April 7, 1942. H. G. DICKENS 2,278,869

KNITTING MACHINE

Filed Feb. 15, 1941 6 Sheets-Sheet 1

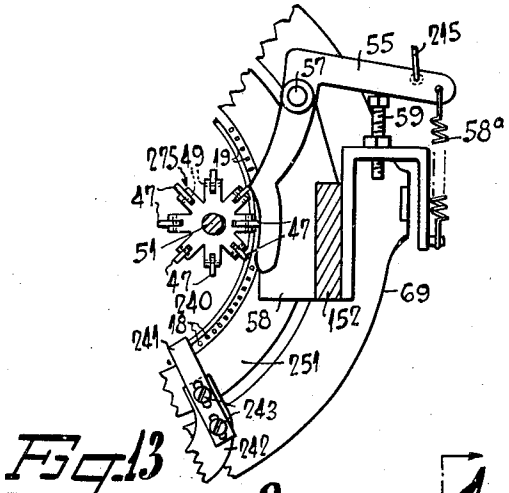


Fig. 1

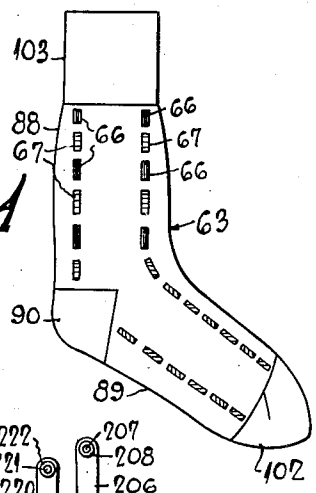


Fig. 13

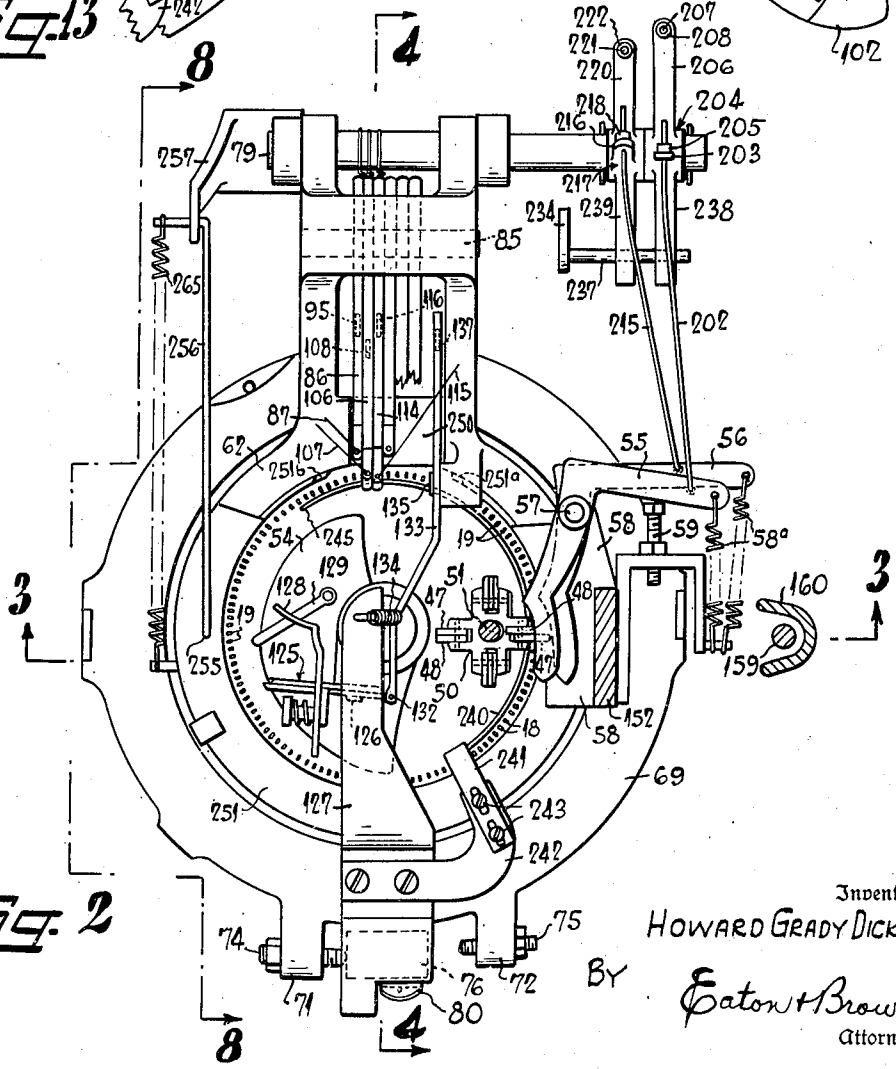


Fig. 2

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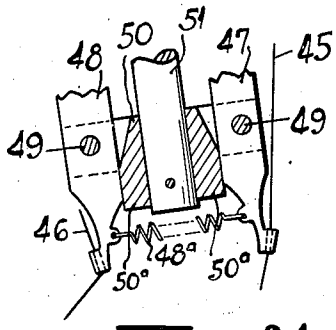


Fig. 3A

Fig. 3

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KNITTING MACHINE

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Fig. 4

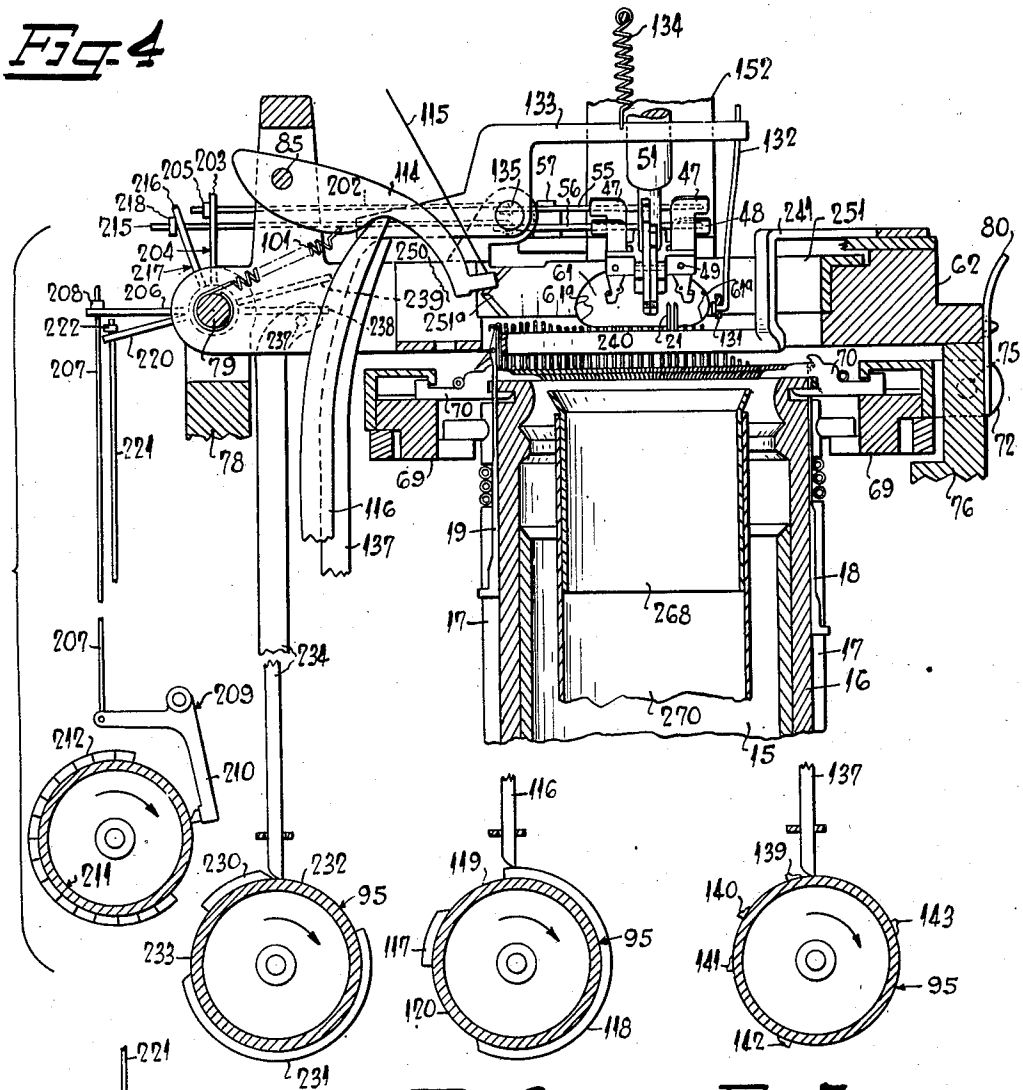


Fig. 5

Fig. 6

Fig. 7

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KNITTING MACHINE

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Fig. 8

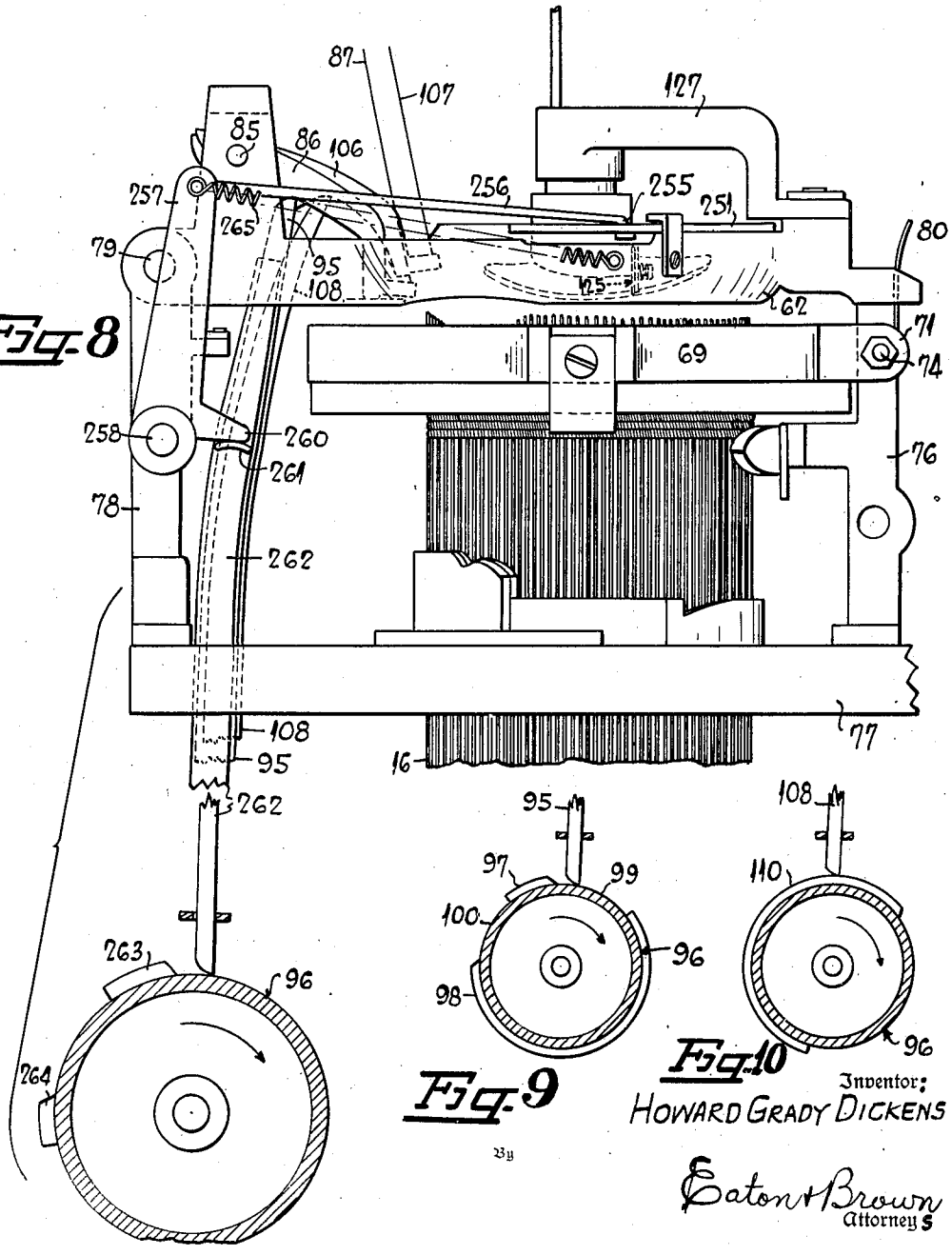


Fig. 9

Fig. 10

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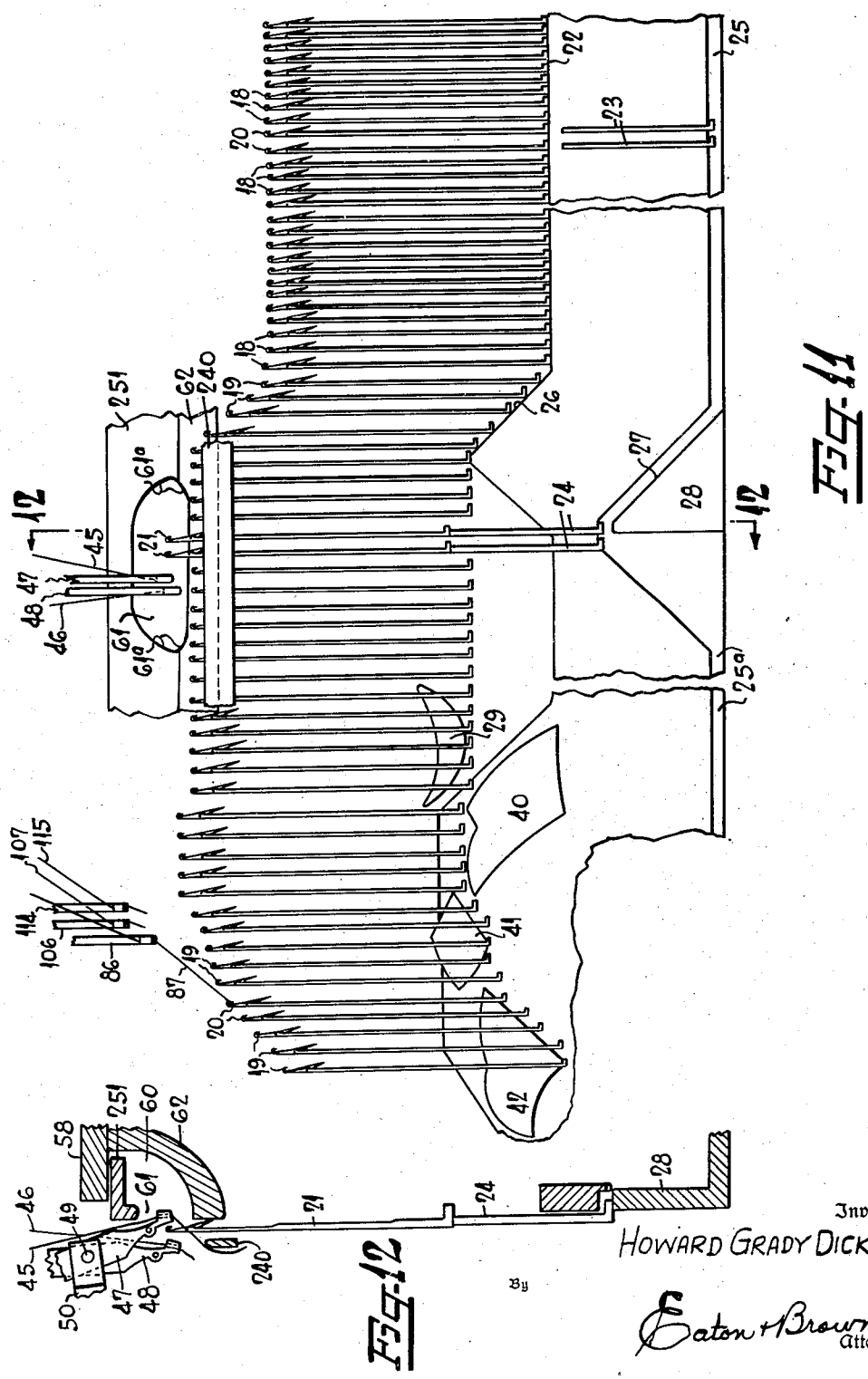


FIG-11

FIG-12

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KNITTING MACHINE

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Fig. 14

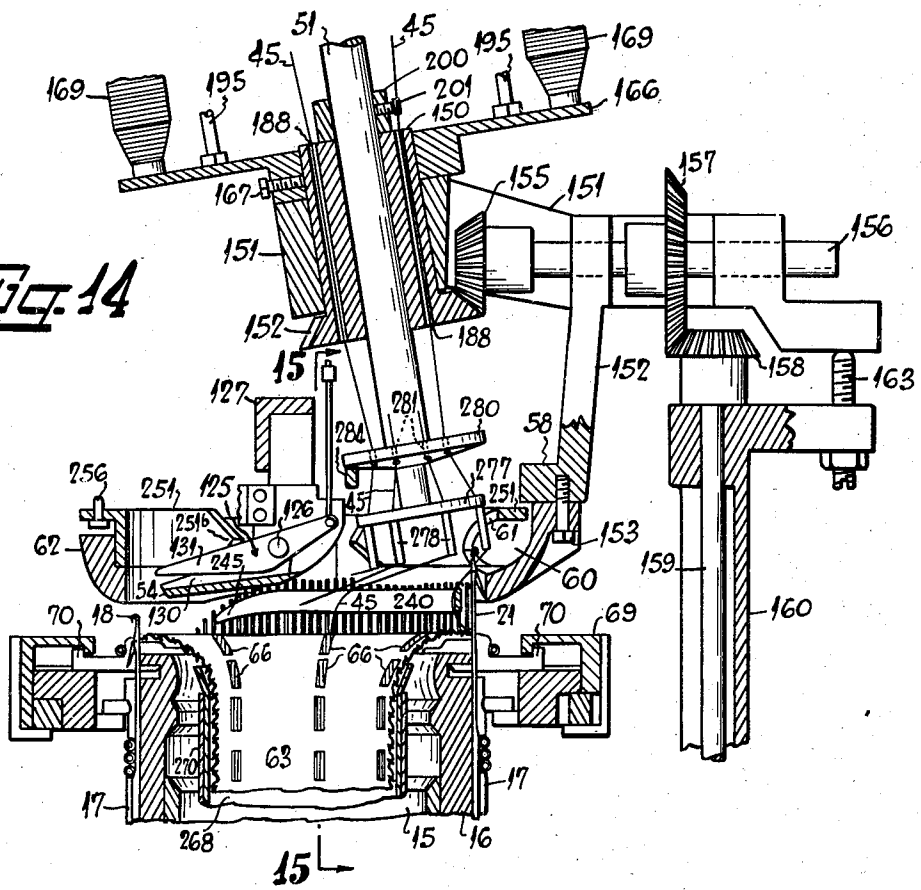
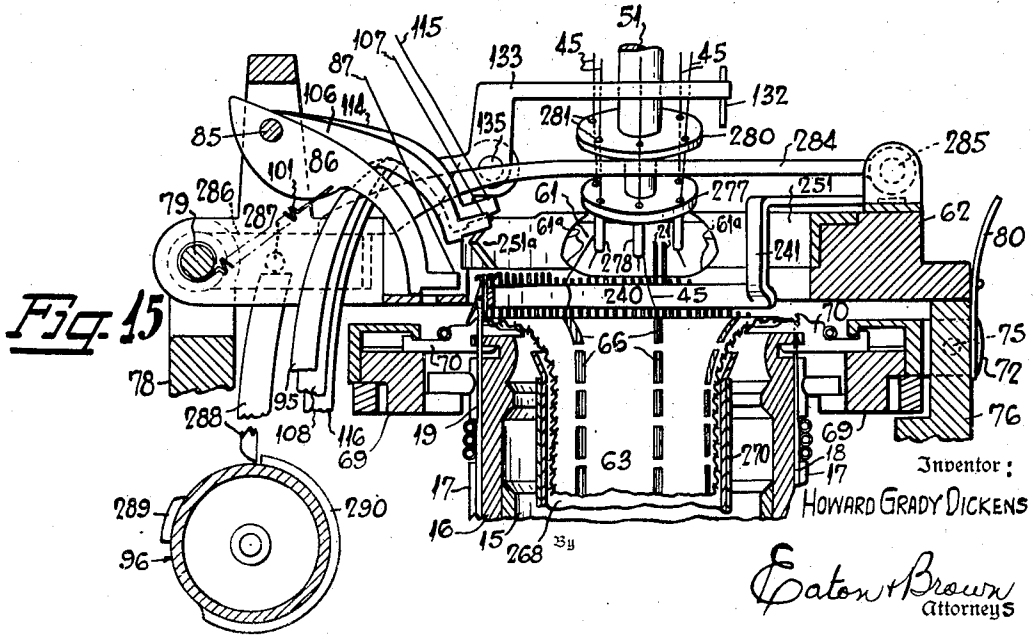


Fig. 15



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Patented Apr. 7, 1942 2,278,869

UNITED STATES PATENT OFFICE

2,278,869

KNITTING MACHINE

Howard Grady Dickens, Thomasville, N. C., assignor, by mesne assignments, to Hemphill Company, a corporation of Massachusetts

Application February 15, 1941, Serial No. 379,053

19 Claims. (Cl. 66—135)

This invention relates to hosiery manufacture and more especially to a wrap stripe apparatus. It is common practice to form walewise stripes, clocks or other ornamentation in hosiery by feeding certain wrap strands to spaced groups of elevated needles during ordinary knitting. These spaced groups are usually elevated above the remaining needles in advance of the knitting point sufficiently to engage the wrap strands as they are fed. At the same time, the conventional stocking yarns or strands are fed to all of the needles in advance of the knitting point thereby resulting in the spaced groups of elevated needles knitting two strands into the stocking. If desired, the spaced groups of needles may have several needles therebetween which are not elevated high enough to engage the wrap strands, resulting in the separated needles knitting the wrap strands and floating the same therebetween. The above-mentioned principles of wrap striping are set forth in my co-pending patent applications Serial No. 312,001 filed January 2, 1940, now Patent No. 2,244,330, and Serial No. 326,074 filed March 26, 1940, now Patent No. 2,244,331.

It is an object of this invention to provide an improvement in a wrap yarn feeding mechanism for circular knitting machines comprising a plurality of radially disposed strand feeding means which are mounted for rotation within the needle circle about a fixed axis which is disposed at an acute angle to the longitudinal axis of the needle cylinder. The axis of rotation of the strand feeding means is inclined so that it approaches the cylinder axis as it progresses upwardly, thereby causing the strand feeding means on the lower end thereof to constantly vary in elevation during rotation. Since there are some who say that difficulty has been heretofore encountered in keeping the wrap strands low enough to be out of engagement with the binder and cutter, and the plate for supporting the same, the parts are so assembled that each wrap strand from its feeding finger clears the binder and cutter plate as it passes therebeneath. In other words, it is possible by employing the inclined axis to position the binder and cutter plate in a lower position than would otherwise be possible.

It is another object of this invention to provide a plurality of radially disposed wrap yarn feed fingers mounted for rotation upon the lower end of an inclined shaft and wholly within the needle circle, in combination with selectively operable cam means for moving the fingers across the needle circle at predetermined times to cause the wrap strands to be engaged by single or spaced groups of raised cylinder needles. These raised needles are subsequently lowered at the knitting point to knit the wrap strands into the stocking along with the regular yarn. By employing cam means to operate the yarn fingers which are normally disposed within the needle circle, it is not necessary to raise the wrap yarn feeding means when the heel and toe portion of the stocking are being knitted.

It is a well known fact that during the knitting of the heel and toe portions of the stockings in circular knitting machines, that certain of the needles are raised to a higher elevation than when knitting other portions. In many cases it is necessary to raise the wrap yarn feeding mechanism a substantial amount during heel and toe knitting to prevent engagement of the raised needles with the feeding attachment, or with the wrap yarns carried thereby.

It is another object of this invention to provide a wrap attachment as above described to be used in combination with a color drum, whereby stripes having yarns of a plurality of colors therein can be formed in stockings.

It is another object of this invention to provide a wrap attachment comprising a plurality of radially disposed wrap strand eyelets mounted for rotation in a circle, which circle intersects with the projected needle circle, said eyelet circle being mounted in a plane which is inclined downwardly and inwardly from the needle circle towards the binder and cutter.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings, in which—

Figure 1 is an elevation of a stocking made with my improved wrap stripe mechanism;

Figure 2 is a sectional plan view of the top portion of a circular knitting machine showing a portion of my invention associated therewith;

Figure 3 is a vertical sectional view taken along the line 3—3 in Figure 2, said view illustrating the interior portions of the needle cylinder, the binder and cutter plate, the latch ring and the wrap thread feeding attachment;

Figure 3A is an enlarged view through the wrap yarn finger support;

Figure 4 is a vertical sectional view taken along the line 4—4 in Figures 2 and 3;

Figure 5 is a sectional view through the color drum illustrating the cam arrangement employed for producing a portion of the color stripes in the stocking;

Figure 6 is a sectional view taken through the main drum of the knitting machine illustrating the cam means for moving the yarn into and out of knitting position during the knitting of the heel and toe;

Figure 7 is a sectional view through the main drum illustrating the cam means for operating the shearing mechanism throughout the knitting of the stocking;

Figure 8 is an elevation taken along the line 8—8 in Figure 2;

Figure 9 is a sectional view through the main drum illustrating cam means for actuating the body and foot yarn feed finger;

Figure 10 is a sectional view through the main drum illustrating the cam means for operating the top yarn feed finger;

Figure 11 is a schematic view looking from the inside of the needle cylinder illustrating the needle, cam and jack arrangement employed in the present embodiment of the invention;

Figure 12 is a vertical sectional view taken along the line 12—12 in Figure 11;

Figure 13 is a plan view similar to the right-hand portion of Figure 2 showing a modified form of the invention;

Figure 14 is a vertical sectional view similar to the central portion of Figure 3, showing another modified form of the invention;

Figure 15 is a sectional view similar to Figure 4, and taken along the line 15—15 in Figure 14.

Referring more particularly to the drawings (Figure 3) the numeral 10 denotes a hollow standard upon which is rotatably mounted a beveled gear 11, said beveled gear meshing with another beveled gear 12 on main drive shaft 13. The central portion of the beveled gear 11 is hollow as at 14 and has integral with the upper portion thereof a circular apron 15, around which needle cylinder 16 is fixedly mounted. This needle cylinder has suitable vertically disposed peripheral grooves 17 therein for accommodating a plurality of knitting needles a few of which are shown and designated by reference characters 18, 19, 20 and 21 (Figure 11).

The cam and needle arrangement is very similar to the disclosure made in my prior patent application Serial No. 326,074. It will be noted that the needles 18 and 19 are identical with the exception that the needles 18 have short butts and the needles 19 have long butts. Similarly, the needles 20 and 21 have short and long butts respectively and are shown positioned in groups of two at spaced intervals in the needle cylinder so that they may be elevated to take the wrap yarn. It is of course to be understood that any desired arrangement of needles can be made. When the needles are in the extreme right-hand position in Figure 11, all the needle butts rest upon the cam ring 22, and during normal operation the needles will move from right to left during knitting. The needles 20 and 21 have short and long butt jacks 23 and 24 thereunder, respectively, the butts on the jacks being adapted to move from right to left within a groove 25 along with their respective needles thereabove.

As the needles 18 to 21 inclusive move to the left, the respective butts gradually approach an inclined cam 26 which serves to raise all needles to a higher elevation and at the same time the butts of jacks 23 and 24 gradually approach an inclined cam surface 27 of a movable cam 28. The inclined surface 27 is positioned so that the butts of the jacks 24 will not contact this surface as quickly as the butts of the needles contact the inclined surface 26 thereabove. This arrangement makes it possible for all of the needles 18, 19, 20 and 21 to be raised by inclined cam surface 26 to a common elevation before the jacks 23 and 24 are raised to elevate their respective needles 20 and 21 to a still higher elevation, such as shown in the central portion of Figure 11. In other words, the needles 21 in the central portion of Figure 11 are higher than the adjacent needles 19 and the hooks of these raised needles are in a position for receiving the wrap strands.

The cam 28 is adapted to be moved in and out at the proper times, that is toward and away from the center of the needle cylinder by a conventional means, not shown. When it is desired that the cam surface 27 engage the butts of all of the jacks 23 and 24 to raise both groups of needles 20 and 21 to wrap strand receiving position, the cam 28 is pushed inwardly toward the center of the needle cylinder the maximum amount by a conventional mechanism, not shown (Figure 12). If it is desired that this cam surface 27 contact only the long butts of the jacks 24, the cam is withdrawn a sufficient amount to clear the short butts of the jacks 23 but at the same time close enough to engage the extremities of the long butts of jacks 24. Under this condition, only the needles 21 will be elevated to wrap strand receiving position.

On the other hand if it is desired not to raise either of the groups of needles 20 or 21, the movable cam 28 can be withdrawn still farther from the needle circle which will permit jacks 23 and 24 to remain in lowered position as shown in the right hand portion of Figure 11. In other words, the jacks 23 and 24 will move in a straight line from groove 25 to groove 25*a* and will not be raised by the inclined cam surface 27. This movable cam therefore provides means whereby certain stripes can be knitted in one portion of the stocking and omitted in the other, as in the case of knitting several stripes on the leg portion and omitting some of these same stripes in the foot portion. After the jacks 23 and 24 pass over the movable cam surface 27 they are again lowered to groove 25*a* to the position previously occupied in the right hand portion of Figure 11.

Although the jacks are lowered to their previous position after passing over cam 28, the raised needles remain in elevated position for a considerable distance. These elevated needles continue their travel to the left (Figure 11) from the cam 28 until a levelling cam 29 is reached, which cam lowers the butts of these needles to an elevated position slightly lower than the top of cam 40. The cam 40 raises the intermediate or lowered needles 18 and 19 to about the same elevation as the raised needles 20 and 21 occupy after contacting the cam 29. After leaving the cam 40, the butts of all the needles move into contact with lowering cam 41 and stitch cam 42 which move the needles to their normal knitting position.

As heretofore stated, the raised needles 21 in Figures 3, 11 and 12 are in a wrap strand receiving position, that is, as these needles pass to the left, the hook portions will engage a wrap strand 45 which serves to form clocks or stripes in the stocking. Also another wrap strand 46 is adapted to be fed at the same point to the elevated needles 20 and 21, if desired. For convenience of description, let us assume that the wrap strand 45 is red and the wrap strand 46 is blue. These wrap strands 45 and 46 are adapted to be projected across the needle circle and into the path of the hooks of the raised needles 20 and 21 by means of suitable pivoted fingers 47 and 48 respectively, both of said fingers being pivoted at a common point such as 49. There are four sets of fingers 47 and 48 in the present disclosure, which fingers are mounted in a cruciform disk 50 (Figure 2), said disk being fixedly

secured upon the lower end of a rotatable shaft 51. The shaft 51 is inclined upwardly at an acute angle to the vertical axis of the needle cylinder thereby causing the lower ends of the fingers 47 and 48 to rotate in a plane which is inclined downwardly from the top of the raised needles 21 toward the center of the needle cylinder. In other words, when the fingers 47 and 48 are in yarn feeding position, the portion of the strand passing therethrough, is at a higher elevation than at any other time during the rotation of shaft 51. This is a very desirable feature because it permits the strand to be lowered at the proper time so that it will easily pass beneath a binder and cutter plate 54.

Normally, the lower ends of the fingers 47 and 48 are wholly within the needle circle and it is only when it is desired to place wrap striping in the stocking that the lower ends of the selected fingers are projected across the needle circle to carry a wrap strand therewith and cause it to be engaged by the high needles 20 or 21, or both. The means for projecting the lower ends of the fingers 47 and 48 across the needle circle at the proper time comprises L-shaped cam levers 55 and 56, the cam lever 55 being adapted to operate fingers 47 and the cam lever 56 being adapted to operate fingers 48. Both of the cam levers 55 and 56 are pivotally mounted as at 57 to the base 58 of a bracket leg 152. Each of the cam levers 55 and 56 has a tension spring 58a which normally tends to move one leg thereof into the path of the upper ends of the fingers 47 or 48 to cause the desired fingers to be rotated about pivot point 49 and to cause the lower ends thereof to cross the needle circle. The amount of rotation of the cam levers 55 and 56 is limited by means of a suitable stop 59.

The control means for the wrap yarn fingers will be described later; however, it should be noted that it is necessary to provide a suitable cavity such as designated by reference character 60 in latch ring 62 and 61 in a gap closing ring 251, so that the lower end of the fingers 47 and 48 may be projected sufficiently beyond the outside of the needle circle so that the projected wrap fingers will pass outwardly and beyond the needle circle so as to clear the upper ends of the raised needles. The extremities of cavity 61 have cam surfaces 61a which serve to either open or close outstanding needle latches during heel and toe knitting to prevent damage or breakage.

The strands 45 and 46 which are engaged by the high needles have the lower ends thereof knitted into a suitable fabric such as stocking 63, said fabric being knitted by the regular body yarns and by means which will be subsequently described. In the present embodiment of the invention, the strands 45 and 46 are employed for placing stripes in the fabric or stocking 63 in the manner shown in Figure 1. Since the strand 45 has been designated as red and the strand 46 designated as blue, the cam and control arrangement for the knitting machine have been so arranged that stripes composed of a series of elongated vertical areas will be formed in the fabric, said stripes comprising alternate red and blue areas 66 and 67 which extend from the lower edge of the stocking top 103 to the toe portion 102.

A conventional sinker ring 69 is provided near the top of the needle cylinder 16. This sinker ring has conventional sinkers 70 therein, the inner ends of which are disposed between the vertically disposed cylinder knitting needles 18, 19, 20 and 21. These sinkers serve to engage the uppermost fabric loops which are disposed around the upper portion of the needles. The uppermost loops which are held by the needles in the needle cylinder form a part of stocking 63 which moves downwardly on the interior of the needle cylinder as it is being knitted.

The near side of the sinker ring 69 as shown in Figure 2 has a pair of spaced projections 71 and 72 integral therewith said projections having bolts 74 and 75 respectively threadably secured thereon. Between the projections is disposed a vertical post 76, and the proximate ends of the bolts 74 and 75 are adapted to engage during heel and toe knitting, the opposed sides of the post. The post 76 extends upwardly from the upper bed plate 77, said bed plate encircling the intermediate portion of the needle cylinder 16 and also being adapted to support another post 78 (Figure 8) which extends upwardly and has pivoted to the upper end thereof as at 79, the latch ring 62 previously mentioned. The free end of the latch ring is adapted to be latched in position to the upper end of the post 76 by any suitable means such as a spring 80.

Body yarn feeding mechanism

The latch ring 62 has pivotally secured thereto as at 85 (Figures 2, 8 and 11), a body yarn feed finger 86, said finger having an eye in the free end thereof through which body strand 87 is adapted to pass during the knitting of the leg portion 88 and the foot portion 89 of stocking 63 (Figure 2). In the position shown in Figures 8 and 11, the finger 86 is lowered and the strand 87 is being fed to all of the needles in the needle cylinder. In other words, the leg portion 88 is being knitted at a point immediately prior to the knitting of heel portion 90. Upon lowering the finger 86, the strand 87 is fed to all of the needles therebelow at a point slightly in advance of the stitch cam 42 (Figure 11).

The body yarn 87 is withdrawn and introduced by means of finger 86 which in turn is raised by a vertically disposed thrust bar 95 (Figures 8 and 9), the lower end of said thrust bar normally resting upon a main drum 96. This drum has cams 97 and 98 on the periphery thereof thereby leaving blank spaces 99 and 100 therebetween. When the lower end of thrust bar 95 is disposed upon the cam 97, the heel portion 90 is being knitted, therefore it is necessary to withdraw the body yarn, and introduce a heel yarn, which will subsequently be described. The heel yarn must be introduced slightly in advance of the removal of the body yarn 87. While the thrust bar 95 is resting upon the blank space 100, the foot portion 89 of the stocking 63 is being knitted and upon completion of the foot portion, the toe 102 is knitted by another yarn to be later described, at which time the thrust bar 95 rides upon the cam 98 to remove the body yarn 87. Yarn 87 remains in the removed position throughout the knitting of the toe portion 102 and the knitting of the top portion 103 on a subsequent stocking.

Top yarn feeding mechanism

The mechanism for feeding the top yarn to the needles for making top portion 103 is illustrated in Figures 2, 8, 10 and 11. This feeding means comprises a feed finger 106 which is likewise pivoted as at 85 alongside the yarn feeding finger 86. The free end of the finger 106 has an eye therein through which top yarn strand

107 passes, and after passing through this eye the yarn is knitted by all of the needles in the knitting cylinder at the knitting point therebelow. A thrust bar 108 has the upper end thereof disposed beneath the free end of the finger 106. The lower end of this thrust bar is adapted to rest either upon the periphery of main drum 95 or upon a cam 110 disposed upon its periphery. When the lower end of the thrust bar 108 is disposed upon the cam 110 as shown in Figure 10, the top yarn feed finger 106 is in raised position so that the top yarn strand 107 will not be engaged or knitted by the needles, but when the drum 95 rotates to a point where the thrust bar 108 falls off the cam 110, the finger 106 is lowered to allow the strand to be introduced to the needles. The finger 106 is maintained in raised position at all times except during the knitting of the top portion 103.

Heel and toe yarn feed mechanism

The mechanism for feeding the yarn during the knitting of the heel and toe of the stocking 63 is illustrated in Figures 4, 6, and 11. A yarn finger 114 is pivoted as at 85, said finger having a hole in its free end through which a strand 115 is adapted to pass. After passing from the free end of the finger 114, the strand 115 is adapted to be engaged by all the needles, when the finger is in lowered position and to be knitted into the heel portion 90 or into the toe portion 102.

The free end of the finger 114 is raised and lowered by means of a thrust bar 116, the upper end of the thrust bar being adapted to rest upon either the periphery of main drum 95 or upon suitable cams 117 and 118 on the periphery of the main drum. These cams 117 and 118 are spaced apart from each other sufficiently to provide blank spaces 119 and 120. When the lower end of the thrust bar 116 is disposed upon the blank space 119 the finger 114 is lowered to permit the heel portion 90 to be knitted; whereas when it is disposed upon the cam 117 the foot portion 89 is being knitted by the conventional body yarn 87, and therefore the heel and toe yarn is withdrawn. Upon reaching the toe portion 102 the body strand 87 is withdrawn and the heel and toe yarn 115 is introduced. The cam 118 serves to hold the heel and toe yarn in withdrawn position during knitting of top portion 103 of stocking 63.

The free ends of each of the yarn fingers 86, 106, and 114 are normally pulled downwardly against the upper ends of their respective thrust bars 95, 108 and 116 by means of tension springs 101. When permitted by the thrust bars to be lowered to yarn feeding positions, the free ends of the fingers are in the position occupied by finger 86 in Figure 8.

Yarn cutting apparatus

Figures 2, 3, 4, and 7 illustrate the apparatus for cutting the strands 87, 107 and 115 during the knitting of the leg, foot, top, toe and heel portions of the stocking. In Figure 3, it is seen that a cutter 125 is mounted as at 126 directly above the inclined binder and cutter plate 54. The binder and cutter plate, in turn, is supported by a bracket 127 (Figure 8) which bracket cantilevers from the free end of latch ring 62 and has one end thereof disposed substantially over the center of the latch ring opening. The cutter 125 is disposed on top of the binder and cutter plate 54 in such a position that as the strands 87, 107 and 115 are withdrawn from knitting position by their respective fingers, they will be passed between the shearing blades 130 and 131 of the cutter 125 and be cut. At the same time the cutter 125 engages a strand to cut the same, the strand will be passed beneath suitable conventional clamps 128 and 129 of the binder which are disposed on top of the binder and cutter plate 54 (Figure 2).

The cutter 125 comprises a fixed blade 130 and a movable blade 131. One end of the movable blade 131 has the lower end of a link 132 pivotally connected thereto, the upper end of said link being fixedly secured in the free end of a lever 133 (Figure 4). Lever 133 is pivoted intermediate its ends as at 135 to the upper portion of latch ring 62. The other end of the lever 133 rests upon a suitable thrust bar 137, the lower end of said thrust bar being adapted to rest upon main drum 95 (Figure 7). The main drum 95 has suitable cams 139, 140, 141, 142 and 143 thereon in the path of the lower end of thrust bar 137. These cams serve to raise the thrust bar 137, which in turn will permit tension spring 134 to operate cutter 125 at the proper time. For example, the cam 139 permits the cutter to be operated when the body yarn 87 is withdrawn, and the heel yarn 115 is introduced to knit the heel portion 90; the cam 140 permits the cutter to be operated when the heel yarn 115 is withdrawn and the body yarn 87 is again introduced; the cam 141 permits the cutter to be operated when the body yarn 87 is withdrawn after knitting the foot portion 89 and when the toe yarn 115 is introduced to knit the toe portion 102; cam 142 permits the cutter to be operated to shear the toe yarn 115 upon its withdrawal prior to the beginning of the top 103 of the next stocking, and finally the cam 143 permits the cutter to be operated by spring 134 to shear the top yarn strand 107 upon its withdrawal while the body yarn 87 is introduced for knitting the leg portion 88.

Wrap yarn attachment

In the preceding portion of the specification, a description has been made of the yarn fingers 47 and 48 which are employed for directing the wrap strands 45 and 46 across the needle circle to allow the selected high needles 20 and 21 to engage the same and knit the strand in the stocking at these needles. The means whereby these fingers are rotated as a unit and the means for supplying the strands to these fingers will now be described (Figure 3). The shaft 51 upon which the fingers 47 and 48 are pivotally mounted is, in turn, slidably mounted in a suitable hub 150 said hub being rotatably mounted in a bracket 151. The bracket 151 has a downstanding leg 152 integral therewith, the lower end of the leg having a base 58 which is secured to the upper portion of the latch ring by any suitable means such as bolts 153. The hub portion 150 has integral with the lower portion thereof a beveled gear 154, said gear meshing with another beveled gear 155 on the end of a horizontal shaft 156. This shaft is also rotatably mounted in bracket 151. Another beveled gear 157 is fixedly secured upon the shaft 156, which gear 157 meshes with a beveled gear 158 on the upper end of a vertically disposed drive shaft 159, said drive shaft being rotatably mounted in bracket 160 and also in upper bed plate 77 and lower bed plate 161 (Figure 3).

On the lower end of the shaft 159, a pinion 162 is fixedly mounted, and this pinion meshes

with a beveled gear 164 on main drive shaft 13. It is therefore seen that members 154, 155, 156, 157, 158, 159, 162 and 164 provide a driving connection between the hub 150 and the main drive shaft 13. The right hand end of bracket 151 is supported by a set screw 163 extending upwardly from bracket 160 (Figure 3).

Fixedly secured around the hub 150 and above the brackets 151 is a disk 166 by any suitable means such as set screw 167. This disk serves as a support for a plurality of packages of wrap strands such as designated by the reference characters 169 and 170, there being a package for each wrap feed finger. In the present disclosure the package 169 has the red strand 45 emanating therefrom, which passes downwardly through the lower end of pivoted finger 47, whereas the package 170 has the blue strand 46 emanating therefrom, which passes downwardly through the lower end of finger 48. Each of the strands 45 and 46 pass through a hole 175 in a second disk 176 which disk 176 is fixedly secured to the upper end of shaft 51 by any suitable means such as set screw 177. A washer 178 is normally pressed over each of the holes 175 by any suitable means such as spring 179. The spring and washer are mounted around a pin 180 and serve as means for applying the necessary friction upon the strand while passing through the hole 175. After passing through hole 175 the strand passes beneath a suitable guide wire 181, and then upwardly through a hook portion 182 on the free end of a take-up wire 183, said take-up wire 183 being pivotally mounted as at 184 in a pin 185. The other end of the take up wire 183 is engaged by a tension spring 183a which rotates the wire and takes up the slack in the strand.

After passing from hook portions 182 the strands 45 and 46 pass through holes 186 in the disk 176, and then through bores 188 in the hub 150. From the lower ends of the bores 188 the strands 45 and 46 pass through the eyelets or holes in the lower ends of wrap yarn fingers 47 and 48 respectively. It is evident that there must be a package of yarn 169 for each of the fingers 47 and also a package of yarn 170 for each of the fingers 48.

The sizes of gears 11, 12, 162, 164, 158, 157, 155 and 154 is such that the rotation of the needle cylinder 16 will be synchronized with the rotation of the shaft 51. In other words, it is necessary that the needle cylinder 16 rotate at the same number of revolutions per minute as the shaft 51.

Also it will be noted that the disks 166 and 176 are connected by means of suitable rods 195, the said rods having their lower ends secured to the disk 166 and having their upper ends slidably mounted in disk 176. The rotation imparted to gear 154 and hub 150 by the beveled gear 155 will be transmitted to the disk 176 by way of rods 195. The disk 176, in turn, will transmit this rotation to the shaft 51 since it is fixedly secured thereto by means of a set screw 177.

The intermediate portion of the shaft 51 has a collar 200 secured thereto by means of set screw 201. This collar serves to limit the lowermost position of the feed fingers 47 and 48 and permits proper adjustment of position relative to the hooks of the needles. If for any reason, it is desired while working on the machine to manually pull the shaft 51 upwardly for a short distance, so that the lower ends of the fingers will be above the latch ring, the sliding fit between the members 51 and 151 and members 195 and 176 permits this to be done. However, it is not necessary during normal operation of the apparatus to raise the fingers 47 and 48 or the shaft 51 from the position shown, because the lower ends of these fingers are normally held within the needle circle by means of tension springs 48a (Figure 3A). In the present embodiment of the invention, there are four pairs of fingers, each pair having a wrap yarn finger 47 pivoted on one side of the member 50 and a finger 48 pivoted on the other side. The lower ends of each pair are connected by a tension spring 48a, which pulls these lower ends toward each other and against restricted portion 50a which acts as a stop.

Finger control for wrap yarn strand

In the foregoing description, the actuation of the yarn feed fingers 47 and 48 by the cam levers 55 and 56 has been described. It is necessary that a suitable control means be employed for operating the cam levers 55 and 56 at the proper time to insure that the proper ornamentation such as red and blue areas 66 and 67 will be provided in the stocking (Figure 1). When it is desired for the red strands 45 to be knitted into the stocking as at 66, it is necessary for the cam lever 55 to engage the upper ends of the corresponding yarn fingers 47 to move the lower ends thereof across the needle circle and thereby cause the wrap strand to move across the path of raised needles 20 and 21. On the other hand, when it is desired to insert the blue strand 46, in areas 67 of the stocking 63, it is necessary to operate the cam lever 56 in a like manner. Of course when it is desired to withdraw both the red strand and the blue strand to thereby allow only the stocking yarns to be knitted, then both of the cam levers are withdrawn by their respective cams to the position occupied by lever 56 in Figure 2. When both levers are withdrawn, the yarn fingers 47 and 48 will rotate entirely within the needle circle.

One leg of the lever 55 has one end of a link 202 pivotally connected thereto, the other end of said link being slidably mounted in upstanding arm 203 of a lever broadly designated by reference character 204 (Figures 2 and 4). A collar 205 is disposed around the rod 202 at the desired position in order to serve as a stop and prevent parts 203 and 202 from becoming separated. Lever 204 also has extending therefrom a laterally projecting arm 206, the outer end of which has a vertically disposed rod 207 slidably penetrating the same. The upper end of this rod has a collar 208 disposed therearound which serves to tie the members 206 and 207 together. The lower end of the rod 207 is connected to a lever 209, which lever has a downstanding leg 210, said downstanding leg being adapted to engage the periphery of a color drum 211, or to engage one of the cam sections 212. When the lower end of lever 210 engages the periphery of color drum 211 as shown in Figure 4, the cam lever 55 will be permitted to move to the position shown in Figures 2 and 3 thereby causing the fingers 47 to be actuated and the red strands 45 to be drawn across the needle circle for engagement by the high needles. When the lower end of the lever 210 is on the cam section 212, the cam lever 55 will not engage the upper ends of fingers 47; therefore, none of the wrap strands 45 will be introduced to the elevated needles.

In a similar manner, the lower lever 56 cooperates with the fingers 48, through which fingers the blue strands 46 pass. One leg of the cam lever 56 has a link 215 connected thereto,

the other end of said link being slidably mounted in upstanding arm 216 of a lever broadly designated by the reference character 217. A suitable collar 218 is fixedly secured upon the link 215 to prevent members 215 and 216 from becoming separated. Also extending from the lever 217 is a laterally projecting arm 220, the outer end of which is slidably penetrated by the upper end of a link 221. A collar 222 is disposed upon the rod 221 and above the arm 220 to prevent parts 221 and 220 from becoming separated.

Figure 5 shows the structural connection between the lower end of link 221 and the color drum 211. It is here seen that the color drum 211 has a cam section 223 thereon spaced in the proper position to cause the wrap strand fingers 48 to be actuated at the proper time to introduce strands 46. The lower end of link 221 is pivotally connected to one leg of a bell crank lever 224, which lever has a downstanding leg 225 for contacting either the periphery of color drum 211 or the raised cam surface 223. In the drawings, all of the cam surfaces on the color drum 211 as well as on the main drum 95 are positioned properly with respect to each other for operation of the knitting machine while the leg portion 88 of the stocking 63 is being knitted. When the lever 224 is positioned as shown in Figure 5, the cam lever 56 will be withdrawn from contact with the upper portions of fingers 48 and therefore these fingers will not be actuated. Of course, when the drum 211 rotates a sufficient distance to permit the leg 225 to engage the periphery of the drum between the ends of cam surface 223, then the cam lever 56 will be released to permit one of the springs 58 to throw a leg of lever 56 into the path of the feed fingers 48. If desired, both cam levers 55 and 56 may be operated to press the upper ends of a set of fingers 47 and 48 inwardly to simultaneously throw both of their threads in front of a selected needle. This would only necessitate the proper arrangement of the cam surfaces 212 and 223 on drum 211.

During the knitting of the heel and toe, it is desirable that both of the cam levers 55 and 56 be held in an inoperative position so that then neither of the fingers 47 or 48 will be actuated and therefore no wrap yarn will be introduced. In order to provide this feature, the main drum 95 (Figure 4) is provided with suitable cam surfaces 230 and 231 thereon, thereby leaving low spaces 232 and 233 therebetween. A suitable thrust bar 234 is adapted to rest either upon the spaces 232 or 233 or upon cam surfaces 230 or 231, depending upon the portion of the stocking which is being knitted. The upper portion of the thrust bar 234 has a laterally extending pin 237 extending therefrom (Figure 2) which pin is disposed beneath suitable arms 238 and 239 on levers 204 and 217, respectively. During the knitting of the heel portion 90 (Figure 1), the cam surface 230 rides beneath the thrust bar 234 and thereby raises both of the arms 238 and 239 to the position occupied by arms 239 in Figure 4. This, of course, will cause both of the cam levers 55 and 56 to be withdrawn from contact with feed fingers 47 and 48, resulting in none of the wrap strands being introduced.

There are times when the lower end of the thrust bar is disposed upon the blank spaces 232 and 233 that both of the cam levers 55 and 56 should be withdrawn. In other words, when the spaces between the elongated areas 66 and 67 in stocking 63 are being knitted, neither of the wrap strands 45 and 46 will be introduced yet the leg and foot portion of the stocking is being formed. In order to produce this result, it is necessary to cause the cam 212 to overlap the cam 223 on the color drum 211 to thereby simultaneously raise the vertical legs 210 and 225 of the levers 209 and 224 respectively, during the knitting of the courses between the areas 66 and 67.

Wrap strand guard and support

It is necessary to provide means for supporting the wrap strands on the inside of the needle circle so that the hooks of the raised needles will properly engage the same and so that the strands will be held above the needle latches until they are knitted. In order to provide this supporting means, a suitable arcuate horn or guard 240 is provided, said horn extending through about a one hundred and eighty degree arc within and parallel to the needle circle. This horn has an L-shaped portion 241 integral therewith which in turn is secured to a bracket 242 by any suitable means such as screws 243. The shapes and width of this guard or horn is such as to maintain the proper position of each wrap strand as it moves from the point of engagement by the high needles to the knitting point. At the knitting point, the arcuate horn 240 is narrowed in width and its upper and lower edges are pointed slightly downwardly as at 245 so that the proper tension will be provided on a wrap strand, as it is being released for knitting and so that the strand will be guided evenly onto the needles.

In other words, the engaged wrap strand floats over the guard and in contact with it until the knitting point is reached. When the wrap strand is first engaged, it is properly guided beneath the needle hooks and above the needle latch throats to prevent chafing or severing of the strand. The portion is slotted for the reception of the screws 243 so as to permit adjustment of the guard with relation to the needles, the slots being somewhat larger than the screws 243.

It is seen that the guard 240 is adjustably mounted so that it can be concentrically or laterally adjusted. It is seen that the selected needles which have been raised into position to receive the wrap strands have the pivotal points of their latches passing beneath the beveled or inclined portion 245 so that the wrap strands are protected from the latches of the needles. This inclined portion is extending into close proximity to the knitting point where the needles are lowered by the stitch cam to make the stitch. It will be seen that the yarn at that time is held up in the hook or hooks of the needle or needles so that the latches cannot touch the wrap strand or strands while the needles are moving downwardly to make the stitch. It is seen that this guard holds the wrap strands at an elevation so that they are taken only by the selected striping needles which are raised above the upper edge of the guard.

Latch ring operating mechanism

A gap 250 is provided in the latch ring into which the conventional yarn feed fingers are adapted to operate. It is very essential that this gap be closed during heel and toe knitting to prevent the latches in the needles from flying outwardly and becoming broken against the sidewalls of the gap. In order to provide this feature, a gap closing ring 251 is provided, said gap closing ring 251 having a recess or notch 61 therein for receiving the lower ends of projected wrap strand fingers 47 and 48. The latch ring

normally has a gap therein sufficiently wide to span the gap 250, while the top, leg and foot portion of the stocking is being knitted. The proximate ends of the gap closing ring 251 are bevelled as at 251a and 251b to prevent injury to the latches of the needles. The latch ring also has a cavity 60 in the same coinciding with gap 61 when the gap closing ring 251 is in normal position where the throat latch is open. When the heel and toe portion is being knitted, however, it is necessary to rotate this latch ring a sufficient amount to close the gap 250. Figure 8 shows mechanism for producing this result. It is here seen that the gap closing ring 251 has connected thereto as at 255, a link 256. The other end of the link 256 is connected to the upper end of a lever 257 and this lever, in turn, is pivoted as at 258 to post 78. The lever 257 has integral therewith a laterally extending arm 260, said arm resting upon a projection 261 on thrust bar 262. The lower end of this thrust bar 262 is adapted to rest either upon the periphery of main drum 96 or upon cam surfaces 263 or 264. When the heel portion of the stocking is reached, the cam surface 263 rides beneath the thrust bar 262 and raises the same to thereby cause the gap closing ring 251 to be rotated the proper amount for closing the gap 250. Likewise when the toe portion is reached, the thrust bar 262 is again raised in the same manner by cam 264. A suitable tension spring 265 is provided for normally returning the gap closer ring to the proper position.

Fabric support

It is desirable to support the upper portion of the fabric in a manner such as shown in Figure 3, during knitting. In order to accomplish this result, a tubular member 268 is provided, the upper end of which is flared outwardly and disposed below the top of the needle cylinder 16. The fabric, after it is knitted is fed inwardly by sinkers 70 and then conducted downwardly through the tubular member 268. The tubular member 268 is telescopically mounted in a second tubular member 270, said tubular member 270 being disposed on the inside of the needle cylinder and having a pin 271 integral with the lower portion thereof. This pin is adjustably mounted in a laterally extending pin 272 and is held in adjusted position by means of a set screw 273.

Figure 13 shows a slightly modified form of the invention. In describing this form like reference characters will be given like parts, and a detailed description will be given only of the parts which differ. The essential difference between the form shown in Figure 13 and the preceding form is that eight separated radially disposed feed fingers 47 are pivotally mounted as at 49, in a star-shaped disk 275 instead of four pairs of adjacent fingers. The disk 275 is fixedly secured on the lower end of shaft 51 as in the preceding form. The equally spaced yarn fingers 47 may vary in number and are all operated by a single cam lever 55 and the cam lever, in turn, may be operated in the same manner as in the preceding form. For example, when it is desired that eight separate stripes be inserted in the leg or the foot portion of the stocking, the cam lever 55 is held in the position shown in Figure 13. When it is desired that no stripes be placed in the stocking, the cam lever is moved to a non-engaging position. In this form of the invention it is not possible to diversify the colors in each individual stripe, because only one lever 55 is employed for actuating the yarn fingers 47.

Figures 14 and 15 show still another modified form of the invention in which the lower end of shaft 51 has a disk 277 fixed thereon, which disk has a plurality of tubular members 278 extending downwardly therefrom. The lower ends of these tubular members are adapted to intersect the upward projection of the needle circle in its circular travel and thereby carry strands of yarn such as designated by the reference character 45 into the path of raised groups of needles 20 or 21. A second disk 280 is disposed directly above the disk 277 and this disk has holes 281 therein corresponding to the tubular members 278. These holes accommodate the strands 45 and guide them between the bores 188 and the tubular members 278.

The shaft 51 is slidably mounted in the hub member 150 and when in lowermost position the collar 200 and set screw 201 serve to limit the downward movement.

Since the tubular members 278 normally pass across the needle circle, when rotating, it is necessary that these tubular members be moved upwardly during the knitting of the heel and toe portions of the stocking, because at this time, some of the needles are elevated slightly higher than in normal operation and would therefore strike the tubular members 278 if they were not raised. In order to effect this raising of the shaft 51 and the associated tubular members 278 during the knitting of the heel and toe, a suitable lever 284 is pivotally secured as at 285 to the free end of the latch ring 62. This lever extends beneath the disk member 280 and has its free end resting upon the free end of a second lever 286, said lever 286 being pivotally mounted. Extending laterally from the lever 286 is a pin 287 beneath which the upper end of a thrust bar 288 is adapted to fit. The lower end of the thrust bar rests upon the periphery of the main drum 96, or upon cam surfaces 289 or 290. When the lower end of thrust bar 288 is resting upon the periphery of the main drum 96 as shown in Figure 15, the shaft 51 and associated parts are permitted to be lowered to the position shown in Figure 14 where the wrap yarn is introduced to the elevated needles, but when the cam surface 289 is reached, the heel portion is being knitted and therefore it is necessary to raise the tubular members 278 and shaft 51. Likewise, when the toe portion and the top of the stocking are being knitted, the thrust bar will ride upon the cam surface 290 to hold the tubular members 278 and the wrap strands out of the path of the needles.

It has already been described as to how the shaft 51 is driven as it is clear in Figure 3 that the disk 166 is secured to the hub 150 forming a part of beveled gear 154, and disk 166 has rods 195 which slidably penetrate the disk 176 secured on shaft 51 and therefore shaft 51 is driven through gear 154, hub 150, disk 166, rods 95 and disk 176.

In the modified form of the invention shown in Figure 14, the same driving arrangement may be employed, as it is evident in Figure 3 that the rods 195 are long enough to permit shaft 51 to be raised upwardly during heel and toe knitting a sufficient amount to clear the needles without the disk 176 passing beyond the upper end of rods 195.

In the drawings and specification there has been set forth a preferred embodiment of the invention, and although specific terms are employed, they are used in a generic and descriptive

sense only and not for purposes of limitation, the scope of the invention being set forth in the following claims.

I claim:

1. A circular independent needle knitting machine having a rotary needle cylinder, means for wrapping strands around a group of selected needles comprising a plurality of wrap strand fingers rotating on a fixed axis in a plane inclined to both vertical and horizontal planes passing through the needle cylinder at a point on said axis which is disposed within the projected needle cylinder.

2. A circular independent needle knitting machine having a rotary needle cylinder, means for wrapping strands around a group of selected needles comprising a plurality of wrap strand fingers rotating on a fixed axis in a plane inclined to both vertical and horizontal planes passing through the needle cylinder at a point on said axis which is disposed within the projected needle cylinder, said fingers being arranged in movable pairs, and means for selectively moving one of a pair across the needle circle to present a wrap strand to selected needles.

3. A circular independent needle knitting machine having a rotary needle cylinder, means for wrapping strands around a group of selected needles comprising a plurality of wrap strand fingers rotating on a fixed axis in a plane inclined to both vertical and horizontal planes passing through the needle cylinder at a point on said axis which is disposed within the projected needle cylinder, pattern means for causing selected fingers to be moved across the needle circle to cause a wrap strand to be presented to a selected needle.

4. In a circular independent needle knitting machine having a rotary needle cylinder, a shaft disposed above the needle cylinder and lying within the confines of the projected circle of needles, said shaft being inclined outwardly towards the needle circle at its lower end, a plate fixed on the lower end of the shaft and a plurality of wrap strand feeding fingers carried by said plate, pattern means for selectively moving the fingers across the circle of needles for placing wrap strands carried by the moved fingers in front of selected raised needles.

5. In a circular independent needle knitting machine having a rotary needle cylinder, a shaft disposed above the needle cylinder and lying within the confines of the projected circle of needles, said shaft being inclined outwardly towards the needle circle at its lower end, a plate fixed on the lower end of the shaft, a plurality of wrap strand feeding fingers carried by said plate, the wrap feeding fingers being movably arranged in pairs, and pattern means for selectively moving one of a pair across the circle of needles to present a wrap strand to a selected raised needle.

6. A knitting machine having a rotary needle cylinder, means for feeding at least one yarn to all the needles, means for clamping and severing withdrawn yarns and a plate disposed within the needle circle for supporting the clamping and severing means, means for presenting one or more wrap strands to selected needles comprising a plate rotating on a fixed axis disposed above the needle cylinder and within the confines of the projection of the circle of needles, said plate having a plurality of wrap strand fingers for feeding wrap strands across the needle circle, the plane in which the lower ends of the wrap strand fingers rotate, when projected, passing substantially below the lower surface of the clamp and cutter plate.

7. A knitting machine having a rotary needle cylinder, means for feeding at least one yarn to all the needles, means for clamping and severing withdrawn yarns and a plate disposed within the needle circle for supporting the clamping and severing means, means for presenting one or more wrap strands to selected needles comprising a second plate rotating on a fixed axis disposed above the needle cylinder and within the confines of the projection of the circle of needles, said second plate having a plurality of wrap strand fingers pivotally mounted therein, pattern controlled means for swinging the lower ends of the fingers across the needle circle to cause selected needles to take wrap strands in advance of the knitting point, the plane in which the lower ends of the wrap strand fingers rotate, when projected, passing substantially below the lower surface of the first plate.

8. A knitting machine having a rotary needle cylinder, means for feeding at least one yarn to all the needles, means for clamping and severing withdrawn yarns and a plate disposed within the needle circle for supporting the clamping and severing means, means for presenting one or more wrap strands to selected needles comprising a plate rotating on a fixed axis disposed above the needle cylinder and within the confines of the projection of the circle of needles, said rotating plate having a plurality of wrap strand fingers pivotally mounted therein, means for swinging the lower ends of the fingers across the needle circle to cause selected needles to take wrap strands in advance of the knitting point, the plane in which the lower ends of the wrap strand fingers rotate, when projected, passing substantially below the lower surface of the clamp and cutter plate.

9. A knitting machine having a rotary needle cylinder, means for feeding at least one yarn to all the needles, means for clamping and severing withdrawn yarns and a plate disposed within the needle circle for supporting the clamping and severing means, means for presenting one or more wrap strands to selected needles comprising a plate rotating on a fixed axis disposed above the needle cylinder and within the confines of the projection of the circle of needles, said rotating plate having a plurality of wrap strand fingers pivotally mounted therein, pattern controlled means for swinging the lower ends of some of the fingers across the needle circle to cause selected needles to take wrap strands in advance of the knitting point, the plane in which the lower ends of the wrap strand fingers rotate, when projected, passing substantially below the lower surface of the clamp and cutter plate.

10. In a circular knitting machine having a rotary needle cylinder with needles mounted therein, and also having means for feeding a body strand to said needles, a wrap yarn attachment comprising a plurality of yarn feeding fingers normally disposed within the needle circle and being rotatable about a fixed axis inclined upwardly and toward the vertical axis of the needle cylinder, means for elevating certain of the needles, and means for moving said wrap yarn feeding fingers across the needle circle to cause the wrap yarn carried thereby to be engaged by the elevated needles and to be knitted into a fabric.

11. In a circular knitting machine having a needle cylinder and means for feeding a body yarn to the needles, a plurality of wrap yarn feeding means disposed within the needle circle and rotatable about a fixed axis inclined to the longitudinal axis of said cylinder, means for elevating groups of selected needles, and means for passing said wrap yarn feeding means outwardly and across said needle circle to thereby position wrap yarns in the path of the said elevated needles.

12. In a circular knitting machine having a needle cylinder and means for feeding a body yarn to the needles, means for elevating groups of selected needles, a clamp and cutter plate mounted within the needle circle, a plurality of wrap yarn feeding means mounted for rotation about a fixed axis within the needle circle, projecting radially from the axis and positioned between the plate and the elevated needles, said fixed axis being inclined upwardly and above said plate whereby the radially disposed yarn feeding means will be in an uppermost position when delivering yarns to the elevated needles and in a lowermost position when passing beneath the clamp and cutter plate.

13. A circular independent needle knitting machine having a rotary needle cylinder, means for wrapping strands around a group of selected needles comprising a plurality of wrap strand fingers rotating on a fixed axis in a plane inclined to both vertical and horizontal planes passing through the needle cylinder at a point on said axis which is disposed within the projected needle cylinder, said fingers being arranged in movable pairs, means for selectively moving one of the pairs across the needle circle to present a wrap strand to selected needles, and means for moving the wrap strand fingers to normal position after the wrap strands have been caught by the selected needles.

14. A circular independent needle knitting machine having a rotary needle cylinder, means for wrapping strands around a group of selected needles comprising a plurality of wrap strand fingers rotating on a fixed axis on a plane inclined to both vertical and horizontal planes passing through the needle cylinder at a point on said axis which is disposed within the projected needle cylinder, pattern means for causing selected fingers to be moved across the needle circle to cause a wrap strand to be presented to a selected needle, and means for moving the wrap strand fingers to normal position after the wrap strands have been caught by the selected needles.

15. In a circular independent needle knitting machine having a rotary needle cylinder, a shaft disposed above the needle cylinder and lying within the confines of the projected circle of needles, said shaft being inclined outwardly towards the needle circle at its lower end, a plate fixed on the lower end of the shaft, a plurality of wrap strand feeding fingers carried by said plate, pattern means for selectively moving the fingers across the circle of needles for placing wrap strands carried by the moved fingers in front of the selected raised needles, and means for moving the wrap strand fingers to normal position after the wrap strands have been caught by the selected needles.

16. In a circular independent needle knitting machine having a rotary needle cylinder, a shaft disposed above the needle cylinder and lying within the confines of the projected circle of needles, said shaft being inclined outwardly towards the needle circle at its lower end, a plate fixed on the lower end of the shaft, a plurality of wrap strand feeding fingers carried by said plate, the wrap feeding fingers being arranged in pairs to be movable from a normal position within the circle of needles to a wrapping position overlapping the needles, a pattern means for selectively moving one of a pair across the circle of needles to present a wrap strand to a selected raised needle, and means for moving the wrap strand fingers to normal position after the wrap strands have been caught by the selected needles.

17. A knitting machine having a rotary needle cylinder, means for feeding at least one yarn to all the needles, means for clamping and severing withdrawn yarns and a plate disposed within the needle circle for supporting the clamping and severing means, means for presenting one or more wrap strands to selected needles comprising a plate rotating on a fixed axis disposed above the needle cylinder and within the confines of the projection of the circle of needles, said rotating plate having a plurality of wrap strand fingers for feeding wrap strands across the needle circle and movable from a normal position within the circle of needles to a wrapping position overlapping the needles, the plane in which the lower ends of the wrap strand fingers rotate, when projected, passing substantially below the lower surface of the clamp and cutter plate, and means for moving the wrap strand fingers to normal position after the wrap strands have been caught by the selected needles.

18. In a circular independent needle knitting machine having a rotary needle cylinder, a shaft disposed above the needle cylinder and lying within the confines of the projected circle of needles, said shaft being inclined outwardly toward the needle circle at its lower end, a plate at the lower end of the shaft rotatable therewith and carrying a plurality of wrap yarn feeding elements, a binder and cutter located within the circle of needles and having a binder plate as the lowermost element thereof inclined upwardly in the direction of the lower end of said shaft and plate rotatable therewith, the construction being such that wrap yarns feeding from the wrap yarn feeding elements are guided below the said binder plate as they are carried across the needle circle thereby to avoid interference with the binder and cutter.

19. In a circular independent needle knitting machine, a rotary needle cylinder, a binder and cutter having a binder plate located within the circle of needles, and wrap yarn feeding means including a rotatable shaft eccentrically arranged with respect to the circle of needles and inclined outwardly at its lower end at which it carries wrap yarn feeding means for guiding wrap threads to selected needles or groups of needles, means for rotating said wrap yarn feeding means at a 1 x 1 ratio with the needles, the said binder plate being inclined upwardly in the direction of the wrap yarn feeding means and at an angle substantially normal to the shaft, the relative elevations of the wrap yarn feeding means at the lower end of the shaft and the binder plate being such that in combination with the angular inclination of the elements, the wrap yarns when drawn outwardly and carried around by needles having taken said yarn, will not interfere with the binder and cutter.

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