Dec. 30, 1947. S. C. MACK 2,433,568

FULL-FASHIONED KNITTING MACHINE

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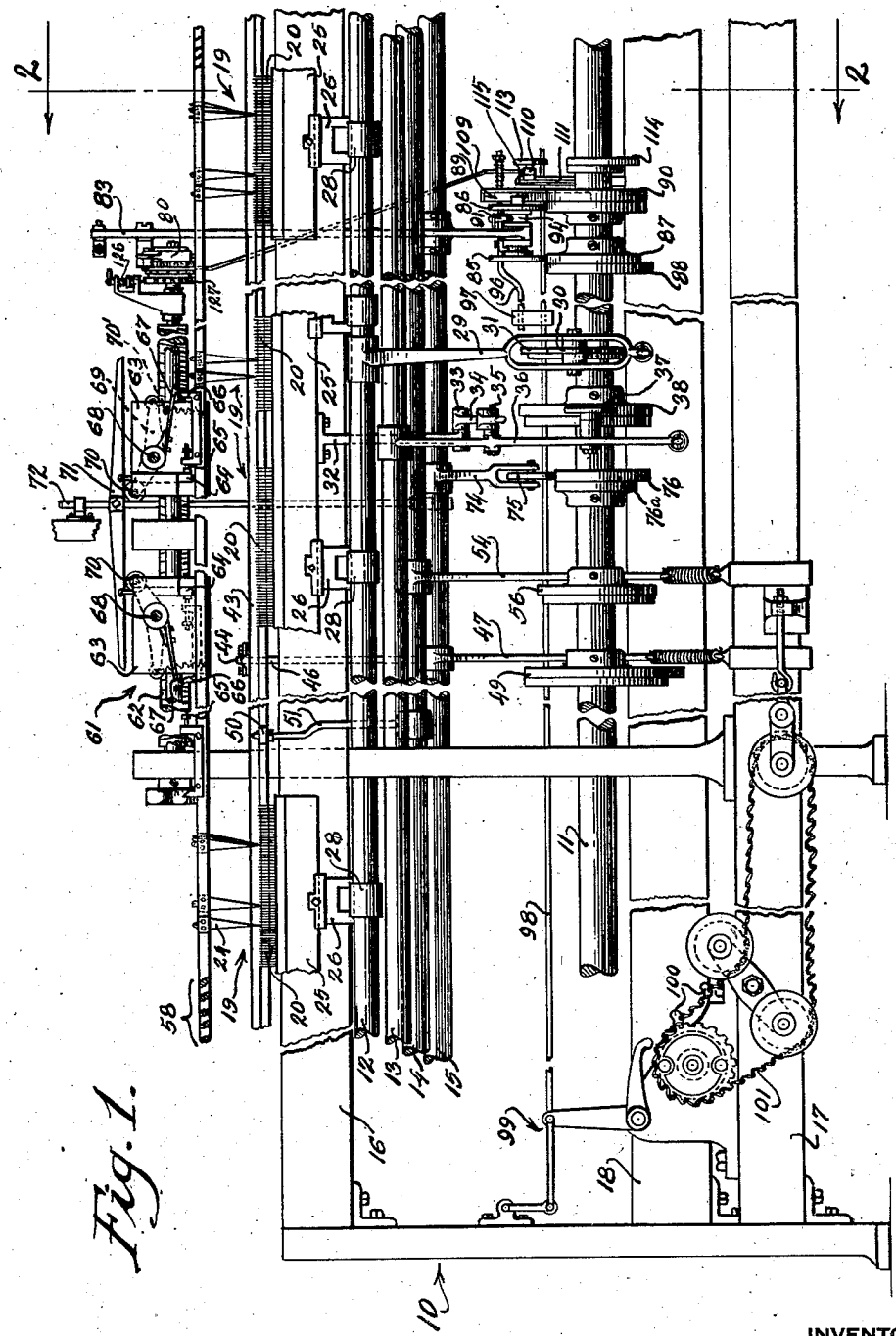


Fig. 1.

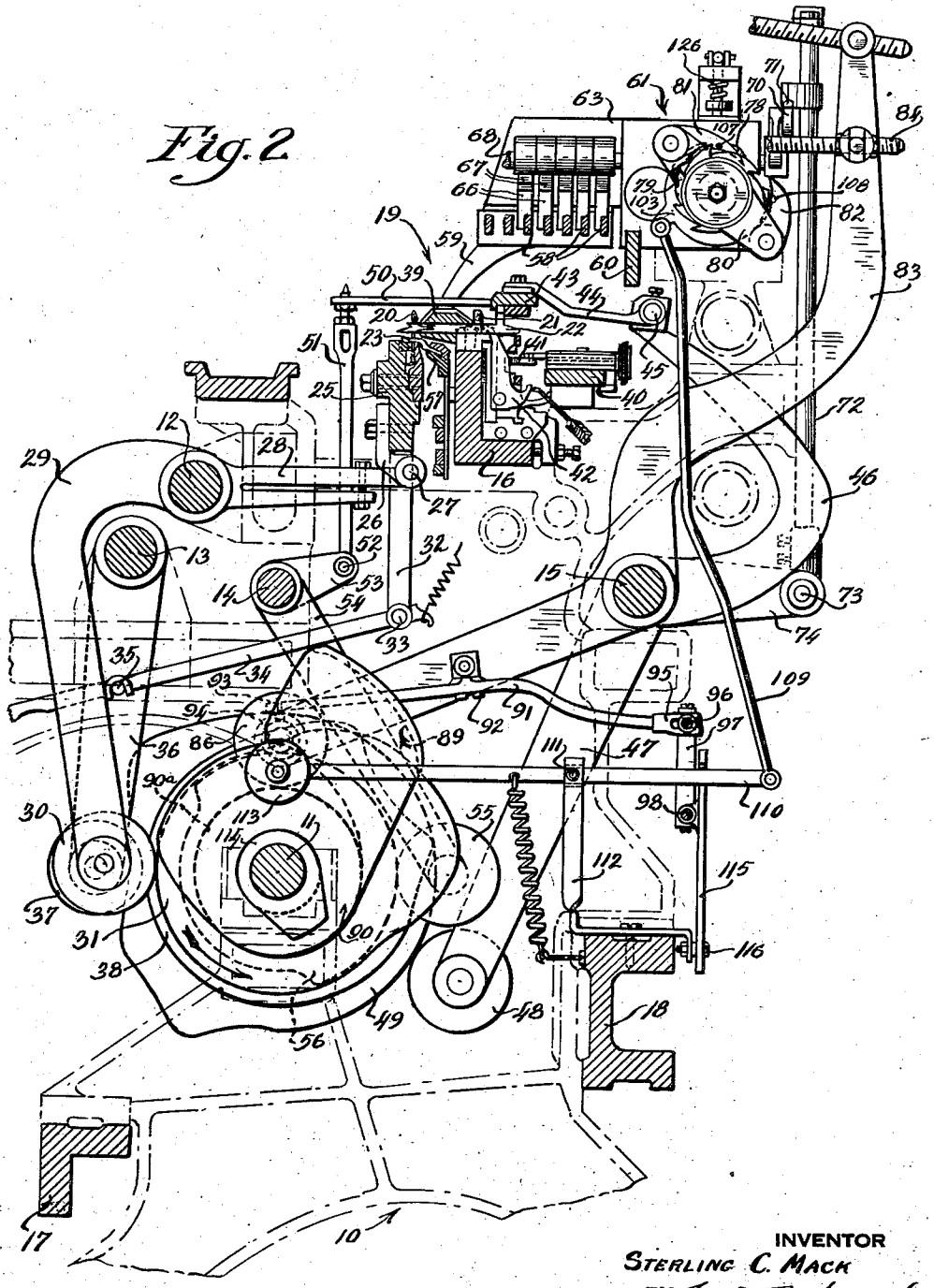
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FULL-FASHIONED KNITTING MACHINE

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Fig. 2



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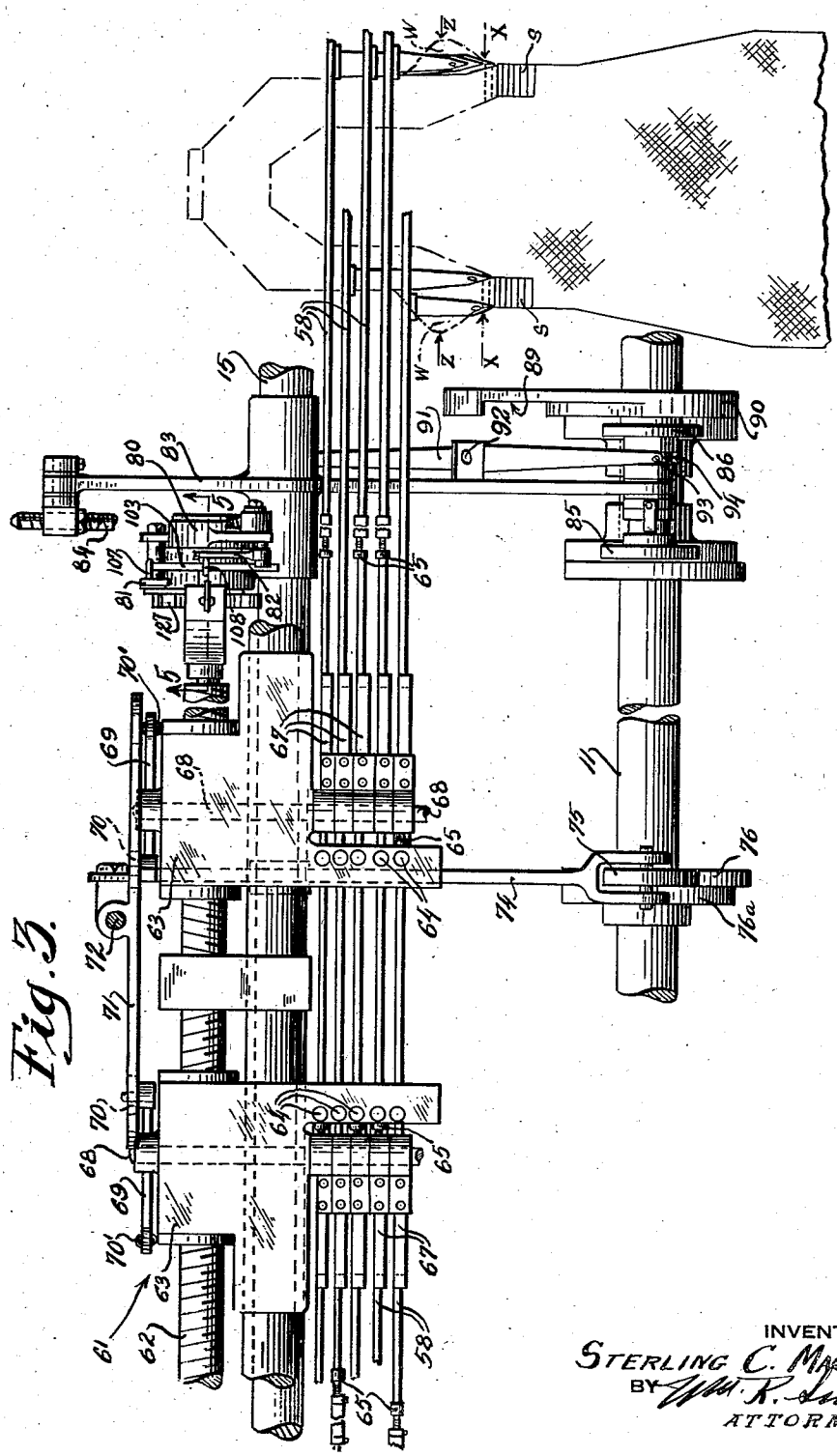


Fig. 3.

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FULL-FASHIONED KNITTING MACHINE

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Fig. 4.

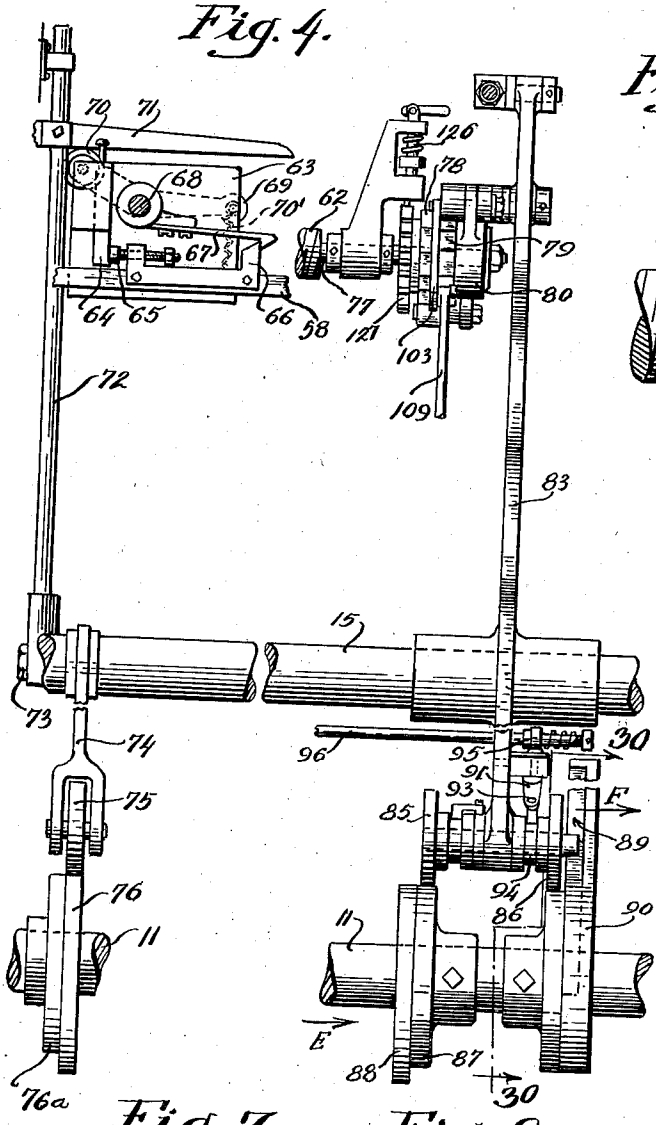


Fig. 5.

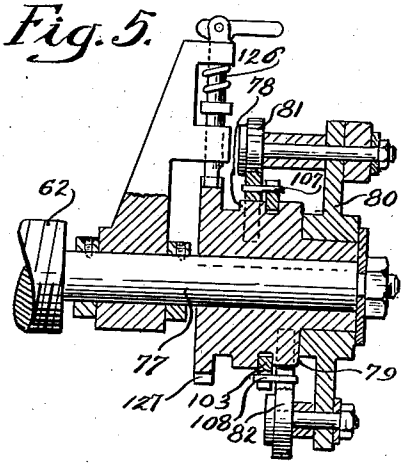


Fig. 6.

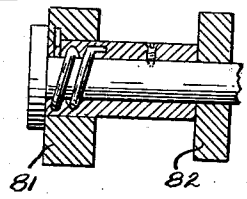


Fig. 7.

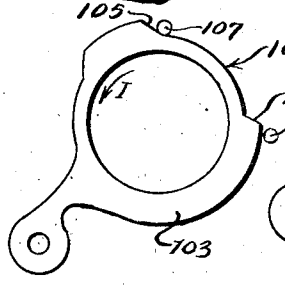


Fig. 8.

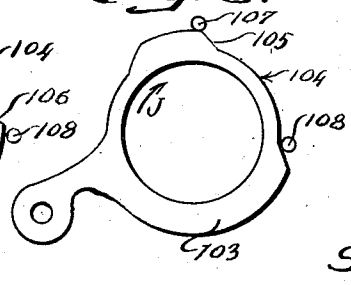
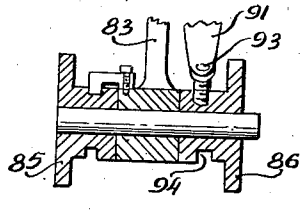


Fig. 9.



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FULL-FASHIONED KNITTING MACHINE

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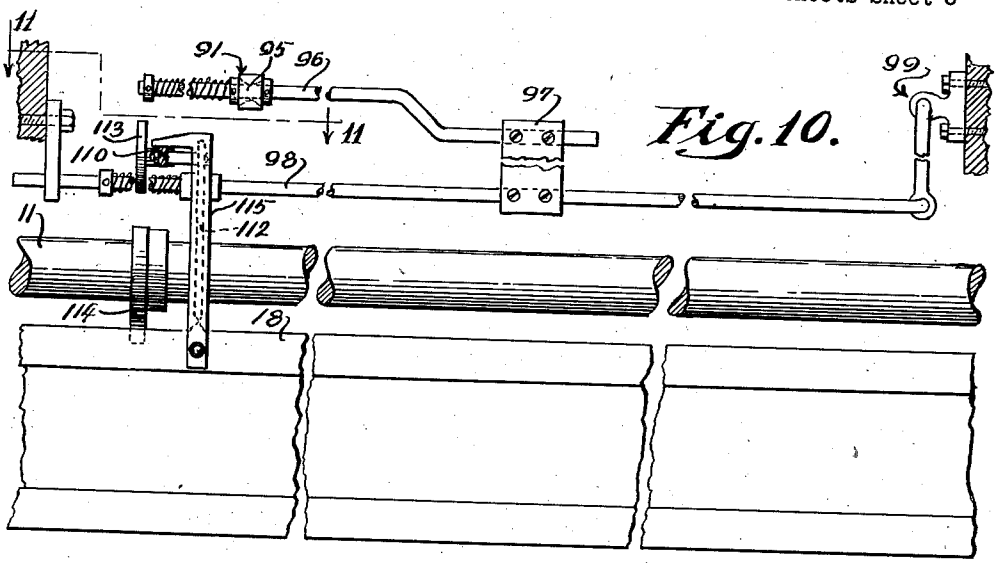


Fig. 10.

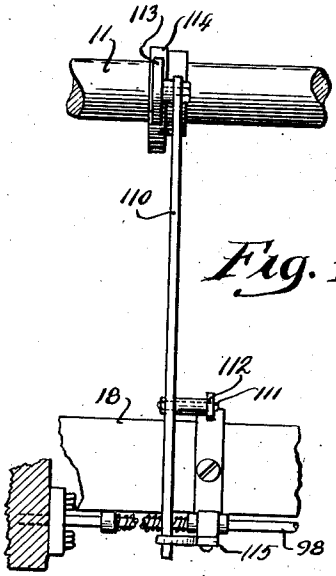


Fig. 11

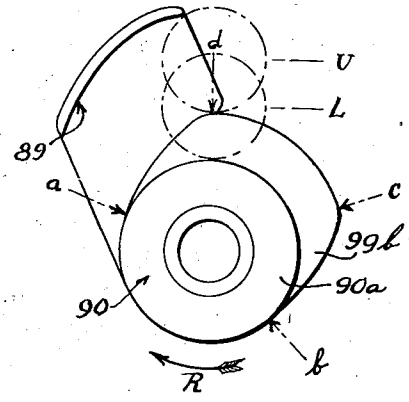


Fig. 30.

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FULL-FASHIONED KNITTING MACHINE

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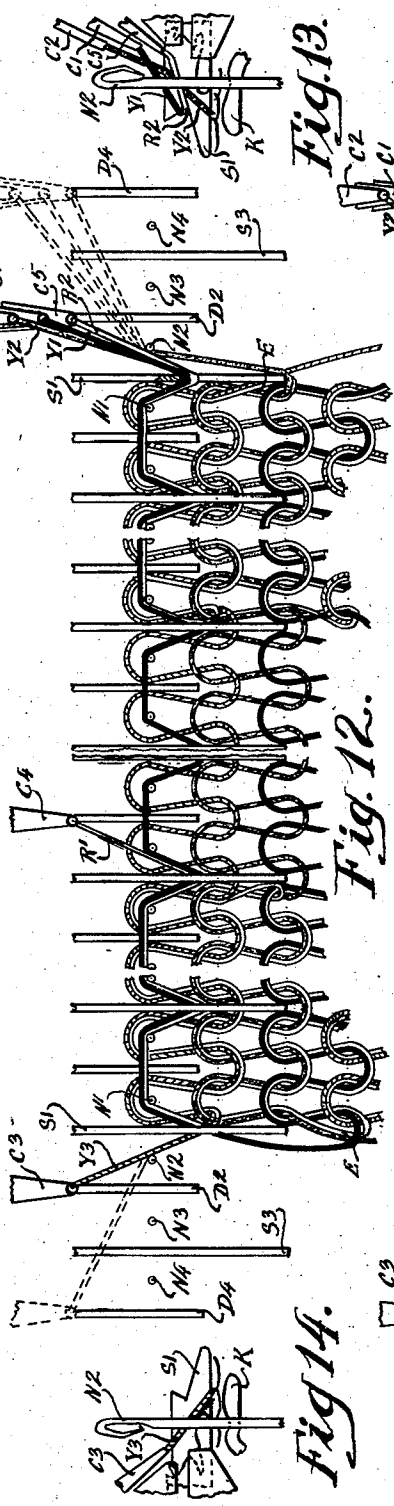


Fig. 13.

Fig. 12.

Fig. 14.

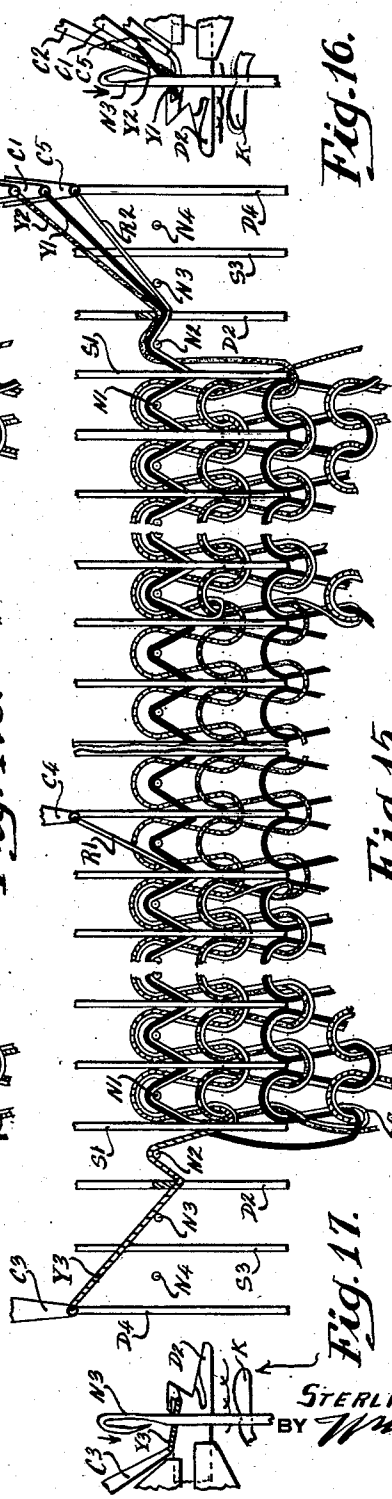


Fig. 16.

Fig. 15.

Fig. 17.

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FULL-FASHIONED KNITTING MACHINE

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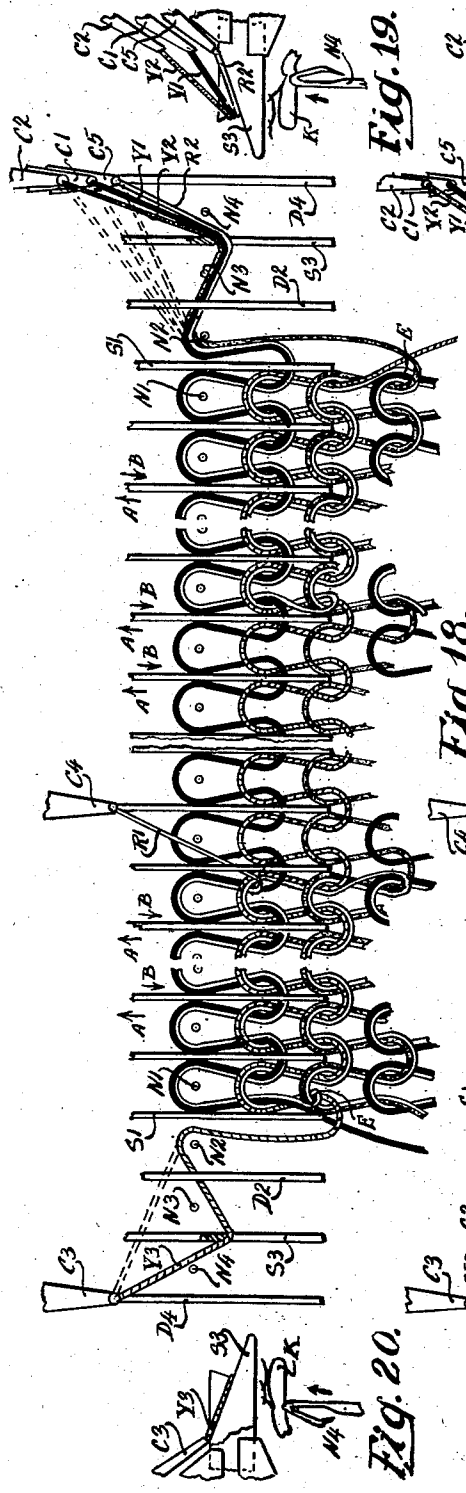


Fig. 19.

Fig. 18.

Fig. 20.

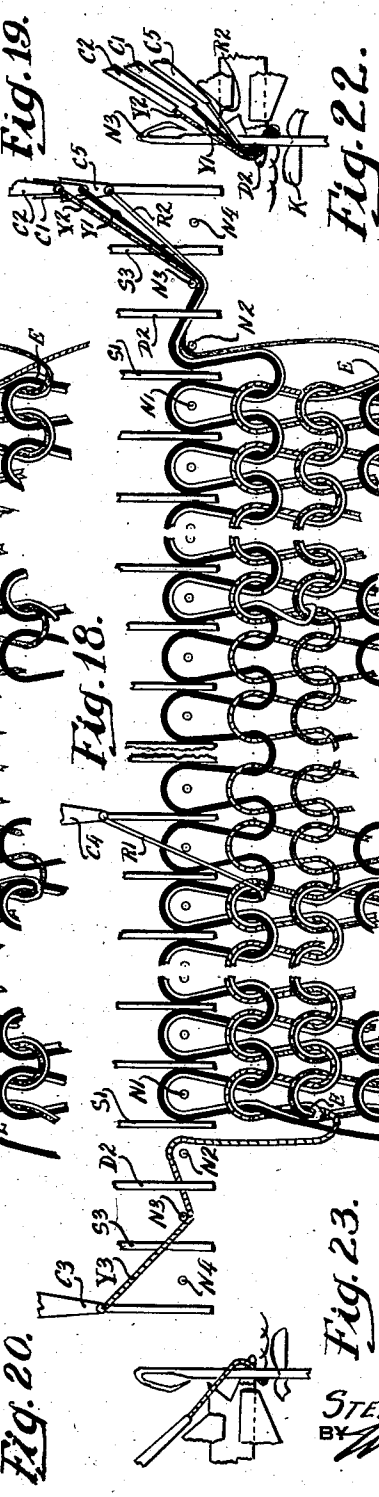


Fig. 22.

Fig. 21.

Fig. 23.

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FULL-FASHIONED KNITTING MACHINE

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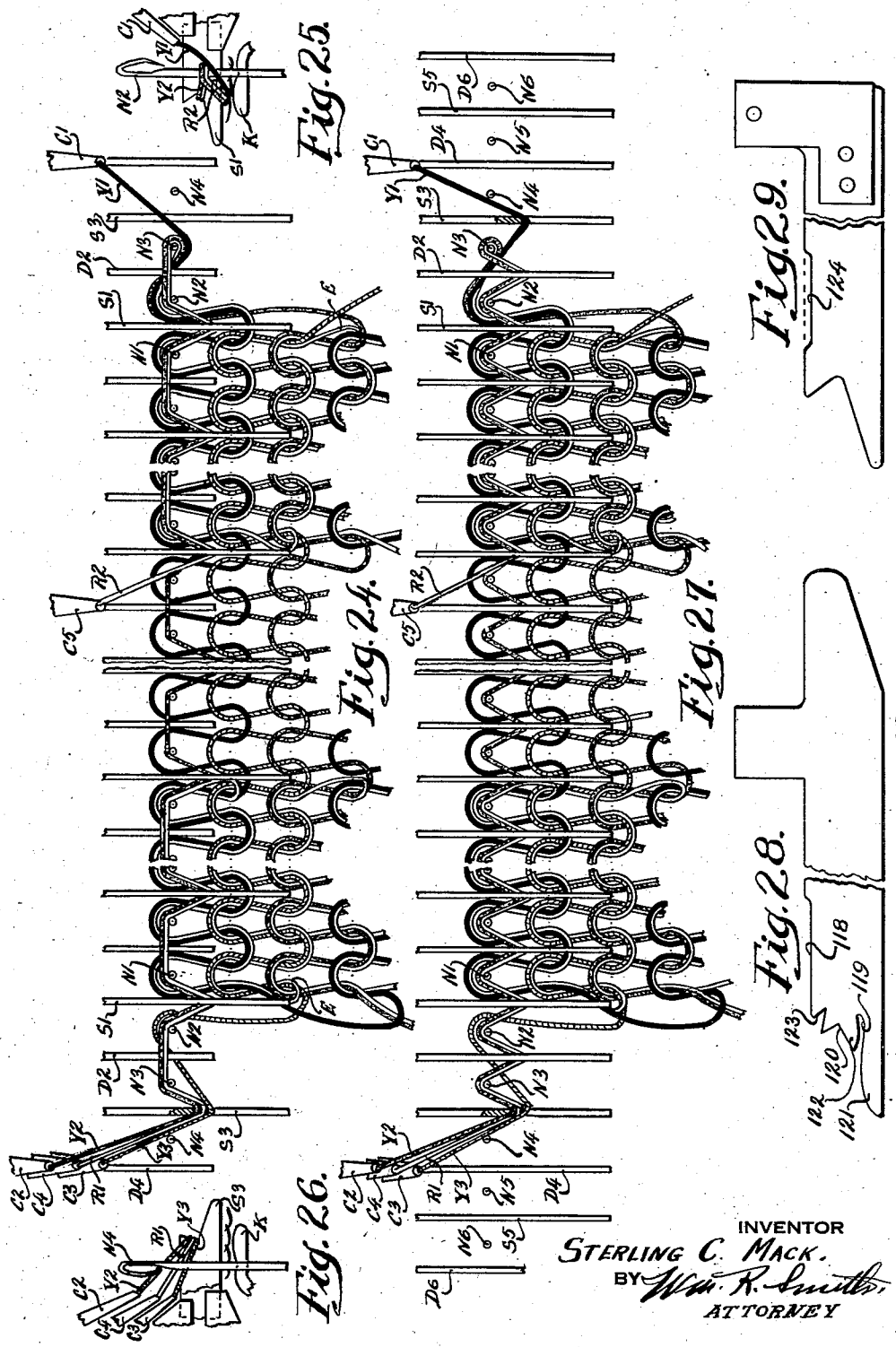


Fig. 25.

Fig. 24.

Fig. 26.

Fig. 27.

Fig. 29.

Fig. 28.

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FULL-FASHIONED KNITTING MACHINE

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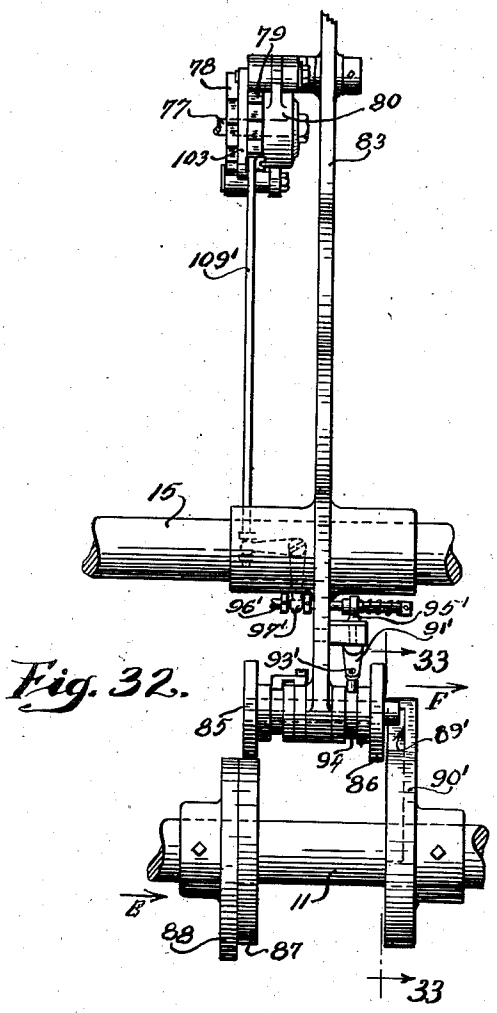


Fig. 32.

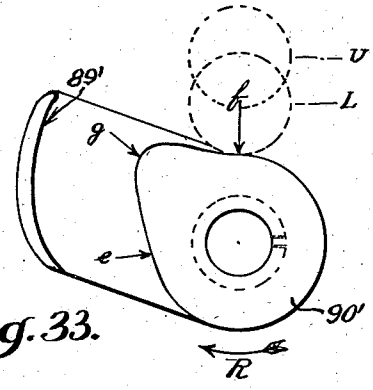
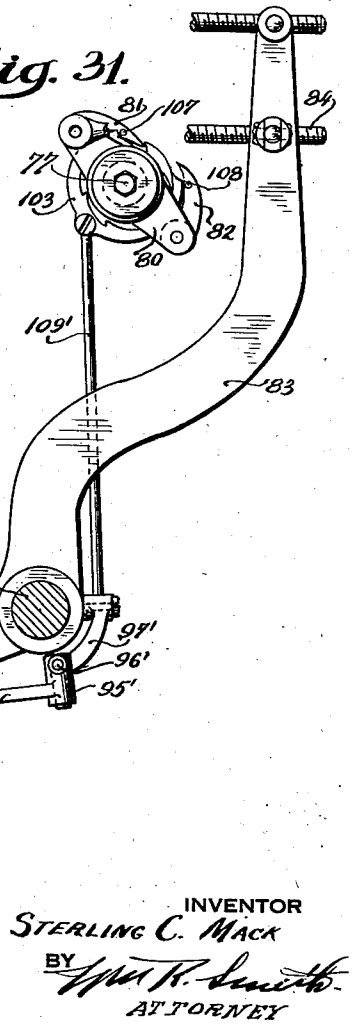


Fig. 33.

Fig. 31.



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Patented Dec. 30, 1947

2,433,568

UNITED STATES PATENT OFFICE

2,433,568

FULL-FASHIONED KNITTING MACHINE

Sterling C. Mack, Bangor, Pa., assignor to Julius Kayser & Co., Brooklyn, N. Y.

Application December 28, 1942, Serial No. 470,355

21 Claims. (Cl. 66—89)

1

The present invention generally relates to the art of widening fabrics on flat knitting machines and, more specifically, pertains to full-fashioned hosiery knitting machines of the kind shown and described in my copending application Serial No. 401,112, filed July 5, 1941, now Patent 2,402,200, of which the present application is a continuation in part.

The invention is particularly concerned with that type of widening wherein loops are added onto the ends of courses, as distinguished from that type of widening wherein loops at the selvedge portions of the fabric are transferred outwardly, and has for one of its primary objects the provision of means capable of being readily incorporated in a full-fashioned hosiery knitting machine whereby the machine may be operated to produce combination leg and foot hosiery blanks with widened portions, especially widened heel portions.

It is also a most important object of the invention to provide a simple attachment capable of being conveniently incorporated in ordinary full-fashioned knitting machines without burdening the knitting machine with complicated and intricate mechanism and without necessitating any material changes in the basic construction of the machine and, further, without requiring detrimental changes in the relative actuation and timed function of the various knitting instrumentalities, such as the bearded needles, the sinkers, the dividers, the knockover bits, and the yarn carriers.

Other important objects and advantages of the invention will be in part obvious and in part pointed out hereinafter.

In order that the invention and its made of operation may be readily understood by those skilled in the art, I have, in the accompanying drawings and in the detailed description based thereupon, set out a possible embodiment of the invention.

In these drawings:

Figure 1 is a front elevation of portions of a full-fashioned knitting machine having the attachment of the invention incorporated therein;

Fig. 2 is an enlarged section taken on line 2—2 of Fig. 1;

Fig. 3 is a top plan of parts shown in Fig. 2;

Fig. 4 is a front elevation of a portion of the mechanism shown in Fig. 3;

Fig. 5 is an enlarged section taken on line 5—5 of Fig. 3;

Fig. 6 is an enlarged detail of one of the pawls operating the carrier nut spindle;

Fig. 7 is a detail illustrating the pawl controlling element in one of its positions;

Fig. 8 is a view similar to Fig. 7 illustrating the pawl controlling element in another of its positions;

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Fig. 9 is a cross sectional detail of the cam controlled rollers;

Fig. 10 is a detail of the control mechanism viewed from the rear of the machine;

Fig. 11 is a top plan of the same; taken on line 11—11 of Fig. 10;

Figs. 12 through 27 inclusive illustrate in a more or less diagrammatic manner the various stages in the operation of the machine for widening the fabric;

Fig. 28 is a side elevation illustrating the preferred construction of the dividers in the widening portions of a knitting head;

Fig. 29 is a side elevation illustrating the prefered construction of the sinkers in the widening portions of a knitting head;

Fig. 30 is a face elevation of the widening cam looking in the general direction of line 30—30 of Fig. 4;

Fig. 31 is a sectional side elevation showing a modification of the attachment;

Fig. 32 is a front elevation of the same;

Fig. 33 is a detail of the widening cam looking in the general direction of line 33—33 of Fig. 32.

Referring more particularly to the drawings wherein like characters of reference will designate corresponding parts throughout, the machine as shown embodies the usual frame 10 provided with bearings for the rotatable shiftable main cam shaft 11, the rockable needle bar up-and-down shaft 12, the rockable needle bar in-and-out shaft 13, the rockable front catch bar shaft 14, and the rockable back catch bar shaft 15.

The machine frame also includes the ordinary center bed 16, front beam 17, and back beam 18. About the center bed are arranged the multiple knitting sections designated in their entirety for convenience herein by the reference character 19.

Each knitting section comprises an association of knitting instrumentalities cofunctioning to form the knitted loops of the fabric through the operation of the machine. These instrumentalities include a bank of bearded needles 20, a bank of sinkers 21 and dividers 22, a bank of knockover bits 23, and a set of yarn feeding carriers 24. The banks of needles are supported in needle bars 25 adapted to have up-and-down movement for the purpose of drawing newly formed loops through previously formed loops, and in-and-out movement for the purpose of pressing off such previously formed loops subsequent to the drawing therethrough of the newly formed loops.

To impart up-and-down movement to the needle bars, there are attached to the latter various brackets 26 pivotally connected, as at 27, to split arms 28 which are secured to the needle up-and-down shaft 12. Also secured to said shaft 12 are levers, such as indicated at 29, each carrying a

roller 30 disposed for riding engagement with a corresponding needle up-and-down cam 31 of the main cam shaft 11.

To impart in-and-out movement to the needle bars, there are attached to the latter bearing brackets 32 pivotally connected, as at 33, to arms 34 which, in turn, are pivotally connected, as at 35, to levers such as shown at 36 secured to the needle in-and-out shaft 13, each lever carrying a roller 37 disposed for riding engagement with a corresponding in-and-out cam 38 on the main cam shaft 11.

Each bank of sinkers and dividers is supported in a sinker bed 39, the individual sinkers and dividers being arranged in alternating relationship to extend between the needles 20 of the associated bank so that one needle is located between a sinker and an adjoining divider.

The sinkers and dividers are adapted to be advanced and retracted relatively to the needles. The sinkers are advanced individually and progressively through the function of the so-called Coulier motion (not shown) which, for this purpose, includes a slur bar 40 carrying slur cocks 41 for reciprocation within the knitting sections, and shaped to act successively and progressively on series of jacks 42, one for each sinker, and operable to push the same outwardly of the sinker bed 39.

The dividers 22 are advanced in gang by means of a catch bar 43 having links such as that shown at 44 pivotally connected, as at 45, to an associated arm 46 fixed onto the back catch bar shaft 15. Also fixed onto the back catch bar shaft 15 are levers such as that shown at 47 each carrying a roller 48 disposed for riding engagement with a corresponding cam 49 on the main cam shaft 11.

The sinkers 21 and dividers 22 are retracted simultaneously by means of the catch bar 42 and, for that purpose, there are provided links 50 connected at one end to the catch bar and engaged at the other end with rods such as that shown at 51 pivoted, as at 52, to an arm 53 fixed onto the front catch bar shaft 14. Also fixed to the front catch bar shaft 14 are levers such as that shown at 54 carrying a roller 55 disposed for riding engagement with a corresponding cam 56 on the main cam shaft 11.

The knockover bits 23 are mounted in a support 57 and disposed below the sinkers 21 and dividers 22 in the vertical plane thereof, so that a needle 20 extends between two adjoining knockover bits. The knockover bits 23 are movable towards and away from the sinkers 21 and dividers 22 and, for that purpose, their support 57 is connected in the usual manner to the ordinary link and lever system (not shown) controlled by the ordinary cam means (not shown) on the main cam shaft 11.

The carriers 24 are positioned to feed yarn upon the nibs of the sinkers 21 and dividers 22 and to the front (that is, the bearded) side of the needles 20. For that purpose, the carriers 24 are arranged on carrier bars 58 mounted for reciprocation in brackets such as shown at 59. The carrier bars 58 receive their reciprocating movement through function of the Coulier motion which, for that purpose, has a friction bar 60 which may be, and preferably is, associated with a suitable well-known three-carrier attachment (not shown) connectable with the carrier bars to impart reciprocatory yarn feeding movements to the carriers in selective repeated sequence.

The reciprocating movement of the carrier bars 58 is controlled by the function of the carrier

narrowing motion mechanism 61 which includes the usual double threaded spindle 62 in engagement with oppositely movable carrier nuts 63. The carrier nuts 63 are provided with stops 64 placeable in the path of movement of a pair of abutments 65 suitably arranged on each of the carrier bars 58 so that the carrier bars are limited in their movement in either direction.

Moreover, each of the carrier bars 58 is supplied with a pair of projections 66 engageable with latch members 67 journalled in the carrier nuts 63 by means of a traverse shaft 68. Rigid with the shaft 68 is an arm 69 acted upon by a spring 70' to normally urge the shaft 68, together with its latch members 67 into position for positive engagement with their associated carrier projections 66.

The arm 69 carries a roller 70 in bearing engagement with a cross piece 71 adjustably affixed to a vertically extending rod 72 pivotally connected, as at 73, to a lever 74 mounted for rocking motion on the back catch bar shaft 15. The lever 74 carries a roller 75 disposed for riding engagement with an active cam 76 or a neutral cam 76a on the main cam shaft 11, depending upon the shifting positions of the latter.

From the foregoing, it will be understood that the carrier bars 58 with their carriers 24 are locked securely to the carrier nuts 63 by means of the spring urged latch members 67 but that, upon action of the cam 76 on the roller 75, the lever 74 is rocked to exert a downward pull on the rod 72 and its cross piece 71 which then presses on the roller carrying arm 69, accordingly causing the latch members 67 to disengage the projections 66 and thus freeing the carrier bars for their reciprocating motion. The cam 76 is so shaped and disposed as to effect the carrier bar release immediately before the reciprocating movement of the carrier starts.

In accordance with the present invention, the reversible threaded spindle 62 of the carrier narrowing mechanism 61 is intended to be rotated in opposite directions, rotation in one direction effecting narrowing of the fabric and rotation in the other direction effecting widening of the fabric. For that purpose, there is rigidly attached to an extended portion 77 of the spindle 62 a pair of integral ratchet wheels 78 and 79 respectively having their teeth extended in opposite directions. Freely mounted on said extended portion 77 is an oscillating pawl carrying arm 80 having one pawl 81 disposed to engage the ratchet wheel 78 and one pawl 82 disposed to engage the ratchet wheel 79. The pawl carrying arm 80 is given its oscillatory motion by means of a lever 83 connected to said arm 80 through an adjustable rod 84 and mounted for rocking motion on the back catch bar shaft 15. The lever 83 is provided with a fixed roller 85 and a shiftable roller 86. The fixed roller 85 is adapted to have riding engagement with the peripheral edge of a neutral cam 87 or with an active cam 88 on the main cam shaft 11 when the latter is shifted to its narrowing position, that is, in the direction of arrow E in Figure 4.

Thus it will be understood that whenever the main cam shaft 11 is shifted to its narrowing position, the cam 88 is brought in contact with the roller 85, thereby causing the lever 83 to exert a rearward pull on the pawl carrying arm 80 and, accordingly, move the pawl 81 to act on its ratchet wheel 78 for rotating the spindle 62 in the direction to move the carrier nuts 63 for effecting narrowing of the fabric. The roller 86 is engageable

with a cam track 89 of a cam 90 also on the main cam shaft 11 when said roller 86 is shifted in the direction of arrow F in Figure 4.

For the purpose of shifting the roller 86, there is preferably provided a shifting lever 91 pivoted at its intermediate portion 92 to the rocking lever 83 and having one end portion 93 in engagement with a groove 94 suitably formed with said roller 86 and having its other end 95 in engagement with a shifting rod 96. The shifting rod 96 is connected by means of a block 97 to a second rod 98 which is associated with an oscillating link and bell crank assembly 99 suitably mounted on the machine frame to be acted upon by buttons 100 on a pattern chain 101 which may be, and preferably is, the usual main pattern chain of the knitting machine. Thus, whenever a button 100 during the progressive movement of the pattern chain 101 comes in position to act on the link and bell crank lever arrangement 99, the latter moves the rods 98 and 96 in a left direction, Figure 1, for causing the shifting lever 91 to shift the roller 86 into engagement with the track 89 of the cam 90. In this manner, the track 89 actuates the level 83 to exert a forward thrust to the pawl carrying arm 80, accordingly moving the pawl 82 to act on its ratchet wheel 79 for rotating the spindle 62 in the direction to move the carrier nuts 63 for widening of the fabric.

In order to provide means for disengaging the pawl 81 or 82 from its associated ratchet wheel 78 or 79, to permit rotation of the spindle 62 when acted on by the remaining pawl and ratchet wheel, there is preferably provided for free oscillating motion on the spindle extension 77 an annular disc 103 having a cut-out portion 104 on a sector of its peripheral edge, thus providing a pair of diametrically opposed camming surfaces 105 and 106 respectively. The pawls 81 and 82 carry pins 107 and 108 respectively disposed for association with the camming surfaces 105 and 106 so that, upon oscillation of the disc 103 in one direction, that is, in the direction of arrow I, the pin 107 will ride down the surface 105 allowing the pawl 81 to engage the ratchet wheel 78, and the pin 108 will ride up the surface 106 forcing the pawl 82 out of engagement with the ratchet wheel 79. However, upon oscillation of the disc 103 in the opposite direction, that is, in the direction of arrow J, the pin 107 will ride up the surface 105 forcing the pawl 81 out of engagement with the ratchet wheel 78, and the pin 108 will ride down the surface 106 allowing the pawl 82 to engage the ratchet wheel 79.

In order that the oscillation of the disc 103 for the relative displacement of the pawls 81 and 82 may be controlled in timed relation with respect to the operation of the knitting machine to effect narrowing or widening of the fabric, said disc is connected by means of a rod 109 to a lever 110 pivotally supported as at 111 in bracket 112 conveniently mounted on the back beam 18. The lever 110 carries a roller 113 disposed for engagement with a cam 114 on the cam shaft 11 and is controlled by a latch 115 pivoted to the bracket 112, for instance, as shown at 116, and connected to an extended portion of the rod 98 so that upon shifting of the latter, the latch 115 is moved out of engagement with the lever 110, thus freeing the same for its actuation by the cam 114. In this manner, it will be appreciated that when the shifting rod 98 is in its inactive position, that is, in the position shown in the drawings, the pawl 81 engages it rachet wheel 78 while the pawl 82 is out of engagement

with its rachet wheel 79 so that narrowing may take place, whereas when the shifting rod 98 is in its active position, that is, shifted to the left (Figure 1), the pawl 81 is out of engagement with its ratchet wheel 78 while the pawl 82 engages its ratchet wheel 79 so that widening of the fabric may take place.

The operation of the knitting machine according to the present invention will now be described in connection with the fabrication of a single unit stocking blank of the type diagrammatically shown in Figure 3 wherein the heel fabric is formed by widening courses in the areas between line X—X and line Z—Z to form widened heel sections W as continuations of the high spliced heel sections S.

In accordance with the present practice in the industry, the fabric of the blank preferably is of "ringless" construction, that is, the stocking fabric is preferably knitted according to the well known alternating three-carrier system which allows the use of three separate body yarns Y1, Y2, and Y3 in the knitting of the stocking, alternating from one to the other at the completion of each course, thereby causing an individual body yarn to be used for every third course only throughout the knitting process.

As is customary in the art, the high splice heel sections S and the widened heel sections W are reinforced and, for that purpose, two separate reinforcing yarns R1 and R2 are utilized. For convenience herein, the reinforcing yarns R1 and R2 are shown unshaded, the body yarn Y1 is shaded solid black, the body yarn Y2 is lined, and the body yarn Y3 is stippled.

In accordance with the usual practice in the art, one reinforcing yarn R1 is used in conjunction with the three body yarns Y1, Y2, and Y3 in forming the desired number of reinforced loops to constitute the reinforced heel area at one side of the stocking fabric, and the other reinforcing yarn R2 is used in conjunction with the three body yarns Y1, Y2, and Y3 in forming the desired number of reinforced loops to constitute the reinforced heel area at the other side of the stocking fabric, said three body yarns Y1, Y2, and Y3 being used alone, that is, without either reinforcing yarn R1 or R2 to form the desired number of non-reinforced loops intermediate the reinforced loops within the heel areas to constitute the sheer instep area.

It will be understood that the desired number of reinforced loops within the reinforced heel areas may be obtained by adjustment of the fabric widening attachment and of the well known "pointex" attachment not shown herein but usually provided on full-fashioned knitting machines, the widening attachment controlling the feeding of the body and reinforcing yarns at the outer selvedge edges of the reinforced areas of the fabric and the "pointex" attachment controlling the feeding of the reinforcing yarns at the inner selvedge edges of said areas.

In order to fully and clearly understand the present invention, the association, actuation, and timed function of the various knitting instrumentalities and associated parts as they occur in the usual operation of an ordinary full-fashioned knitting machine must be borne in mind.

As is well known in the art, and as hereinbefore stated, the sinkers 21 and dividers 22 within each sinker head 39 are arranged in alternating relationship, the knockover bits 23 are so positioned that there is one knockover bit below and in the vertical plane of each sinker and

divider, the needles 20 are so disposed that one needle extends between every two adjacent knockover bits and between a sinker and an adjoining divider, and the carriers 24 are so positioned that yarn is fed upon the nibs of the sinkers and dividers and to the front (that is, the bearded) side of the needle. The yarn carriers 24 and sinkers 21 are actuated through the Coulier motion, whereas the needles 20, dividers, and knockover bits are actuated through their respective cams provided on the main cam shaft 11.

The friction rod 60 and slur bar 40 are reciprocated in unison and in uniform strokes lengthwise of the knitting machine, but the reciprocating yarn laying strokes of the carriers are variably controlled by means of the stops associated with the narrowing nuts 63 of the carrier narrowing mechanism 61. The operation of the carrier narrowing mechanism is such that the carrier stops are adjusted to arrest the carriers always over the divider outside the needle next to the desired end needle so that the sinker between said end and additional needles may function to sink the yarn on the end needle for the formation of the selvedge loop. While the carriers are arrested, the Coulier motion continues to the end of its stroke so that the slur cocks 41 continue in their movement to advance all the sinkers 21 and, for that purpose, the location of the slur cocks 41 with respect to the sinker heads 39 and end of the Couliering motion is such that by the time the Couliering motion has reached the end of its stroke in either direction, the slur cocks have passed beyond the last sinkers in the sinker head.

The dividers 22 are advanced in gang by means of catch bars 43 which, at times, also act to engage and simultaneously move the sinkers 21 and the dividers 22; the knockover bits 23 are given a slight up and down motion by means of levers attached to the knockover shaft (not shown); and the needles 20 receive movement in a general vertical direction, that is, at right angles to the sinkers, dividers, and knockover bits, by means of the lever and link arrangements referred to. The catch bars, the knockover bits motion imparting levers, and the needle movement imparting lever and link arrangements are controlled by appropriate cams on the main cam shaft, as hereinbefore stated. These cams, however, are so shaped and corelated that the movements of the various knitting instrumentalities and associated parts take place in a definite timed relationship. Thus, at the beginning of a course, the needles are in their uppermost position, the sinkers and dividers are in their innermost position, and the knockover bits in their lowermost position. Thereupon, the Coulier motion, coming into operation, moves the carriers in one direction which lay the yarn in said direction in the manner hereinbefore specified. As the carriers move, the slur cocks follow at a short distance, thus successively advancing the sinkers and, accordingly, kinking the yarn between alternate needles.

When all the sinkers have been advanced, and before the Couliering starts in the opposite direction, the catch bars are caused to move forwardly, thus forcing the dividers to advance in unison and, accordingly, the yarn which has already been kinked between alternate needles now becomes kinked between each needle.

With the sinkers and dividers remaining in their advanced positions, the needles are caused to descend vertically so that the yarn kinked about the needle shanks becomes engaged within the needle beards to be drawn through the loops of a previously formed course, whereupon pressing off of the loops of said previously formed course takes place in the usual manner.

As is known, during the press-off, the sinkers and dividers are drawn back simultaneously by the catch bars while the knockover bits are being moved upwardly. In this manner, the newly sunk loops, due to the downward movement of the needles, are caused to slip off the nibs of the sinkers and dividers onto the knockover bits, whereupon the sinkers and dividers are advanced simultaneously by the catch bars, thereby holding the fabric in place as the subsequent raising of the needles takes place.

Following the press-off, and after the needles are returned to their uppermost position, the sinkers and dividers are withdrawn en masse to their innermost position by the catch bar, whereupon the laying of another course begins.

In accordance with the present invention, when a widening course is to be made, the yarn feeding is done in the ordinary manner as above described, the selected carriers being arrested as usual over the dividers outside the needle next to the ultimate knitting needle in operation while the sinkers beyond said needle are being advanced, but between the time when all the sinkers have been advanced and the time when the dividers are to be advanced, the active as well as the idle carriers, except the idle reinforcing carrier, are displaced preferably a distance of two needles passing over the extended sinker therebetween and coming to rest over the succeeding divider so that, with the advance of the dividers, that divider at either end of the knitting field over which the carriers were originally arrested engages the yarns and firmly holds the same against the needle between said divider and the immediately preceding sinker whereupon, during the subsequent operation of the knitting instrumentalities, there are formed a loop on said needle next to the original ultimate needle and a firm selvedge loop on the second added needle.

Referring more particularly to Figures 12 to 27 inclusive, there are shown certain knitting needles of a needle bar and knitting elements associated therewith. The needle at each of the opposite ends of the series on which the last fabric course before the knitting of a widening course takes place is indicated at N1, whereas the first three needles in the widening area over which added loops are extended or widening courses are formed, are indicated at N2, N3, and N4. Corelated with the needles in the order mentioned are sinkers S1, dividers D2, sinkers S3, and dividers D4, with each of which are associated the knockover bits K. Carriers C1, C2, and C3 respectively intended to feed the body yarns Y1, Y2, and Y3, and carriers C4 and C5 respectively intended to feed the reinforcing yarns R1 and R2, are shown in their relative positions.

It will be understood that in the laying of the yarns for the formation of regular courses, that is, courses of uniform width, the carriers are arrested over the dividers D2 so that the sinkers S1 may cooperate in forming the selvedge loops E.

In accordance with the present invention, as represented in Figures 12, 13, and 14, as the widening operation commences, the carrier C1, threaded with the body yarn Y1 which has just been used to lay a course, and the carrier C5, threaded with the reinforcing yarn R2 which has

just been used to reinforce certain loops of said course, are arrested in their movement towards one end of the needle series over the divider D2 at that end of the machine and over which lies idle the carrier C2 threaded with the body yarn Y2 which is to be used for laying the next succeeding course, whereas the carrier C3, threaded with the body yarn Y3 which is to be used for laying the third course, lies idle over the divider D2 at the other end of the needle series. These carriers are held in that position until all the sinkers within the widening portion in the knitting head have reached their advanced position.

In the interval after the sinkers in the widening portion of the knitting head have moved outwardly, and before the dividers are moved forwardly, the carriers C1, C2, and C5 at one end of the needle series, and the carrier C3 at the other end of the needle series are relatively displaced outwardly over a distance of two needles, that is, said carriers pass over the respective needles N3, over the respective extended sinkers S3, and come to rest over the respective dividers D4 so that a portion of each of the yarns Y1, Y2, R2, and Y3 is laid across the nib of the respective dividers D2, as indicated in dotted lines in Figure 12. Such outward movement of the carriers takes place after the sinkers up to and including the right hand sinker S3 (Fig. 12) have been advanced to sinking position and during the advance of the remaining sinkers in the head beyond the widening portion and prior to the advance of the dividers to dividing position.

The dividers are then advanced simultaneously to sink the yarns between each needle, thus forming the loops of the new laid course, as represented in Figure 15. In so doing, as illustrated in Figures 15, 16, and 17, the dividers D2 engage that portion of each of the yarns Y1, Y2, R2, and Y2 which were laid across the nibs of the dividers D2 by the movement of the carrier bars to locate the carriers over the dividers D2 and thus firmly hold the yarns against the needles N2.

At this particular moment, the needles, in their usual sequence of movement, descend, as indicated by the arrow in Figures 16 and 17, for the purpose of drawing the newly formed loops of the widened courses being made through the previously formed loops of the preceding course.

It will be understood that in this descending movement of the needles, the yarn portions held against the needles N2 become engaged within the beards thereof, but that the yarn portions passing over the needles N3 are not engaged thereby because of the angle at which said yarn portions are drawn.

As the needles continue to descend, the sinkers and dividers, as is customary for the press-off operation, are withdrawn en masse, as indicated by arrow A (Figure 18) and then advanced en masse, as indicated by arrow B (Figure 18), for the purpose of holding down the newly drawn loops while the needles are raised to their uppermost position. It is to be noted that the yarns being engaged within the beards of the needles N2 will be drawn downwardly as the needles descend and, accordingly, upon withdrawal and subsequent advance of the sinkers and dividers, said yarns are permitted to be caught under the dividers D2 which place the portions of the yarns leading from the needles N2 to the main carriers C1, C2, and C3 and reinforcing carrier C5 at such an angular position (dotted lines, Figure 18) that, upon the advancing movement of the sinkers and dividers, the sinkers S3 engage the

yarns, as indicated in full lines in Figure 18. Since this advance of the sinkers and dividers takes place prior to the raising of the needles, as indicated by the arrow in Figure 19, the yarns leading from the carriers, as above specified, become located forwardly of the needles N3 in the manner clearly shown in Figures 21, 22, and 23 when the needles reach their uppermost position and the sinkers and dividers are withdrawn in unison in their innermost position preparatory to the laying of yarn for the next course.

In laying yarn for the formation of the next course, the carrier C2 threaded with the body yarn Y2, and the carrier C5 threaded with the reinforcing yarn R2, are moved in the reverse direction, wrapping said yarns Y2 and R2 about the needles N3 (Figures 24 and 25), while the carrier C1 remains idle. As more clearly shown in Figure 24, the carriers C2 and C5 travel together for that distance necessary to form the desired number of reinforced loops of one heel area, whereupon the carrier C5 is arrested while the carrier C2 continues to travel alone for that distance necessary to form the desired number of non-reinforced loops of the instep area, when the carrier C4 threaded with the reinforced yarn R1 joins the movement of the carrier C2 to form the desired number of reinforced loops in the other heel area, said carriers C2 and C4 travelling together, as illustrated in Figures 24 and 26, to the end of the yarn laying movement for the formation of the course, the yarns being sunk between alternate needles by the usual function of the sinkers. As represented in Figure 27, after the laying of the yarns has been completed, the dividers are advanced en masse so that the yarns become sunk between each needle, whereupon the needles operate in their usual manner to knit in the course.

In forming the next course, the carrier C3 threaded with the body yarn Y3, and the carrier C4 threaded with the reinforcing yarn R1, move together in the opposite direction for the required distance, whereupon carrier C4 is stopped while carrier C3 continues to move alone for the formation of non-reinforced loops. Then carrier C5 threaded with the reinforcing yarn R2 joins in the movement of the carrier C3 to the end of the yarn laying stroke which brings said carriers C3 and C5 to a stop over divider D4. Subsequently, the carriers C1 and C5 are moved the distance of two additional needles so that said carriers come to rest over the divider D6 for widening the course in the same manner as hereinbefore described.

It is to be understood that succeeding widened courses are formed in the same manner, but it is also to be understood that instead of widening immediately succeeding courses, one or more courses of a width identical to the immediately preceding course may be knitted before the knitting of another widened course.

In order that the production of the stocking fabric, as explained above, may be carried out without change in the proven advantageous relative position between the carriers and sinker heads, I have devised modified constructions for the dividers and sinkers located within the widening area of the sinker heads. The preferred constructions for such dividers and sinkers are shown respectively in Figures 28 and 29.

In ordinary full-fashioned knitting machines, it has been found that in order to assure the proper laying of yarn for preventing accidental dropping of loops and the formation of rough

selvedges, the tips of the yarn carriers must be slightly lower than the top edges of the sinkers, and because the carriers are always stopped over a divider so that the preceding divider may be used in forming the corresponding selvedge, the leading edge of each divider is formed with a cut-out portion, such as shown at 118 in Figure 28, whereby said leading edge lays in a plane somewhat lower than the top edges of the sinkers. In this manner, the lower tips of the carriers are cleared when the dividers are advanced.

Also in ordinary full-fashioned knitting machines, in order to provide means for taking up excess yarn that would usually be drawn by the regular dividers when carried forward by the catch bar and thus contributing to the formation of tight selvedges, it is customary to form the selvedge dividers with a slot 119 at a point below the usual throat 120 of each such divider. Because of the provision of said slot 119, when a carrier is reversed at the end of its stroke, the yarn fed by such a carrier is wrapped securely around the last needle in operation and pulled over the nib 121 of the associated selvedge divider so that, upon forward movement of said divider to form the loops between adjoining needles, the yarn is forced under the shortened nib 122, accordingly making the ultimate or selvedge loop smaller than normal size.

Moreover, in accordance with the present invention, the selvedge dividers which are located in the widening area of the knitting section are each provided with a notch 123 at the leading edge of the divider adjacent the cutout or recessed portion 118 and immediately above the throat 120 thereof. By providing this notch 123, in the manner stated, the yarns, as more clearly shown in Figure 16, become engaged within said notch when the divider (for instance, the divider D2) is advanced after the carriers have moved to their extreme positions over the next following divider (for instance, divider D4) as hereinbefore described. Since the tips of the carriers extend below the normal upper edges of the sinkers and since, in accordance with this invention, the movement of the carriers from their positions over one divider (for instance, divider D2) to their positions over the next succeeding divider (for instance, divider D4) occurs, after the sinkers have been advanced, the upper edges of these sinkers located within the widened area of the knitting section are provided with recessed or cut-out portions 124 so disposed that the carriers may undergo their movements from one stop position to their other stop positions without interference.

From the description herein, it will be understood that an ordinary full-fashioned knitting machine may be operated to knit single unit full-fashioned stocking blanks with widened heel sections by providing such machine with the attachment herein shown and described.

As more clearly shown in Figure 30, the cam 90 includes a neutral part 90*a* and an active part 90*b*. The neutral part 90*a* is round, whereas the active part 90*b* comprises four sectors, that is, a neutral sector extending from point *a* to point *b*, a rising sector extending from point *b* to point *c*, an idling sector extending from point *c* to point *d*, and a lowering sector extending from point *d* to point *a*. Thus during normal knitting, the roller 86 riding on the neutral part 90*a* idles at its lowest level, as indicated at L, so that the spindle actuating pawl and ratchet mechanism remains inoperative. The operation of the chain mechanism causes the shifting of the roller 86 from the neutral part 90*a* onto the active part 90*b*. This shifting is timed to take place when the cam 90, rotating in the direction of arrow R, brings the neutral sector *a*—*b* in line with the roller 86. Then, as the cam progresses in its rotation, the rising sector *b*—*c* and the idling sector *c*—*d* are brought successively in alignment with the roller, elevating and maintaining the same at its highest level indicated at U, thus causing said pawl and ratchet mechanism to be racked back and held in readiness for actuating the spindle for widening. With continued rotation of the cam, the lowering sector *d*—*a* is brought in engagement with the roller which then, guided by the track 89, rides down to the lowermost level L causing the pawl and ratchet mechanism to be racked forward, accordingly operating the carrier nut spindle to effect widening.

It is particularly pointed out that the cam 90 is so disposed on the main cam shaft that the sector *d*—*a* becomes operative at a time following the advance of the outermost selvedge sinker of the widened heel area in the direction of Couliering as for instance during the advance of the sinkers beyond the widened heel area but always at a time prior to the advance of the dividers. In other words, the sector *d*—*a* may, and preferably does, become operative in the interval of time subsequent to the projection of the outermost selvedge sinker in the widened heel area, and during the continued operation of the Couliering motion, and previous to the start of the dividing motion.

In Figures 31 through 33 there is shown a modification of the attachment. As represented in Figures 31 and 32, the shiftable roller 86 carried by the lever 83 oscillating on the back catch bar shaft 15 to actuate the arm 80 for imparting movement to the pawl 81 or 82 associated with the respective ratchet wheel 78 or 79, is disposed for riding engagement with an actuating cam 90′ provided with a guiding track 89′.

For the purpose of shifting the roller 86, there is preferably provided a shifting lever 91′ pivoted at its intermediate portion 92′ to the rocking lever 83 and having one end portion 93′ in engagement with the groove 94 formed with said roller 86 and having its other end 95′ in engagement with a shifting rod 96′. The shifting rod 96′ is associated with the oscillating link and bell crank assembly 99 (Figures 1 and 10) mounted on the machine frame to be acted upon by the pattern chain. Thus, whenever a button during the progressive movement of the pattern chain comes in position to act on the link and bell crank lever arrangement, the latter moves the shifting rod 96′ in the direction of arrow F in Figure 32 for causing the shifting lever 91′ to shift the roller 86 into engagement with the cam 90′. In this manner, the cam 90′ actuates the lever 83 to exert a forward thrust on the pawl carrying arm 80, accordingly moving the pawl 82 to act on its ratchet 79 for rotating the spindle in the direction to move the carrier nuts for widening the fabric in the same manner as hereinbefore described.

In order to operate the disc 103 acting on the pins 107 and 108 of the pawls 81 and 83 for controlling the latter, there is provided a rod 109′ having one of its ends connected to said disc and the other of its ends connected to a bell crank lever 97′ which, in turn, is connected to the shifting rod 96′. In this manner it will be appre-

ciated that the function of the pawl and ratchet mechanism and the function of the controlling device for said mechanism are corelated for operation and proper timed relationship.

As more clearly shown in Figure 33, the cam 90' comprises three sectors, that is, a neutral sector extending from point *e* to point *f*, a rising sector extending from point *f* to point *g*, and a lowering sector extending from point *g* to point *e*. The shifting of the roller 86 to engage the cam 90' is timed to take place when said cam, rotating in the direction of arrow R, brings the neutral sector *e*—*f* in line with said roller. Then, as the cam progresses in its rotation, the rising sector *f*—*g* is brought in alignment with the roller elevating the same from its lowest level L to its highest level U, thus causing the pawl and ratchet mechanism to be racked back in readiness for actuating the spindle for widening. With continued rotation of the cam, the lowering sector *g*—*e* is brought in engagement with the roller which then, guided by the track 89', rides down to its lowermost level L causing the pawl and ratchet mechanism to be racked forward, accordingly operating the carrier nut spindle to effect widening.

It is particularly pointed out that the cam 90' is so disposed on the main cam shaft 11 that the sector *g*—*e* becomes operative at a time following the advance of the outermost selvedge sinker of the widened heel area in the direction of Couliering, but always at a time prior to the advance of the dividers. In other words, the sector *g*—*e* may, and preferably does, become operative in the interval of time subsequent to the projection of the outermost selvedge sinker in the widened heel area, the continued operation of the Couliering motion, and previous to the start of the dividing motion.

From the foregoing description, it will be understood that the cam 90 and the cam 90' operate in substantially the same manner, although their construction differs slightly. The differences are occasioned by the modified construction of the spindle actuating pawl and ratchet control mechanisms.

It is, of course, to be understood that the invention is not to be limited to the specific embodiment herein shown and described, but includes any possible changes and modifications which come within the scope of the subjoined claims.

What I claim is:

1. In a flat knitting machine having carriers operable to feed yarn for the formation of successive courses in a hosiery blank knitted on the machine: a carrier nut mechanism for arresting the carriers; a pawl and ratchet device operable to move said carrier nut mechanism to effect narrowing; a pawl and ratchet device operable to move said carrier nut mechanism to effect widening; an operating arm common to both pawl and ratchet devices to actuate the same; means for operating said arm to impart to the narrowing pawl and ratchet device its movement; means for operating said arm to impart to the widening pawl and ratchet device its movement; and mechanism operatively associated with the pawl and ratchet devices to set the same in operation in timed relationship with respect to the operation of said arm by either of said means.

2. In a flat hosiery knitting machine having a shiftable main cam shaft, a pattern chain mechanism, and a plurality of carriers selectively operable to feed a plurality of yarns in repeated sequence for the formation of successive courses in a hosiery blank knitted on the machine: a carrier nut mechanism for arresting the carriers; a pawl and ratchet device operable to move said carrier nut mechanism to effect narrowing; a pawl and ratchet device operable to move said carrier nut mechanism to effect widening; an operating arm common to both pawl and ratchet devices to actuate the same; a fixed roller and a shiftable roller carried by said arm; a cam on the main cam shaft engagable with said fixed roller upon shifting of the main cam shaft for operating said arm to impart to the narrowing pawl and ratchet device its movement; a cam on the main cam shaft engageable with said shiftable roller for operating said arm to impart to the widening pawl and ratchet device its movement; and pattern chain controlled mechanism operatively associated with said shiftable roller to bring the same in engagement with its cam on the main cam shaft and operatively associated with the pawl and ratchet devices to set the same for operation in timed relationship with respect to the operation of said arm for widening.

3. In a flat hosiery knitting machine having needles, sinkers, and dividers operable to sink yarn into loops, and a plurality of carriers selectively operable to feed a plurality of yarns to the needles in repeated sequence for the formation of successive courses in a hosiery blank knitted on the machine: displaceable means for arresting the carriers after feeding yarn to a series of needles equal in number to the number of wale loops in the preceding course; and a mechanism operable to displace said means for the movement over a number of additional needles subsequent to the movement to sinking position of the sinkers adjacent to such additional needles but prior to the movement of the dividers to dividing position, of the carrier which has fed its yarn for the formation of a first course, of the idle carrier at one side of the blank and which is to feed its yarn for the formation of a second course, and of the idle carrier at the other side of the blank and which is to feed its yarn for the formation of a third course.

4. In a flat hosiery knitting machine having needles, sinkers, and dividers operable to sink yarn into loops, and a plurality of carriers selectively operable to feed a plurality of yarns to the needles in repeated sequence for the formation of successive courses in a hosiery blank knitted on the machine: displaceable means for arresting the carriers after feeding yarn to a series of needles equal in number to the number of wale loops in the preceding course; and a mechanism operable to displace said means for the movement over two additional needles subsequent to the movement to sinking position of the sinkers adjacent to said additional needles but prior to the movement of the dividers to dividing position, of the carrier which has fed its yarn for the formation of a first course, of the idle carrier at one side of the blank and which is to feed its yarn for the formation of a second course, and of the idle carrier at the other side of the blank and which is to feed its yarn for the formation of a third course.

5. In a flat hosiery knitting machine having needles, sinkers, and dividers operable to sink yarn into loops, a plurality of carriers threaded with body yarns and operable to feed the same to the needles in repeated sequence for the formation of successive courses in a hosiery blank knitted on the machine, and a plurality of car-

riers threaded with reinforcing yarn and operable to feed the same to certain needles for reinforcing certain loops at the end portions of said courses: displaceable means for arresting the carriers after feeding yarn to a series of needles equal to the number of wale loops in the preceding course; and a mechanism operable to displace said means for the movement over a number of additional needles subsequent to the movement to sinking position of the sinkers adjacent to such additional needles but prior to the movement of the dividers to dividing position of the carrier which has fed its body yarn for the formation of a first course, of the idle carrier at one side of the blank and which is to feed its body yarn for the formation of a second course, and of the idle carrier at the other side of the blank and which is to feed its body yarn for the formation of a third course.

6. In a flat hosiery knitting machine having needles, sinkers, and dividers operable to sink yarn into loops, a plurality of carriers threaded with body yarns and operable to feed the same to the needles in repeated sequence for the formation of successive courses in a hosiery blank knitted on the machine, and a plurality of carriers threaded with reinforcing yarn and operable to feed the same to certain needles for reinforcing certain loops at the end portions of said courses: displaceable means for arresting the carriers after feeding yarn to a series of needles equal to the number of wale loops in the preceding course; and a mechanism operable to displace said means for the movement over two additional needles subsequent to the movement to sinking position of the sinkers adjacent said additional needles but prior to the movement of the dividers to dividing position, of the carrier which has fed its body yarn for the formation of a first course, of the carrier which has fed its reinforcing yarn to reinforce loops of said course, of the idle carrier at one side of the blank and which is to feed its body yarn for the formation of a second course, and of the idle carrier at the other side of the blank and which is to feed its body yarn for the formation of a third course.

7. In a flat hosiery knitting machine having needles, sinkers, and dividers operable to sink yarn into loops, a plurality of carriers threaded with body yarns and operable to feed the same to the needles in repeated sequence for the formation of successive courses in a hosiery blank knitted on the machine, and a plurality of carriers threaded with reinforcing yarn and operable to feed the same to certain needles for reinforcing certain loops at the end portions of said courses: displaceable means for arresting the carriers after feeding yarn to a series of needles equal to the number of wale loops in the preceding course; and means for moving the feeding body yarn carrier and the idle body yarn carrier over a number of additional needles outside the fabric selvedges between the time the sinkers adjacent said additional needles have been advanced and the time when the dividers are advanced.

8. In a flat hosiery knitting machine having needles, sinkers, and dividers operable to sink yarn into loops, a plurality of carriers threaded with body yarns and operable to feed the same to the needles in repeated sequence for the formation of successive courses in a hosiery blank knitted on the machine, and a plurality of carriers threaded with reinforcing yarn and operable to feed the same to certain needles for reinforcing certain loops at the end portions of said courses: displaceable means for arresting the carriers after feeding yarn to a series of needles equal to the number of wale loops in the preceding course; and means for moving the feeding body yarn carrier and the idle body yarn carrier over two additional needles outside the fabric selvedges between the time the sinkers adjacent said two additional needles have been advanced and the time when the dividers are advanced.

9. In a flat hosiery knitting machine having needles, sinkers, dividers, and carriers operable to feed yarn to the needles for the formation of successive courses in a hosiery blank knitted on the machine: a mechanism for arresting the carriers; a mechanism for actuating the sinkers; a mechanism for actuating the dividers; and a mechanism operable for displacing said carrier arresting mechanism subsequent to the advance of certain of the sinkers by said sinker actuating mechanism and prior to the advance of the dividers by said divider actuating mechanism, each of the dividers within the widening areas having a yarn engaging notch immediately below its leading edge, a yarn engaging slot immediately above its nib, and a yarn engaging throat intermediate said notch and said slot.

10. In a flat hosiery knitting machine having needles, sinkers, dividers, and carriers operable to feed yarn to the needles for the formation of successive courses in a hosiery blank knitted on the machine: a mechanism for arresting the carriers; a mechanism for actuating the sinkers; a mechanism for actuating the dividers; and a mechanism operable for displacing said carrier arresting mechanism subsequent to the advance of certain of the sinkers by said sinker actuating mechanism and prior to the advance of the dividers by said divider actuating mechanism, each of the sinkers within the widening areas having a recessed portion upon its leading edge, and each of the dividers within the widening areas having a yarn engaging notch immediately below its leading edge, a yarn engaging slot immediately above its nib, and a yarn engaging throat intermediate said notch and said slot.

11. In a knitting machine having needles and alternating sinkers and dividers intended to knit hosiery with widened heels: reciprocating mechanism including means for feeding yarn to a certain number of said needles, and means for projecting the sinkers individually and progressively; means operable to project the dividers in unison subsequent to the operation of said mechanism; and means operable for the actuation of said yarn feeding means for feeding yarn to an additional number of needles in the interval of time subsequent to the projection of the outermost selvedge sinker in the widened heel area, during the continued operation of the reciprocating mechanism, and previous to the projection of the dividers by the divider projecting means.

12. A flat knitting machine comprising a cam shaft which is axially shiftable to change the machine from knitting to fashioning phases of operation, and vice versa; a narrowing head with a stop controlling screw spindle, and a pair of different ratchet wheels on said spindle; racking mechanism including a member oscillatable about the axis of said spindle and individual pawls for the ratchets carried by said member on opposite sides of said axis; normally quiescent means for actuating the pawls, and a pair of rotary cams on the cam shaft corresponding re-

spectively to the different ratchets and having faces effecting, through influence upon the pawls, partial rotations of said ratchets to move the spindle in opposite directions; and control mechanism determining selection as between the pawls and selective actuation of the pawl actuating means by the respective cams during different fashioning phases.

13. In a flat hosiery knitting machine having needles, sinkers, dividers, and carriers operable to feed yarn to the needles; mechanism for arresting the carriers; mechanism for actuating the sinkers to sink yarn between some of said needles; mechanism for actuating the dividers to divide the sunk yarn, and a mechanism operable for displacing said carrier arresting mechanism subsequent to the sinking of an aforesaid yarn and prior to dividing the same sunk yarn.

14. In a flat hosiery knitting machine having a main cam shaft, needles, sinkers, dividers and carriers operable to feed yarn to the needles for the formation of courses in a hosiery blank knitted on the machine; a mechanism for arresting the carriers; mechanism for advancing sinkers between needles; mechanism for advancing the dividers between needles after the advance of the sinkers; and a mechanism operable for displacing said carrier arresting mechanism after the advance of at least some of the sinkers to sinking position and prior to the next advance of the dividers to dividing position.

15. In a flat hosiery knitting machine having a pattern chain, a main cam shaft, needles, sinkers, dividers, and carriers operable to feed yarn to the needles for the formation of courses in a hosiery blank knitted on the machine; a mechanism for arresting the carriers; a mechanism for actuating the sinkers; a mechanism for actuating the dividers; and a mechanism controlled through said pattern chain and operable for displacing said carrier arresting mechanism subsequent to the advance of some of said sinkers to sinking position by said sinker actuating mechanism and prior to the advance of the dividers to dividing position by said divider actuating mechanism, all of said mechanisms being activated through the main cam shaft.

16. In a flat hosiery knitting machine having needles, sinkers and dividers operable to sink yarn into loops, and a plurality of carriers operable to feed yarn to the needles for the formation of successive courses in a hosiery blank knitted on the machine; displaceable means for arresting the carriers after feeding yarn to a series of needles equal in number to the number of wale loops in the preceding course; and a mechanism operable to displace said means for the movement of a carrier over a number of additional needles subsequent to the sinking of the yarn fed to said former group of needles but prior to the dividing of such yarn for widening the heel section of the blank.

17. In a flat hosiery knitting machine having needles, sinkers and dividers operable to sink yarn into loops, and a plurality of carriers selectively operable to feed a plurality of yarns to the needles in repeated sequence for the formation of successive courses in a hosiery blank knitted on the machine; displaceable means for arresting the carriers after feeding yarn to a series of needles equal in number to the number of wale loops in the preceding course; and a mechanism operable to displace said means for the

movement of the carriers over two additional needles subsequent to the movement of the sinkers to sink the yarn fed to the former group of needles but prior to the operation of the dividers to divide the sunk yarn.

18. In a flat hosiery knitting machine having needles, sinkers and dividers operable to sink yarn into loops, and a plurality of carriers selectively operable to feed a plurality of yarns to the needles in repeated sequence for the formation of successive courses in a hosiery blank knitted on the machine; means for moving the feeding yarn carrier and the idle yarn carrier over a number of additional needles outside the fabric selvedges between the time when the sinkers adjacent the additional needles have been moved to sinking position and the time when the dividers are moved to dividing position.

19. In a flat hosiery knitting machine having needles, sinkers, and dividers operable to sink yarn into loops, and a plurality of carriers selectively operable to feed a plurality of yarns to the needles in repeated sequence for the formation of successive courses in a hosiery blank knitted on the machine; means for moving the feeding yarn carrier and the idle yarn carrier over two additional needles outside the fabric selvedges between the time when the sinkers adjacent to a selvedge have been moved to sinking position and the time when the dividers are moved to dividing position.

20. In combination with the carrier arresting mechanism, the sinker actuating mechanism, and the divider actuating mechanism of a full-fashioned knitting machine; a mechanism operable for displacing said carrier arresting mechanism subsequent to the advance of certain of the sinkers by said sinker actuating mechanism and prior to the advance of the dividers by the operation of said divider actuating mechanism.

21. In a full-fashioned knitting machine, in combination, a yarn carrier, a group of sinkers, a group of dividers, a bank of needles, and means automatically manipulating said carrier, sinkers, dividers, and needles to draw a sinker loop around a yarn section connecting selvedge loops of successive courses, said means including carrier control mechanism halting the carrier during the advance of a sinker beyond the carrier halting point and releasing the carrier for further movement in the direction of its movement before halting and before the complementary advance of the dividers.

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