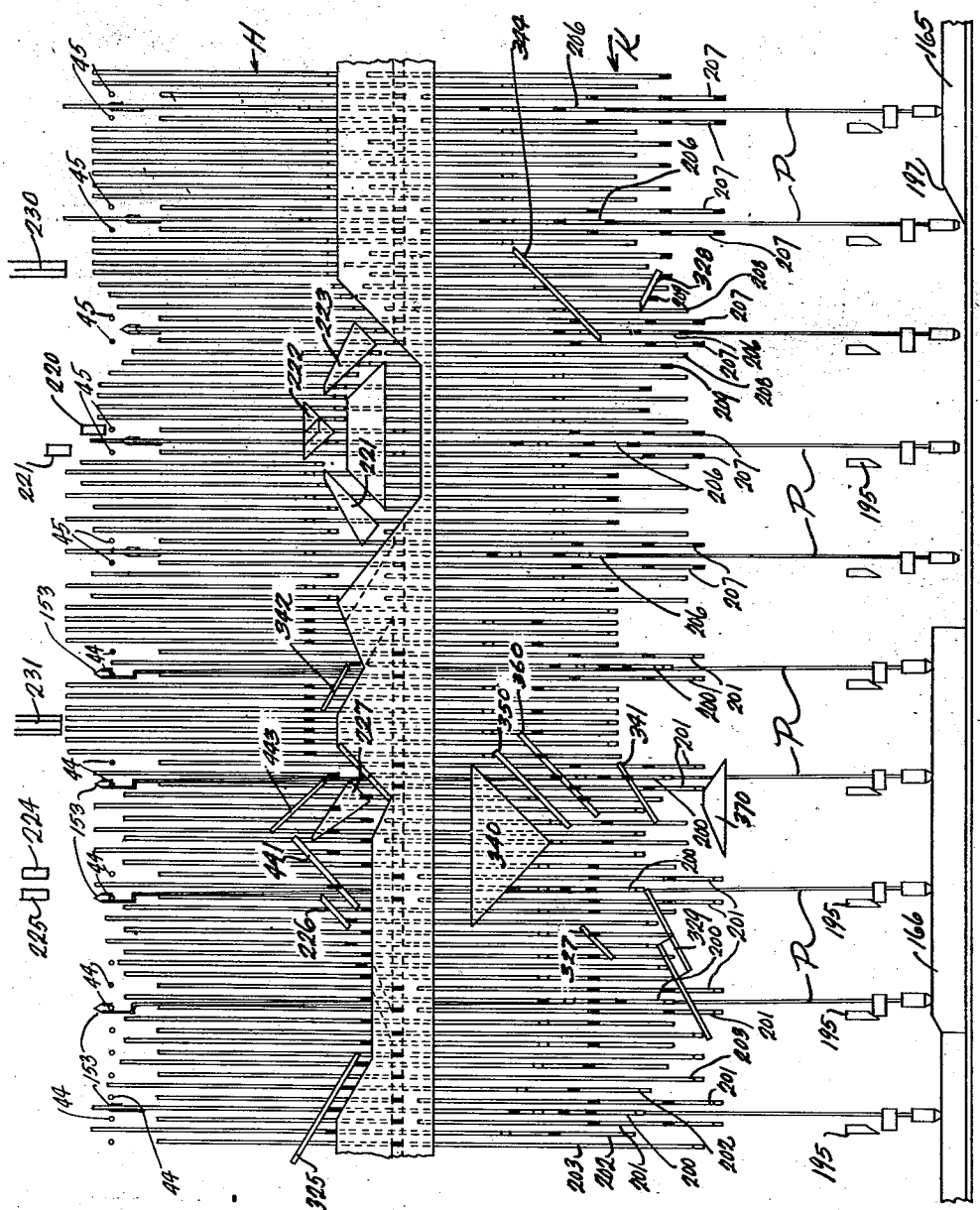


FIG. 5.

Harry McAdams.
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KNITTING MACHINE AND METHOD OF PRODUCING STOCKINGS THEREON

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Fig. 7.

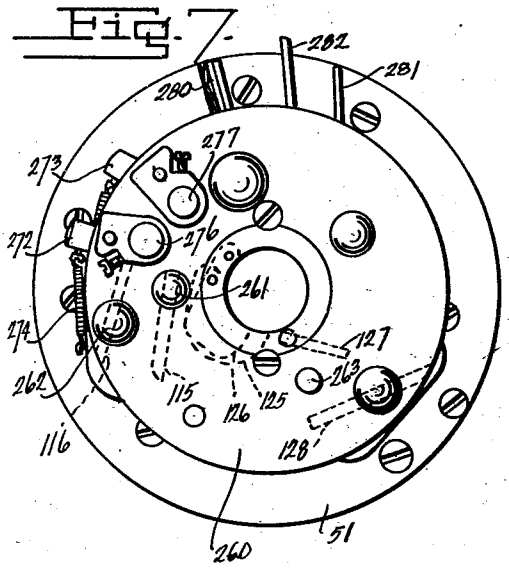


Fig. 9.

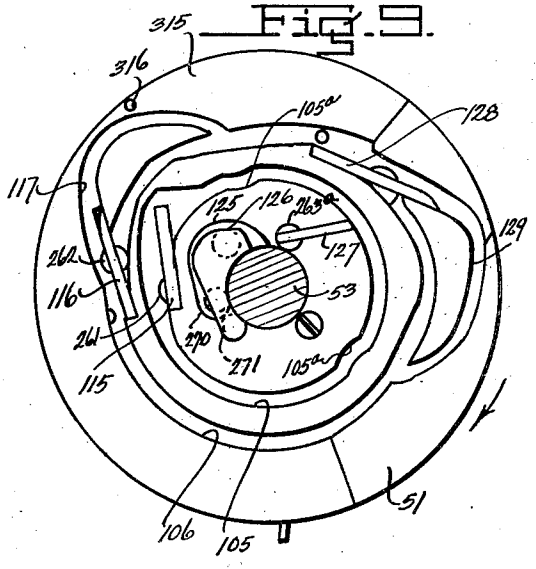


Fig. 8.

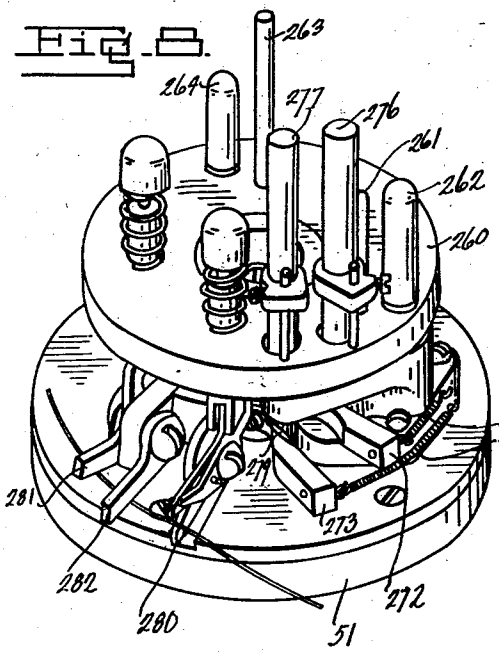
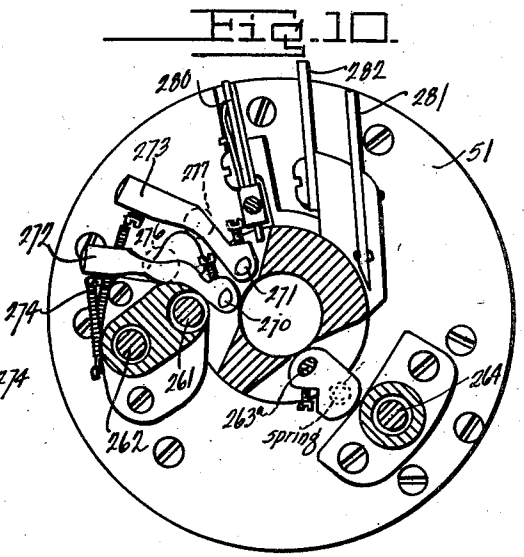


Fig. 10.



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KNITTING MACHINE AND METHOD OF PRODUCING STOCKINGS THEREON

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Fig. 11.

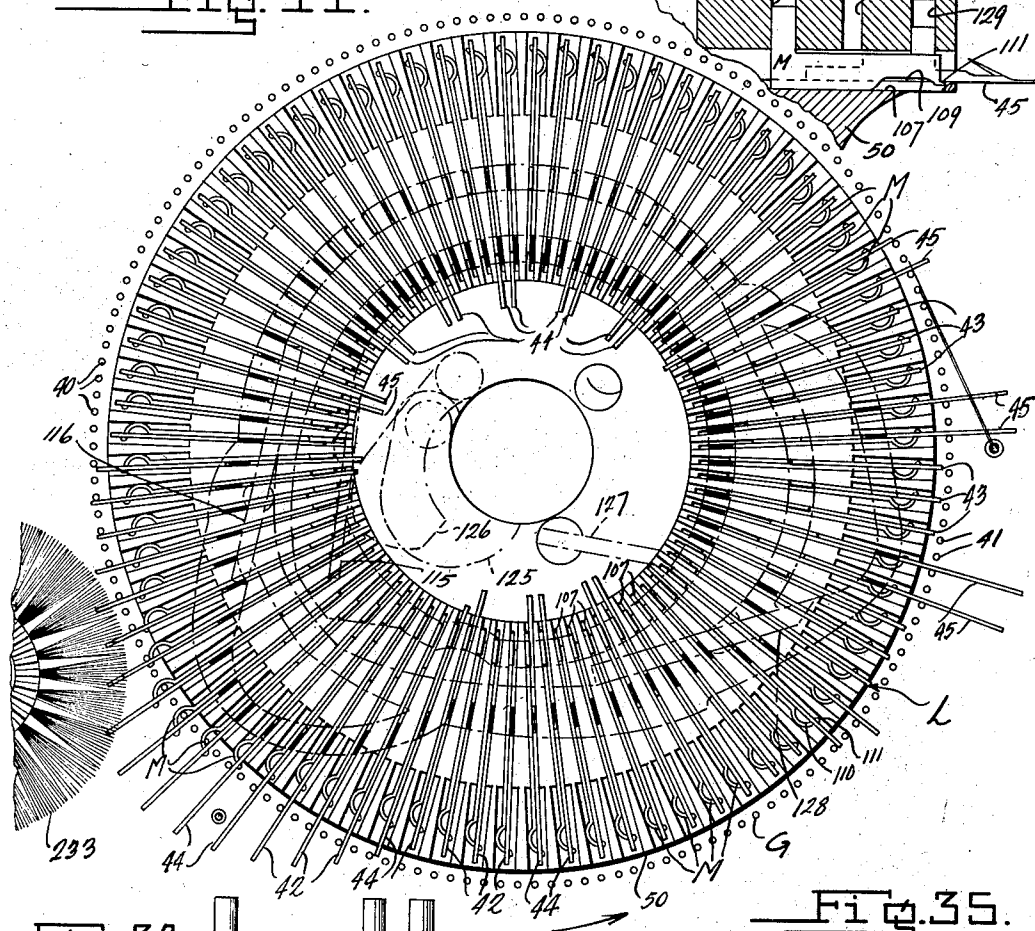


Fig. 30.

Fig. 34.

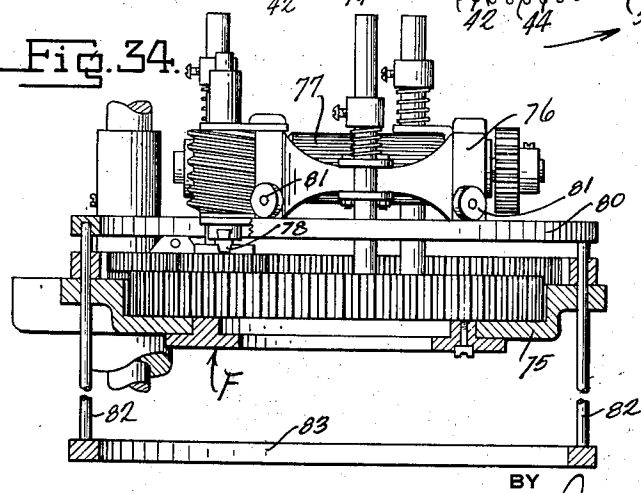


Fig. 35.

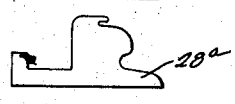
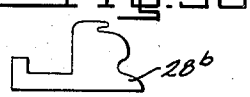


Fig. 36.



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Fig. 12. Typical series of jacks under long butt cylinder needles.

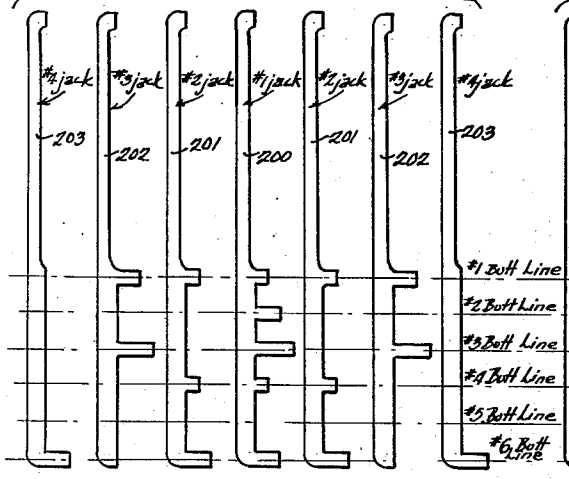


Fig. 13. Typical series of jacks under short butt cylinder needles.

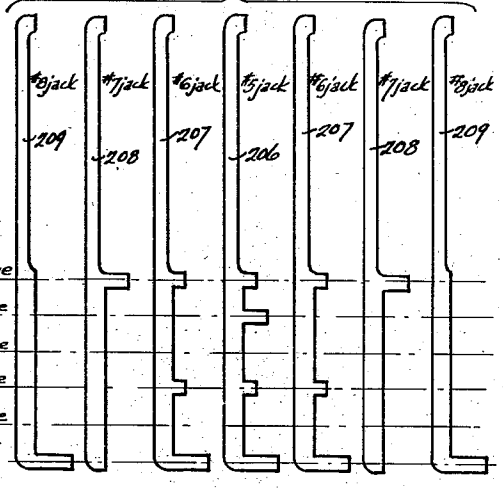


Fig. 14. Typical dial needles and bit used with short butt cylinder needle set.

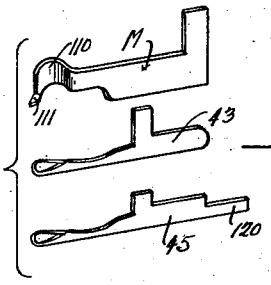


Fig. 15. Typical dial needles and bit used with long butt cylinder needle set.

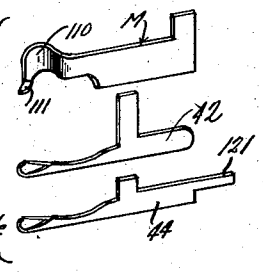


Fig. 16.

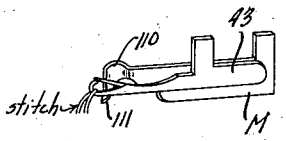


Fig. 19.

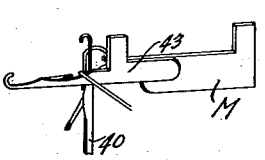


Fig. 17.

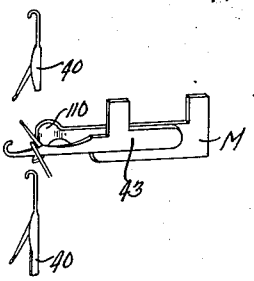


Fig. 20.

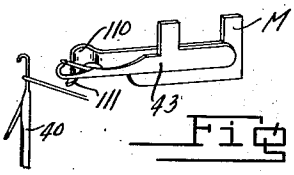
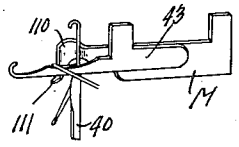


Fig. 18.



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KNITTING MACHINE AND METHOD OF PRODUCING STOCKINGS THEREON

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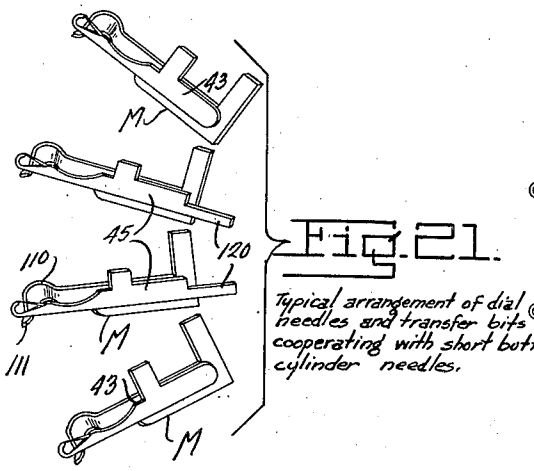


Fig. 21.

Typical arrangement of dial needles and transfer bits cooperating with short butt cylinder needles.

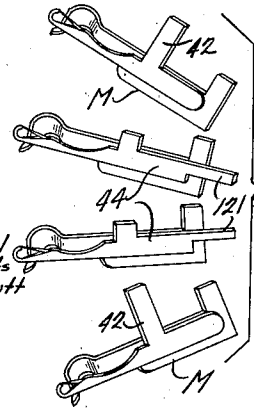


Fig. 22.

Typical arrangement of dial needles and transfer bits cooperating with long butt cylinder needles.

Fig. 23.

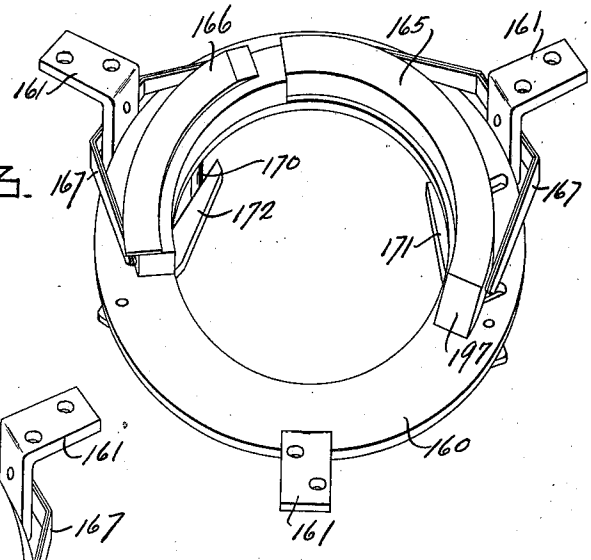
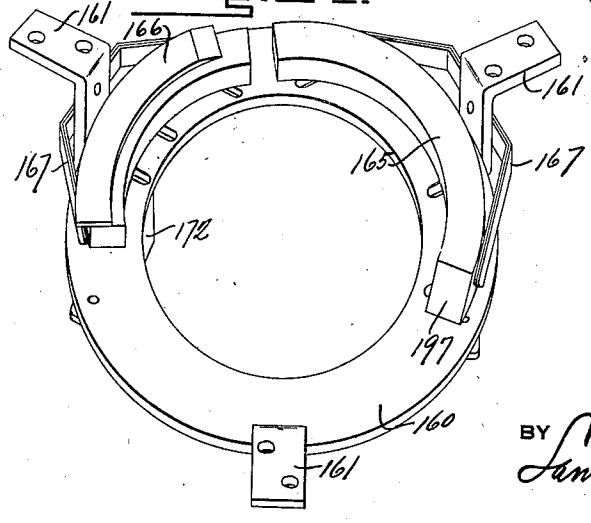


Fig. 24.



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July 4, 1939. H. McADAMS 2,164,337

KNITTING MACHINE AND METHOD OF PRODUCING STOCKINGS THEREON

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Fig. 25.

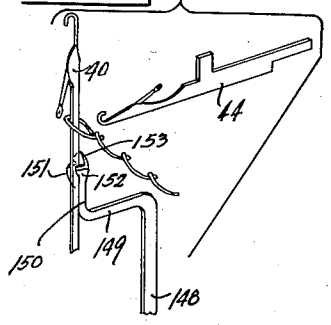


Fig. 26

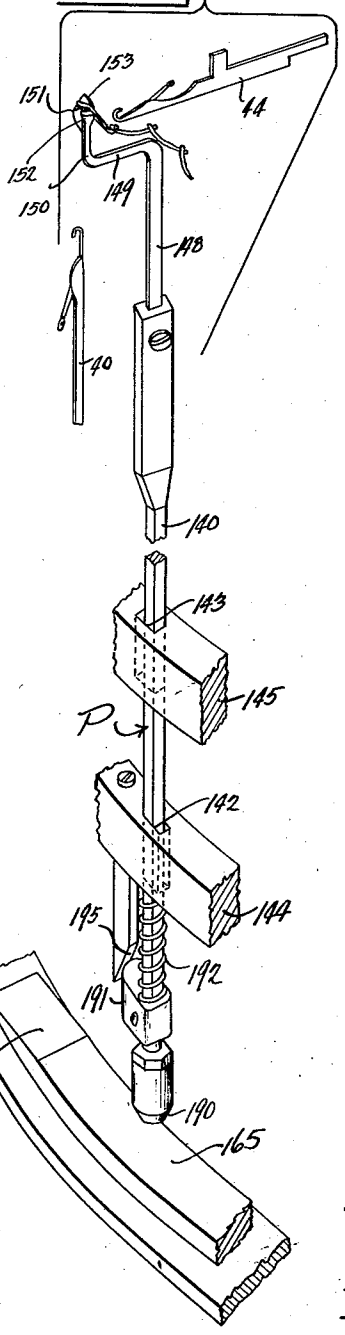


Fig. 27.

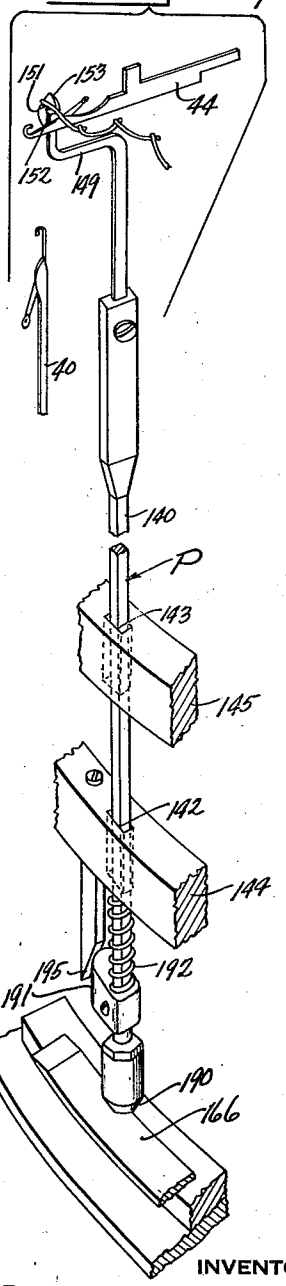


Fig. 28.

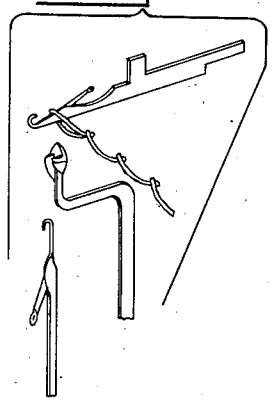
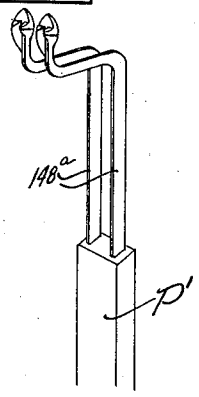


Fig. 29.



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KNITTING MACHINE AND METHOD OF PRODUCING STOCKINGS THEREON

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Fig. 30.

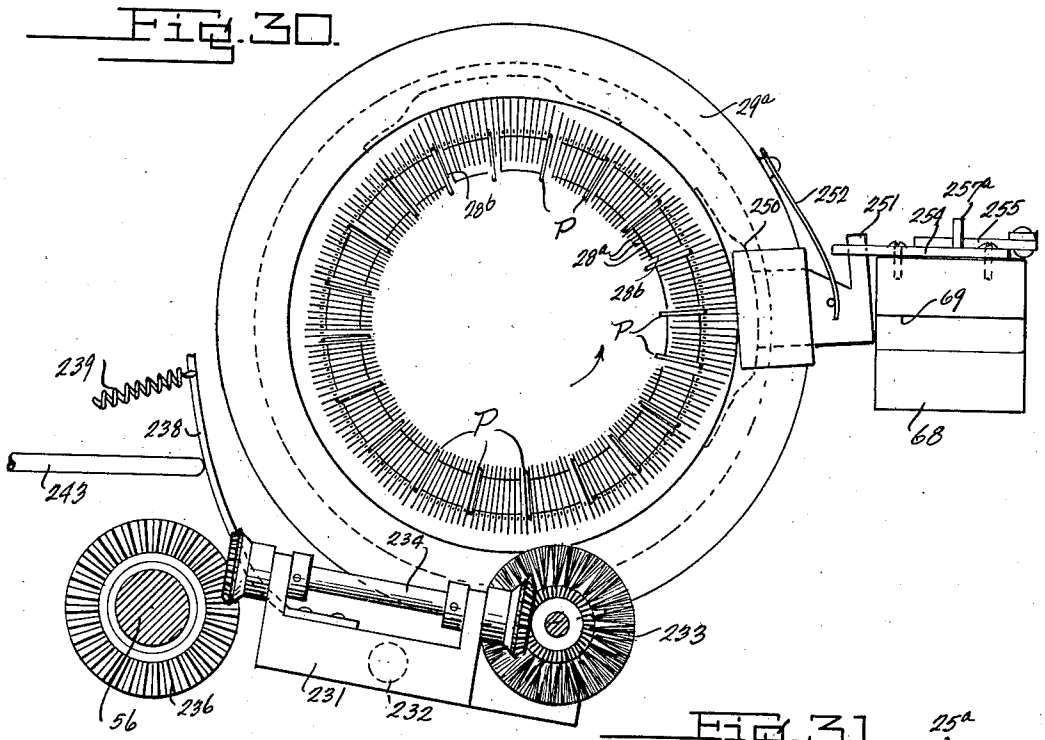


Fig. 31.

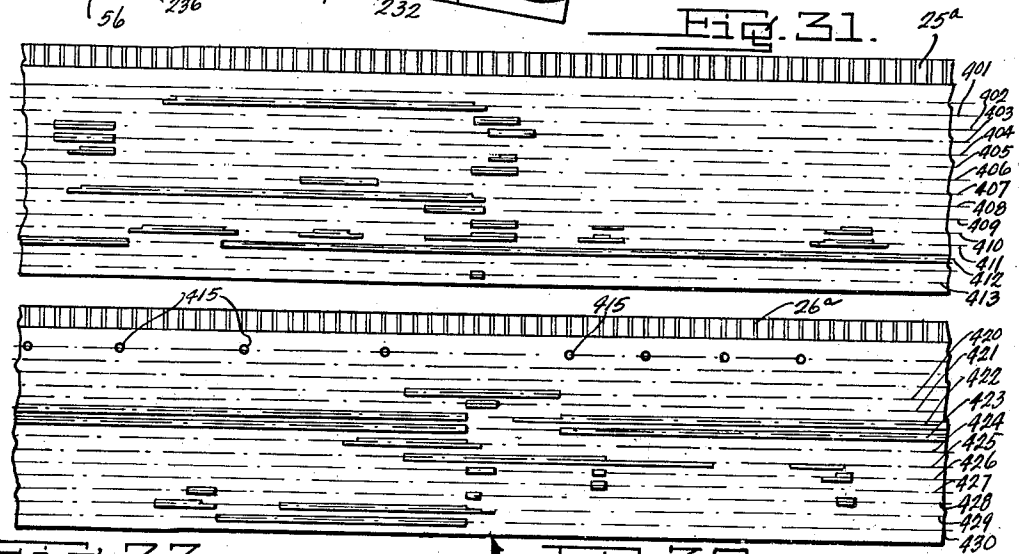


Fig. 33.

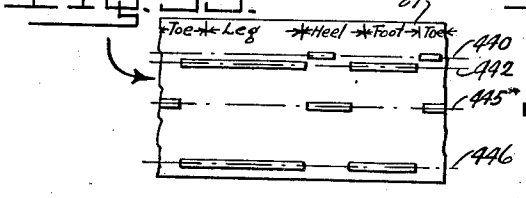


Fig. 32.

INVENTOR,
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ATTORNEYS.

Patented July 4, 1939

2,164,337

UNITED STATES PATENT OFFICE

2,164,337

KNITTING MACHINE AND METHOD OF PRODUCING STOCKINGS THEREON

Harry McAdams, Reading, Pa., assignor to Nolde and Horst Company, Reading, Pa., a corporation

Application December 1, 1934, Serial No. 755,621

43 Claims. (Cl. 66—24)

This invention relates to improvements in knitting machines.

The primary object of the invention is the provision of an improved knitting machine whereon seamless knitted fabric, such as stockings, may be knitted continuously with an automatic transferring of the stitch loops of the fabric from one set of needles to another set of needles and vice versa for the production of ribbed and plain fabric portions and a combination thereof.

A further object of this invention is the provision of improvements in knitting machines of the general type set forth in my co-pending application, Serial No. 558,798, filed August 22, 1931, but embodying improved means for the continuous knitting of a string of stocking blanks thereon.

A further object of this invention is the provision of an improved knitting machine capable of knitting either plain or rib knitting with improved means for transferring the stitch loops in order to accomplish either plain or rib knitting.

A further object of this invention is the provision of an improved automatic knitting machine for the continuous production of integrally connected seamless knitted articles, such as stockings, embodying improved yarn feed features; improved stitch loop transfer mechanism between dial needles and cylinder needles and vice versa; improved yarn take-up mechanism; improved dial mechanism; improved dial needle stitch loop transfer mechanism, and improved means to insure an accurate and practical production of stockings expeditiously and economically.

Other objects and advantages of this invention will be apparent during the course of the following detailed description.

In the accompanying drawings, forming a part of this specification, and wherein similar reference characters designate corresponding parts throughout the several views,

Figure 1 is a front elevation of the improved knitting machine.

Figure 2 is a side elevation of the improved knitting machine.

Figure 3 is a vertical cross sectional view taken through the cylinder and dial mechanism of the improved knitting machine, showing the relation of sets of dial and cylinder needles with respect to each other and with respect to cam mechanism and transfer implements.

Figure 4 is a fragmentary side elevation of a string of stockings, such as may be produced upon the improved machine, showing a stocking blank having integrally connected and knitted portions of other stocking blanks at the ends thereof.

Figure 5 is a developed view in a plane of the cooperative needle action of the improved knitting machine and the association of needles and cams therefor as positioned for the double feed knitting of one and one rib.

Figure 6 is a developed view in a plane of the cylinder needle, jack and cam arrangement in associated relation with certain transfer implements, with the parts positioned as they will appear at the time of stitch loop transfer when going from conventional one and one rib knitting into seven and two rib knitting.

Figure 7 is a plan view of the improved dial cap of the knitting machine showing associated cam control and other parts thereof.

Figure 8 is a perspective view of the dial cap shown in Figure 7.

Figure 9 is a bottom plan view of the cam groove arrangement of the dial cap for the control of dial needles and transfer implements associated therewith.

Figure 10 is a cross-sectional view taken transversely through the dial cap just above the grooved plate thereof and looking downwardly.

Figure 11 is an enlarged plan view of the slotted dial bed showing the associated relation therein of the dial needles and transfer bits or implements in position as they will appear at the time of stitch loop transfer from conventional rib knitting to the so-called English rib knitting.

Figure 12 illustrates a series of jacks in a typical arrangement for use under the long butt cylinder needles.

Figure 13 designates a typical series of jacks for use under the short butt cylinder needles.

Figure 14 designates a typical dial needle and bit arrangement used with the short butt cylinder needle set.

Figure 15 designates a typical dial needle and bit set used with the long butt cylinder needle set.

Figures 16 to 20 inclusive designate the cooperative positioning of a dial needle and its transfer bit or member as they will appear for the transferring of a stitch loop from a dial needle to a cylinder needle when it is desired to transfer from rib knitting to plain knitting or partial plain and rib knitting.

Figure 21 designates a typical arrangement of dial needles and bits cooperating with the short butt cylinder needles.

Figure 22 designates a typical arrangement of

dial needles and bits cooperating with the long butt cylinder needles.

Figures 23 and 24 designate cam arrangements for the transfer implements used with the cylinder needles, respectively in the operative and inoperative positions.

Figures 25 to 28 inclusive show successively the arrangement of cylinder and dial needles and the cooperating cylinder needle transfer implements for the transfer of stitches upon the cylinder needles to the dial needles.

Figure 29 is a fragmentary perspective view of the stitch transferring end of one of the improved transfer implements, showing that it is possible upon a single transfer implement to transfer more than one stitch from a plurality of cylinder needles onto the respectively adjacent cooperating dial needles.

Figure 30 is a fragmentary plan view of the sinker ring of the improved knitting machine, showing the arrangement of cylinder needles and sinkers in association with the transfer implements used with the cylinder needles, etc.

Figures 31, 32 and 33 designate fragmentary developed portions, on a plane, of the lug lay-outs upon pattern drums for controlling cams and other parts of the knitting machine.

Figure 34 is a cross sectional view through the fabric take-up mechanism associated with the improved knitting machine, which is of the general character of the take-up mechanism set forth in my U. S. Patent No. 1,991,563, but embodying improvements thereover.

Figures 35 and 36 respectively designate conventional and special sinkers employed with the needles of the knitting machine; it being necessary to provide special sinkers such as shown in Figure 36 in cooperation with the cylinder needle stitch transfer implements operating inside of the cylinder.

Figure 37 is a fragmentary side elevation of operating lever mechanism associated with a movable sinker retracting cam, also designated in Figure 30.

Figure 38 is a fragmentary cross sectional view taken through the dial showing the manner in which the transfer bits are mounted in the dial in relation to the dial needles.

In the drawings, wherein for the purpose of illustration is shown but a preferred embodiment of the improved knitting machine, the letter A may generally designate the machine. It includes a frame B; cylinder C; dial D; dial and cylinder driving mechanism E; a take-up F for tensioning and holding taut the fabric G produced upon the machine.

Generally the machine frame B includes a supporting bed **20**[a] whereon the cylinder C is rotatable. The operating parts of the knitting machine are generally the same as used in conventional United States manufactured knitting machines, such as the Hemphill Company and Scott and Williams Company types. Reference in this connection may be made to U. S. Patent #933,443. Thus, the cylinder C is driven off a main shaft **21**[a], shown in Figure 2 whereon are positioned the usual gearing including a gear **22**[a] meshing with a gear **23**[a] keyed with the lower end of the cylinder as shown in Figure 3. Suitable means is also provided for driving the conventional "104" gear, shown at **24**[a] in Figure 2 of the drawings, whereon may be positioned suitable lugs or mechanism for intermittently advancing the upper and lower drums **25**[a] and **26**[a] of the pattern control mechanism, as has been described in detail in my co-pending application Serial No. 666,914, filed April 19, 1933 as a division of my above identified co-pending application Serial No. 558,798, filed August 22, 1931.

The cylinder C is provided with the usual vertically disposed needle and jack guide grooves. At its upper end it has keyed therewith the usual sinker bed ring **27**[a] whereon the sinkers **28**[a] and **28**[b] are mounted for radial action in the usual web holding manner. They are actuated by cam means upon the stationary cam ring **29**[a], in the usual manner.

The machine is of the independent latch needle type, but it is to be understood that the improved features of the machine are not to be limited in the application to such type of machine except as limited by the scope of the claims. A latch ring **30**[a] is pivotally supported at **31**[a], shown in Figure 2, upon suitable bracket mechanism attached to the frame of the machine. This latch ring in the present invention supports the dial mechanism and the main or auxiliary yarn feeds.

The cylinder needles as well as the dial needles are of the hook and pivoted latch type. The set of cylinder needles H are divisible into long butt needles **40** and short butt needles **41**. A set of cylinder jacks K cooperate with the needles H for regulating manipulation thereof in order to knit ribbed, plain, variable rib and plain work, and for continuously knitting stockings and transferring from one type of knitting to another.

The dial D has associated therewith a set of dial needles L, shown in Figure 11, which consists of long butt needles **42** and short butt needles **43**. In addition the dial needles have associated in the long butt series thereof other needles **44** provided with rearwardly extending upper tails at the inner ends thereof, and the short butt series of dial needles have associated therewith certain other needles **45**, shown in Figures 11 and 21, provided with longitudinally extending lower tails at the inner ends thereof.

Associated with the set L of dial needles is a set of dial bits M. These bits or implements cooperate with the dial needles in effecting transfer of stitches from the dial needles to the cylinder needles when transferring from one type of knitting to another, such, for instance, as when transferring from rib knitting to plain knitting or English rib knitting.

There are also provided cylinder needle cooperating transfer bits or implements P which cooperate in transferring the stitch loops of the fabric from the cylinder needles to the dial needles in order to change from one type of knitting to another.

The dial D includes the radially slotted rotatable needle supporting bed **50** and the stationary cam plate **51**. This mechanism is supported by a compact bracket mechanism **52** detachably mounted upon the latch ring **30**[a]. This bracket rotatably supports the vertical dial bed drive shaft **53**, shown in Figures 1, 2 and 3 of the drawings, and of course the dial bed is keyed to the shaft **53**. The shaft **53** is axially disposed with respect to the cylinder C and has a vertical adjustment through the supporting nut **55**.

The mechanism for driving the dial consists of a vertically disposed shaft **56** mounted in the bed of the machine alongside of the cylinder much in the same manner as the dial drive shaft set forth in my co-pending application Serial No. 558,798, and which shaft **56** is driven in the same manner as set forth in said co-pending applica-

tion. That is, the cylinder gear 23ª shown in Figure 3 meshes with a gear 57 keyed with the shaft 56, shown in Figure 2. The shaft 56 extends upwardly above the bed of the machine and its upper end is provided with a gear 60 meshing with a gear 61 attached to the horizontal shaft 62 which is rotatably supported by the bracket 52 above described. The shaft 62 at its inner end is provided with a suitable gear 63 meshing with the pinion 64 upon the dial shaft 53, as shown in Figures 1 and 2 of the drawings. The pinion 60 is keyed to the drive shaft 56 by means of an adjustment 66, shown in Figure 1 of the dawings, which enables the gear to be circumferentially adjusted with respect to the drive shaft 56 in order to permit the dial to be properly positioned with respect to the cylinder so that the drive of the cylinder and dial synchronizes, and so that the dial and cylinder needles will properly mesh and cooperate during knitting.

Since the latch ring supports more weight than the conventional knitting machine latch ring, due to the mounting of the dial and drive mechanism thereon, in order to properly position the same and stabilize it, a vertically disposed bracket 68 is mounted upon the bed of the machine at the front thereof, shown in Figures 1 and 2 of the drawings, provided at its upper end with a seat 69 whereon an extension 70 of the latch ring rests in order to properly position the latter. A suitable detent 71 may cooperate in holding the latch ring in position on this bracket 68, in addition to the usual latch ring detent 72.

The take-up F is generally the same as set forth in my U. S. Patent No. 1,991,563, including a supporting frame 75 which may be detachably connected to the lower part of the machine frame B, as shown in Figures 1 and 2 of the drawings. The revolving frame 76 is rotatable upon the frame 75 and synchronously driven with the cylinder of the machine through gearing driven off the shaft 56 in the same manner as set forth in my said U. S. Patent No. 1,991,563. The revolving frame 76 has the take-up rollers 77, between which the stocking or other tubular article is clamped; these rollers 77 being driven in the same manner as set forth in my said U. S. Patent No. 1,991,563. The drive for the take-up roller 77 includes a clutch 78 which is disengaged when the pull upon the fabric being knitted is such as to raise the frame 76.

As an additional feature to the take-up mechanism I provide a circular track 80 which is vertically movable with respect to the frame 75. The revolving frame 76 has rollers or supporting wheels 81 which run on the circular track 80. During heel and toe knitting, and in some cases where plain knitting is resorted to it is necessary to throw the take-up out of action so that it will not pull upon the fabric. Means is provided to throw the take-up out of action consisting of pins 82 anchored at their upper ends in the track ring 80, as shown in Figure 34, which are reciprocably mounted on the frame 75. A ring-shaped control lever 83, shown in Figures 2 and 34 of the drawings, is pivoted at 84 upon the frame of the machine and positioned so that it operates against the lower ends of the pins 82. The movable end of the lever 83 is connected at 85 to operating mechanism 86 controlled by means of lugs off a pattern control drum 87 for the purpose of lifting the ring track 80 and throwing the clutch 78 out of action during knitting of the heel and toe, etc.

In Figure 4 is illustrated a string of stockings as knitted upon the improved machine. This stringwork is continuously produced upon the machine without the necessity of the operator stopping the machine to transfer ribbed tops upon the legs of the stockings. The stockings are preferably knitted commencing with the welt. In the example shown the stocking includes a welt 90, preferably a French welt; a ribbed top 91; a leg 92 which may either be plain knitted or which may be combination plain or rib knitting. For instance, it is possible with the improved machine not only to knit the leg plain, but of one and one rib knitting; two and one rib knitting, or any other desired arrangement or proportion of rib and plain wales. In the example shown the leg and instep of the stocking presents an English ribbed effect of seven and two rib, although it can be appreciated that any desired arrangement and proportion of rib and plain wales may be knitted. The stocking furthermore includes the heel pocket 93; instep 94; sole 95, ring toe 97; toe pocket 98; loopers rounds 99 finished with a selvage 100. Sections 101 and 102 of slack and ravel courses may be knitted thereafter before commencing the French welt 90 of the next stocking, and it is an important feature of the present invention that these sections 101 and 102 in combination with the take-up mechanism permit an even circumferential pull upon the stitches hung upon the needles of the machine at the time of commencement of the welt and ribbed top of the next stocking to be knitted so that a tightly knitted and elastic rib top may be obtained and a uniform welt knitted.

Referring to the means for transferring stitch loops hung on the dial needles to the cylinder needles, as is necessary when transferring from rib knitting to plain wale knitting, Figures 16 to 20 clearly designate the mechanism and the method. Furthermore this means has been generally set forth in my co-pending application, Serial Number 729,655, filed June 8, 1934. Referring to Figure 9, wherein is shown the cam arrangement and butt grooves of the dial cap for controlling the dial needles and transfer bits, the inner groove surrounding the axis of rotation of the dial bed, designated at 105, receives therein the butts of the transfer implements or bits M, and the outer groove 106 receives the butts of the dial needles.

The bits M are of special construction, having body portions which are relatively deeper than the body portions of the dial needles, as is indicated in Figures 16 to 20 inclusive, so that the lower marginal portions of the dial bits may ride in individual slots 107 provided therefor in the dial bed 50, as designated in Figures 11 and 38 of the drawings, in order to stabilize the position of the dial bits and prevent their lateral displacement except at the outer transfer end of the dial bit at the time of transferring. In Figure 38 is indicated the slot 107 wherein the lower marginal portion of the dial bit rides. It is to be noted that the forward end of each dial bit is reduced or cut away at the lower margin thereof, so as not to interfere with lateral flexing of the extreme end of the transfer bit as when the cylinder needle is passing between the transfer bit and the dial needle when displacing a stitch loop from a dial needle to the cylinder needle, as indicated in Figures 19 and 20. While the dial bed has a dial needle and its transfer bit disposed in the same slot, the slot is not recessed as deeply at the portion where the dial needle rides, that is, the lower

edge of the dial needle rides at the level 109 indicated in Figure 38. The transfer bit M is curved and offset at its outer end, at 110, to provide an opening through which the cylinder needle slips, indicated in my above identified application. In order to stabilize the position of the dial needles and the transfer bits, each of the latter is provided with a horizontal lip 111 at its free end along which the lower margin of the dial needle slides.

In order to transfer the stitch loops from the dial needles to the cylinder needles the dial needles and their transfer bits must be projected in order to position the stitch so that the cylinder needle may be slipped therethrough. To that end a plunger type of cam 115 is mounted upon the dial cap for operation across the transfer bit butt groove 105 for the purpose of engaging said butts of the transfer bits M and projecting the latter radially outward as indicated in Figure 11 of the drawings. This cam 115 is shown both in Figures 9 and 11 of the drawings. A second cam 116 operates in conjunction with the dial needle butt groove 106 in order to project the butts of the dial needles into the projecting slot 117 of the dial cap for the purpose of shedding the stitches hung on the dial needles over the latches thereof in order to effect the transfer action. This cam 116 also comes into play, as will be subsequently mentioned, when using the machine as a double feed machine, since a yarn feed is positioned at this location.

It will be noted from Figures 14, 15, and 11 that the set of transfer bits M are divided into a long butt section and a short butt section. The long butts designated in full black in Figure 11 of the drawings cooperate with the short butt dial needles and the short butt transfer bits cooperate with the dial needles in the long butt section. The long butts of the dial needles are designated in full black in Figure 11. As before mentioned certain dial needles which it is desired to use in the full automatic knitting machine during the knitting of a ribbed leg other than one and one, are provided with tails at their inner ends which extend longitudinally of the needles. These tails may be at different levels, and as shown in Figures 14, 15, and 11, tailed dial needles 44 are provided with upper level tails 121 when used with the long butt dial needles, and tailed dial needles 45 are provided with tails 120 at the lower levels when used in the short butt dial needle section. All of the needles 44 and 45 are provided with butts of the same height, as indicated in Figures 14 and 15. These special needle butts are very short and indicated with "X's" in Figure 11 of the drawings. As indicated in Figures 9 and 11 cams 125, 126, and 127 are provided for co-action with the tails 120 and 121 of the special dial needles 44 and 45 in order to manipulate them during transfer and other knitting actions as will be subsequently mentioned. The cams 125 and 126 are in position to respectively cooperate with the tails 121 and 120.

At the main knitting feed the dial cap 51 is provided with a plunger cam 128 operating across the dial needle butt groove 106 for the purpose of directing butts of the dial needles into the projecting groove 129 as when projecting the dial needles for shed of the stitches over the latches and to take the body and other yarns, as will be subsequently mentioned.

Referring to the mechanism for transferring stitch loops from the cylinder needles to the dial needles as is necessary when it is desired to change from one type of rib knitting to another type of rib knitting, or for changing the rib channeled pattern in a portion of the fabric, Figures 25 to 29 inclusive show details of the mechanism and the sequence of steps. The means for accomplishing such transfer and the co-action thereof with associated cylinder and dial needles, as well as other parts such as cams, is designated in Figures 3 and 6, as well as the above mentioned Figures 25 to 29 inclusive. The transfer implements or members consist of elongated body portions 140 arranged within the cylinder C close to the inner periphery thereof in such position as not to interfere with the position of the fabric being knitted. These transfer members are closely arranged around the inner peripheral wall of the cylinder and the bodies 140 are slidably mounted for vertical sliding and lateral tilting in suitably openings 142 and 143 arranged in collars 144 and 145 respectively. Thees collars are shrunk or otherwise fixed in the cylinder C at the lower end thereof and the openings 142 and 143 permit the vertical sliding of the transfer members and the lateral tilt thereof parallel with the wall of the cylinder, but not radially towards the interior of the cylinder. A spring 146 is provided for each transfer member mounted on the collar 145 and normally urging the transfer member at its upper end in the direction of rotation of the cylinder. The upper ends of the bodies 140 of these transfer members P may be detachably provided with transfer points 148 offset radially substantially horizontally at 149 towards the respective cylinder needles with which they cooperate and thence upwardly at 150 providing spaced lips 151 and 152 which define a channel or groove receiving the cylinder needle therein for sliding co-action therewith. These lips 151 and 152 provide substantially horizontal top surfaces and the point 148 is peaked at 153 above these horizontal surfaces so as to slip into the stitch loop at the back of the cylinder needle, as can readily be gained from Figures 25 to 28 of the drawings, when the transfer members are slid upwardly along their respective cylinder needles in order to push the stitch loops over the latch of the cylinder needle and catch the stitch loop on the lips 151 and 152 with the peak 153 inserted in the stitch loop as is clearly designated in Figure 26 of the drawings.

Inasmuch as the dial needles intermesh in the spaces between the cylinder needles it will be necessary to laterally shift the position of the transfer implement P when transferring a stitch hung thereon to a dial needle. This lateral shift of the transfer members is made in a direction counter to the direction of rotation of the cylinder and the lip 152 is cut away quite closely at the side thereof in order to permit the close sliding of the dial needle alongside of the transfer point, so as to properly enter the loop, as will be understood from Figure 27 of the drawings.

The means for elevating and laterally tilting the transfer implements P is indicated in Figures 3, 6, and 23 to 27 inclusive. On the bottom of the bed of the frame B of the knitting machine immediately below the cylinder C there is disposed a cam supporting ring 160 which is provided with brackets 161 offset upwardly and laterally, and detachably connected at 162 to the bottom of the channel wherein the anti-friction bearing forming the cylinder support is mounted. This supporting ring 160 is provided with a pair of radially movable cams 165 and 166 thereon normally spring urged at 167 to their inner positions.

They are each in the form of an arc and mounted to slide in definite paths by means of a pin and slot connection in the ring. Their extreme positions are shown in Figures 23 and 24 of the drawings. The cam 165 is intended to be used for moving the transfer implements upwardly at their transfer points on the cylinder needles and the cam 166 co-acts with other cam means in tilting the transfer members for positioning the stitches hung the points thereof into the path of the projecting dial needles.

The cams 165 and 166 have depending pins 170 thereon. The cams are respectively provided with actuating levers 171 and 172 pivoted at the bottom of the ring 160. These levers 171 and 172 are connected through suitable connecting links 173 and 174 with levers 175 and 176, shown in Figure 2, pivoted at their ends at 177. These levers 175 and 176 rest at their intermediate portions in slots of a bracket 178 and therein are raised and lowered by means of levers 179 pivoted at 180 on the machine. A series of levers 181 pivoted at 182 operate on the pattern drum 26a and connected by connecting rods 183 with the levers 179. It can readily be understood that the levers 181 riding along the lugs and in the depressions of the pattern drum 26a will, through the thus described leverage and linkage, actuate the arc acms 165 and 166.

Referring once more to the mounting of the transfer implements P the same at their lower ends are provided with cylindrical shaped beveled feet 190 adapted to ride on the arc cams 165 and 166. Adjacent thereto and below the collar 144 each transfer implement P is also provided with a laterally extending boss 191. Springs 192 under compression between the bosses 191 and the lower surface of the collar 144 normally urge the transfer members to a position where the seat 190 may engage the cams 165 and 166 during cylinder rotation. It is to be noted that in their downward inoperative position upon the cylinder needles (see Figure 3) the feet 190 do not contact the cam ring 160. That is true because the horizontal portions 149 of the transfer members rest upon the sinker leveling ring 194, as shown in Figure 3. The transfer member P has associated therewith a tilting cam 195 mounted on the collar 144 and depending therefrom, as shown in Figures 3, 26 and 27 of the drawings, formed with a beveled surface adapted to contact with the extension 191 of the transfer member to perfect the lateral tilting of the transfer member at its upper end into transfer relation with the dial needle.

The cam 165 in its inner position as shown in Figure 23 permits the foot 190 of the transfer member to ride upwardly upon the beveled end 197 and thence to the top of the cam 165, moving the point of the transfer member upwardly along the cylinder needle into the stitch, and in cooperative action with certain cam means which controls the cylinder needles, to be subsequently mentioned, transfers the stitch to the point 148 of the transfer implement P, as shown in Figure 26. As the cylinder continues to rotate the foot 190 rides against the cam 166 moving the transfer implement upwardly sufficient to engage the lateral extension 191 with the cam 195 and laterally tilting the transfer member in its loosely fitting openings 142 and 143 of the collars 144 and 145 respectively in a direction counter to the action of the spring 146, so as to position the transfer points in proper relation with the dial needle upon which the stitch loop is to be transferred. The conventional web holders or sinkers, as shown in Figure 35 have web holding feet 28a sufficiently long to impede the lateral shifting of the transfer member, and so special sinkers at these locations are provided, as shown in Figure 36 of the drawings, having shortened feet 28b which do not interfere with the transfer point as the transfer implement is shifted laterally.

As shown in Figure 29 of the drawings a transfer member P' may carry a plurality of the transfer points 148a, for simultaneously transferring a plurality of stitch loops from the cylinder needles to the dial needles. It is furthermore to be understood that a transfer implement P may be provided for each cylinder needle, or they may be provided in any desired arrangement around the cylinder, since their use may be variable for the knitting of various types of rib knitting, such as one and two, six and three, seven and two, etc.

Referring to the cylinder needle and jack set-up, it is to be understood that the jack arrangement will vary widely, depending upon the type of knitting which is to be done upon the improved machine. The developed showing of the needle and jack sets, as illustrated in Figures 5 and 6, are arranged for the knitting of one and one rib in the upper of the stocking, and a leg and instep of seven and two rib.

As is shown in Figures 12 and 13 there are six butt levels for the cylinder needle jacks. These jacks are of a conventional type in that they are supplied with six butts and the butts may be broken off completely at any level or in any fragmentary length. There are three lengths of butts used in the present set-up. The long butts are designated in full black in Figures 5 and 6 of the drawings, the conventional short butts are designated in blank spaces, and the shortest or stub butts are designated in "X's" in blank spaces thereon.

During one and one rib knitting, as preferably done for the rib top of the stocking, we employ alternate cylinder needles and all of the dial needles; the remainder of the cylinder needles being buried. Then in transferring from such one and one rib knitting to seven and two rib knitting wherein we knit seven consecutive plain wales, and two rib wales on the dial needles, it will be necessary to transfer at substantially the same time and course both stitch loops from dial needles to cylinder needles and vice versa.

In the typical jack set-up shown in Figures 12 and 13, in order to simplify the description we may refer to the center jack in each series under the long butt cylinder needles as the #1 jack, designated at 200, in Figure 12; the jacks at each side of the #1 jack as #2 jacks indicated by numerals 201 in Figure 12; the next adjacent jacks as #3 jacks designated by numerals 202; and the next adjacent jacks as #4 jacks designated by numerals 203. In the jacks under the short butt cylinder needles the centerjack of each series may be designated as #5 jack indicated by numeral 206 in the drawings; the next adjacent jacks as #6 jacks indicated by numerals 207; the next adjacent jacks as #7 jacks indicated by numerals 208; and the next adjacent jacks as #8 jacks indicated by numerals 209. In the jacks under the long butt cylinder needles except for the #1 and #2 jacks the #3 and #4 jacks alternate from series to series, and in the series of jacks under the short butt cylinder needles except for the #5 and #6 jacks the #7 and #8 jacks alternate between each series.

Main and auxiliary feeds are provided upon the machine. Thus a feed finger 220 is provided

at the main feed for feeding a body yarn to the needles. Other feed fingers 221 may be provided for the feeding of such yarns as striping yarns, plating yarns, heel and toe yarns, reinforcing yarns, etc., since the improved machine may be used with different attachments such as plating attachments, yarn wrapping attachments, etc. At this main yarn feed the conventional main knitting cams 221, 222, 223, etc., are provided, all of which are conventional and need no further description. At the auxiliary feed the yarn feed fingers 224 and 225 may be provided, or more may be provided as found necessary, for the feeding of body, heel and toe, plating, reinforcing, or other types of yarns to the needles. A latch shedding cam 226 may be provided, as part of the auxiliary feed which operates in conjunction with the auxiliary feed knitting cam 227.

Various other cams for manipulating the needles and jacks of the knitting machine are provided, the purpose of which will be apparent during a description of the knitting cycle. It is of course understood that conventional and cam mechanism for narrowing and widening are provided, and the usual binding and cutting mechanisms are provided at each of the main and auxiliary yarn feeds, as indicated at 230 and 231, diagrammatically in Figures 5 and 6.

A power driven brush is provided for throwing open the latches of the dial needles as they are projected at the auxiliary feed of the knitting machine, particularly during the transfer of stitch loops from the dial needles to the cylinder needles. This mechanism is such that the brush can be thrown into or out of action with respect to the dial needles. It is thrown into action to open the latches at the start of rib knitting, but it is not needed during plain knitting. The mounting and control of the power driven brush comprises a supporting frame 231 pivotally mounted on the pick block at 232, as shown in Figure 2 of the drawings, and also in Figure 30. This frame 231 rotatably supports the latch opening brush 233. The frame also supports a shaft 234 which is geared to the brush 233 at 235 and also geared at 236 with the drive shaft 56, as shown in Figure 2. This gearing rotates the brush 233 counter to cylinder operation. As shown in Figure 30 the frame 231 has an arm 238 actuated by a spring 239 for normally urging the brush 233 into latch opening position. The means for throwing the brush out of action includes a lever 240 pivoted at 241 on the extension frame of the machine as shown in Figure 2, connected pivotally at its upper end to a rod 243 which is slidably supported on a shaft bracing bracket 244 and operating against the finger 238, as shown in Figure 30. The bell crank lever 240 is actuated in an upper slotted end of a plunger member 246 actuated off the lug and depression arrangement on the pattern drum 25^a.

The stationary sinker cap 28^a is provided with a movable sinker retracting cam 250 which is pulled into action to retract the sinkers at the point where the transfer implements P are laterally shifted to position the stitch loops for transfer from the cylinder needles to the dial needles, as is shown in Figure 30 of the drawings. This sinker retracting cam 250 is the same as the usual sinker retracting cam on the sinker cap except that it is differently positioned and it is movable into and out of operation. It has an arm portion 251 extending laterally of the sinker cap and it is spring urged at 252 into normally retracted relation. The means for pulling the sinker retracting cam 250 into operation is shown in Figures 2, 30 and 37, and includes a sliding bar 254, having a pin and slot mounting on the upper end of the latch ring supporting bracket 68. A bell crank lever 255 pivoted at 256 operates against a pin 257^a on the slide bar 254. The bell crank lever 255 has a link connection 257 with an end of one of the levers 181 pivoted as before mentioned at 182 and operable off the pattern drum 26^a. It is apparent that a lug on the drum 26^a will pull the bell crank lever 255 into position for retracting the sinker cam in order to retract the sinkers during the stitch shifting and transfer operation.

Referring to a more detailed description of the dial cap, the cams thereof and the means for operating the cams, preferably spring actuated plunger cams are provided, as set forth in my above identified co-pending application, Serial No. 558,798. In order to support the plungers the dial cap 51 has mounted thereon a disc and frame super-structure 260 which vertically slidably supports plungers 261, 262, 263 and 264 for controlling the vertical movement of the dial cams 115, 116, 127 and 128 respectively. The split cams 125 and 126 for operating respectively upon the upper and lower tails of the special dial needles are oscillatively mounted cams and have a special plunger mechanism for controlling oscillative movement. They are mounted upon shafts 270 and 271 respectively, and above the dial cap but below the frame disc 260 these shafts are respectively provided with outwardly extending horizontal arms 272 and 273, as shown in Figure 10, spring urged at 274 for normally retracting said cams against the dial shaft and in inoperative position. Supported on top of the frame 260 of the dial cap are plunger shafts 276 and 277 respectively having the lower edges thereof beveled, as shown at 279 in Figure 8 of the drawings and actuable against the arms 272 and 273 respectively for turning the cams 125 and 126 into operative position when said plungers 276 and 277 are depressed.

Referring further at this time to the binder and cutter mechanism, the main yarn binder and cutter mechanism is mounted upon the dial cap 51 including a spring actuated cutter 280, a spring actuated binder 281 and a drag binder 282.

The binder and cutter mechanism at the auxiliary yarn feed, shown in Figures 1 and 2 of the drawings, at 231 is actuated by mechanism controlled off the pattern drum 25^a. As shown in Figure 2 this mechanism includes a spring urged slide bar 290 having a pin and slot mounting upon the latch ring frame. This slide bar 290 supports an operating lever 291 pivoted at 292 and at its upper end operates against the cutter and binder bar 295. At its lower end the lever 291 is inturned for actuation off a cam 300 mounted upon the sinker ring of the cylinder. Normally the spring retracts the slide bar 290 so that the lever 291 is out of the path of travel of the cam 300. However, a lever 301 pivoted at 302 operates against a pin on the slide bar 290 and said lever 301 is controlled by linkage 304 off one of the bell crank levers 305 which are pivoted at 241 and actuated off the pattern drum 25^a as above described for the lever 240. The cam actuating plungers upon the superstructures of the dial cap as well as the control feed fingers at the auxiliary feed are actuated by means of suitable levers 310 pivoted at some part or other upon the frame 52 carried by the

latch ring; these levers 310 being actuated by means of plunger rods 311, shown in Figure 2, which are guided in the framework of the machine and actuated off of the levers 179, which as aforesaid are disposed in individual guide slots at their outer ends in a bracket 178 and pivoted at their opposite ends at 180. These arms 179 are moved upwardly and downwardly to actuate the plungers 311 through their connections 183 with the levers 181; the latter being actuated off the lug and depression arrangement on the pattern control drum 26a and guided at their ends adjacent the pattern control drum by suitable slots in the lower end 315 of the bracket 316 on which the pivot 180 is disposed.

Referring to the sequence of operation of the parts for the knitting of the string of stockings, starting with the French welt, dial cam 116 is lowered at the auxiliary feed starting with the long butt needles and then the short butt needles in order to project all of the dial needles at the start of the French welt. Alternate cylinder needles are used at this time at the auxiliary feed and the auxiliary feed yarn is fed to all of the dial needles and the alternate cylinder needles which are ordinarily active during the knitting of one and one rib. Before either web of the French welt is knitted the dial stitch cam 315, shown in Figure 9 of the drawings, which is pivoted at 316, is moved by means 315a to increase the length of the dial needle stitches so as to give sufficient slack in the French welt. At the main feed of the knitting machine alternate cylinder needles which are active during rib knitting are elevated by the stitch cam 221 to take the main yarn for starting the outside web of the welt; the knitting being done at the knock-over cam 223. A cam 325 is then thrown into action to operate on the butts of the cylinder needles in order to lower them so that the auxiliary feed yarn can then be fed only upon all of the dail needles to knit the inside web of the welt. Both webs of the welt are of course knitted at the same time. The welt webs can be of any number of courses desired.

At the last joining course of the welt the dial cam 128 is lowered to project all of the dial needles for the purpose of taking the main yarn at the main feed. At the same time the cylinder needle cam 325 is pulled out to miss the short butt needles and then the long butt needles. The machine then goes into knitting one and one rib at both feeds. The stitch lengthening cam 315 is retracted to shorten the stitches to the usual length. Of course since one and one rib is knitted at both feeds during the knitting of the rib top 91 the stitch cams at both feeds are in operation.

Changing from knitting the one and one rib top 91 of the stocking to the English rib leg (seven and two rib knitting in the example shown) the cylinder needle cam 325 is pushed in half-way to operate only upon the long butt needles to lower them, that is, the alternate cylinder needles which are active during the rib knitting. The jack actuating cam 327 is then pushed in, in order to engage the long #3 butts of jacks 200 and 202 in order to raise the long butt needles thereabove, which are active during rib knitting, so that said needles will engage the shedding cam 226. This enables me to continue knitting regular one and on rib for about three courses in order to give the pattern control mechanism time to properly position the pattern drums. At about the same time that the cam 327 is thus thrown into action the jack cam 328 is pushed into action to lower the 201 jacks under the long butt cylinder needles and the 207 jacks under the short butt cylinder needles so that these jacks will have their #6 butts in position to miss the elevating cam 329 since these jacks and the needles thereabove are inactive during the knitting of seven and two rib. It is to be noted from Figures 5 and 6 that the cam 328 engages the #4 butts of these jacks but will miss the #4 butts of jacks 200 and 206, inasmuch as the latter jacks are slightly elevated; the needles thereabove being active during one and one rib knitting.

It is to be noted that the transfer of the stitch loops from dial needles to cylinder needles when changing from one and one rib to the seven and two rib commences with the short butt cylinder needles, and that a half revolution later the transfer of stitch loops from the cylinder needles to the dial needles in order to produce seven and two ribs starts with the long butt cylinder needles. In order to get the dial needles in position to transfer, the dial cam 125 is then pushed into action to hit the upper tails of dial needles 44 which lie in the long butt dial needle section. This takes place because the dial cam 116 is slightly raised at this time and misses the very short stub butts of the dial needles 44. At the same time the dial transfer bit controlling cam 115 is moved into action in order to project all of the transfer bits into position to transfer the stitches of the dial needles cooperating therewith on the cylinder needles. The dial cam 127 also moves into position the entire way in order to hit both the upper and lower tailed dial needles 44 and 45 for the purpose of moving them into position to transfer and project them for receiving the yarn at the main feed to produce the English rib knitted fabric. Dial cam 128 is pushed down sufficiently to engage the long butts of the dial needles, but it misses the short butts and the stub butts of the dial needles. Then the cylinder latch shedding and stitch cams 226 and 227 move out half-way in order to miss the short butt needles. The cylinder needle cam 325 is pushed in the entire way (it had previously been in only to catch the long butt cylinder needles) and now lowers the short butt cylinder needles. The transfer cam 329 is pushed in, in order to engage the #6 butts of the jacks 203 and 209, but of course this cam will miss the #6 butts of jacks 201 and 207 inasmuch as they have been previously lowered by the cam 328, as is shown in Figure 6 of the drawings. The elevation of these jacks by the cam 329 pushes the alternate cylinder needles which were previously inactive during the knitting of one and one rib into position to transfer the dial needle stitches to these cylinder needles, starting with the short butt cylinder needles, as above mentioned. Then the auxiliary feed yarn of the feed finger 224 is brought out of action cut and bound and the main feed yarn is the only one that is used during the knitting of seven and two rib.

Remembering that the transfer of the stitches from the cylinder needles above jacks 200 and 206 commences with the long butt cylinder needles, and that the jack leveling cam 340 is in position to level off the jacks, the jack cam 341 is thrown into action in order to engage the #6 butts of jacks 203 and 209, since these jacks do not have any butts acted upon by the leveling cam 340 and are in the same position as elevated

by cam 329. Thus, the cam 341 elevates the cylinder needles thereabove to a point above the needle lowering cam 342, so I am able to bury with the cam 342 all of the cylinders that are not used during the knitting of seven and two rib. The jack cam 344 is thrown into position to elevate jacks 200 and 206, starting with the long butt cylinder needle series, in order to shed the loops of the stitches hung thereon beneath the latches, to position the needles above these jacks 200 and 206 for transfer to dial needles cooperating therewith. Of course the cam 344 will also engage the #1 butts of jacks 202 and 208, since these butts are of the same length as the #2 butts of jacks 200 and 206, but the needles above the jacks 202 and 208 will not be sufficiently elevated by cams 344 to shed their stitches beneath the latches, as can be understood from Figure 6.

Referring now to the actuation of the transfer implements P, the cams 165 and 166 controlling elevation thereof are thrown radially inward together, about half-way, starting in the short butt cylinder needle series just before the first long butt cylinder reaches the bevel of the cam 197. This action elevates the transfer implements under the long butt cylinder needles into the stitches hung on the long butt cylinder needles, that is, only those cylinder needles with which a transfer implement P cooperates (the needles above jacks 200 and 206). Of course the cam 166 acts as above described to raise the transfer implement and tip it in cooperation with the tipping cams 195 for positioning the stitch hung on the transfer implement into the projecting path of the dial needle intended to receive the same. Prior to the lateral shift of the transfer implement, however, the cam 325 which has been in position to engage both short and long butt cylinder needles will lower these cylinder needles with which the transfer implement P cooperates, leaving the stitches hung on the points of the implements P. The center sinker cam 250 is of course retracted, as above mentioned, to pull the sinkers out of the way, permitting the shift of the transfer members into position to transfer the stitches to the dial needles. Before the long butt cylinder needles reach them, just prior to transfer, the jack elevating cam 327 is pulled out of operation, as are also the latch shedding and stitch cams 226 and 227. Also dial cam 128 is retracted before the long butt dial needles reach the same just prior to the transfer action from cylinder needle to dial needle, and the cam 116 comes out half-way in order to miss the short and medium butt dial needles, inasmuch as in this section of needles the transfer from dial needle to cylinder needle has been accomplished. Dial cam 115 is retracted after the transfer from dial needles to cylinder needles has been accomplished in the entire set.

Completing the positioning of the needles for the knitting of seven and two rib, the cylinder jack actuating cam 350 is thrown into action to engage the #1 butts of cylinder needle jacks 202 and 208 so that the needles thereabove will be positioned to miss the cylinder needle cam 342, in order that with said cam 342 I can then bury the needles above the jacks 200 and 206, the stitches of which have been positioned on the transfer points of the implements P. This cam 342 is shown in the act of burying one of the needles, in Figure 6 of the drawings. The lowering cam 342 first goes in half-way to catch the long butts above jacks 200 and then the short butt needles above jacks 206, burying these needles during the knitting of seven and two rib. Remember also that the needles at each side of these needles which are buried by the cam 342 have previously been buried, inasmuch as they are inactive during the knitting of one and one rib.

As is shown in Figure 6 of the drawings, just before the jacks are actuated by the aforementioned cams 341 and 350 the transfer implements P are tipped to position the stitches thereon for transfer to the dial needles. The dial needles for this transfer operation are projected by dial cam 127, as is shown in Figure 11 of the drawings. After the complete transfer operation the dial cams 115 and 116 are retracted inasmuch as no auxiliary feed is used during the knitting of seven and two rib. Also the jack and needle cams 342, 350, 341, 329, 344, 328, and 325 are retracted to an inoperative position. The tilting cam 166 for the transfer implements P moves out half-way just sufficiently to permit the foot of each transfer member to miss the tilting elevation part of this cam 166, and of course at this time the spring acting on the transfer member will move the transfer member to its normal position, and thereafter the transfer members are lowered to an inoperative position upon their proper needles by retraction of the cams 165 and 166. The dial and cylinder needles are now in position for the knitting of seven and two rib, that is, in each typical series seven cylinder needles are knitting plain wales and two dial needles are knitting rib wales, which produce in the outer surface of the leg and instep of the stocking a channeled effect.

Just before the start of knitting the heel the cam 325 is moved in half-way to engage the long butt cylinder needles and then in the entire way, lowering all of the cylinder needles, to clear the way for transfer of dial needles which are active during the knitting of seven and two rib, to their complementary cylinder needles. Jack cam 329 is moved in half-way to engage the long butt jacks which of course are in the short butt needle section. The leveling cam 370 is of course active at all times to properly level the jacks so that the cam 329 may co-act properly during the sequence of knitting. Dial cam 115 is moved out half-way in order to engage only the long butt transfer bits, which of course are in the short butt dial needle section. Dial cam 126 is now moved out to engage only the lower tailed dial needles to project them into a transfer position. These lower tailed dial needles are of course in the short butt dial needle section, which is used during knitting of the heel. It is at this time that the jack elevating cam 329 elevates the long #6 butt jacks in the short butt needle section into the dial needle loops hung on the transfer members for transferring the dial needle loops to the cylinder needles inasmuch as plain knitting is used in the heel. Dial cam 127 is moved up half-way so as only to engage the top tailed dial needles 44 in the long butt dial needle section. This permits the knitting of the seven and two rib in the instep and takes it out of the heel and sole. Then the transfer dial cams 126 and 115 go out of action as well as the cylinder needle and jack cams 325 and 329.

Seven and two rib is knitted on the long butt cylinder and dial needles and plain knitting on the short butt cylinder needles with full cylinder rotation for several courses (may vary) before going into the knitting of the heel.

When going into knitting of the heel, at which time the cylinder reciprocates, the dial cam 127 is retracted the whole way in order to prevent the dial needles on the instep from taking the main yarn. The cylinder reciprocates in conventional manner first narrowing and then widening in knitting the heel. After the heel has been knitted the dial cam 127 is lowered halfway and going into full rotary knitting the instep is knitted with the seven and two rib and the sole of plain knitting, as previously mentioned.

Just before the ring toe is reached cylinder needle cam 325 goes into action half-way to catch the long butts and then the entire way to clear the cylinder needles for transfer at the instep section from the dial needles to the cylinder needles in order that plain knitting may be accomplished at the ring toe on all of the cylinder needles. Cam 329 goes into the half-way position and then the entire way to elevate all cylinder needles whose jacks have #6 butts. Dial cam 115 goes into action the whole way to shove out all of the transfer bits and cam 125 goes into action at the dial to project the upper tailed dial needles 44 in the short butt needle section and transfer takes place from dial needles used during the knitting of seven and two rib to the cooperating cylinder needles as elevated by the jack elevating cam 329. Thereafter dial cams 125, 115, and cylinder cams 329 and 325 are withdrawn to inoperative positions. I am now knitting plain on all of the cylinder needles during full rotary knitting. This is done for about twelve courses to knit the ring toe section 97. The toe pocket is then knit in the regular manner and full rotary knitting on the cylinder needles is accomplished for about sixteen courses to knit the loopers rounds. A binding yarn is knitted in with the regular body yarns for about four courses to provide a selvage indicated at 100 in Figure 4 of the drawings to prevent the run-back of stitches into the toe of the stocking during the subsequent dropping of stitches as will be hereinafter described. Thereafter the binding yarn is withdrawn and knit for about twelve courses to provide the ravel section 101 and I later divide the cylinder needles. This knitting is done on all of the cylinder needles.

Thereafter the cylinder needles are divided by putting the jack cams 350 and 360 into operation to engage the butts of only the alternate cylinder needles which are active during rib knitting. These jack cams 350 and 360 raise the alternate cylinder needles to a point where the cylinder needles thereabove have their butts positioned above the path of the needle lowering cam 342. The needle cams 226 and 342 are then brought into action, the cam 226 elevating the butts so that the stitches will be shed from beneath the latches and the butts of these needles will miss the lowering cam 342. The latter cam buries the alternate cylinder needles inactive during rib knitting. The cylinder and jack cams 342, 350, and 360 then go out of action and knitting takes place only on alternate cylinder needles which are active during rib knitting. This is accomplished for about eight courses without throwing the dial needles into action, to knit part of the section 102 shown in Figure 4 of the drawings. The dial needle latch opening brush 233 is then thrown into action and cylinder needle cam 325 is thrown in half-way and then the entire way in order to lower the alternate cylinder needles which are active during rib knitting. Dial cam 116 goes down the entire way to project all of the dial needles so that the brush can open the latches thereof. The dial revolves about two and one-half revolutions in this manner, and when the dial cam 125 goes into action to project the upper long tailed dial needles 44, which are disposed in the long butt dial needle section. The dial cam 116 then comes out halfway to miss the short and medium butts of the dial needles. For this reason the cam 125 is in position so as to project the short and stub butt dial needles which are in the long butt needle section. Dial cams 116 and 125 then are thrown out of action and all of the dial needles are retracted with their latches open. At the same time that the dial cam 125 went into action as immediately above described, the cylinder stitch cam 227 was also thrown into action. The latch opening brush is then pulled out of action, cylinder needle cam 325 is pulled out of action. Since latch shedding cam 226 has been in action the needles will then be in proper co-action to receive the auxiliary feed which is now thrown into action at 224 and the knitting on alternate cylinder needles with two feeds takes place for about eight courses through the section 102. The French welt on the next stocking is then knitted as above described and the cycle of operation is continued as long as desired.

Referring to the pattern lug arrangement on the pattern drums, the upper and lower rear pattern drums 25^a and 26^a are synchronously driven through gearing 400 and by means of a step by step ratchet mechanism operating off the gear 24^a in a manner similar to that set forth in my co-pending applications serial Nos. 666,914 and 591,689, and the pattern drum 87 is driven in the usual manner.

Referring to the pattern lug lay-out on upper rear drum 25^a, as shown in Figure 31, the lug lay-out indicated by dot and dash lines 401 operates stitch cam 227. The lug lay-out indicated on dot and dash line 402 operates the jack cam 341; pattern lug lay-out on dot and dash line 403 operates jack cam 350; pattern lug lay-out on dot and dash line 404 operates jack cam 360; pattern lug lay-out on line 405 operates cylinder needle lowering cam 342; pattern lug lay-out on line 406 operates jack cam 344; pattern lug lay-out on line 407 operates the plunger mechanism to move the dial stitch cam 315, as shown in Figure 9 to slacken the stitches for the French welt; pattern lug lay-out on line 408 operates the latch shedding cam 226; pattern lug lay-out on line 409 operates the jack actuating cam 327; pattern lug lay-out on line 410 operates the jack actuating cam 329; pattern lug lay-out on line 411 actuates cylinder needle cam 325; pattern lug lay-out on line 412 operates the latch opening brush for the dial needles; pattern lug lay-out on line 413 operates the auxiliary binder and cutter mechanism into a working position.

Referring to the pattern lug lay-out as shown for the lower rear drum in Figure 32 of the drawings, this drum is provided with the usual stop lugs 415 which actuate to control the pattern drum in the manner set forth in my above identified applications. The dot and dash lines indicated at 420 in Figure 32 shows the lug arrangement for actuating through suitable leverage mechanism the jack cam 328; the lug arrangement on line 421 is used to operate the center sinker cam shown at 250 in Figure 30 of the drawings; the lug lay-out on line 422 operates the transfer implement cam 165; the lug lay-

out on line 423 operates the cam 166 for throwing the transfer implements P into their final working relation for transferring from cylinder needle to dial needle; the lug lay-out on line 424 operates the dial cam 128; the lug lay-out on line 425 operates the dial cam 127; the lug lay-out on line 426 operates the dial cam 115; the lug lay-out on line 427 operates dial cam 126; the lug lay-out on line 428 operates dial cam 125; the lug lay-out on line 429 operates dial cam 116; the lug lay-out on line 430 operates yarn finger at the auxiliary feed of the machine.

Referring to drum 87 shown in Figure 33 the lugs on the dot and dash line 440 operate the heel and toe cam 441; the lug arrangement on the line 442 operates the cam 443 to lower the needles; the lug arrangement on line 445 puts the web take-up mechanism F out of action during heel and toe knitting; the lug arrangement on line 446 operates the conventional gap closing attachment at the yarn feed.

In Figures 1 and 2 of the drawings wherever possible the cams for actuating the cylinder needles and jacks have been designated, and the leverage and linkage mechanism for actuating the same are extended to the pattern drums above designated. This linkage to avoid complication in describing the operation of the machine will not be further described, except to state that the connecting linkage operating cams off of the rear pattern control drum 25^a operates through bell crank levers and plungers similar to those shown at 305 and 246 respectively in Figure 2, and the cams operating off the lower drum 26^a are actuated through their connecting linkage off of levers and mechanism similar to that described at 181 in Figure 2 of the drawings.

It is to be understood that I do not wish to be limited to the making of any particular type of stitch, since it is entirely possible in the stocking to make tuck or mesh stitches, and to incorporate plating or wrapping yarns. It is also to be understood that considerable variation in the set-up of the machine is possible since the lug arrangements for the pattern drums are detachable and the jacks and dial needles may be arranged for the knitting of any type of rib knitting other than seven and two. It is entirely within the contemplation of my invention to selectively bury the type of rib knitting throughout the leg of the stocking, or even in the rib top, to produce channeled ribbed patterned effects.

It is of course understood that at the point in the cycle of the above description where the alternate cylinder needles are dropped when going from knitting the section 101 to the section 102 the cylinder needles which are dropped will release their stitches and since the take-up mechanism is in action the stitches will ravel back to the binding yarn section 100. This lengthens the section 101 and due to the length of the sections 101 and 102, with the fabric take-up in operation, the pull upon the string will be such as to produce an even tension on all of the stitches hung upon the cylinder and dial needles during the knitting of the next French welt. This is very important, so as to insure a properly knitted French welt and a tightly knitted and elastic rib top.

Various changes in the method of knitting ribbed work upon the machine to produce different types of knitted stockings as well as changes in the shape, size, and arrangement of parts may be made to the form of invention herein shown and described, without departing from the spirit of the invention or the scope of the claims.

I claim:

1. The process of continuously knitting a stocking which consists in knitting upon two sets of needles a rib upper portion with a welt marginal top, transferring certain stitches upon the needles of one set to the needles of the other set and knitting the stocking leg, foot, heel and toe, knitting a binder yarn at the ring of the toe, continuing the knitting of a tensioning evening portion, holding the stocking and tension evening portion under lengthwise tension in order to place a uniform tension on the stitch loops hung on the needles at and during the commencement of the knitting of the next stocking, and then repeating the knitting in the above sequence of steps to produce another stocking.

2. The process of continuously knitting a stocking which consists in knitting upon two sets of needles a rib upper portion with a welt marginal top, transferring certain stitches upon the needles of one set to the needles of the other set and knitting the stocking leg, foot, heel and toe, knitting a binder yarn at the ring of the toe, continuing the knitting of a tensioning evening portion upon one set of needles and while the thus knitted stocking is under tension permitting certain stitches in said tension evening portion to ravel back to produce an even tension upon the stiches hung upon the needles, and thereafter repeating the above sequence of steps to produce another stocking.

3. The process of continuously knitting a series of connected stockings which consists in knitting upon a machine having two sets of rib knitting needles a tubular web of ribber knitting, transferring certain loops of one set of needles to the second set of needles and certain loops of the second set of needles to the first set of needles in producing the leg and foot of the stocking, transferring all of the stitches to one set of needles and knitting thereon to produce a toe with a selvage at the ring tip thereof, holding the stocking under lengthwise tension and knitting a connecting tube of sufficient length to produce an even tension upon the stitches hung upon the needles, and continuing the above sequence of steps.

4. The method of knitting seamless tubular articles having ribbed parts and plain parts upon a knitting machine having a set of dial and a set of cylinder needles which consists in knitting a rib portion upon said dial and cylinder needles, and at substantially the same location in the article changing the character of the knitting by transferring stitch loops of certain cylinder needles to certain dial needles and transferring certain stitch loops of certain dial needles to certain cylinder needles, and continuing the knitting of the article.

5. The method of knitting seamless integrally connected stockings having differently knitted ribbed sections therein upon a machine having a set of dial and a set of cylinder needles which consists in knitting one rib section upon certain dial and certain cylinder needles and then changing the character of the rib knitting by transferring certain stitch loops from certain dial needles to certain cylinder needles in order to knit groups of succeeding plain wales and also at substantially the same location transferring certain stitch loops from certain cylinder needles to certain dial needles in order to knit groups of succeeding rib wales.

6. The improvement in the art of knitting seamless stockings upon a machine having two sets of needles which consists in first knitting a welt by feeding a pair of yarns thereto to produce welt webs having joining courses, producing a ribbed portion by double feeding a plurality of yarns to both sets of needles, transferring stitch loops of one set of needles to certain needles of the other set to vary the knitted fabric, and continuing the knitting upon said needles.

7. In a knitting machine a cylinder having needles thereon, laterally movable stitch transfer members for said needle, and means for manipulating the transfer members for laterally shifting stitches into a transfer relation with other needles.

8. In a knitting machine the combination of a carrier, a set of needles in the carrier, independently movable transfer bits cooperatively positioned side by side with respect to said needles including stitch entering lip portions at the outer ends thereof upon which the backs of the needles slidably rest.

9. In a knitting machine the combination of a carrier, a set of needles in the carrier, transfer bits cooperatively positioned side by side with respect to said needles including lip portions at the outer ends thereof upon which the needles slidably rest, means for moving the transfer bits to pick stitches off the respective needles with the needles still resting on the lips of said transfer bits, means for passing needles of another set between the transfer bits and their respective needles and through the stitches hung on said transfer bits, and means for retracting the first mentioned needles and their transfer bits while the needle upon which the stitch is to be transferred is still in position to pass between the first mentioned needle and its transfer bit.

10. In a dial needle set the combination of a circular dial bed, dial needles slidable in the bed and having hook ends and transverse butts thereon, and special dial needles slidable in the bed and having hook ends, transverse butts thereon, and longitudinally extending tail butts projecting relatively beyond the ends of the conventional dial needles, said special dial needles having said tail butts at relatively different levels, and cam means in the central area of the dial bed for selectively actuating the special dial needles through said tail butts.

11. That method of knitting fabric having rib knitted portions and other portions with different kinds of knitting comprising the feeding of knitting yarn to two sets of needles to produce rib knitting, automatically transferring stitch loops from one set of needles to the other set of needles and feeding yarn to said other set of needles to produce another kind of knitting, continuing and varying said other kind of knitting, feeding a selvage binding yarn to the last mentioned set of needles for a number of courses subsequently knitting upon the needles of that set to provide a tensioning portion and during the knitting of said portion dividing that set of needles by dropping the stitches from predetermined needles of said set in order to permit them to ravel under tension, and then again feeding yarn to the active needles of said set and to the needles of the other set to produce rib knitting.

12. That method of knitting seamless stockings having rib knitted portions and other portions with another kind of knitting comprising the feeding of yarn to one set of needles and to certain active needles of a second set which includes predetermined needles inactive during rib knitting and continuing the knitting to produce a rib top, automatically transferring the stitch loops from needles of the first mentioned set to previously inactive needles of the second set and continuing the knitting of the stocking to produce leg, foot and other portions of the stocking, knitting a binding yarn onto the needles of the second set at the toe of the stocking to prevent unraveling thereof, continuing knitting beyond the toe of the stocking and during said knitting after a predetermined number of courses dropping the yarn from the previously mentioned inactive needles of the second set to provide a distinctive loose knitted section, and continuing the above described sequence of steps to produce a string of the stockings.

13. In a knitting machine for the knitting of fabric having rib knitted portions and other portions with a different kind of knitting, the combination of two sets of needles, yarn feeding means for laying yarn onto the two sets of needles to produce rib knitting, transfer means for automatically shifting stitch loops from one set of needles to the other set of needles without stopping the operation of the machine and thus producing said other kind of knitting, means for continuing and varying said other character of knitting, yarn feeding means for laying a binding yarn for a limited number of courses on needles of the set to which said stitches were transferred, means for continuing the knitting upon the last mentioned set of needles after cutting out the binding yarn, means for dividing said needles and rendering predetermined needles inactive in order to provide a distinctive loose knitted section, and means for subsequently feeding yarn to the active needles of the last mentioned set and to the needles of the other set to produce rib knitting.

14. In a knitting machine for the knitting of a seamless stocking having rib knitted portions and other portions with a different kind of knitting, the combination of two sets of needles, yarn feeding means for laying yarn onto the needles of one set and to certain active needles of the other set to produce a rib top, transfer means for automatically shifting stitch loops from needles of the first mentioned set of needles to needles of the second set which are normally inactive during rib knitting, means to thereafter produce a leg and foot of the stocking on said needles, means for feeding a binding yarn onto the needles of the second set at the toe of the stocking for a predetermined number of courses to prevent unraveling, means for subsequently feeding yarn in the continuation of the knitting beyond the toe of the stocking merely upon the needles of the second set of needles which are active during rib knitting to produce a loose knitted section between stockings, and means for continuously knitting in a connected relation a plurality of such stockings.

15. In a knitting machine for the knitting of seamless tubular articles having rib parts and plain parts, the combination of a dial, a cylinder, a set of dial needles, a set of cylinder needles, means for manipulating the dial and cylinder needles to knit a rib portion of a stocking, pattern controlled means acting at the same course location for transferring stitch loops from certain cylinder needles to certain dial needles and for transferring stitch loops from certain

dial needles to certain cylinder needles, and means for continuing and completing the knitting of the article.

16. In a knitting machine for the knitting of seamless stockings having differently knitted rib sections therein, the combination of a dial, a cylinder, a set of dial needles, a set of cylinder needles, means for feeding yarn to said cylinder and dial needles to produce rib knitted fabric, and pattern controlled means to interchange certain stitch loops from certain dial needles to certain cylinder needles, and vice versa, at substantially the same zone of knitting to vary the character of rib knitted sections in the stocking.

17. In a knitting machine the combination of a dial, a cylinder, said dial and cylinder having slotted needle beds, a set of dial needles operable in the slots of the dial bed, a set of cylinder needles operable in the slots of the cylinder bed, means for feeding yarn to said sets of needles for the knitting of rib fabric, and stitch transfer members slidable along the cylinder bed, radially removed from the circular line of needles in the cylinder, each having portions adapted to cooperate with a cylinder needle above the cylinder bed for the transfer of a cylinder needle stitch to a dial needle.

18. In a knitting machine having a main yarn feed and an auxiliary yarn feed the combination of a dial including a slotted dial bed, a set of needles independently slidable in the dial bed, a dial cam cap, cams at each of the main and auxiliary feeds for projecting the dial needles in knitting waves to receive and knit yarn, and other means at each of said main and auxiliary feeds for selectively and independently moving predetermined dial needles into projected yarn receiving and transferring positions.

19. In a knitting machine the combination of two different sets of needles, means for feeding yarn thereto for the knitting of fabric, and a transfer member slidable along the back of a needle of one set having means thereon to catch the stitch loop on said needle, and means for laterally moving said transfer member into position for holding the loop in a transfer relation to a predetermined needle or needles of the other set.

20. In a dial and cylinder knitting machine the combination of a dial, a cylinder, sets of needles in the cylinder and dial, means for actuating said needles to produce knitting, transfer members slidable along needles of the cylinder set to catch the stitch loops thereon and move them into transfer relation to the cooperative dial needles, and means for laterally moving said transfer members relative to the complementary dial and cylinder needles for shifting the stitches.

21. In a knitting machine the combination of cooperative sets of needles, needles of one set being positioned in alternate intermeshing offset relation to the needles of the other set, means for feeding yarn to said sets of needles for producing fabric, stitch transfer members cooperatively related in substantial parallelism to the needles of one set for the lifting of stitches therefrom, and means for laterally shifting said transfer members relative to the complementary needles of the sets with which they respectively cooperate for positioning the stitches thereon in proper transfer relation to the needles of the set to which the stitches are to be transferred.

22. In a double feed circular knitting machine for the automatic knitting of stockings in string work the combination of a dial, a cylinder, a set of dial needles, a set of cylinder needles, a plurality of yarn feeds for the said sets of needles whereby to knit a plurality of courses at one revolution, means for manipulating said needles and the dual yarn feeds for knitting a French welt top margin on the stocking, means for manipulating said sets of needles and the dual feeds for the knitting of rib top on the stocking, means for transferring stitches from the needles of one set to the needles of the other set and continuing the knitting throughout the remainder of the stocking, and means for knitting on one of said sets of needles a distinctive connecting section between the successively knitted stockings.

23. In a knitting machine the combination of a pair of rotary needle holders, a set of needles for each of said holders, means for simultaneously feeding yarn to the needles of said holders for the knitting of tubular ribbed fabric, transfer members operable along one of said rotary holders having stitch loop pick ends adapted to ride along the backs of the needles, means for manipulating said transfer members to move the pick ends into the stitches of the needles into complementary stitch transfer relation with the needles of the other set.

24. The combination, in a knitting machine, of two sets of latch needles, means for feeding yarn thereto to knit ribbed seamless stockings, and pattern controlled means for the substantially simultaneously intertransfer of selected stitches from needles of each set to needles of the other set.

25. In a knitting machine the combination of a rotary dial, a rotary cylinder, a set of latch needles for the dial, a set of latch needles for the cylinder, means for feeding yarn to said dial and cylinder latch needles for the knitting of ribbed seamless fabric, and means for the substantially simultaneously transfer of selected stitches from cylinder needles to dial needles and from dial needles to cylinder needles.

26. In a circular knitting machine, the combination of a dial, a cylinder, a set of dial needles, a set of cylinder needles, means for the knitting of ribbed fabric upon said sets of needles, the active needles of the dial and cylinder sets during rib knitting being relatively offset in an intermeshing relationship, and means for transferring stitches from cylinder needles to dial needles including means to take the cylinder needle stitches and shift them laterally into receiving relation in the paths of travel of the dial needles to which the said stitches are to be respectively transferred.

27. In a circular knitting machine arranged for ribbed and plain knitting the combination of two sets of needles, a main yarn feed, an auxiliary yarn feed, cam means for actuating the needles in the usual knitting wave at the main yarn feed, cam means at the auxiliary yarn feed for actuating the needles in an auxiliary knitting wave, means for the inter-transfer of stitches from needles of one set to needles of the other set and vice versa, and means for rendering the cam means forming the auxiliary knitting wave active or inactive.

28. In a knitting machine dial cam construction the combination of a dial body, a set of dial needles therefor having transverse cam actuated butts therefor, cam means for said butts, a set of cams on the dial positioned at different levels at the rear ends of said dial needles, and cooperative butts located at different levels between the cams of said sets and the dial needles

for selectively actuating the latter upon operative positioning of the cams of said sets.

29. In a knitting machine the combination of a needle having a hook end, a bit slidably located side by side with the needle and independently movable with respect thereto, said bit having the fore end thereof provided with an eye opening facing said needle, with the opening extending in a line transverse to the needle action, said transfer bit having a stitch loop entering lip extending at the back edge of the needle and movable therealong to facilitate stitch entry and transfer.

30. The process of continuously knitting articles such as stockings, each article including at least two distinctively knitted sections which consists in knitting on two sets of needles one of said sections of predetermined rib proportioning, transferring certain yarn stitches from needles of one set to needles of the other set and knitting the other article section, knitting a binding selvage at the completion of the last mentioned stocking section, knitting yarn on the needles of at least one of said sets for a predetermined number of courses, dropping the yarn stitches from predetermined needles of said set of needles, and permitting the yarn to run back to said selvage to provide a distinctive ravel section, and continuing the knitting of articles in the above described sequence of steps.

31. The process of continuously knitting articles, such as stockings, each article including at least two differently rib knitted sections which consists of knitting on two sets of needles one of said rib sections in a predetermined rib proportioning, substantially simultaneously intertransferring stitches from needles of one set to needles of the other set and vice versa, continuing the knitting of the article to produce the other article section of a different rib proportioning than the rib proportioning of the first mentioned article section, and completing a connecting section between said articles.

32. In a knitting machine the combination of a cylinder, a dial, cylinder needles, dial needles, independently actuated cams at different locations around the dial for projecting the dial needles into yarn receiving position, means at each of said locations for feeding yarn to the dial needles to receive the yarn, transfer bits associated with the dial needles, and independently actuated cam means positioned in complementary relation to one of the cams above mentioned for projecting the transfer bits into dial needle stitch receiving and cylinder needle transfer positions.

33. In a knitting machine for automatically changing from rib knitting to plain knitting the combination of a dial, a cylinder, a set of dial needles, a set of cylinder needles, transfer implements independently movable in the dial, an independently movable cam for projecting the transfer implements in cooperative relation with the dial needle projecting cam for taking the stitches from the dial needles and projecting them into cylinder needle transfer position, a second independently controlled cam situated at a different location around the dial with respect to the first mentioned dial needle projecting cam for projecting the dial needles into yarn receiving position, and yarn feed means for feeding yarn to the dial needles at each of the above mentioned dial needle projecting cams.

34. In a knitting machine the combination of a dial, a cylinder, a set of dial needles, a set of cylinder needles, cam means at different locations around the dial for projecting the dial needles into yarn receiving position, yarn feed means at each of said locations, and means cooperating with the said dial needles at one of said locations for transferring stitch loops from the dial needles to the cylinder needles.

35. The process of continuously knitting articles such as stockings, in which the different portions of each article are not in line with each other, such as the leg and foot of a stocking, which consists in knitting such an article, and then with the knitted article under tension knitting a tension evening portion of a nature to compensate for the out of line position of the portions of said article and enable the stitch loops hung on the needles at the commencement of and during the knitting of at least a portion of the next article to be uniformly under tension.

36. The process of continuously knitting tubular articles such as a stocking, in which the different portions of each article are not in line with each other, such as the leg and foot of a stocking which consists in knitting such an article, and then with the knitted article under tension knitting a tension evening portion wherein after a predetermined length of such tension evening portion has been knitted the stitches are dropped so as to permit the raveling thereof in order that different circumferential portions of said tension evening portion may vary in length under tension so as to compensate for the out of line position of the portions of said article and enable the stitch loops hung on the needles at the commencement of and during the knitting of at least a portion of the next article to be uniformly under tension.

37. The process of continuously knitting articles such as a stocking, in which the different portions of said articles are not in line with each other, such as the leg and foot of a stocking, which consists in knitting such an article, and then with the article under tension knitting a tension evening portion which varies in length at the different circumferential portions thereof while under tension so as to compensate for the out of line position of the portions of said article and enable the stitch loops hung on the needles at the commencement of and during the knitting of at least a portion of the next article to be uniformly under tension.

38. In a knitting machine the combination of a set of dial needles, a set of cylinder needles, means for feeding yarn to said sets of needles for the knitting of ribbed fabric, and selector means for the inter-change of stitches from one set of needles to the other and vice versa at the same zone of knitting for the purpose of changing the character of rib knitting by knitting the fabric upon relatively spaced groups of successive needles in each set wherein each of the groups comprises a plurality of adjacent needles of that set.

39. In a knitting machine the combination of a set of dial needles, a set of cylinder needles, means for feeding yarn to said sets of needles for the knitting of ribbed fabric, and selector means for the inter-change of stitches from one set of needles to the other and vice versa at the same zone of knitting for the purpose of changing the character of rib knitting by knitting the fabric upon relatively spaced groups of successive needles in each set wherein each of the groups comprises a plurality of adjacent needles of that set, and means for selectively transferring the stitches from needles of a group of one set to needles of a group of the other set of needles.

40. In a knitting machine for transferring stitches from one set of needles to the other set of needles the combination of a set of needles, a second set of needles intermeshing with the first set of needles, transfer members cooperatively movable along the needles of one set, and means for giving a compound movement to each of said transfer members for entering and longitudinally pushing the stitches along the respective needles and then laterally shifting said stitches into transfer position with respect to the particular needle of the other set.

41. In a knitting machine having two sets of needles, one of which operates in a cylinder, transfer members individually provided for the cylinder needles cooperating therewith inside of the normal circular needle line, and means for both lifting and laterally shifting the transfer members with respect to the complementary cylinder needles and bringing the stitches into transfer position with respect to desired needles of the other set.

42. In a knitting machine the combination of a needle bed, a set of needles therefor, means independent of the needles for longitudinally moving the stitches into needle transfer positions, and means for laterally shifting the last mentioned means to spread the stitches at the transfer positions.

43. In a rib knitting machine the combination of a cylinder, a dial, a set of cylinder needles, a set of dial needles, means for knitting one and one rib fabric upon said needles, and means for the substantial simultaneous inter-transfer of stitches from one set of needles to the other set of needles and vice versa for the knitting of English rib fabric wherein a plurality of groups of the cylinder needles knit a plurality of adjacent plain wales in each group, and wherein a plurality of groups of rib needles knit a plurality of adjacent rib walls in each group.

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