

March 9, 1937.

V. C. ELWELL

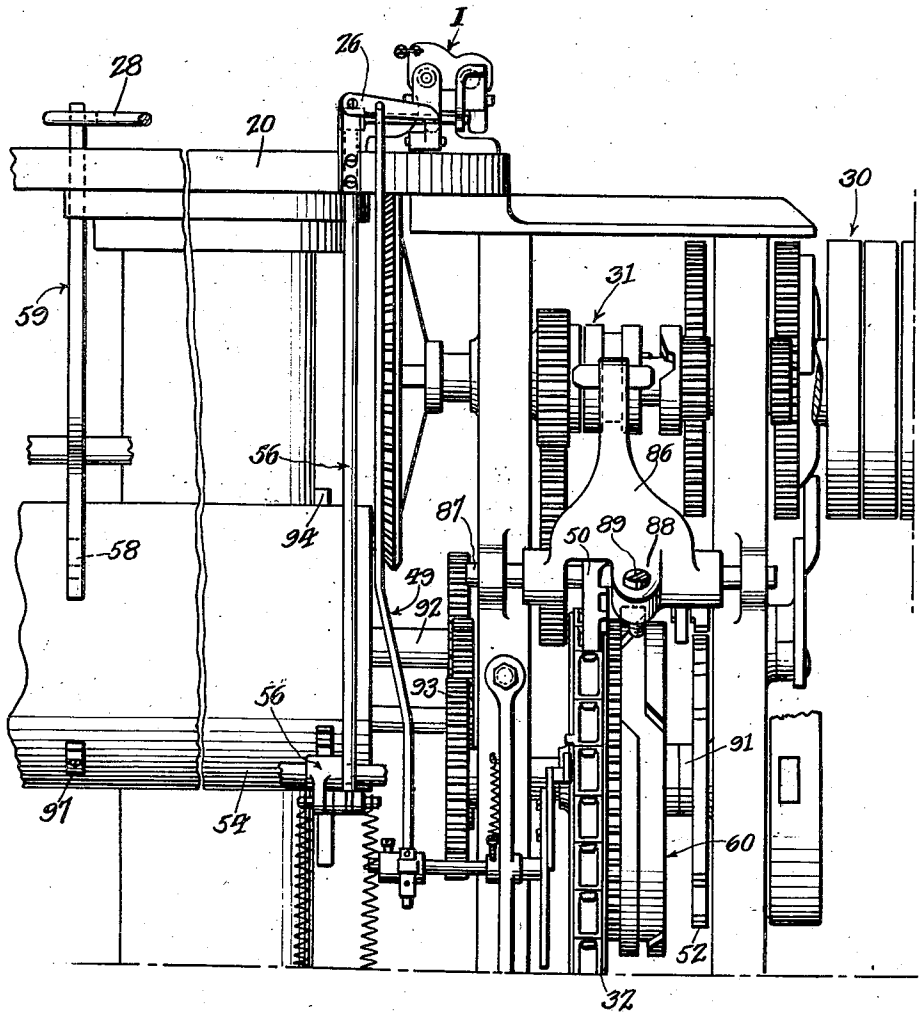
2,073,554

AUTOMATIC CIRCULAR KNITTING MACHINE

Filed Dec. 20, 1934

9 Sheets-Sheet 1

Fig. 1.



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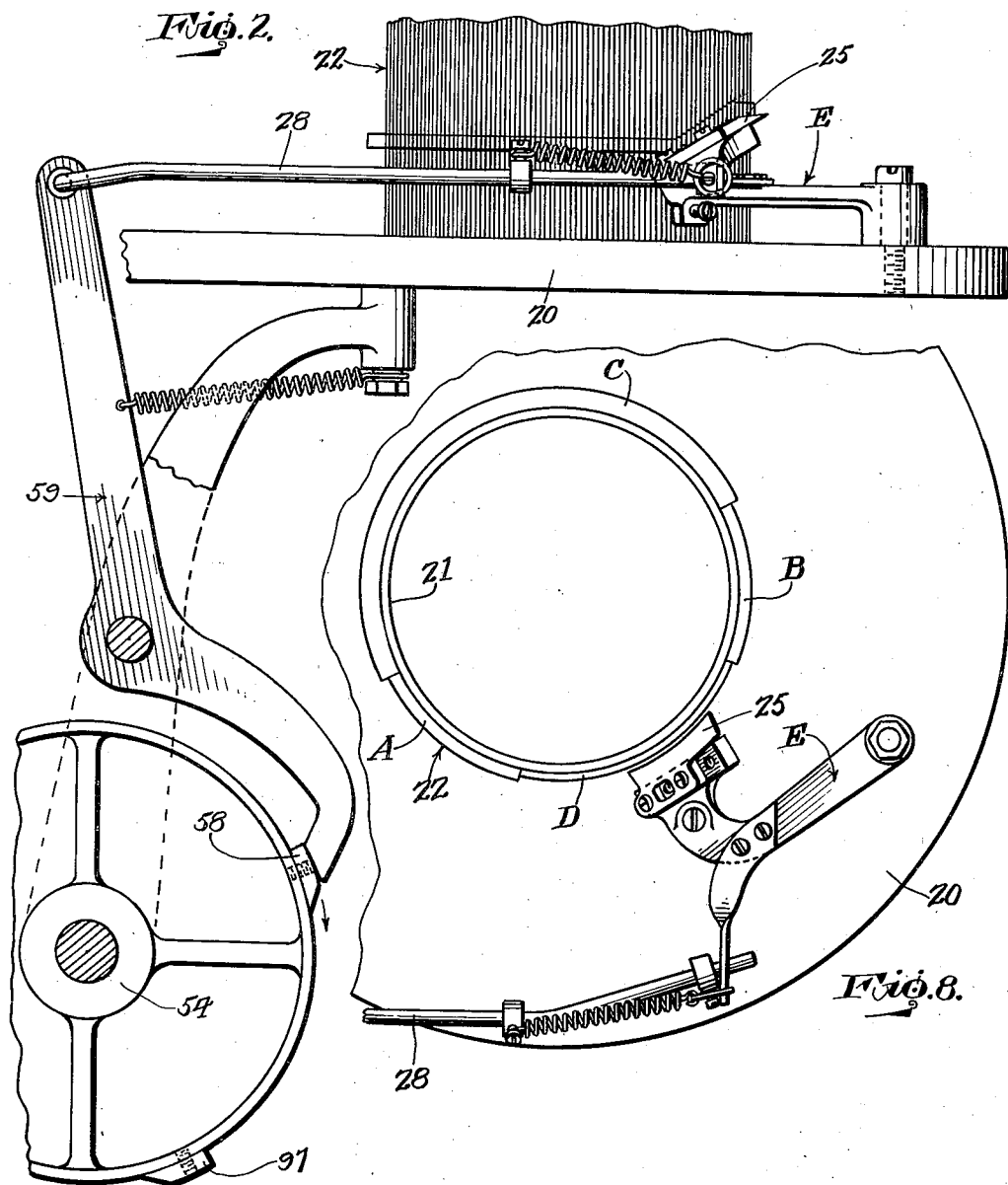
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2,073,554

AUTOMATIC CIRCULAR KNITTING MACHINE

Filed Dec. 20, 1934

9 Sheets-Sheet 2



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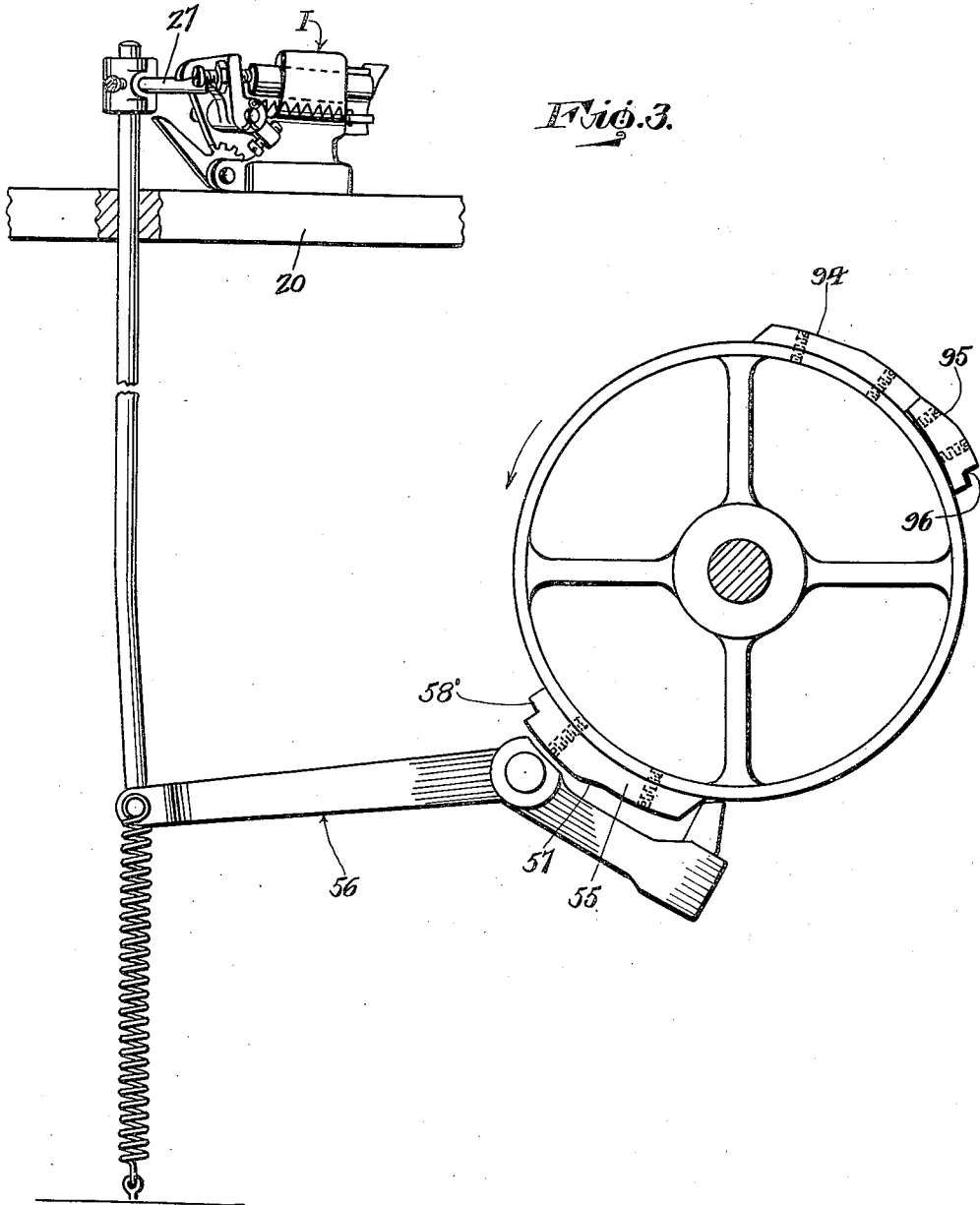
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2,073,554

AUTOMATIC CIRCULAR KNITTING MACHINE

Filed Dec. 20, 1934

9 Sheets-Sheet 3



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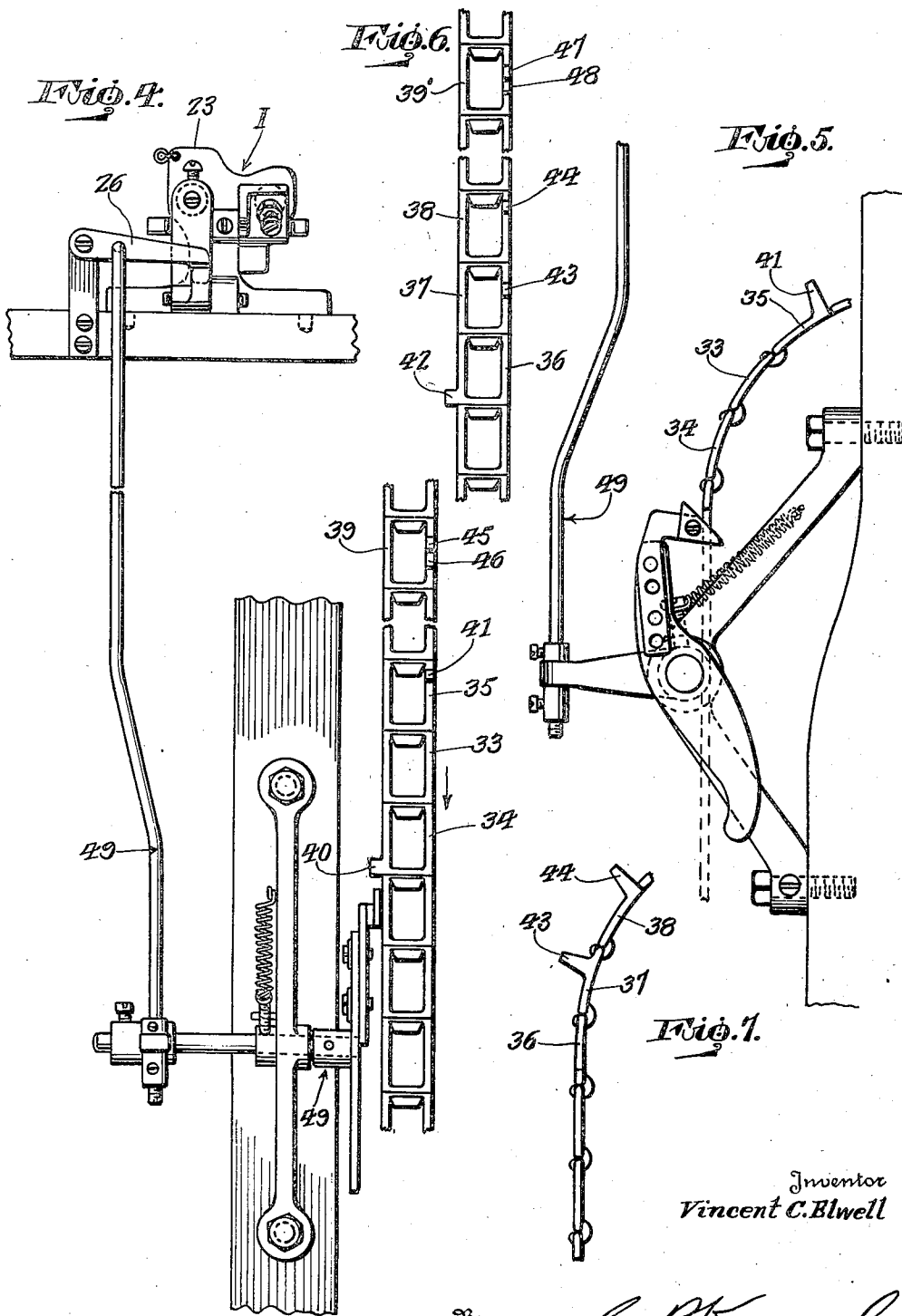
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AUTOMATIC CIRCULAR KNITTING MACHINE

Filed Dec. 20, 1934

9 Sheets-Sheet 4



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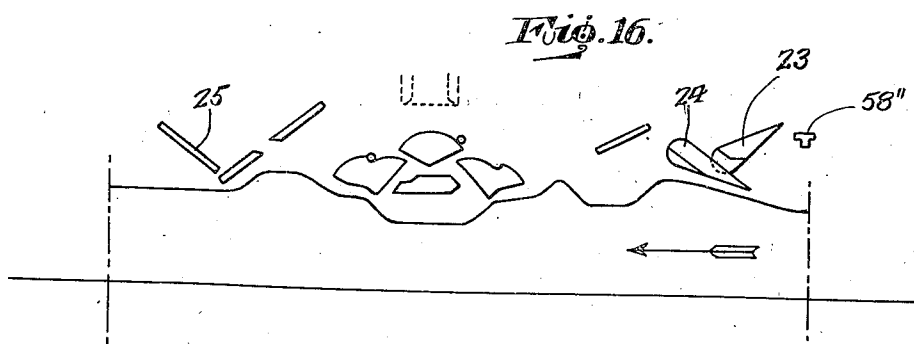
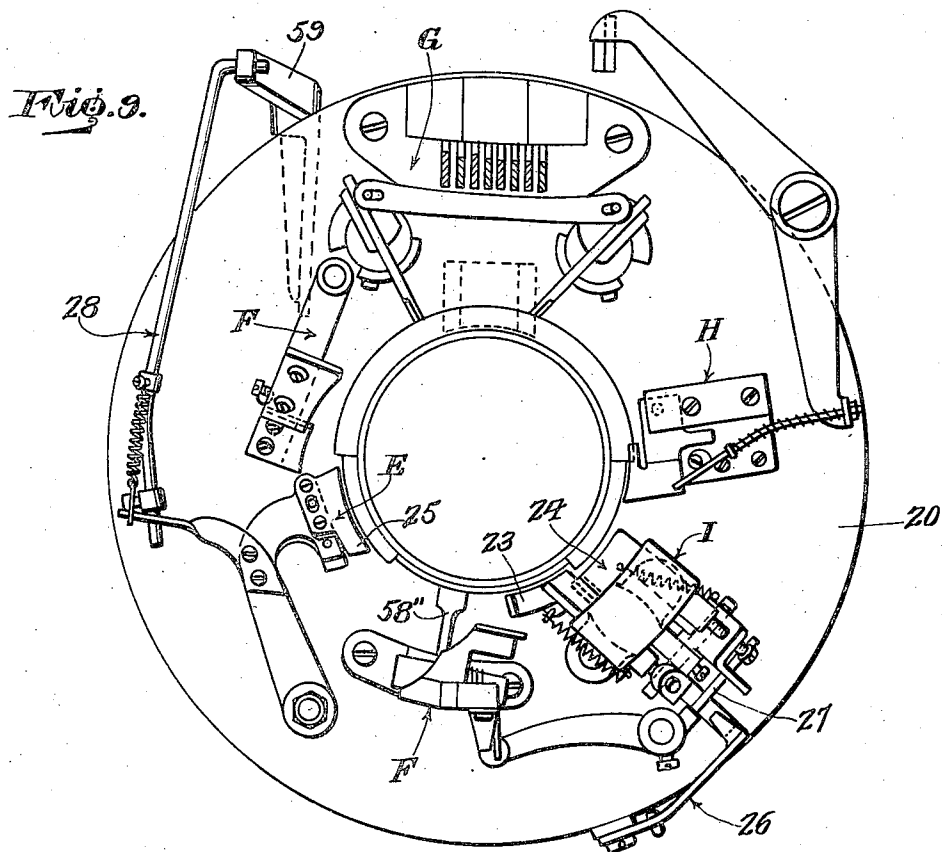
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AUTOMATIC CIRCULAR KNITTING MACHINE

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9 Sheets-Sheet 5



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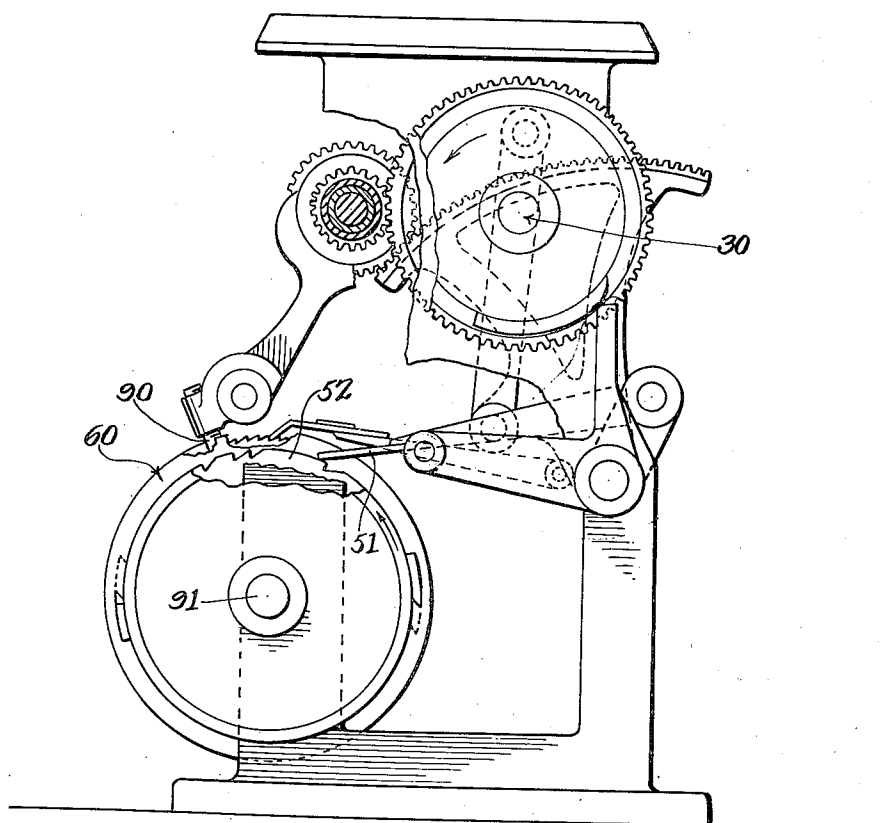
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AUTOMATIC CIRCULAR KNITTING MACHINE

Filed Dec. 20, 1934

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Fig. 10.



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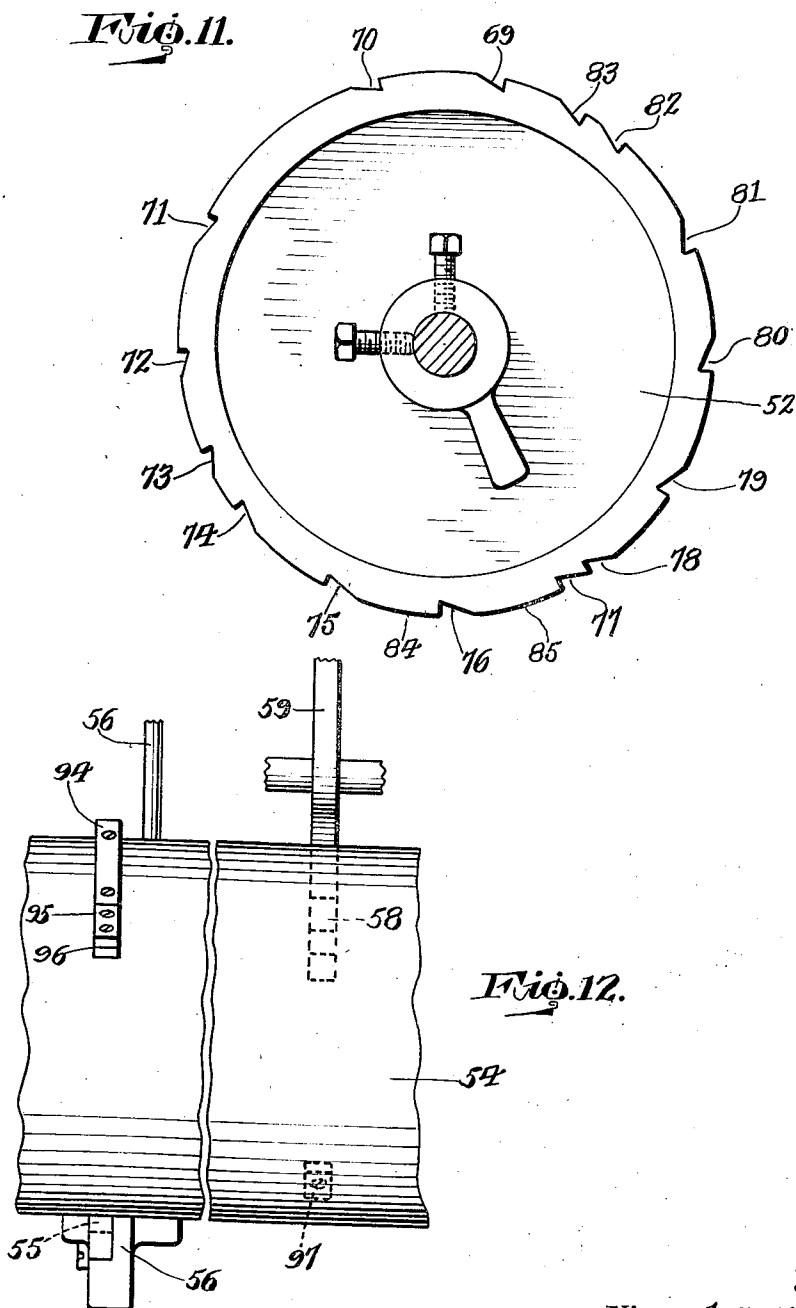
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Filed Dec. 20, 1934

9 Sheets-Sheet 7



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AUTOMATIC CIRCULAR KNITTING MACHINE

Filed Dec. 20, 1934

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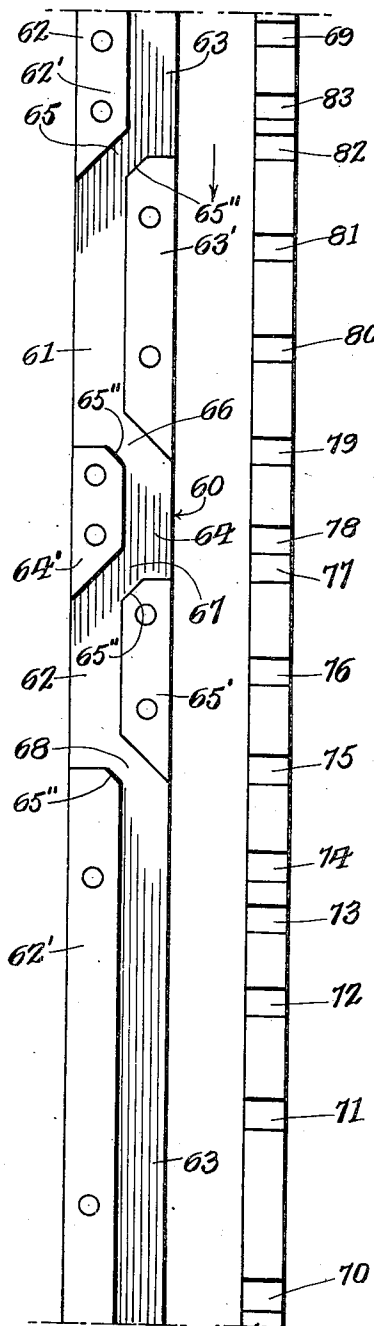


Fig. 13. Fig. 14.

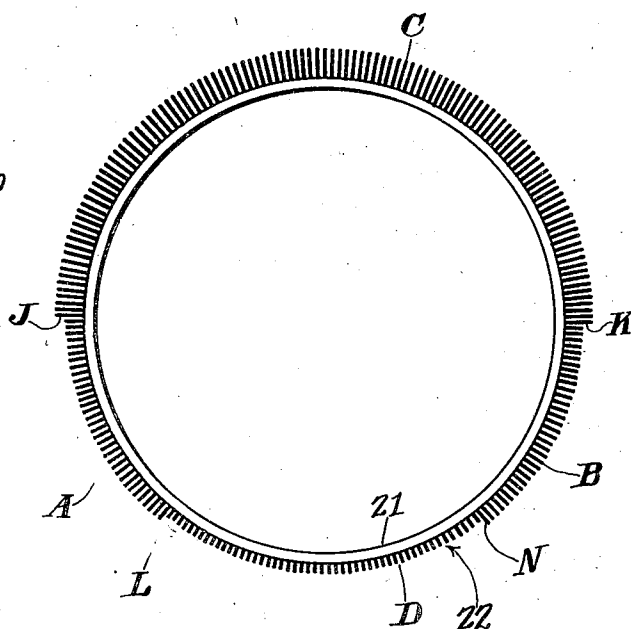


Fig. 15.

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AUTOMATIC CIRCULAR KNITTING MACHINE

Filed Dec. 20, 1934

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Fig. 17.

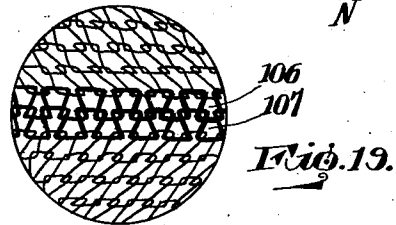
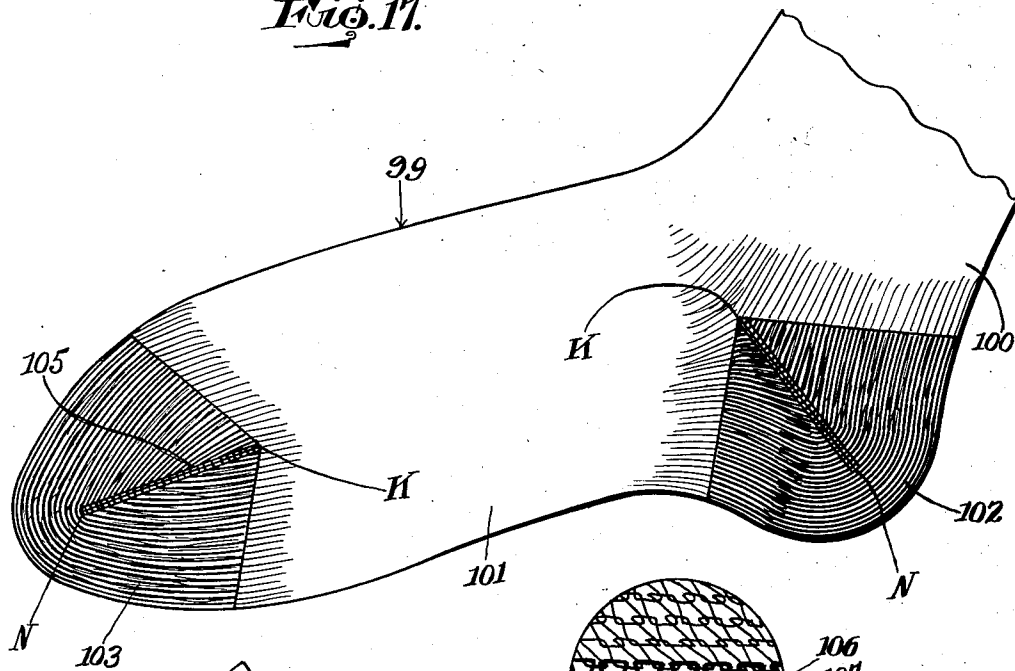


Fig. 19.

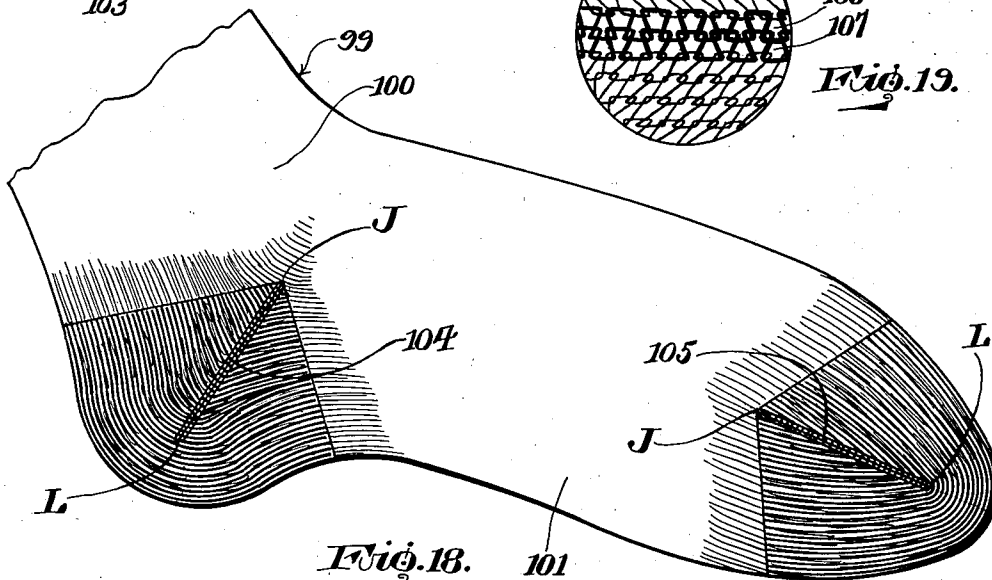


Fig. 18.

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UNITED STATES PATENT OFFICE

2,073,554

AUTOMATIC CIRCULAR KNITTING
MACHINE

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Application December 20, 1934, Serial No. 758,519

6 Claims. (Cl. 66—48)

This invention relates to an automatic circular knitting machine for producing finished welt, rib and plain fabric hose having a two course gusset in each side of the heel and toe pocket.

5 One of the objects of the invention resides in the production of an article of manufacture, such as half hose, a stocking or sock, more particularly the half hose with a new and improved gusset toe and heel portion.

10 A further object of the invention is to provide, in a manner as hereinafter set forth, an automatic circular knitting machine having new, novel and improved means for producing a half hose having each side of its heel and toe pocket formed with a new and improved form of gusset.

15 A further object of my invention resides in the production of a half hose having a new and improved elastic gusset in each side of the heel and toe pocket, at a lower manufacturing cost in regard to shortening of knitting operations, as well as a saving in material with respect to gusset half-hose now manufactured, and at the same time improving the fit, wearing and comfort characteristics of the half hose.

20 A further object of my invention resides in the elimination of the congestion of the stitches that are always found in the gusset type stocking, thereby allowing for more elasticity in the heel and toe which insures for a better fit, longer wear and more comfort. It is well known that certain forms of half-hose have gusset fashioned heels and toes with supplementary or fashioned stitches which cause the non-fitting of the hose at the instep thus allowing the hose to bag at this point
25 resulting in a poor appearance and at the same time being uncomfortable to the wearer. These objections are overcome by a gusseted half hose in accordance with this invention.

30 My invention eliminates all the puckering or ridges that are found in ordinary seamless stockings as there is no congestion of stitches. This feature is of considerable value in coarse gage heavy men's socks because the ridges and puckering are increased in size in proportion to the thickness of the stocking. This feature is even of greater value in wool and wool combination stockings because after they have been washed several times they have a tendency to shrink which will increase the puckering and lumps, as
35 shrinking tends to tighten the stitches even more than when they are knit.

A further object of the invention resides in the production of a half hose having a gusset at each side of the heel pocket and its toe pocket
40 whereby any combination of different yarns of a

like fiber or color or of different fibers or colors may be employed.

A further object of the invention is to provide, in a manner as hereinafter set forth, means for producing a more elastic heel and toe pocket in
5 a half hose of the gusset type than that in the half hose of the gusset type now manufactured.

To the above ends essentially and to others which may hereinafter appear, the invention consists of such steps and such parts and such combination of steps and parts which fall within the scope of the invention as claimed.

In the drawings:

Figure 1 is a fragmentary view in front elevation of a circular knitting machine illustrating
10 the driving mechanism and the needle controlling mechanism in accordance with my invention,

Figure 2 is an elevation of parts of the needle controlling mechanism looking towards the left side of the machine,

Figure 3 is an elevation of parts of the needle controlling mechanism looking from the right side of the machine,

Figure 4 is a fragmentary view in front elevation of parts of the needle controlling mechanism.

Figure 5 is a fragmentary view in side elevation of parts of the needle controlling mechanism,

Figures 6 and 7 are fragmentary views in front and side elevations respectively of the timing chain in accordance with this invention,

Figure 8 is a top plan view of the needle set up showing the adaptation therewith of parts of the needle controlling mechanism,

Figure 9 is a top plan view of the head of the machine showing the arrangement of the needle butts in accordance with this invention,

Figure 10 is a view in elevation, from the right, of a part of the driving mechanism shown in Figure 1,

Figure 11 is an elevation looking to the left of the kick or rack wheel in accordance with this invention,

Figure 12 is a fragmentary view in elevation of the pattern drum looking from the rear of the machine and having associated therewith parts of the needle controlling mechanism,

Figure 13 is a diagrammatical view showing the complete edge or circumference of the shipper wheel in accordance with this invention,

Figure 14 is a similar view of the kick or rack wheel,

Figure 15 is a diagrammatical view illustrating the butt arrangement of the needles,

Figure 16 is a diagrammatical view illustrating the position of the needle cams,

Figure 17 is an elevation looking towards one side of a stocking showing the gussets therein produced in accordance with this invention,

Figure 18 is a view similar to Figure 17 looking towards the other side of the stocking, and

Figure 19 is a fragmentary view in elevation and upon an enlarged scale of a gusset formed from a plurality of stitches.

The knitting machine, as disclosed, is of the automatic type and the complete description with respect to several of the mechanisms shown is omitted. Further, certain elements which are employed in a machine of the type referred to are not shown, but they will be employed and their construction, operation and arrangement will correspond to those now employed in the well known type of automatic circular knitting machine as set forth by Patent 1,641,101 and commonly known as the Scott and Williams model HH machine provided with a gusset forming attachment, such as shown in Patent 1,841,205. The descriptions of the mechanisms shown by the drawings of my application which correspond in structure to mechanisms shown by the patents referred to are to be understood to be the same as the description of said mechanisms set forth in the patents aforesaid.

In this type machine, timing is an all important factor. In the present instance certain changes have been made which, briefly enumerated, are as follows: links added to timing chain, changes in shipper drum cam, changes in rack or kick wheel, changes on the periphery of the pattern drum relative to the pattern cams, and changes in needle bank arrangement. As a result of these changes the timing of the machine has had to be changed. Each of the usual parts of the machine perform their same function except as modified by the changes made and except that they have had to be shifted in their position so as to be in time. It will be seen that the customary pattern cams are in no wise modified except that a part of them has been shifted about to place them in time with the modified action of the machine which has been altered to permit of the knitting of a two-course gusset heel and toe hose.

Referring to the drawings, a supported bed plate 20 of known form has arranged thereon a cylinder 21 which is encompassed by vertically movable needles 22 travelling in peripheral grooves in the cylinder. The arrangement would be the same as that shown in Patent 1,641,101 with this exception that the needles have long, medium and short butts in a manner as shown in Figure 15. Half of the full number of the needles of the entire cylinder have long butts. The number of needles having the medium butts will be materially greater than the needles having the short butts, but less in number than the needles having the long butts. The latter encompasses half of the cylinder. The needles having the medium butts are arranged in two groups A, B, each group being interposed between an end of the group C of needles having the long butts and one end of the group D of needles having the short butts. The number of needles of each group of needles having the medium butts is the same. By way of example, the number of needles employed may be one hundred and seventy-six. The group A is to contain twenty-eight needles, the group B is to contain twenty-eight needles, the group C is to contain eighty-eight needles and the group D is to contain thirty-two needles.

In any event the number of needles of group C must be greater than the number of needles in any one of the groups and the number of needles by combining the needles of groups A and B must be greater than the number of needles in group D.

With reference to Figure 9 there is shown a cam mechanism E and also other mechanisms employed in a picker-type machine. The said other mechanisms are indicated at F, G, H, and I. The mechanisms F, G, H and I correspond to like mechanisms shown in Patent 1,841,205. The mechanism I is a switch mechanism including a lowering cam 23 and an elevating cam 24 which are employed in making the gusset, in accordance with this invention. The lowering cam 23 lowers all of the long and medium butt needles. The cam 24 raises all of the long butt needles on the same revolution of the cylinder and after the gusset is made it raises all of the medium butt needles on one side of the cylinder. It is unnecessary to throw the long butt needles into knitting position except that this must be done in order to throw the medium butt needles into position, which action of the medium butt needles is necessary to make the gusset. As soon as thrown into knitting position the long butt needles are thrown out of knitting position before they actually knit. The mechanism E includes a cam 25 and is employed for raising the medium butt needles on the other side of the cylinder after the gusset is finished. A shifting arm 26 is employed for cam 23. A push arm 27 is used for operating cam 24. A pull bar 28 is employed for cam 25. The arms 26, 27 and bar 28 will be hereinafter referred to. The cam 25 performs the same function as the cam 29 of Patent 1,841,205.

With reference to Figure 1, the main driving mechanism of the machine is indicated at 30 and it includes a clutch 31. This mechanism is connected in a known manner for operating the cylinder 21. There is a means, to be referred to, which associates with clutch 31 to effect an advance of the reciprocatory action of the cylinder with respect to the timing of the pattern chain when the change is made from rotary to reciprocatory action when going into the heel and a retarding of the reciprocatory action with respect to a rotary action when going out of the heel to knit the foot. The said means, however, provides for entering the toe at the same time as is indicated in Patent 1,841,205, but the reciprocatory action is so timed that it does not change in coming out of the toe until after a plurality of courses have been knit whereby a delay is created before the rotary action takes effect to complete the selvage courses.

The pattern chain 32, as is well known, is in continual movement all the time the machine is in operation and makes a complete revolution for every stocking produced. The pattern chain is of the link type and it includes a plain link 33 which is interposed between a side lug link 34 and a high lug link 35. The leading end of link 33 is connected to the follower end of link 34. The follower end of link 33 is connected to the leading end of link 35. The chain also includes a side lug link 36 which has its follower end connected to the leading end of a high lug link 37. The follower end of link 37 is connected to the leading end of a high lug link 38. The chain also includes a pair of two spaced stepped links 39, 39'. The link 39 is spaced the desired distance from and follows link 34. The link 39' is spaced the desired distance from link 38 and

follows the latter. The lugs on links 34, 35, 36, 37 and 38 are designated 40, 41, 42, 43 and 44 respectively. The lugs 40, 42 extend laterally from the same side of the chain. The lugs 41, 43 and 44 project outwardly from the other face of the chain at one side thereof. The steps on link 39 are indicated at 45, 46. The steps on link 39' are indicated at 47, 48.

The shipper wheel, Figures 1 and 13, is designated 60 and has its edge throughout the circumference thereof formed with a pair of endwise aligning spaced raceways 61, 62, a pair of endwise aligning spaced raceways 63, 64 and two pair of inclined grooves. The grooves of each pair are oppositely disposed. The raceway 61 is of greater length than raceway 62. The raceway 63 is of greater length than raceway 64. The grooves of one pair are designated 65, 66. The grooves of the other pair are indicated at 67, 68. The groove 65 connects one end of raceway 61 to one end of raceway 63. The groove 66 connects the other end of raceway 61 to one end of raceway 64. The groove 67 connects the other end of raceway 64 to one end of raceway 62. The groove 68 connects the other end of raceway 62 to the other end of raceway 63. The raceways 61, 62 provide for reciprocatory action of the cylinder. The raceways 63, 64 are for revolving the cylinder. The grooves and raceways are formed from spaced cams 62', 63', 64' and 65' which are connected upon the edge of the wheel body and of the desired lengths. The cams are so arranged relatively to each other in a manner whereby the leg cam 62' is of such a length that will enable the cylinder to shift out of rotary motion into reciprocatory motion sooner when going from the leg into the heel. The heel cam 65' is of such a length to provide for the reciprocatory action to go in sooner and stay longer. The cam 64' is of such a length as to enable the cylinder to shift later from the reciprocatory motion in the heel to the rotary motion in the foot. The words "sooner", "later" and "longer" are used in comparing the operation of a standard Scott-Williams Model HH machine (Patent #1,641,101) with the machine in accordance with this invention. This describes one of the changes made in timing of a regular HH machine in order to produce the gusset, in accordance with this invention. In other words "sooner" means that the starting or commencing of the reciprocatory motion has been advanced, commencing sooner than it would commence on the regular Model HH machine.

The word "later" means that the timing of the reciprocatory motion of the cylinder of the regular Model HH machine has been altered to accommodate the timing of the machine in order to produce the gusset heel. The altered timing produces more reciprocatory revolutions, and the change from reciprocatory motion of the cylinder back to rotary motion of the cylinder has been retarded.

The word "longer" is used in the sense that the reciprocatory motions of the cylinder are more numerous than in the regular Model HH machine, and the cylinder remains in reciprocatory motion for a greater length of time than in the regular Model HH. In order to make the gusset, in accordance with this invention, more reciprocatory revolutions of the cylinder are necessary than in making the ordinary gore in the heel as made by the regular Scott-Williams Model HH machine #1,641,101. During the process of the operation in the regular Model HH the reciproca-

tory motion starts at a particular time and ends at a particular time after the heel is finished. To make the gusset, in accordance with this invention, as more reciprocatory revolutions are needed, it is necessary that the reciprocatory motions start sooner than they would start on the regular Model HH machine, and since there are more revolutions to be made the revolutions continue for a greater number of times than in the regular Model HH. Since the reciprocatory motion continues for more revolutions than in the action of the regular Model HH, it necessarily follows that the rotary motion of the cylinder starts the same number of revolutions later as the reciprocatory motion continued longer than in the regular Model HH.

In the regular Scott-Williams Model HH there are two notches made in the rack wheel (Figure 14), the first for going into the heel operation and the second for going out of the heel operation. It is understood that in camming of the shipper wheel (Figure 13) it has to be cammed so that it will be in time with the rack wheel, so that when the rotary motion is shifted to reciprocatory motion the usual cams on the pattern drum (Figure 2, No. 54) will work at the proper time. The above is in reference to the regular Scott-Williams Model HH before changes were made.

As to the changed operation, in accordance with this invention, referring to page 12, line 20 of the description, the notch 75 in Figure 14 was cut in ahead of where the notch would have been on the regular Model HH. This notch is used for going into the heel. The next notch 76 is used to advance the pattern drum in order to make the gusset. This notch is located approximately where the notch on the regular Model HH was located for going out of the heel. Notch 77 is a new notch which was cut to delay the pattern drum as described on page 13 of the description. The cam 63' is of a length to change the rotary motion for the foot into the reciprocatory motion to form the toe. The cam 62' coacts with cam 63', so that the change from reciprocatory action on the toe to rotary action for the loopers selvage will be had. The rotary motion of the cylinder after the loopers selvage is formed is in position to start to repeat the foregoing operations.

The inner corners of the follower ends of the cams 62', 63', 64' and 65' are beveled as at 65''. These beveled corners associate with the leading ends of said cams to provide the grooves 65, 66, 67 and 68.

The kick or rack wheel 52 with reference to Figures 11 and 14, has its edge provided with notches or ratchets 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82 and 83. The wheel 52 is different from any known form of kick wheel due to the fact that the wheel retimes the pattern drum so that the motions that are obtained from the usual bank of cams on the drum will produce the proper motion on time in relation to the advance action I have made in the reciprocatory action of the cylinder to produce the heel. The means referred to consists of the notch 75, an uninterrupted edge portion or land 84 between notches 75, 76, and the notch 77 and an uninterrupted edge portion or land 85 between notches 76 and 77. The notch 75 is employed to advance the pattern drum in regard to the advance of the reciprocatory action of the cylinder when going into the heel. It also leaves the pattern drum in position so cam 24 will raise the long butt

needles when they are pulled down when making the gusset in heel. The notch 76 is employed to shift the pattern drum to result in the operation of cam 24 to move the medium butt needles A on one side of the cylinder out of knitting position after the heel gusset is finished. On the same impulse of the pattern drum it results in the action of cam 25 to raise the medium butt needles B on the other side of the cylinder out of knitting position after the heel gusset is finished. The groups A and B are moved simultaneously out of knitting position. The same impulse results in the action of the dropper or pull down pick in the usual manner. The notch 77 is employed to delay the pattern drum in regard to the delay of the reciprocatory action of the cylinder when coming out of the heel. The other notches of the wheel 52 act for the same timing as that of the kick or rack wheel of the patents aforesaid.

The shipper 86 is slidably mounted on a short shaft 87 with a lug 88 carrying an adjustable stud 89 for operating in the raceways of the shipper wheel 60 to provide for the shifting of the clutch 31 in opposite directions resulting in the reciprocatory and revolving movement of the cylinder.

The wheels 52 and 60 are fixed on a shaft 91, and between the latter and the pattern drum shaft 92 is a transmission 93 to provide for the intermittent operation of the said drum shaft from wheel 52.

With respect to knitting the heel gusset. The lug 40 on link 34 is employed for actuating the shifting mechanism 49 for the arm 26 which functions to shift the cam 23 which acts to lower all the long and medium butt needles. The cam 23 is so formed as to clear the short butt needles. The lug 41 on the link 35 is employed for elevating a counterbalanced adjuster 50 of known form for a reciprocatory pusher pawl 51 (Figure 10). The adjuster positions the pawl 51 to engage in the notch 76 of the kick or rack wheel 52 for the purpose of imparting an impulse to the latter. The wheel 52 is connected with the driving means 93 for the pattern drum 54, the latter being intermittently revolved for successive impulses applied to the wheel 52 by the pawl 51. When the lug 41 causes the adjuster 50 to arrange the pawl 51 to impart an impulse to drum 54, the latter is revolved to an extent to have lobe 57 of cam 55 thereon actuate a spring controlled lifting mechanism 56 for the push arm 27 which acts to position the cam 24 to raise the needles with the medium butts A out of knitting position after the gusset is made. The cam 55 has a low step 58' whereby mechanism 56 will act to put needle dropper 58'' in action for the usual purpose. The impulse given to the wheel 52, when lug 41 acts on the adjuster 50, is of such an extent to revolve drum 54 (Figure 2) to cause the cam 58 on drum 54 to engage and actuate a spring controlled shifting mechanism 59 for operating the pull bar 28 in a direction to position cam 25 so it will raise the medium butt needles B on the other side of the cylinder out of knitting position after the completion of the heel gusset.

The two step lug on link 39 raises the adjuster 50 to provide for the pawl 51 to engage in the notch 77 for imparting an impulse to drum 54 to change the time to coincide with the change from reciprocatory to rotary movement of the cylinder whereby known cams on the cylinder will act for the purpose of completing the foot of the stocking from the heel to the toe. When

going into the toe it is to be understood that I do it at the same time by the same arrangement as is disclosed by Patent 1,841,205.

The lug 42 on link 36 is employed for actuating the shifting mechanism 49 for the cam 23, subsequent to the shifting of mechanism 49 by lug 40. When mechanism 49 is shifted by lug 42 it functions to shift arm 26 whereby cam 23 acts to lower the medium butt needles to make the toe gusset. The lug 42 serves the same purpose as lug 40, but shifts mechanism 49 subsequent to the shifting of mechanism 49 by lug 40.

The lug 43 on link 37 acts on the adjuster 50 to position pawl 51 relative to notch 80 for imparting an impulse to wheel 52 for the purpose of imparting movement to the pattern drum 54 to the extent to have cam 94 actuate mechanism 56 to provide for cam 24 to raise all the long butt needles.

The lug 44 on link 38 acts on the adjuster 50 to position pawl 51 relative to notch 81 for the purpose of giving an impulse to wheel 52 which in turn will shift drum 54 so that cam 95 will have cam 24 elevate the medium size butt needles A on one side of the cylinder from knitting position two courses later after the gusset in the toe is formed. The cam 95 has a low step 96 for lowering the needle dropper referred to. When the impulse which is obtained by the coaction of pawl 51 with notch 81 the drum 54 will carry cam 97 thereon a sufficient distance for the cam to engage and actuate mechanism 59 resulting in the operation of cam 25 which elevates the medium size butt needles B two courses later on the other side of the cylinder from knitting position after the gusset in the toe has been formed.

The two steps 47, 48 of the lug on link 39' raise the adjuster 50 to provide for the pawl 51 to engage in notch 82 for imparting an impulse to drum 54 to change the time to coincide with the change from reciprocatory to rotary movement of the cylinder two courses later than in Patent 1,841,205 before the formation of the looper selvage.

With reference to Figures 17 and 18, a stocking 99 produced by the machine is illustrated. The leg, foot, heel and toe are indicated at 100, 101, 102 and 103 respectively. The gussets in the heel 102 and in the toe 103 are indicated at 104, 105 respectively. With reference to Figure 19, a gusset 104 and 105 is shown. Each gusset consists of one or more pairs of complete rows of stitching. Preferably of but one pair and is so referred to. Each gusset as shown, consists of a pair of complete rows of diagonal stitches 106, 107 which are added to each side of the heel pocket and to each side of the toe pocket. The stitches of each row interengage with each other. One of the rows of stitches of each gusset interengages with the narrowed row of stitches on a side of a pocket and the other row of stitches of the gusset interengages with the widened row of stitches on the same side of the pocket. The rows of gusset stitches are of the same length. Each gusset extends the full length of narrowed and widened portions of each side of the heel and toe pocket.

When knitting the two course gusset stocking as shown in Figures 17 and 18 you start knitting the heel in the usual manner, that is by raising one medium butt needle out of action on each side of the heel pocket on each revolution until you reach the point N (Figures 15 and 17). When this point is reached the cylinder is travel-

ling in a counter-clockwise direction and the cam 23 is set so it does not touch short butt needles, however it is set to lower medium butt needles from L to J to knitting position and is also set so it lowers long butt needles, however cam 24 is set so it raises the long butt needles out of knitting position on the same course at the beginning of reciprocating knitting in the heel. Then it lowers the medium butt needles from K to N to knitting position thus putting all needles in proper position to knit the two course gusset. The knitting is done from N to J and from J on the return revolution to K and from K on the return revolution to L. When point L is reached the two course gusset is finished on each side of the heel pocket. At the finish of the gusset at point L the cylinder is revolving counter clockwise and cam 24 in Figure 9 is put in position so it will raise all the medium butt needles from L to J out of knitting position and cam 25 in Figure 9 is set in action so it raises all the medium butt needles from K to N out of knitting position thus putting all needles back in the proper or former position so the heel can be finished in the usual manner. The same sequence of operation is used when producing the gussets in the sides of the toe pockets.

During the process of making the heel by this machine, as well as by the regular Model HH machine, reciprocatory action of the cylinder takes place throughout the formation of the heel as well as throughout the formation of the gusset in the heel. During the whole process of knitting this heel or the heel on the regular Model HH machine the long butt needles are not used for knitting purposes. They are not used during the knitting of the gusset nor during the knitting of the rest of the heel. The long butt needles are thrown out of action and remain out of action from the time the heel is commenced until the point N is reached wherein the gusset is commenced. At this point the long butt needles are lowered into knitting position in order to allow the medium butt needles to be lowered into knitting position. The long butt needles are, however, immediately raised out of knitting position before they actually knit, and after being so raised out of knitting position remain out of knitting position until the heel is finished.

The cylinder and pattern chain are driven in a known manner and as set forth in the patents aforesaid. The yarn is fed to the needles in the known manner.

The group of needles A is termed a primary group. That end of group A which opposes one end of the group of needles C is termed the inner end of group A. That end of group A which opposes one end of the group of needles D is termed the outer end of group A. The group of needles B is termed a secondary group. That end of group B which opposes the other end of the group of needles C is termed the inner end of group B. That end of group B which opposes the other end of the group of needles D is termed the outer end of group B.

What I claim is:

1. In an automatic circular knitting machine for producing finished welt, rib and plain fabric hose having a two course gusset in each side of the heel and toe pocket, a kick wheel provided with a leading notch for controlling the change of the rotary movement of the machine cylinder into reciprocatory movement for knitting a pocket, a follower notch for controlling the knitting

of the gusset separated from the leading notch by an uninterrupted land, and a second follower notch for controlling the change of reciprocatory movement of the machine cylinder into rotary movement and separated from the first follower notch by an uninterrupted land.

2. In an automatic circular knitting machine for producing finished welt, rib and plain fabric hose having a two course gusset in each side of the heel and toe pocket and including the usual timing chain, a needle cylinder including long butt and medium butt needles, a cam mechanism for lowering all of the long butt and medium butt needles on one revolution of the cylinder preparatory to knitting a gusset, an actuating mechanism for said cam mechanism, and means carried by the timing chain for operating said actuating mechanism.

3. In an automatic circular knitting machine for producing finished welt, rib and plain fabric hose having a two course gusset in each side of the heel and toe pocket, a revoluble and reciprocatory needle cylinder containing a group of long and a pair of groups of medium butt needles, an intermittently driven kick wheel, an endless pattern chain for continuous operation provided with a pair of spaced side lugs, a pair of spaced front lugs and a pair of spaced stepped front lugs, an intermittently revoluble pattern drum provided on its periphery with a long and a short cam, an actuatable cam mechanism for lowering all of the long and medium butt needles on one revolution of said cylinder, an actuating mechanism for said cam mechanism successively operated from first named pair of lugs, an actuatable second cam mechanism for elevating all of the long butt needles during one revolution of the cylinder and for subsequently elevating one of the groups of medium butt needles, an actuating mechanism for said second cam mechanism operated from said long cam, an actuatable third cam mechanism for elevating the other group of medium butt needles simultaneously with the elevation of the said first mentioned group, an actuating mechanism for said third cam mechanism operated from said short cam, driving means for the kick wheel controlled by said pairs of front lugs, driving means for the pattern drum operated from the kick wheel, and controlling means interposed between the pattern chain and kick wheel for changing the rotative movement of the cylinder into a reciprocative movement.

4. In an automatic circular knitting machine for producing finished welt, rib and plain fabric hose having a two course gusset in each side of the heel and toe pocket, a revoluble and reciprocatory needle cylinder containing a group of long and a pair of groups of medium butt needles, an endless pattern chain for continuous operation provided with lugs, an intermittently revoluble pattern drum provided on its periphery with a long and short cam, an actuatable cam mechanism for lowering all of the long butt needles and medium butt needles on one revolution of said cylinder, an actuating mechanism for said cam mechanism operated from a pair of said lugs, an actuatable second cam mechanism for elevating all of the long butt needles during one revolution of said cylinder and for subsequently elevating one of the groups of medium butt needles, an actuating mechanism for said second cam mechanism operated from said long cam, an actuatable third cam mechanism for elevating the other group of medium butt needles si-

multaneously with the elevation of the said first mentioned group, an actuating mechanism for said third cam mechanism operated from said short cam, driving means for the kick wheel controlled by the others of the said lugs, driving means for the pattern drum operated from the kick wheel, and controlling means interposed between the pattern chain and kick wheel for changing the rotative movement of the cylinder into a reciprocative movement.

5. In an automatic knitting machine for producing finished welt, rib and plain fabric hose having a two course gusset in each side of the heel and toe pocket, a revoluble and reciprocatory needle cylinder containing long butt needles and two groups of medium butt needles, an intermittently revoluble pattern drum, an intermittently revoluble kick wheel for controlling the impulses to said pattern drum, a cam extending circumferentially of the outer face of the drum and having a leading and a following working surface, the latter being outset with respect to and of less length than said leading surface, said leading and following surfaces controlling respectively the elevation of all of the long butt needles and one of the groups of the medium butt needles, the length of said cam being materially less than the circumference of said drum, a cam mechanism for elevating all of the long butt needles during one revolution of the cylinder and for subsequently elevating the said group of medium butt needles after the gusset has been made, an actuating mechanism for said cam mechanism normally bearing on the outer face of the drum and disposed in the path of and operated by the cam,

said actuating mechanism being given two successive impulses from said cam during one revolution of said drum for operating said cam mechanism to an extent to elevate all of the long butt and said group of medium butt needles, means having its operation controlled from said kick wheel for imparting impulses to said drum, a second cam on said drum, a second cam mechanism for elevating the other group of medium butt needles, and a second actuating mechanism for said second cam mechanism operated by said second cam for operating said second cam mechanism to simultaneously elevate the said other group of medium butt needles with the first mentioned group.

6. In an automatic circular knitting machine for producing finished welt, rib and plain fabric hose having a two course gusset in each side of the heel and toe pocket and including a kick wheel, an element for controlling the operation of the machine, said element consisting of an endless chain for traveling continuously, said chain being formed of a series of interengaging links, a pair of said links arranged in spaced relation being formed on one side thereof with side lugs for controlling the lowering of the long and medium butt needles of the cylinder of the machine, another pair of said links arranged in spaced relation being formed on the front thereof with high lugs, and another pair of said links arranged in spaced relation being formed on the right front thereof with stepped high lugs, the said several high lugs controlling the operation of the kick wheel of the machine.

VINCENT C. ELWELL.