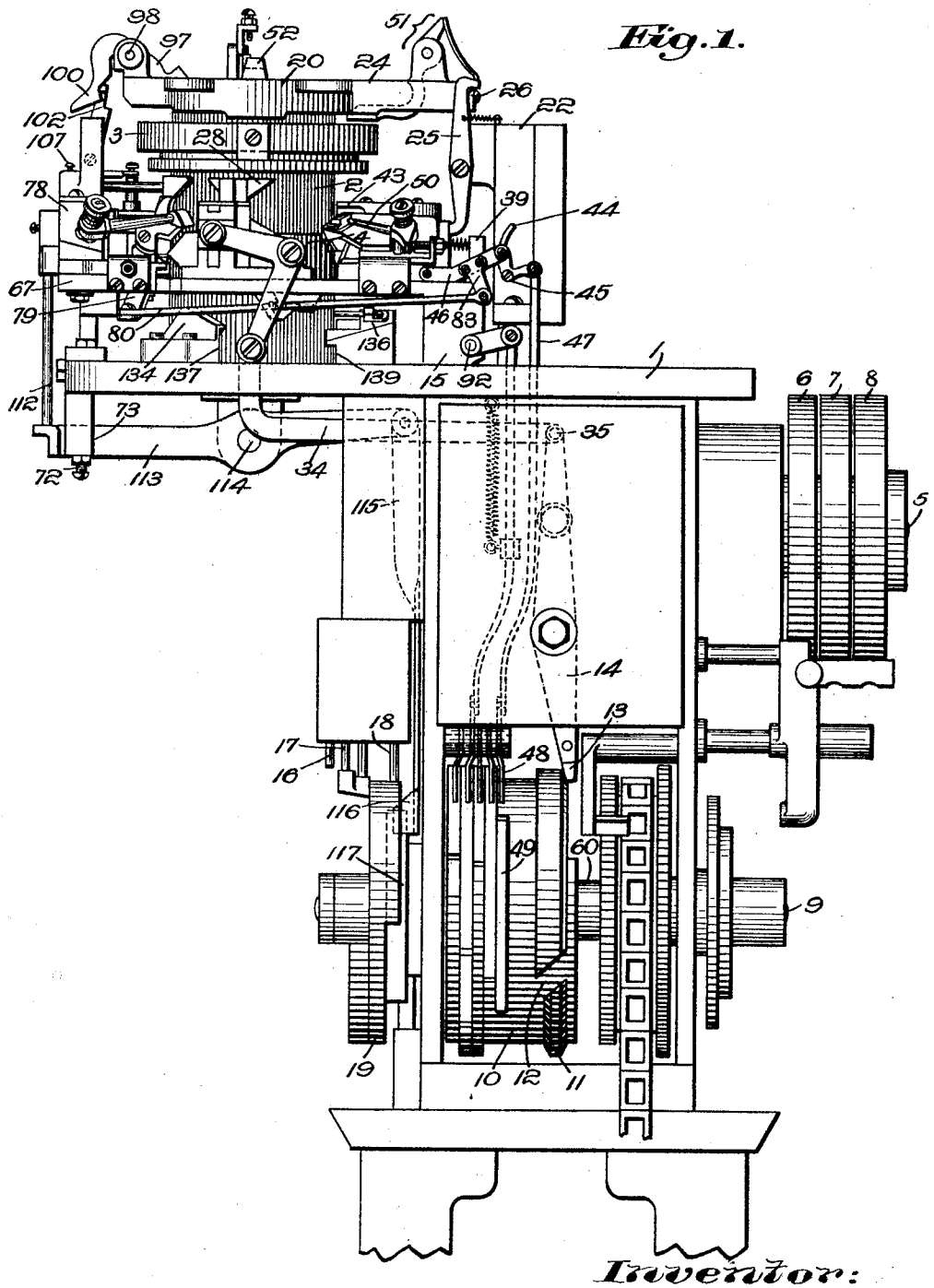
June 12, 1923. 1,458,833

R. H. LAWSON

KNITTING MACHINE AND PROCESS OF PRODUCING SPLIT FABRIC

Filed Sept. 25, 1922 13 sheets-sheet 1

Fig. 1.



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June 12, 1923. 1,458,833

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KNITTING MACHINE AND PROCESS OF PRODUCING SPLIT FABRIC

Filed Sept. 25, 1922 13 sheets-sheet 2

Fig. 2.

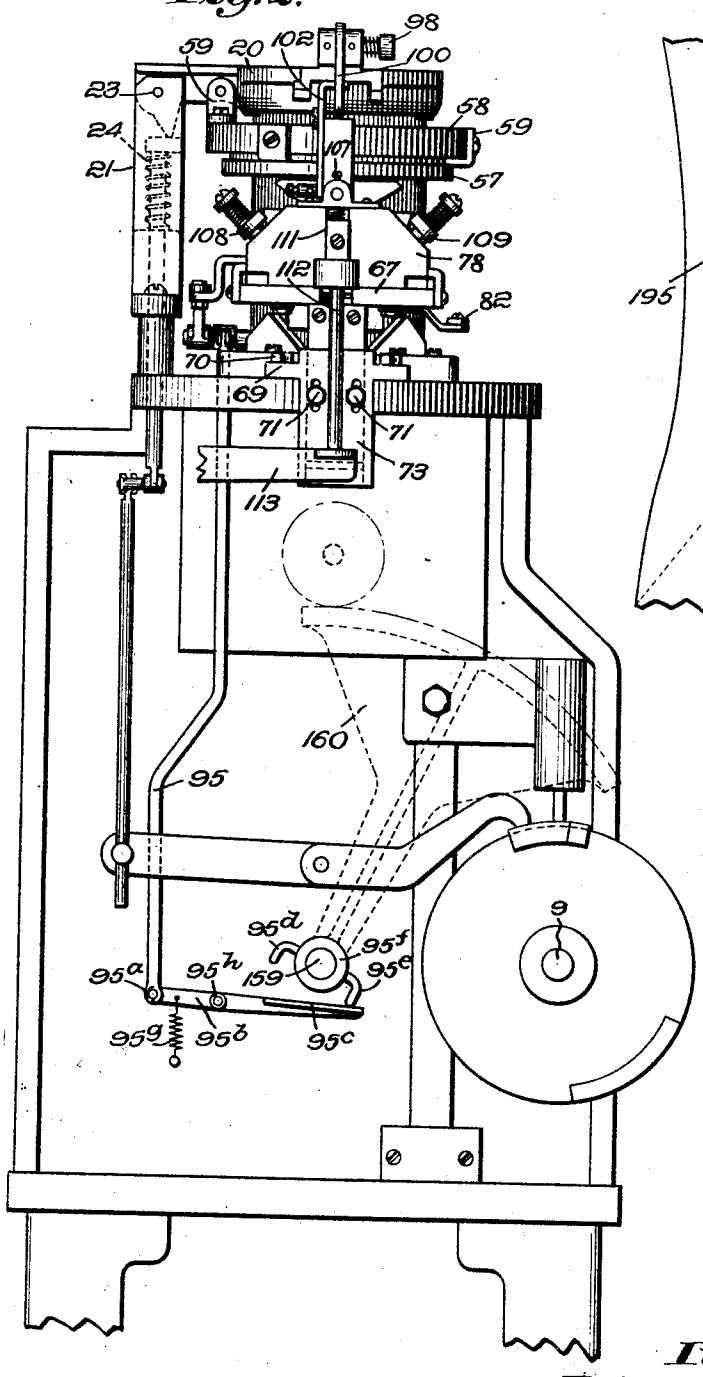


Fig. 10.

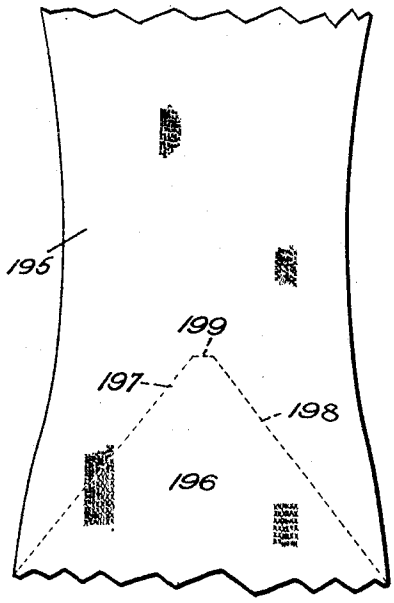
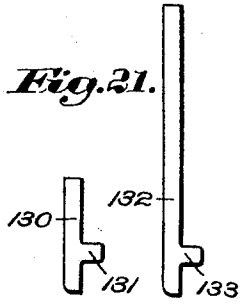


Fig. 21.



Inventor:
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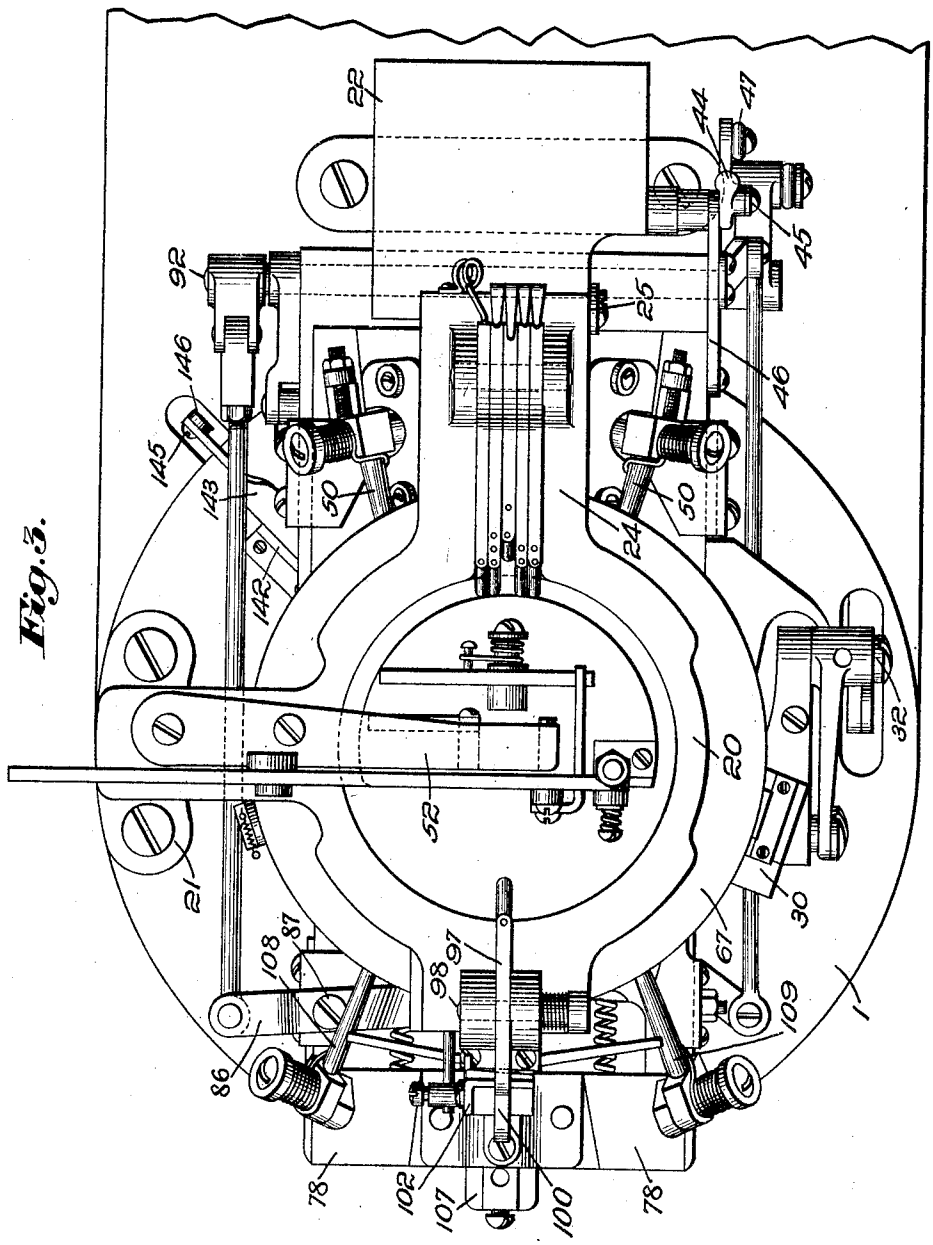
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KNITTING MACHINE AND PROCESS OF PRODUCING SPLIT FABRIC

Filed Sept. 25, 1922 13 sheets-sheet 3

Fig. 3.



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KNITTING MACHINE AND PROCESS OF PRODUCING SPLIT FABRIC

Filed Sept. 25, 1922 13 sheets-sheet 4

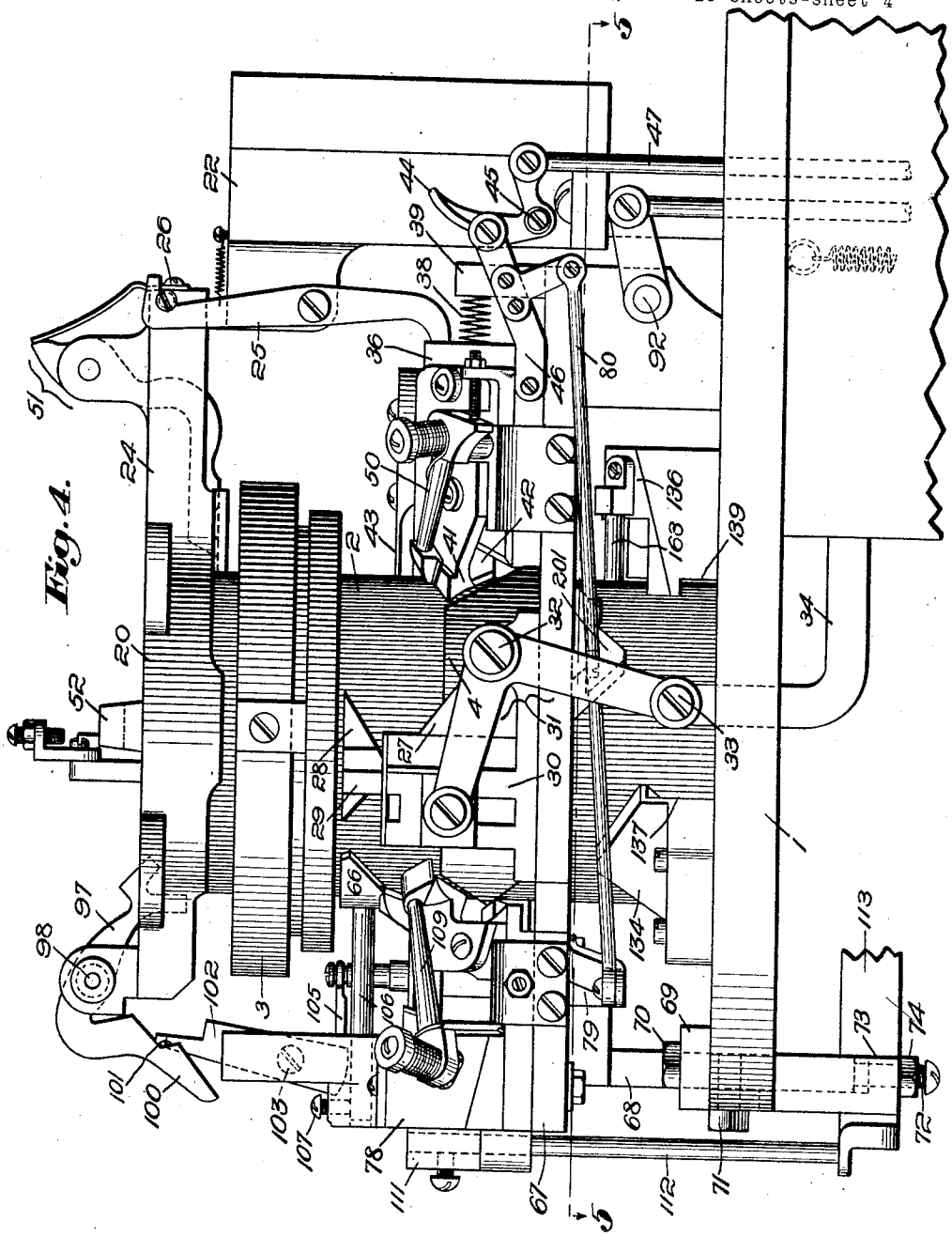


Fig. 4.

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KNITTING MACHINE AND PROCESS OF PRODUCING SPLIT FABRIC

Filed Sept. 25, 1922 13 sheets-sheet 5

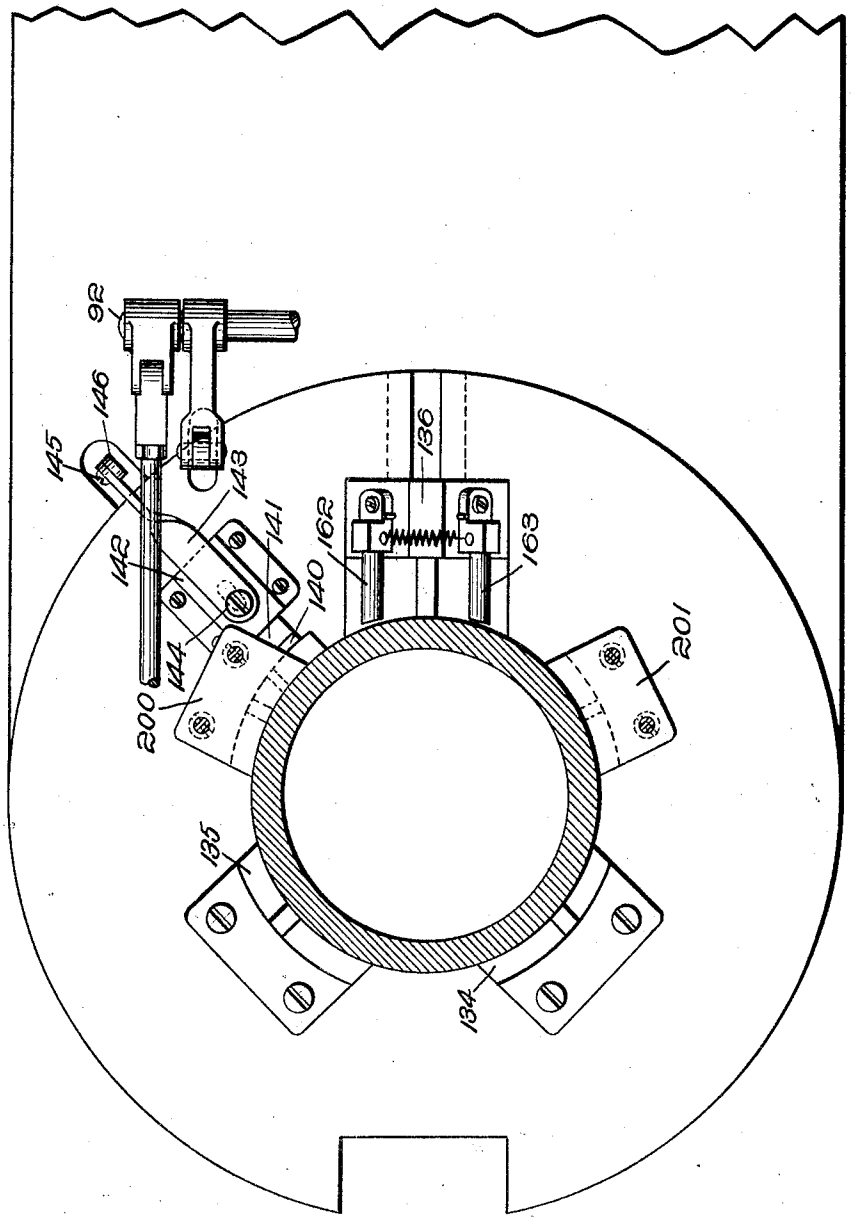


Fig. 5.

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June 12, 1923. 1,458,833

R. H. LAWSON

KNITTING MACHINE AND PROCESS OF PRODUCING SPLIT FABRIC

Filed Sept. 25, 1922 13 sheets-sheet 6

Fig. 6.

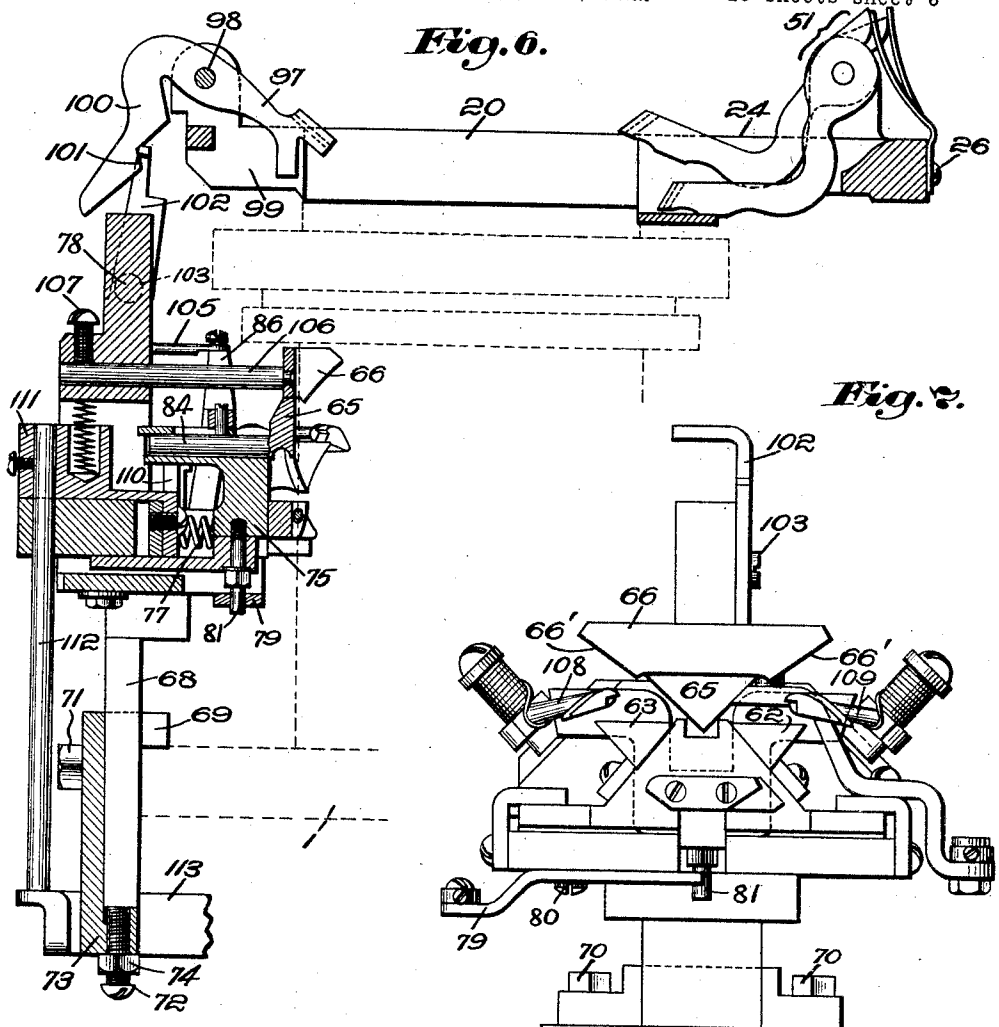


Fig. 7.

Fig. 22.

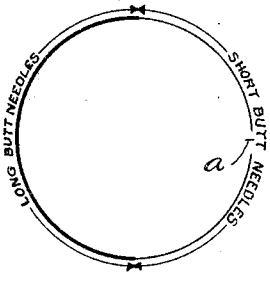
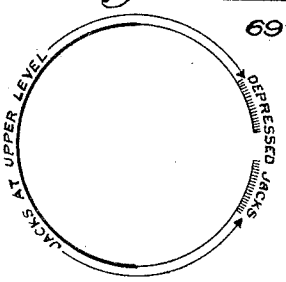


Fig. 23.



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June 12, 1923. 1,458,833

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KNITTING MACHINE AND PROCESS OF PRODUCING SPLIT FABRIC

Filed Sept. 25, 1922 13 sheets-sheet 7

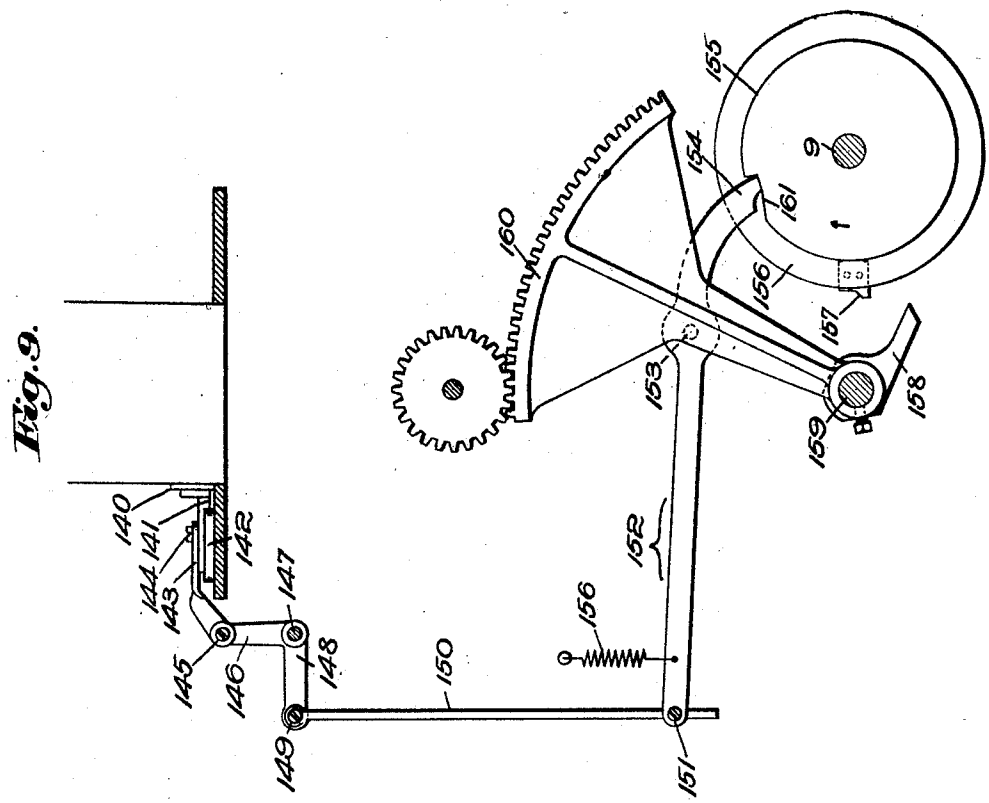


Fig. 9.

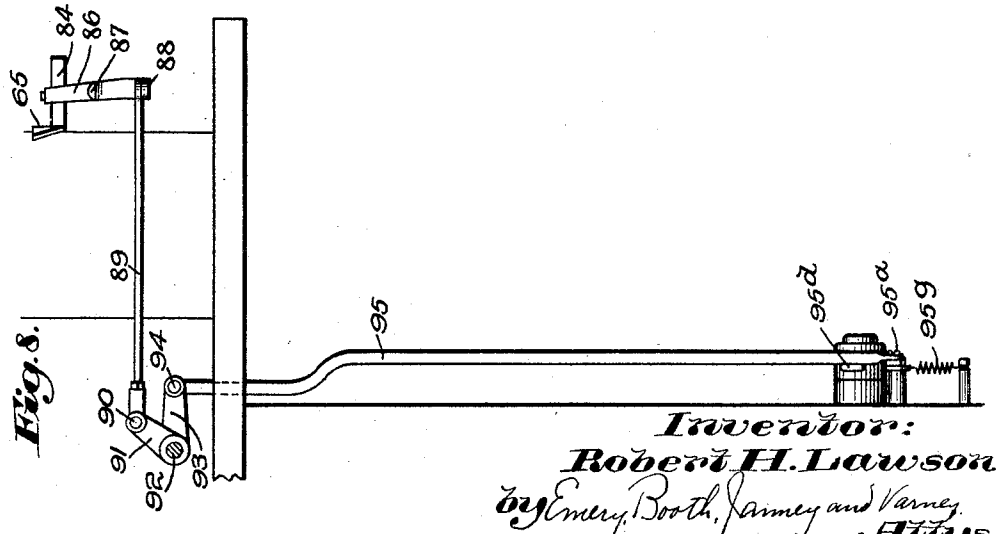


Fig. 8.

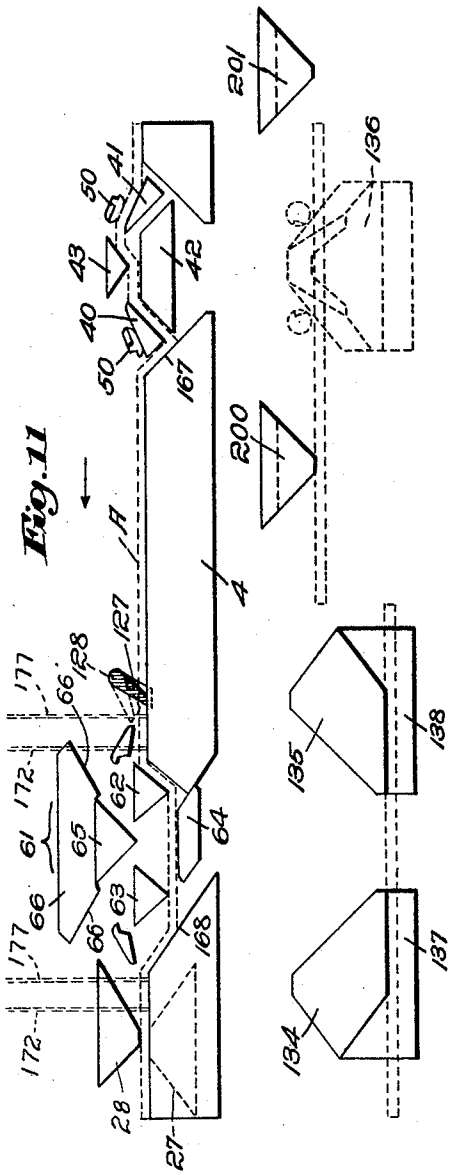
Inventor:
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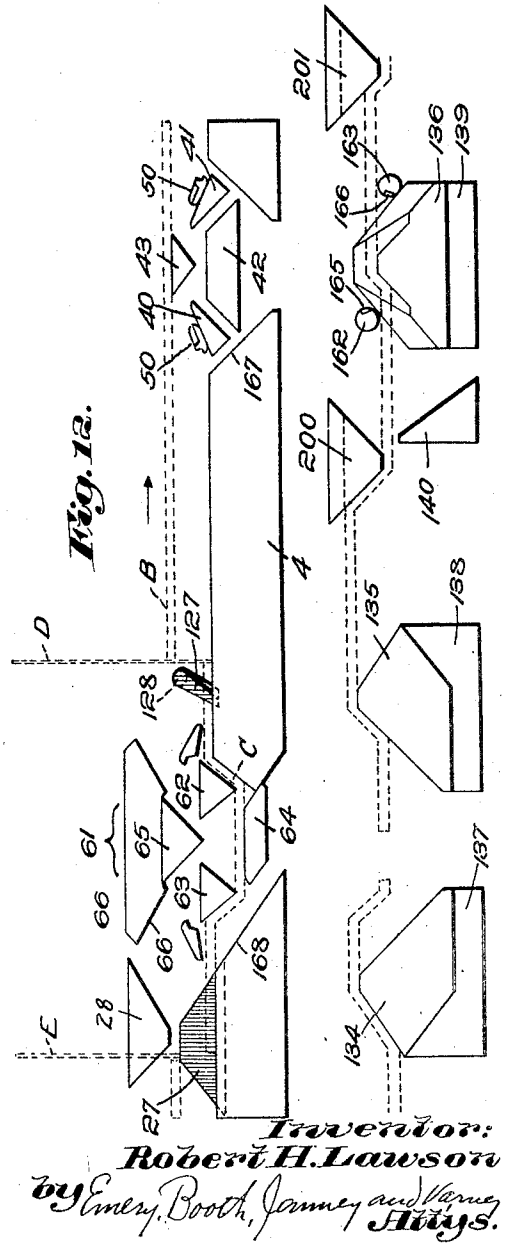
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R. H. LAWSON

KNITTING MACHINE AND PROCESS OF PRODUCING SPLIT FABRIC

Filed Sept. 25, 1922 13 sheets-sheet 8





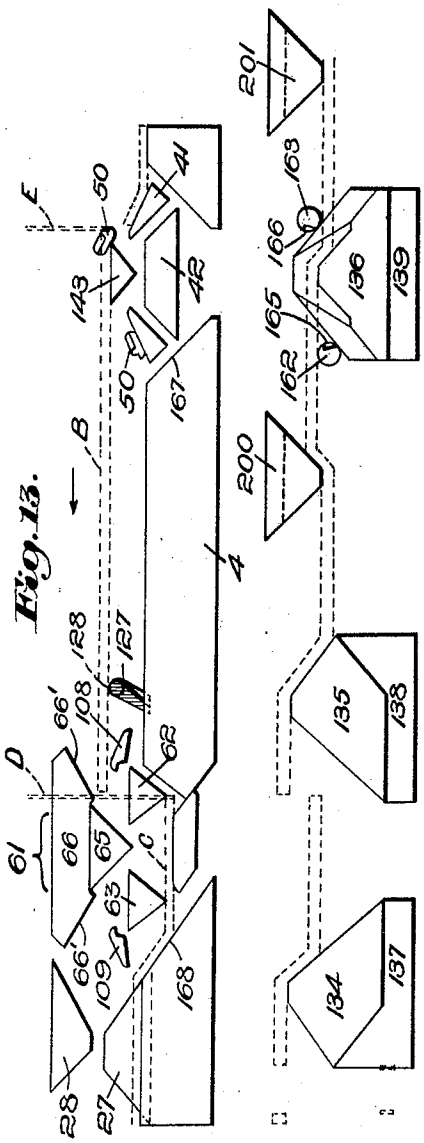
Inventor:
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Attys.

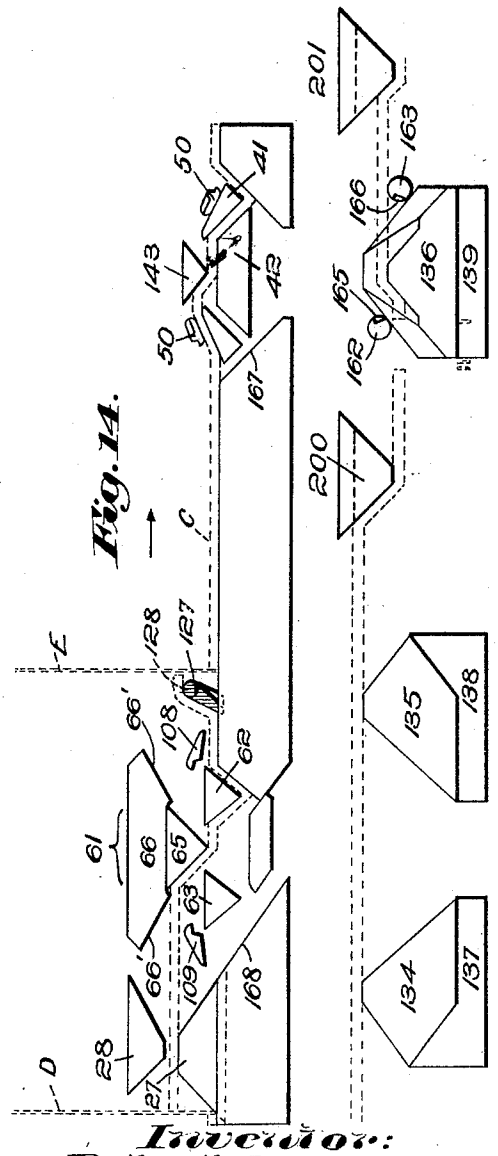
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R. H. LAWSON

KNITTING MACHINE AND PROCESS OF PRODUCING SPLIT FABRIC

Filed Sept. 25, 1922 13 sheets-sheet 9





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June 12, 1923. 1,458,833

R. H. LAWSON

KNITTING MACHINE AND PROCESS OF PRODUCING SPLIT FABRIC

Filed Sept. 25, 1922 13 sheets-sheet 10

Fig. 17.

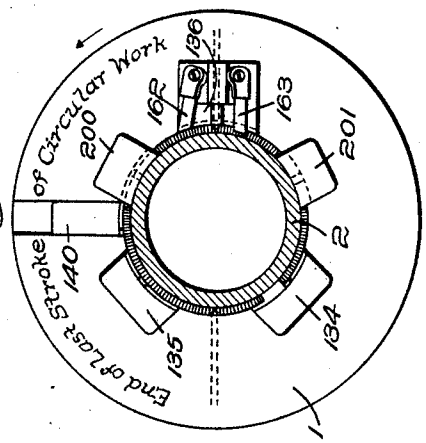


Fig. 20.

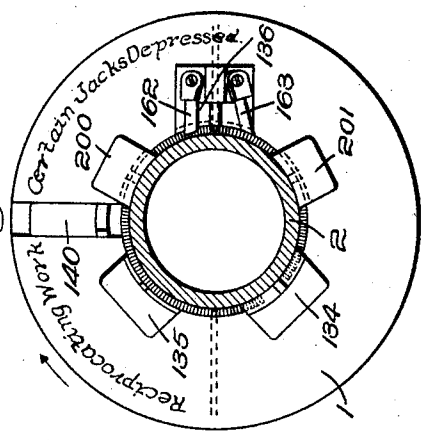


Fig. 16.

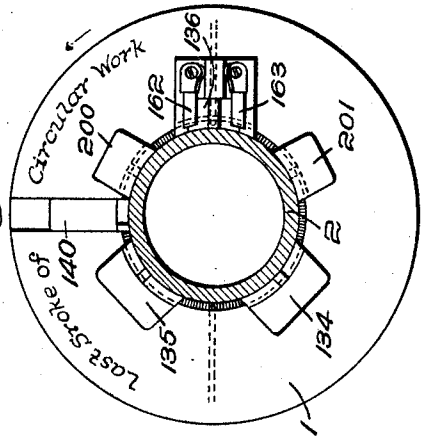


Fig. 19.

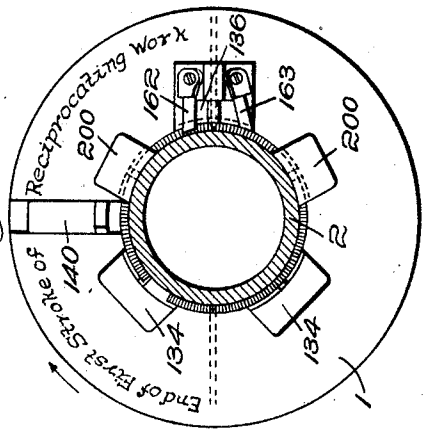


Fig. 15.

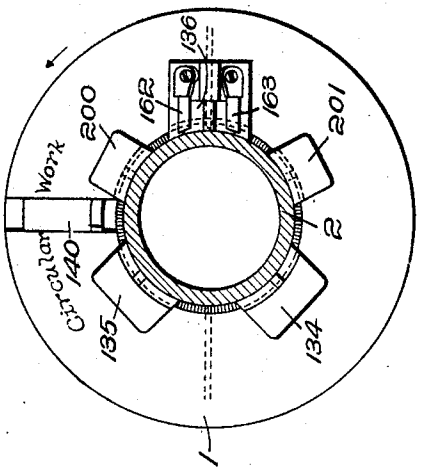
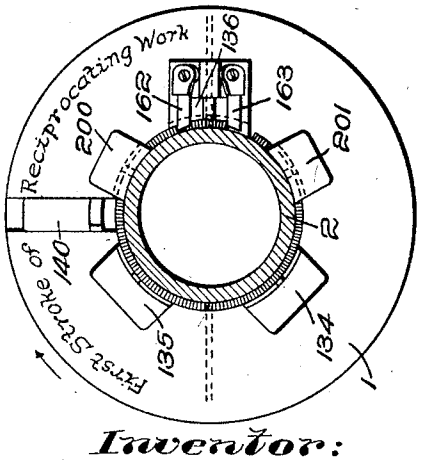


Fig. 18.



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June 12, 1923. 1,458,833

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KNITTING MACHINE AND PROCESS OF PRODUCING SPLIT FABRIC

Filed Sept. 25, 1922 13 sheets-sheet 11

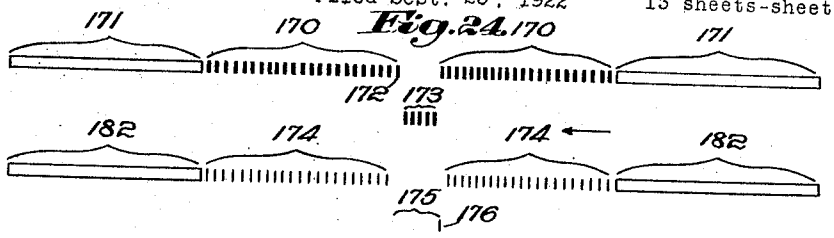


Fig. 24.

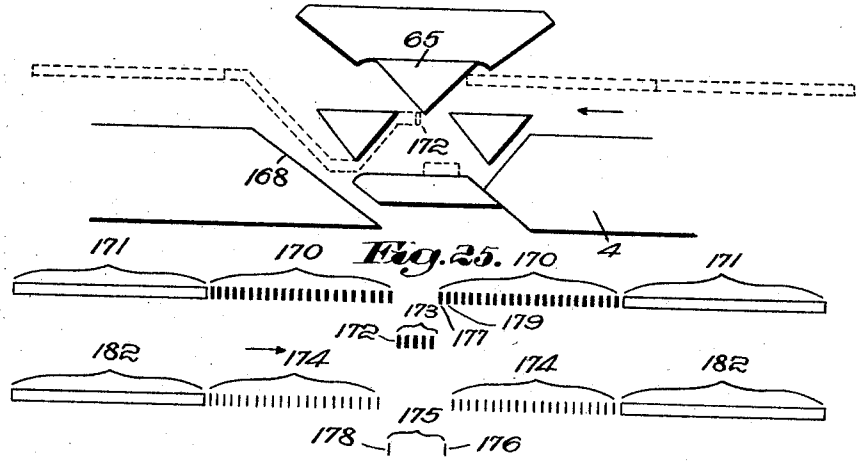


Fig. 25.

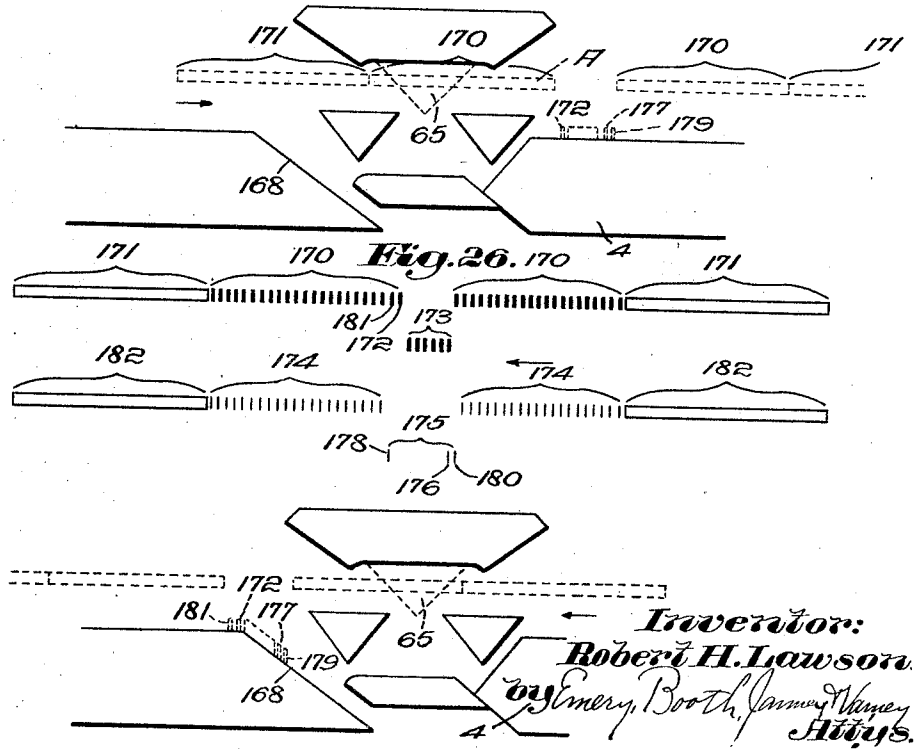


Fig. 26.

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KNITTING MACHINE AND PROCESS OF PRODUCING SPLIT FABRIC

Filed Sept. 25, 1922 13 sheets-sheet 12

Fig. 28.

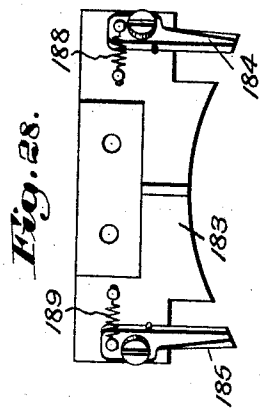


Fig. 29.

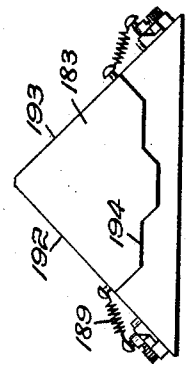
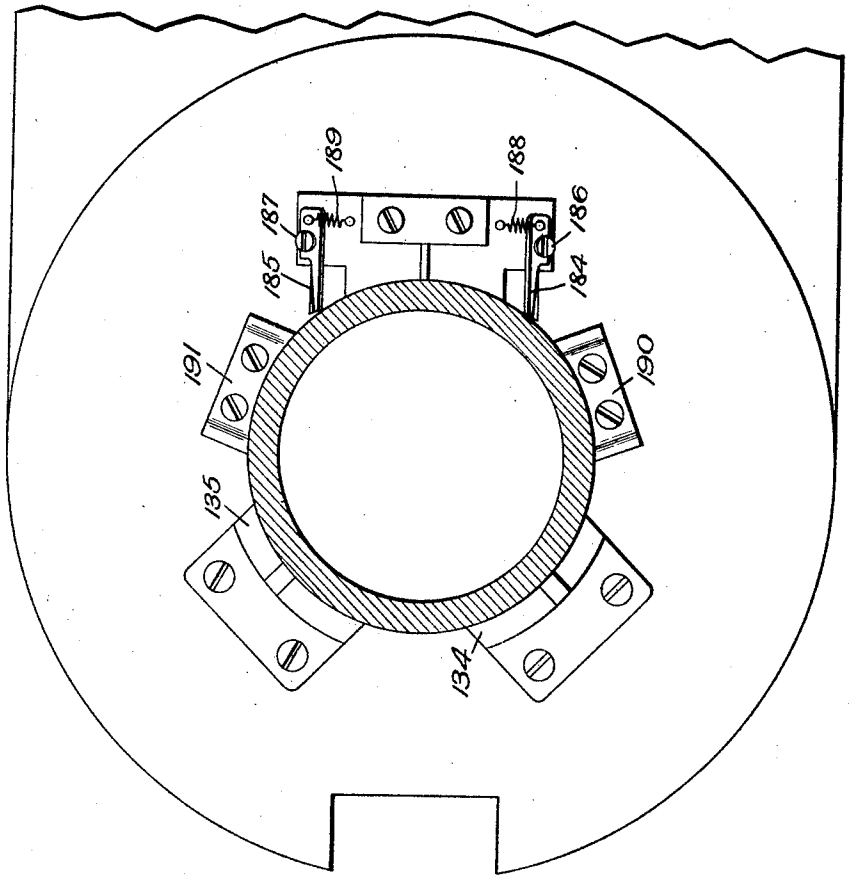


Fig. 28.



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June 12, 1923. 1,458,833

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KNITTING MACHINE AND PROCESS OF PRODUCING SPLIT FABRIC

Filed Sept. 25, 1922 13 sheets-sheet 13

Fig. 31.

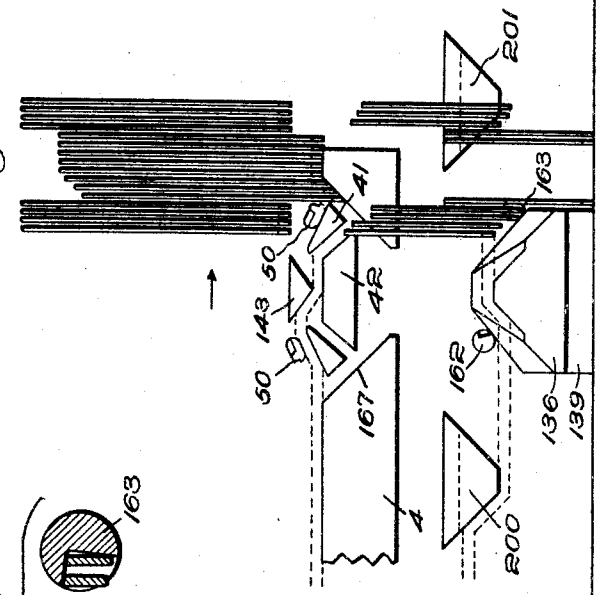


Fig. 32.

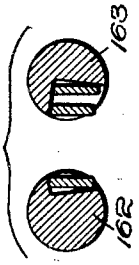


Fig. 33.

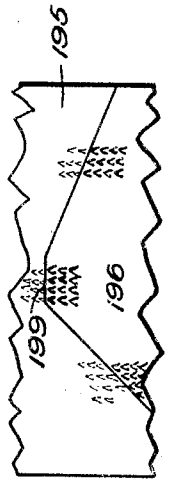
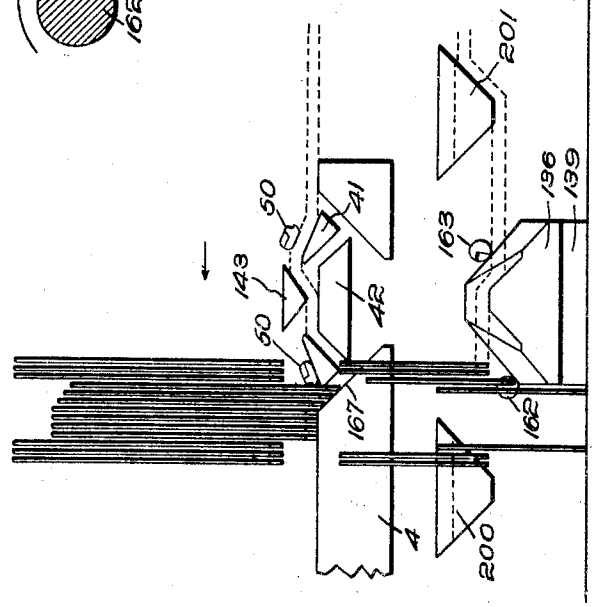


Fig. 30



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Patented June 12, 1923. 1,458,833

UNITED STATES PATENT OFFICE.

ROBERT H. LAWSON, OF CENTRAL FALLS, RHODE ISLAND, ASSIGNOR TO HEMPHILL COMPANY, OF CENTRAL FALLS, RHODE ISLAND, A CORPORATION OF MASSACHUSETTS.

KNITTING MACHINE AND PROCESS OF PRODUCING SPLIT-FABRIC.

Application filed September 25, 1922. Serial No. 590,238.

To all whom it may concern:

Be it known that I, ROBERT H. LAWSON, a citizen of the United States, and a resident of Central Falls, in the county of Providence and State of Rhode Island, have invented an Improvement in Knitting Machines and Processes of Producing Split Fabric, of which the following description, in connection with the accompanying drawings, is a specification, like characters on the drawings representing like parts.

This invention relates to knitting machines and processes for producing split fabric, and more especially to circular automatic knitting machines adapted to split foot hosiery and to processes for producing split foot hosiery.

In order that the principle of the invention may be readily understood, I have disclosed in the accompanying drawings mechanism constituting an embodiment of my invention and by which mechanism the process of my invention may be practised, and the fabric thereof be produced. In said drawings,—

Fig. 1 is a front elevation of a circular knitting machine embodying the invention and whereby my process may be practised and my fabric be produced;

Fig. 2 is a side elevation of said machine;

Fig. 3 is a plan view of the machine;

Fig. 4 is a front elevation upon an enlarged scale of the knitting head of the machine;

Fig. 5 is a section upon the dotted line 5—5 of Fig. 4;

Fig. 6 is a detail in vertical section through the central portion of the secondary knitting cams and through the latch ring or support, and showing the two sets of yarn guides or fingers, the needle cylinder being shown in dotted lines;

Fig. 7 is an inside elevation of the secondary cam set and associated parts:

Fig. 8 is a side elevation of means for moving a portion of the guard cam;

Fig. 9 is a view in side elevation of means for elevating the jacks preparatory to certain split work;

Fig. 10 is a somewhat diagrammatic representation of part of a stocking and indicating the manner in which the high splice is knitted by split work;

Fig. 11 is a development of the various cams for actuating the needles and the jacks, said cams occupying their proper positions for circular knitting.

Fig. 12 is a view similar to Fig. 11, illustrating the various cams in position for certain split work;

Fig. 13 is a view similar to Fig. 12, the cams being in position for split work, with the cylinder moving in the forward direction;

Fig. 14 is a view similar to Fig. 13, but with the cylinder moving in the reverse direction;

Figs. 15 to 20 are diagrammatic sections upon substantially the line 5—5 of Fig. 4, but omitting all unnecessary parts and representing successive stages in the knitting of the high splice or other reinforced or contrasting area by split work;

Fig. 21 is a side elevation of jacks used respectively for the short butt and long butt needles;

Figs. 22 and 23 are diagrams indicating the arrangement of needle sets;

Figs. 24, 25 and 26 are diagrams indicating the action of the needles and the jacks in split work;

Fig. 27 is a transverse section through the machine (omitting certain parts) and indicating an arrangement preferably employed when the knitting of the stocking is begun at the toe;

Fig. 28 is a plan view; and Fig. 29 a side elevation of one of the cams and jack narrowing pickers preferably used when the knitting is begun at the toe;

Figs. 30 and 31 are views similar to the right hand portions of Figs. 13 and 14, respectively, but showing a slightly modified form of my invention;

Fig. 32 is a transverse section through two jack pickers used in that modified form of my invention shown in Figs. 30 and 31; and

Fig. 33 is a view similar to Fig. 10, but indicating the manner in which the high splice or the like is formed when using that form of my invention shown in Figs. 30 and 31.

My invention, while applicable to the production of numerous fabrics as well as to various parts of hosiery, more particularly relates to means for producing reinforced or contrasting areas in hosiery, such, for example, as high splices of triangular or other suitable shape by means of split work, and to a method or process by which such reinforced or contrasting areas are produced as well as to such fabric. I shall herein disclose mechanism whereby this result is accomplished. Such mechanism may be used with many different types of knitting machines. I will, however, without limiting myself thereto, disclose the same as used in connection with a circular knitting machine of the so-called Banner type and organized for producing split work, but not in itself capable of effecting the production of a reinforced or contrasting area having non-parallel sides, to which latter feature my invention is more particularly directed.

I will first describe in necessary detail a circular knitting machine for producing a stocking of split work and will then disclose the fundamental changes therein and with which my invention is particularly concerned.

The knitting machine herein disclosed, but to which my invention is in no wise limited, embodies the characteristics of the so-called Banner machine fully disclosed in the U. S. patent to Hemphill, No. 933,443, dated September 7, 1909. Said machine has a frame 1 within which is mounted a needle cylinder 2 preferably, although not necessarily revoluble, and a non-revoluble cam carrier 3 having an annular portion or ledge 4. Mounted in the frame 1 is a main shaft 5 carrying suitable pulleys 6, 7, 8, respectively employed as quick speed, slow speed and loose pulleys. A pattern shaft 9 is mounted in said frame and has thereon an appropriate cam or pattern drum 10. Upon said pattern drum is a peripheral rib or cam 11 which engages with a follower 13 carried by a pivoted clutch shifting lever 14 connected with the usual clutch for shifting from reciprocating to rotary driving instrumentalities, and vice versa, said latter instrumentalities being well known features of said Hemphill patent, and for further information concerning the same reference may be had thereto. The follower 13 is adapted to travel through cross slots 12 from one side of the rib 11 to the other so as to effect the shifting of said clutch member. One of said cross slots is shown in Fig. 1.

By means of the mechanism just described the needle cylinder 2 is adapted to be given at certain times in the knitting operation a continuous rotary movement, as, for example, during the knitting of the leg of the stocking, while at other times said cylinder is given a to and fro or reciprocating movement not only during the knitting of the heel and toe pocket of the stocking, but also during the knitting of a portion of the ankle, and particularly that part which includes the high splice and also during the knitting of the foot, although, as stated, the disclosed embodiment of my invention pertains more particularly to the knitting of the high splice by a reciprocating movement, whereby through the formation of suture seams at opposite sides of the stocking a reinforcing or contrasting area is presented, said suture seams being desirably, and as herein disclosed, along lines which are non-parallel to the wales of the fabric; and as herein shown are along lines crossing a series of consecutive wales of the fabric. As hereinafter more fully disclosed said suture lines are or may be at one end in proximity to each other and they slope in opposite directions at desirably substantially equal angles, whereby in the particular embodiment herein disclosed a generally triangular area is bounded on two sides thereby. In accordance with my invention, the reinforced or contrasting area may be at the back or the front of the stocking, and may be of triangular or other suitable shape involving the production of non-parallel suture lines, as hereinafter more fully set forth, and the fabric, if a stocking, may be commenced at either end, as, for example, the top of the leg or the top of the toe.

Depending upon whether the stocking is commenced at the top of the leg or at the toe of the stocking, said suture lines either commence or terminate in proximity to each other in the illustrated embodiment. I will more particularly describe that embodiment of the invention wherein the knitting is begun at the top of the leg, in which case said suture lines (in the event that the reinforcing or contrasting area is not quadrangular in shape) commence in suitable proximity to each other and diverge either in straight, curved or irregular lines and desirably at equal angles or symmetrically (though not necessarily symmetrically), whereby a reinforced or contrasting area is produced, which is bounded on two sides by said two suture lines. In the disclosed embodiment of the invention said suture lines are straight but inclined, thus crossing a series of wales.

The means whereby such suture lines are produced will be hereinafter more fully set forth.

The cam plate 3 has provisions for a limited vertical movement, the same being herein mounted upon the usual cam slide 15, itself mounted for vertical movement in said frame 1 and carrying at its lower portion cam followers 16, 17, 18, adapted to engage ribs upon a cam 19 mounted upon and adapt-

ed to turn with the pattern shaft 9, said cam being adapted to move said cam slide up or down to vary the length of the loops during the knitting of the leg and other portions of the stocking.

My invention may be practised upon either a latch needle or a spring beard needle machine, but merely for convenience of description, I shall refer to certain features more particularly pertaining to latch needle work, such, for example, as the latch ring, it being understood that I may employ spring beard needles in which event a suitable support preferably in the form of a partial ring, would be substituted for the latch ring.

Here in a latch ring 20 is pivoted at one side of the machine upon an upright post 21 by a pivot pin 23 and yieldingly engaging the under side of said latch ring is a spring actuated foot 24 mounted in said post 21 and adapted to exert a yielding upward pressure against said latch ring, which under normal conditions is locked in its operative position against the standard 22 by a latch 25 engaging a pin 26 upon said latch ring.

The needles shown in the present embodiment are of the latch needle type, but as hereinbefore stated, spring beard needles may be used within the scope of my invention. The needles, of whichever type employed, are arranged in a circular series and are of a number consistent with the diameter of the work to be performed upon the machine. These needles are divided into two substantially equal sets, one set here having what are known as long knitting butts, while the other set has the usual short knitting butts, said long butt needles, also termed instep needles, being adapted to be withdrawn, preferably by elevating them at suitable times in the operation of the machine by the usual instep cams 27, 28 (as shown in Fig.4). Said cams 27, 28 are mounted upon a slide 29 arranged to slide vertically in a standard 30 secured to the cam plate 3. Appropriate movement is imparted to said slide by a bell crank lever 31 pivoted at 32 to a part of the standard 30, one arm of said lever being connected with said slide 29, the other arm being connected at 33 with a link 34 extending to and having connection at 35 with the upper end of the clutch shifting lever 14. Said connections are such that when said clutch shifting lever 14 is in the position for rotary knitting, the cams 27, 28 will be in their lowermost or depressed positions, and when said lever 14 is in a position to effect to and fro or reciprocating knitting, said cams 27, 28 will automatically be moved to the upper positions and thereby effect the withdrawal of the instep or long butt needles whose butts are arranged to engage said cam 27 and be elevated thereby, said cam 27 being far enough from the face of the needle cylinder to engage only the long butts permitting the short butts to pass without interference. The cam 28, however, is placed close up to the cylinder so as to engage either long or short butts which happen to be in their elevated positions when said cam 28 and the cam 27 are depressed.

Mounted upon the cam plate 3 with the instep cams is a cam block 36 arranged to slide radially with respect to the needle cylinder between suitable angle plates at opposite sides of said block and secured to the cam plate 3. A spring 38 is interposed between said cam block and a suitable fixed abutment 39 and constitutes means yieldingly to maintain said cam block in its operative position with respect to the needle cylinder. Said cam block 36 herein constitutes the support for what are termed the primary knitting cams of the machine, and herein consisting of the usual stitch cams 40, 41, a lower central guide cam 42 and an upper central guide cam or member 43. The inner faces of the cams 40, 41, 42, 43 are concaved and lie normally in the plane coinciding with the outer face of the needle cylinder 2, said cams being withdrawn from this position only when it is desired to level the needles for transferrng or when it is desired to withdraw said cams to get at the needles of the cylinder for the purpose of withdrawing or replacing needles. The usual means employed in the Banner machine for either manually or automatically retracting the cam block 36 for the purpose just described may be and herein are employed, said means consisting of a hand lever 44 pivoted at 45 to the standard 22, said lever being connected by a link 46 with the cam block 36. Automatically to retract said cam block the means herein shown consists of a link 47 extending from one arm of the lever 45 downwardly to and into engagement with a cam lever 48 arranged to cooperate with a suitable rib 49 upon the face of the pattern drum 10. The withdrawing of said cam block 36 also serves to rock the latch 25 which has an end engaging the rear end of said cam block, and this disconnects said latch from the pin 26, thereby permitting the latch ring to be moved upwardly by the spring foot 24. The cam block 36 is also provided with a pair of narrowing picks 50, 50 pivoted upon said block in a manner characteristic of said Banner machine and arranged to operate in the usual manner.

The said latch ring 20 is also provided with the usual supply of yarn levers indicated generally at 51 in Fig. 1, and herein five in number, and hereinafter referred to as the primary yarn guides. Said levers are desirably operated in the usual manner from the pattern drum 10. Also supported upon said latch ring is a supporting arm

52 for the usual yarn clamping and yarn cutting devices for the primary yarns, said devices being omitted from certain figures for sake of clearness and because not constituting any part of the present invention. They are, however, preferably of the usual type and are operatively connected with the pattern shaft to operate automatically with the changing of the yarn.

The needle cylinder is provided with the usual web holder bed 57 shown in Fig. 2, and surmounted by the web holder cam ring 58 of the usual Banner construction and having lugs 59 to engage the latch ring 20 so as to effect relative movement between said cap ring and the sinker bed ring, all of which parts being operable in the usual manner, require no further description.

The parts hereinbefore described by reference numeral are generally common to the Banner type of knitting machine and are operated automatically from the pattern shaft 9 by pattern mechanism generally indicated by the numeral 60 in Fig. 1.

Inasmuch as an important and indeed the main object of the invention is to provide a machine for knitting split fabric with suture lines characterized as hereinbefore set forth, a secondary set of knitting cams is provided, which set is indicated generally at 61 in Figs. 11 to 14. This set of knitting cams preferably includes a pair of stitch cams 62, 63, a lower guide cam 64, and an upper guide cam 65, said upper guide cam 65 being automatically radially moved at suitable times as hereinafter disclosed for permitting reciprocation of the needles. There is also provided upper guard cam 66 for the upper guide cam 65, said guard cam 66 being stationary. The inner faces of said several cams are concaved and are arranged normally to lie in a plane substantially coinciding with the plane of the outer face of the needle cylinder, which plane also coincides with the plane of the inner faces of the cams of said primary set. Appropriate supporting instrumentalities are provided for said secondary knitting cams to maintain such cams in substantially the same horizontal plane as are the primary knitting cams, whereupon certain needles including those with long knitting butts will be actuated during the knitting of certain parts of the stocking or at substantially the same time that other needles including the regular short butt needles are acted upon as hereinafter stated.

Said secondary cams may be adjustable vertically with respect to the primary cams in order to provide perfect alignment between the two and for this purpose said secondary cams are mounted upon a plate 67 which is attached to a slide 68 adjustably arranged to move vertically in a bracket 69 which is secured to the frame 1 by screws 70. The bracket 69 is shown in the form of a channel within which the slide 68 moves and screws 71 extend through slots in the bracket into screw threaded engagement with the slide for the purpose of fixing said slide in its predetermined adjusted relation with the bracket. Suitable means such as a screw 72 is provided to move the slide relatively to the bracket, said screw having an engagement with a laterally projecting portion 73 of the bracket. Such screw is held in position by a check nut 74.

I preferably move the secondary knitting cams radially of the needle cylinder to withdraw them to positions where they will not act upon needle butts, as, for example, when the needles are to be levelled for transferring, or when the needles may have become caught or are to be replaced by hand. For this purpose the stitch cams 62, 63 and the lower guide cam 64 are mounted on a cam block 75 shown in Figs. 6 and 7, said block being arranged to slide upon the plate 67 and being yieldingly maintained in operative position by springs 77 interposed between it and an abutment or bracket 78. Said cam block 75 is capable of manual as well as automatic retraction. For automatically retracting said cam block 75 a lever 79 is provided, pivoted at 80 to the under side of the plate 67. One end of said lever is adapted to engage the side nearest the needle cylinder, of a pin 81 depending from the under side of the cam block 75, said pin being arranged to work within a slot formed in the plate 67. The opposite end of the lever 79 is connected by means of a link 82 with an arm 83 attached to the link 46 hereinbefore referred to as constituting a part of the means for retracting the primary cam block.

There are occasions during the operation of the machine when it is desirable to retract the upper guide cam 65 from its operative position independently of the cam 62, 63, as, for example, when return reciprocation is to be made in the knitting of split work. For this purpose said cam 65 is slidably mounted in the cam block 75, said cam having a radially extending projection 84 adapted to slide in a suitable groove in the top of the cam block. Said cam 65 is so mounted that it may be withdrawn either manually or automatically, but preferably automatically and herein by means connected with the quadrant of the machine.

For this purpose there is provided a lever 86 shown in Figs. 6 and 8, said lever being pivoted at 87 upon the framing and connected at its lower end 88 to a link 89 itself connected at 90 with a lever arm 91 fast upon a shaft 92. Also fast upon said shaft is a lever arm 93 connected at 94 to a link 95 pivoted at 95^a to a lever 95^b having a flange 95^c, which is adapted to be struck

alternately by lugs 95^d and 95^e upon a collar 95^f on the shaft of the quadrant. A spring 95^g is provided acting normally to elevate the longer end of said lever 95^b by rocking the same upon its pivot 95^h.

The construction and operation of parts are such that toward the end of each stroke of the quadrant the guard cam 65 is moved out and again returned, so as to permit the butts of the elevated needles passing by said cam without being depressed into knitting position, as indicated clearly in the diagram (Fig. 24).

The shaft 92 may be and desirably is provided with means for withdrawing the cam 65 during heel and toe work, but such movement does not interfere with the described withdrawal of the cam 65 during split work.

When an auxiliary or secondary set of cams is employed for split work, means must also be provided to feed yarn to the needles that are actuated by said auxiliary or secondary set of cams. Hence a secondary yarn guide 97 is provided upon the latch ring 20 in a position appropriate to said secondary knitting cam set, and herein substantially diametrically opposite to the primary knitting cams. The secondary yarn guide 97 is in the form of a lever pivoted at 98 to the latch ring, and the free end of said yarn guide is arranged to move in a suitable slot 99 in the latch ring.

The purpose of the secondary cams, as previously stated, is to function certain of the needles during the knitting of split fabrics and where the formation of such fabrics is limited to a certain portion of the knitted article, as, for example, the ankle portion and the foot of a stocking, the secondary yarn guide 97 must be moved into and out of its operative position when said secondary knitting cams are moved into and out of their operative positions. Preferably said yarn guide 97 is arranged to operate automatically with the upper guide cam 65 which controls the operation of said secondary cams. Herein the yarn guide 97 is shown as provided with an extension 100 having a cam surface 101 on its under edge to be engaged by a lever 102, itself pivoted at 103 to the bracket 78 and having a lateral projection extending underneath said extension 100. The lower end of the lever 102 is connected through link 105 with the lever 86. Therefore any movement of the lever 86 to move the cam 65 will effect a similar movement of the yarn guide 97; that is, if the cam 65 is retracted from its operative position, the yarn guide 97 will be raised to its inoperative position, and vice versa.

To insure the proper engagement of the long butts of the needles with the cams 65, the guard cam 66 is mounted directly above the cam 65 and is provided with cam surfaces 66′ at opposite ends thereof to cause a deflection of the needle butts if they are too high to strike the cam 65, and said guard cam 66 is shown as supported upon the bracket 78 by means of a rod 106 extending rearwardly from the cam into engagement with the bracket and within which it is secured by screws 107 as shown most clearly in Fig. 6.

The usual widening pickers 108, 109 (see Fig. 3) for acting upon certain needles, are pivotally mounted upon the bracket 78 with their operative ends capable of cooperation with the cam 63, 64, and means preferably of the usual type are provided for holding said pickers in their inoperative positions when narrowing and widening operations are not to be performed. Herein these means consist of a stop plate 110 that is arranged to engage the arms of the pickers 108, 109 to depress said arms. To control the stop plate a bracket 111 is provided to which said plate is attached, said bracket being mounted at the upper end of a rod 112 vertically movable in the bracket 67. The lower end of said rod 112 is operatively connected with a lever 113 shown in Fig. 1 as pivoted at 114 to the under side of the frame 1 and operatively connected by means of a link 115 and a cam lever 116 with the cam surfaces 117 formed upon the cam 19.

Arranged at the back of the needle cylinder between the primary and secondary sets of cams is a switch cam 127 which may be of usual construction and is arranged to engage only the long knitting butts and then only when the needle cylinder is traveling in a reverse direction, whereupon the said butts will be moved upwardly to the idle level.

When the butts of the needles are passing in the opposite direction, namely, forwardly and along the usual channel for circular knitting, the long butt needles will engage said switch cam and throw the same up without changing the position of said needles. For this purpose the cam 127 is provided with a shaft 128 in a suitable bracket and has a spring for normally holding the switch cam in the position shown in Figs. 11 and 12.

In machines for producing split work as heretofore constructed, the needles have been divided into two groups equal or substantially equal in number, and those two groups have each been composed of a fixed and unvarying number, so that the suture lines or seams at opposite sides of the stocking or other fabric were substantially parallel with the wales and did not cross the same in the manner herein set forth. In accordance with my invention and referring for clearness of description to the specific embodiment of the invention herein illustrated, I provide two sets of needles which are respectively to work upon opposite parts of a

stocking or other fabric in split work, but I automatically transfer certain needles from one of said sets to the other as the work progresses, so that the number of needles in one group is increased from time to time, and the number of needles in the other group is correspondingly decreased. This result or action I desirably effect automatically, and referring for clearness and convenience of description to the manufacture of stockings, I place certain of the needles, as, for example, the long butt or instep needles, in one group, and also place in the same group a certain number of the short butt needles, leaving in the second group only the remaining short butt needles. The numbers in the two groups obviously may differ in accordance with the different designs to be produced. In the event that the article being knitted is a stocking and assuming that the reinforced or contrasting area thereof is a high splice of triangular form, the needles in the group which knits said high splice will at the commencement of the high splice be limited to a few in number, as, for example, about four. As the knitting of the reinforced or contrasting area,—in the assumed instance a triangular high splice—proceeds, the number of needles in the smaller group is constantly increased by additions at each end of the group from the larger group.

If the reinforced or contrasting area is to be at some other part of the stocking than at the high splice area, obviously the grouping of the needles should be different from that of the specific instance recited, and the number of needles in each group would obviously depend upon the configuration of the reinforced or contrasting area. Also the period when needles are transferred from one group to the other and the number that are so transferred from time to time depend upon the configuration of the reinforced or contrasting area. For example, such area may have opposite sides with straight sloping lines which are either symmetrical or unsymmetrical with respect to each other, and said lines or one of them may be curved or may be irregular. In all cases, however, the lines or at least one of them are non-parallel with the wales of the fabric, so that such line or lines cross a series of consecutive wales of the fabric.

The stocking may be commenced either at the top of the leg or at the toe, and I will describe as the preferred method of manufacture, the knitting of the stocking beginning at the top of the leg, in which case circular knitting proceeds in the ordinary manner down to the commencement of the reinforced or contrasting area which for clearance of description and as a concrete example will be referred to as a high splice of triangular form, the apex being upward and substantially at the back median line of the stocking. In such instance, the needles for the first reciprocation of split work are divided into two groups, one group consisting of all the long butt or instep needles and all the short butt or heel needles excepting the minimum number at the back of the ankle, as, for example, four, and the second group consisting of said minimum number of needles.

In order to effect the automatic knitting of the stocking in the manner herein disclosed and having a reinforced or contrasting area, and in the event that the stocking is commenced at the top, it is necessary to provide means automatically to transfer needles from one group to the other. While various means may be provided for the purpose, I preferably provide means which I will now specifically describe without limiting myself thereto. In the disclosed embodiment of the invention none of the long butt or instep needles is at any time transferred to the other group, but the number of needles in the smaller group, which knits the high splice, is constantly augmented, although obviously in other embodiments of the invention, the reverse may be the case. Therefore in the disclosed embodiment of the invention I provide a jack underneath each of the short butt needles, which occupy one half the entire circle of needles, being desirably equal in number with the long butt needles, each said jack being positioned in the needle groove of that needle and being wholly distinct therefrom and movable independent thereof. One of said jacks is shown at 130 in Fig. 21. Said jacks for the short butt needles may be of any suitable form, but are preferably short as shown and are provided with butts 131. I also desirably place under each of the long butt needles what may be termed a "dummy" jack, as indicated at 132 in Fig. 21, said "dummy" jacks having butts 133 preferably of the same length as the butts 131. The dummy jacks are desirably longer than the jacks under the short butt needles, but otherwise do not differ therefrom in the disclosed embodiment of the invention. Each dummy jack is placed in its groove beneath its long butt needle and is wholly distinct therefrom, and is movable independently thereof.

The main purpose in providing the dummy jacks is to prevent the means which transfer the jacks from an upper level to a lower level for the purpose of transferring a needle from one group to another, from acting upon the jacks under the short butt needles at each side of the machine next to the long butt needle at such side, which would result if a gap were left in the jack circle where the long butt needles are located. I may therefore substitute for said dummy jacks any suitable means for ac-

complishing the same result, and I may, for example, substitute therefor a half ring co-extensive with said jacks and secured to the needle cylinder to prevent action by the selecting means upon the wrong jacks for the short butt needles.

Assuming the stocking to commence at the top of the leg and the reinforced or contrasting area to be a tapered high splice of the form of an upright triangle, the knitting proceeds in the usual manner for circular work and the butts of all the jacks ride in their travel through horizontal grooves in the faces of certain cams which are employed to act upon said jacks during split work. Certain of said cams are indicated at 134, 135, 136 in Figs. 11, 12, 13 and 14. The horizontal grooves at the inner faces of said cams are respectively shown at 137, 138, 139, being at the base thereof. During circular work the butts 131, 133 of the jacks merely pass idly through said grooves and consequently the jacks all remain down. Preliminary to the commencement of certain split work, it is necessary to elevate the jacks so that their needles may be brought into the upper level with the long butt needles, said upper level being more fully referred to in the description of Figs. 13 and 14, it being noted that preliminary to beginning reciprocating knitting, all the long butt needles are elevated by cam 27. For this purpose any suitable means may be provided but preferably I employ a cam 140 indicated in Figs. 15 to 20, and elsewhere and also shown in Fig. 9, where I have represented one form of means for operating the same, and which I will now describe without limiting myself to such means.

The said cam 140 is provided with a radially extending stem or slide portion 141 adapted to move in a suitable radially extending stationary guide 142, and which at its upper face is suitably slotted or formed to permit the connection to said slide portion 141 of a link 143, by means of a screw 144. Said link is connected at 145 to an arm 146 of a lever pivoted at 147, and having an arm 148 to which is pivotally connected at 149, a link or rod 150 that in turn is pivotally connected at 151 to the arm 152 of a lever pivoted at 153 and having a toe or end 154 adapted to rest upon a peripheral cam 155 mounted fast upon the pattern cam shaft 9. The toe 154 is held against the peripheral cam 155 by a suitable spring 156. Also fast upon said cam shaft 9 is the usual stop motion wheel 156 having thereon a projection 157 adapted at the proper time to be struck by a kicker 158 fast upon the rocker shaft 159 whereon is fast the usual quadrant 160 by which reciprocating motion is conveyed to the needle cylinder during split work and for heel and toe work.

The construction and arrangement of parts are such that when the cam shaft 9 is moved forward in changing to reciprocating work, the toe 154 drops into the depression 161 thereby moving the cam 140 in, and elevating all the jacks to the upper level. When the quadrant 160 is at the full limit of its backward stroke on the first reciprocation the kicker 158 moves the disk 156, and thereby the entire set of drums on the shaft 9 far enough to cause the toe 154 to ride out of the depression 161, thereby moving outward the cam 140.

It will therefore be clear that the cam 140 is thrown radially inward while the knitting is still on circular work, but just at the beginning of split work and as the needle cylinder is moving contraclockwise as indicated in Fig. 15. Said figure is intended diagrammatically to indicate the operation of the parts at this time.

Inasmuch as it has been assumed for clearness of description that the stocking is commenced at the top of the leg, I, at each stroke of reciprocation (after the cam 140 has functioned) act by a widening action to throw down a jack pertaining to a needle at the back of the leg of the stocking, so that upon the next stroke said needle will function with the other group of needles which include the needles at the back of the stocking.

It will be understood that in split work as ordinarily practised the long butt needles knit at that side of the machine having the single yarn guide 97 (auxiliary side) and that the short butt needles knit at the opposite side of the machine, namely, that having the group of yarn guides 51 (regular side), it being also understood that the two short butt needles which stand respectively at the two ends of the short butt series function as suture needles, by acting with both sets.

In the present organization this arrangement is continued so that the long butt needles knit at the side having the yarn finger 97 (auxiliary side) and the other group of needles knit at the side having the group of yarn fingers 51. In the present organization when a jack is at the upper level, the needle pertaining thereto knits with the long butt needles at the long butt needle side, that is, at the side where is positioned the yarn finger 97. In order to effect the automatic transfer of a needle from time to time from the larger group into the smaller, I pick down one jack at each end of each reciprocation during split work,—that is, during the formation of the reinforced or contrasting area,—and this converts the needle of that jack into a short butt needle, so that it knits at the short butt needle side, namely, that where the group of yarn fingers 51 is located.

The widening means which I employ to

throw down from time to time the jacks of certain needles so that they thereafter knit at the short butt side, namely that where the yarn fingers 51 are located (regular side), may be of any suitable nature. Preferably such widening means consists of two widening pickers 162, 163 mounted upon a block 164 shown in the several diagrammatic Figures 15 to 20 inclusive, as well as being indicated in Figs. 11 to 14 and elsewhere. The said pickers 162, 163 act only upon the jacks or certain of them and are herein for clearness of description termed jack pickers. They may be of the general character of the needle widening pickers of the Banner machine, but are desirably shorter and smaller and their inner ends are notched as indicated at 165, 166, to engage the butt of a single jack at a time. If a reinforced or contrasting area of unsymmetrical form be desired, I may so construct the notches of the said two jack pickers that one of them picks down one jack at a time and the other picks down two jacks at a time, as indicated in Figs. 30, 31 and 32 wherein the jack picker 163 acts on two jacks simultaneously, thereby making the fabric shown in Fig. 33. As shown in the other figures of the mechanism, however, each of said jack pickers picks down a single jack only at a time. I have thus provided jacks for the needles, and especially for certain of the needles and herein the short butt needles, each jack being separate and independent from the needle pertaining thereto, but mounted in the groove of said needle and normally retaining the position lengthwise of the groove in which it is placed either by the cams which elevate the same or the pickers or other means which depress the same. I thus provide jacks in two levels in the operation of the machine with means to move the jacks from one level to another. This is a characteristic feature of my invention, and I claim the same broadly.

In Figs. 15, 16 and 17, I have diagrammatically indicated the action of the main parts during the first stroke of reciprocation in split work. In Fig. 16, the cam 140 has been thrown in just as split work is to begin, and in Figs. 16 to 20 the subsequent movements are indicated during said first stroke of reciprocation in forming split work.

It will be understood that in split work the instep needles which do not knit at the side of the machine having the yarn fingers 51 (main side) are elevated too high at that side to knit, and at the opposite side of the machine where the yarn guide 97 is located, the needles which do not there knit are depressed too low at such side as is customary in the formation of split work. I preferably follow this practice but vary the number of needles in the two groups to effect the formation of the reinforced or contrasting area, it being pointed out that such reinforcement or contrast arises from the fact that at the heel side yarn fingers 51 I introduce a yarn which differs in color or in weight from the active yarn at the opposite side, or I may introduce through the said heel side yarn fingers 51 a plurality of yarns including the regular knitting yarn and an additional or reinforcing yarn.

The throwing in of the cam 140 elevates the jacks so as to elevate the short butt needles to the level of the long butt needles. On the last stroke of circular work, which is in a contraclockwise direction as indicated in Figs. 16 and 17 no needle is or need be thrown up. On the first stroke of reciprocating work, as represented in Fig. 18, a needle is thrown up by an upper or needle narrowing picker on what may be termed the far side of the machine viewing Figs. 15 to 20, or viewing Fig. 3. This may be regarded as the needle indicated at A in the diagram Fig. 22 where I have indicated the half circle of long butt needles, and the half circle of short butt needles, the latter, however, being in two groups between which is a gap in the upper level in which gap the needle A occurs, and said needle A together with the adjoining needle whose jack was depressed on the preceding stroke act at this time as suture needles at other end of the gap, the way in which the suture needles are caused so to act, being pointed out hereinafter. It may be here stated that the raising of said adjoining needle is so that it will take yarn at the auxilary side with the long butt needles and the already elevated short butt needles. Said needle A I term a jackless needle, meaning a needle whose jack is at this time down. Such needle A so elevated by the upper or needle narrowing pick on the far side of the machine, knits on that stroke on the auxiliary side with the long butt needles, together with the needle whose jack was depressed on the preceding stroke as described, said two needles knitting as suture needles at opposite ends of the gap, and with them knit all of the other short butt needles which are up, that is, all of said needles knit at the side of the machine having the yarn finger 97. Hence all the needles function as long butt needles at the instep side of the stocking except those at the gap in the upper level indicated at X in Fig. 22 (and which are the only needles acting at the heel side of this stroke), and upon all subsequent strokes in the same direction a corresponding action occurs, the gap X becoming larger and larger with successive strokes, because upon each stroke a needle is transferred from the long butt or instep group to the short butt or heel group, since a jack is depressed on each side on

each complete reciprocation. On each reciprocation the needles whose jacks are at the lower level do not knit at the auxiliary side—the side of the machine having the yarn finger 97—as they are there too low to take the yarn, but all other needles than those thus defined do knit at said auxiliary side together with the suture needles. At the opposite or regular side, namely, the side where the yarn fingers 51 are located, a jackless needle—namely, a needle whose jack is wholly depressed, is elevated by the upper or needle narrowing picker on the near side of the machine, viewing Figs. 15 to 20, and Fig. 2, and at said regular side it therefore acts as a suture needle. This is the action upon each reciprocation and as reciprocating knitting continues the gap X in the upper level is growing constantly larger, because the jacks as before stated, are being pulled down, the increase continuing until all the jacks under the short butt needles are depressed to the lower level and then the knitting of the heel is begun in the usual manner characteristic of the Banner machine.

Desirably the foot is knitted as a split foot, all the jacks being down and staying down and hence not functioning, and therefore the two suture seams are along parallel non-inclined lines. It will be understood that the knitting of the high splice, which has been taken as a typical instance of the reinforced or contrasting area, is knitted at the so-called regular side, namely, the side where the yarn fingers 51 are located, and the remainder of the said courses on the instep side of the stocking is knitted upon the auxiliary side, namely, that where the yarn finger 97 is located.

It will thus be evident that as the split work continues, more and more needles knit on the regular side—that is, at the heel side of the stocking—and that upon each stroke of reciprocation one needle is thrown up so as to act as a suture needle with the long butts and one jack is thrown down so that its needle is transferred to the short butt side.

Before proceeding to describe the course of the jacks in split work, I will by reference to Figs. 11, 12, 13 and 14 describe the course of the needles; first, in regular or circular work; second, in reciprocating work for forming the heel and toe pockets, and third, the split work for which the needles are divided into the two groups as previously stated, one of said groups being constantly augmented from the other.

Referring to Fig. 11, and assuming that circular knitting is to be produced, the needle cylinder moves in the direction of the arrow in said figure, causing all of the needles to travel along the path indicated by the dotted line at A, both long and short butts passing over the stitch cam 41 of the primary knitting cams, under the guide cam 43 and stitch cam 40 to form the usual knitting waves.

After leaving the cam 41 the needles are raised by an incline 167 (Fig. 11) on the annular ledge 4 to the normal level A along which all of the needles pass until they strike the first stitch cam 62 of the secondary set, this cam being arranged to depress all of the needles below the yarn receiving position, so that neither the long nor the short butt needles will take yarn at this time, said needles being raised again to their normal level by the incline 168. As the long butt needles pass the switch cam 127, said cam will be raised to the dotted position shown in Fig. 11, and the short butt needles being too short to engage said cam will not interfere with the same.

I will now describe the action of the needles in heel and toe work and then their action in forming the high splice, thus reversing the actual order of operations.

It will be understood that preliminarily to forming the heel the instep cam 28 is raised to its upper position, as shown in Fig. 12, but the needle cylinder is not reversed until all the long butt needles B have passed said instep cam and been elevated thereby, said Fig. 12 showing the arrangement of the long butt needles B and the short butt needles C immediately prior to the first reverse movement of the needle cylinder, the direction of which is indicated by the arrow in said Fig. 12. In the formation of the heel and toe pockets the long butt needles B are in their upper position and are not brought into operation, and it is therefore desirable that the cam 65 be withdrawn so that said long butt needles may pass along the idle level as shown at B without interruption, the means for operating said cam 65 being hereinbefore described. Continued reciprocating movements of the needle cylinder result in the gradual raising of the leading short butt needles by means of the needle narrowing pickers 50 until the desired number of courses have been knitted, whereupon the widening pickers which up to this time have been held out of action by the means described, are released and return those needles previously raised by the narrowing pickers, in reverse order to their operative positions, thus effecting the gradual increase in the length of courses forming the heel pocket. The procedure in knitting the toe pocket is the same.

I will now describe the action of the needles in split work beginning at the top of the high splice and I point out that the foot is preferably made by split work, and I may or may not in so forming the foot effect transfer of needles from one group to the other. I will assume, however, for

clearness of description that in making the foot by split work there is no transfer of needles from one group to the other, and that therefore the suture seams are straight and parallel, being at opposite sides of the foot and there defining the limits of the upper part of the foot and the sole.

In the following description I will set forth the action of the suture needles at each side and refer to the said two needles always by the same characters, but it is to be understood that in knitting the high splice the suture needles are constantly changing,—that is to say, the needle which is a suture needle in one stroke of reciprocation, (acting at the upper level with the long butt needles) is immediately thereafter depressed so as to join the needles at the ankle or high splice part of the stocking and thereupon the next needle becomes the suture needle at that side—namely—the needle in the instep needles which is next to the suture needle that has just been transferred to the high splice needles. This same action occurs at both sides or portions of the stocking and continues so long as the high splice is being knit, assuming the high splice to be of triangular form, or of some form in which the opposite sides thereof diverge, in knitting from the top of the stocking downward.

In usual split work such for example as that which may be resorted to in knitting the foot, the two suture needles are the two short butt needles at the two ends of the short butt series and therefore next to the end needles of the long butt series. This is not the condition in knitting the high splice. On the contrary, the suture needles at the commencement of the high splice are the two end needles at each end of the short gap shown in Fig. 22, and as the knitting of the high splice continues and said gap grows larger by transfer of the needles from the larger group to the smaller group, the suture needles continue to be the endmost needles at the gap. When, therefore, I refer to the action of the endmost short butt needles I mean the two needles which are temporarily at the opposite ends of said gap, and not the needles which are next the long butt or instep needles. I have already pointed out that the lower widening pickers to throw jacks down will not operate upon the jacks under the short butt needles beginning next the long butt or instep needles at each side of the machine because I have employed dummy jacks or other means to form an unbroken line of jacks except at the gap before referred to.

Upon said first stroke the first short butt needle D, being the needle at one edge of said gap, passes along to the first narrowing pick 50 and is raised to the idle or upper level of the long butt needles B and is thereby prevented from receiving yarn from the primary yarn guide. The needle cylinder during reciprocating movements makes approximately a rotation; hence said elevated short butt needle D, together with all of the long butt needles B will pass into engagement with the cam 65 near the end of its stroke, Fig. 12, and will be caused to pass below said cam and below the stitch cam 62, thus receiving yarn from the secondary yarn guide 97 and casting the same to form loops.

Referring now to Fig. 13, and assuming all the cams herein to be in the position similar to those of the cams in Fig. 12, with the needle cylinder having already started on its next forward movement (that is, in the direction of the arrow shown in Fig. 13), the needle E which is the short butt needle at the opposite end of the said gap shown in Fig. 22, from the needle D, being now the first needle in the short butt series counting from the said gap, engages the narrowing picker resting normally against the top of the stitch cam 41 and is elevated by said picker to the upper level which thereby transfers said needle to the long butt series B so that it will knit as a suture needle at the auxiliary side. The needles of this series B which travel along the upper level, engage the cam 65 and are depressed thereby beneath the secondary stitch cam 63, causing all of the needles thereof to take yarn and form stitches including the short butt needle E which here acts as a suture needle. After passing the cam 63 the long butt needles pass along the incline 168 and over the instep cam 27 to the upper level, but by reason of the fact that said cam 27 is away from the face of the needle cylinder the needle E being a short butt needle, passes up said incline 168 and then along the top of the annular portion 4 which is the normal level of the short butt needles, thus returning to the needles of said short butt series. This needle, however, does not move far enough again to engage the picker on this particular movement of the needle cylinder, and as the needle cylinder reverses before such engagement with the picker can take place, the said needle E will upon the return movement pass through the primary knitting cams and take its yarn in the usual manner thus again acting as a suture needle, but on the lower level, and interknitting the loop formed of the regular yarn with that previously formed from the secondary yarn, thus forming a suture stitch and thereby uniting the fabric formed upon the long butt needles, which is formed from said secondary yarn, with the fabric formed upon the primary needles to which the primary yarn is advanced in the usual manner.

Upon the next reverse movement of the cylinder as shown in Fig. 14, the needle D will again be raised by the narrowing picker of the primary set to the upper position, and will pass over the primary knitting cams and

through the secondary set of cams, thus taking yarn from said secondary yarn guide. The long butt needles B, after passing through the secondary set of cams in the direction of the arrow shown in Fig. 14, will be raised to their upper idle level by means of the switch cam 127, but the needle D, being a short butt needle, will not engage said cam 127, which can be engaged only by the long butt needles. Said needle D will therefore pass along the normal level of the needles of the course C and hence through the primary knitting cams and receive a second yarn which is interknit with the yarn received from the secondary knitting cams, thereby creating a suture stitch at said side of the stocking, and thus uniting the two portions of the fabric.

The operations described resulting in the formation of two suture stitches at opposed portions of the fabric, are constantly repeated at each complete reciprocation during the formation of the high splice, but upon different needles as hereinbefore stated, because of the transfer at each stroke of an instep needle to the high splice needles.

Figs. 24, 25 and 26 are diagrammatic views of needles and jacks at the regular knitting cams or regular knitting side of the machine and the needles and cams at the auxiliary knitting cams or auxiliary side, indicating successive steps in the knitting of certain split work, and are intended to represent diagrammatically the needle movements already explained.

The needles indicated in the groups 170 are short butt needles and the needles indicated in the groups 171 are long butt needles. In Fig. 24, as is indicated by the direction of the arrow, as the needles pass the pickers at the regular knitting cams, a short butt needle 172 is picked up from the short butt needle level from the group of short but needles 173 to one of the groups 170 at the long butt needle level so as to act as a suture needle. As the machine rotates in the same direction a short butt jack 176 is depressed from the jack group 174 at the upper level of the jacks to the group 175 at the lower level of jacks so that the needle pertaining thereto will be transferred to the lower level. The long butt needles and short butt needles, at the long butt needle or upper level, including the needle 172, then go through the auxiliary set of cams and knit at that side of the machine. The long butt needles 171 and the short butt needles 170 are then elevated to the long butt needle level again, the said long butt needles being elevated by the cam 27 and the short butt needles being elevated by their jacks passing over the jack cam 134 (as indicated in Fig. 13) because said short butt needles are still functioning as long butt needles.

It will be seen from the diagram (Fig. 24) that the needle 172 is jackless and therefore it will not be elevated to the long butt needle level by the cam 134, but said needle will ride up the cam 168 to the short butt level thus being transferred to the high splice needles.

Fig. 25 represents the next step in the operation of said split work and indicates the needles and jacks traveling in the reverse direction. As the short butt needles 170 and the long butt needles 171 which are at the long butt level travel in the direction of the arrow on said figure, they go through the auxiliary set of cams and knit, but the needle 172 which is at the short butt needle level, will not knit at this time. The short butt needles indicated in the group 173 will pass the narrowing pickers at the regular cam side of the machine and a short butt needle 177 will thereby be picked up from the short butt needle level to the long butt needle level there to function as a suture needle. Then a short butt needle jack 178 will be picked down from the group 174 at the upper level of jacks to the group 175 at the lower level of jacks. Then all the long butt and short butt needles at the long butt needle level, including the needle 177, will pass through the auxiliary set of cams and knit, the long butt needles being thrown up by the cam 27 and the short butt needles, excepting the needles 177 and 179, being elevated to the long butt needle level by the jack cam 135. As indicated in the lower part of the diagram (Fig. 25), the needle 177 being a jackless needle and the needle 179 having previously had its jack depressed to the lower jack level, will not be elevated by the jack cam 135, but will be elevated to the short butt needle level by the cam 4. The cam 65, shown in dotted lines, has been retracted by the mechanism previously described, and this retraction takes place at the end of each reciprocation, so that the short butt needles 170, as shown in Fig. 24, will not be depressed by the cam 65 but will pass straight through the auxiliary set of cams without knitting.

Fig. 26 indicates the next succeeding step of reciprocation. As the short butt needles indicated in the group 173, pass through the regular knitting cams, they will knit and the needle 172 will be elevated from this group to the long butt needle level there to act as a suture needle. At the next step, the jack 180 will be depressed from the upper jack level to the lower jack level. As the short butt needles and long butt needles at the long butt needle level including the needle 172, pass through the auxiliary set of cams, they will knit and the long butt needles will be elevated to the long butt needle level by the cam 27 and the short butt needles, excepting the needles 172 and 181, will be elevated to the long butt needle level by

the cam 134. The needle 172 being a jackless needle and the needle 181 having its jack depressed to the lower level, will not be elevated by the cam 134, but will be elevated to the short butt needle level by the cam 163.

Thus it will be readily evident from the diagrams, Figs. 24, 25, 26, that the needles in group 173 become larger and larger in number as the successive reciprocations of the machine take place and as this increase occurs, the needles will be transferred from knitting on the auxiliary cam side of the machine to knitting at the regular cam side of the machine. Through this action of transferring needles from knitting at one side to knitting on the other side, the gradual widening of the high splice portion of the stocking is accomplished. The jacks 182, as previously explained, are dummy jacks and are employed to prevent the pickers at the regular cam side of the machine from picking a short butt needle jack from the upper jack level to the lower jack level at the wrong end of the group.

Within the scope of the invention, I may begin knitting of the stocking at the toe instead of at the top of the leg. In such case, the general arrangement, as hereinbefore described, is employed, excepting that narrowing pickers are used instead of widening. The toe and heel may be knitted in the usual way, and the foot may be knitted either by circular knitting or by usual split foot work, and immediately upon the completion of the heel, all the jacks being down, together with all the short butt needles, a short butt needle is thrown up by the upper narrowing picker, and the lower or jack narrowing picker throws up the corresponding jack. Such short butt needle then goes through the auxiliary set of cams and stays up with the long butt needles, because of the jacks and the cams underneath. This operation is repeated on each side until all the short butt needles, except four or five in the center of the short butt needles, are knitting at the auxiliary cams. Thereupon the machine goes into circular work, all needles being returned to the normal level and all jacks being returned to the lowest level.

I have indicated one form of means for operating by a narrowing action in Figs. 27, 28, 29, wherein I have represented a cam block 183, it having mounted thereon jack narrowing pickers 184, 185 respectively pivoted at 186, 187 and having co-acting coil springs 188, 189. Said pickers act as described upon the short butt needle jacks, and I preferably employ two cams 190, 191, which respectively elevate the jacks to the level of the narrowing pickers 184, 185.

A jack that is elevated by either picker 184, 185 rides up the inclined face 192, 193 of the cam 183 as the case may be, the other jacks passing under the ledge 194 of said cam without elevation.

The upper leg portion is preferably seamless, being knit by circular work and from a single yarn, by which I mean that a yarn for knitting the upper leg portion is introduced at one side only of the machine and not at opposite sides, as in split work. Obviously the yarn for the upper leg portion may be replaced from time to time by another yarn of different character or weight, and a reinforcing yarn may be introduced if desired. The lower leg portion is a structural part of the upper leg portion, whether the knitting begin at the top of the leg or at the toe. At either side of the machine, obviously more than one yarn guide may be employed, and particularly at the main knitting cam side, where normally four or more yarn guides or fingers may be used.

It is clear from the foregoing description that the upper leg portion, the high splice, the heel, the lower part of the foot and the toe are knitted at the main set of knitting cams; and that the other parts of the stocking are knitted at the auxiliary set of cams, namely, the front or instep lower leg portion and the top of the foot.

In Fig. 10, I have represented a portion of the back of a stocking at 195. A part of the high splice is indicated at 196, it being substantially triangular in shape and having tapered sides 197, 198, which may meet at a point or at a short horizontal line 199, representing about four needles. The lines 197, 198 represent the suture seams hereinbefore described. In Fig. 33, as previously stated, I have shown that variation of the fabric consequent upon the use of two jack pickers, one of which acts upon two jacks simultaneously.

Referring to that type of my invention wherein the knitting is begun at the top of the leg, I preferably employ cam means to depress the jacks, so that they may come at the proper times into the range of the widening pickers 162, 163. For this purpose, and as shown particularly in Figs. 13 and 14, I provide cams 200, 201.

Having thus described one illustrative embodiment of my invention and the best method for carrying out the process of my invention, I desire it to be understood that although specific terms are employed, they are used in a generic and descriptive sense and not for purposes of limitation, the scope of the invention being set forth in the following claims.

1. Knitting mechanism comprising in combination, a circular series of independent needles, substantially one half of which have long butts and the other half of which have short butts, jacks arranged under all the short butt needles and causing them to

function temporarily as long butt needles, picking means for said jacks to cause said jacks to permit the transfer of their needles to the set of short butt needles so as to function therewith, means to supply yarn to the two sets of needles respectively and means to cause all of said needles to function to knit a tubular fabric.

2. Knitting mechanism comprising in combination, a circular series of independent needles having two groups distinguished by contrasting butt formations, jacks arranged under all of the needles of one of said groups and causing them temporarily to function with the other group, picking means to act upon said jacks so as to permit the transfer of their needles from the group in which they temporarily functioned to the other group, means to supply distinct yarns to the said two groups respectively, and means to cause all of said needles to function to knit a tubular fabric.

3. Knitting mechanism comprising in combination, a circular series of independent needles, a part of which have long butts and the remainder of which have short butts, jacks arranged under all of the needles of one of said groups and causing them to function temporarily with the other said group, picking means periodically to act upon said jacks so as to permit the transfer of the needles pertaining thereto from that group with which they temporarily functioned, means to supply distinct yarns to said groups respectively, and means to cause all of said needles to function to knit a tubular fabric.

4. Knitting mechanism comprising in combination a circular series of independent needles, substantially one half of which have long butts and the other half of which have short butts, active jacks arranged under all the short butt needles and causing them to function temporarily as long butt needles, dummy jacks under all the long butt needles, means periodically to act upon said active jacks, so as to permit the transfer of the needles pertaining thereto to the set of short butt needles, and means to supply distinct yarns to the said two groups of needles respectively, for the formation of a tubular fabric having two suture seams.

5. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to rotate said parts to produce rotary work on the needles; means to divide the needles into two groups for reciprocating knitting of which certain needles may be changed from one group to the other group; means to introduce distinct yarns at spaced points; means relatively to reciprocate said needle carrier and cam carrier and to cause on each of a series of successive strokes of such reciprocation one group of needles to knit at one yarn and the other group to knit at the other yarn and the loops of the two series to be interengaged as suture seams; and means to transfer needles from one of said groups to the other, thereby to vary the wale in which at least one of said suture seams is formed.

6. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to rotate said parts to produce rotary work on the needles; means to divide the needles into two groups for reciprocating knitting of which certain needles may be changed from one group to the other group; means to introduce distinct yarns at spaced points; means relatively to reciprocate said needle carrier and cam carrier and to cause on each of a series of successive strokes of such reciprocation one group of needles to knit at one yarn and the other group to knit at the other yarn and the loops of the two series to be interengaged as suture seams; and means to transfer end needles of one group to the other group so as to vary the wales in which the suture seams are formed.

7. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to rotate said parts to produce rotary work on the needles; means to divide the needles into two groups for reciprocating knitting of which certain needles may be changed from one group to the other group; means to introduce distinct yarns at spaced points; means relatively to reciprocate said needle carrier and cam carrier and to cause on each of a series of successive strokes of such reciprocation one group of needles to knit at one yarn and the other group to knit at the other yarn and the loops of the two series to be interengaged as suture seams; and means successively to transfer the end needles of one group to the other group persistently and throughout a prolonged number of the needles of such group so as to cause said suture seams to be formed along inclined non-parallel lines.

8. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to rotate said parts to produce rotary work on the needles; means active at the end of rotary work to divide the circle of needles for reciprocating knitting into two groups having butts at a higher level and a lower level respectively; means to introduce distinct yarns at spaced points; means relatively to reciprocate the needle carrier and cam carrier and to cause on successive strokes of such reciprocation one group of needles to knit at one yarn and the other group to knit at the other yarn and the loops of the two series to be interengaged as suture seams; and means to transfer needles from one of said groups to the other, thereby to vary the wale

in which at least one of said suture seams is formed.

9. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to rotate said parts to produce rotary work on the needles; means active at the end of rotary work to divide the circle of needles for reciprocating knitting into two groups having butts at a higher level and a lower level respectively; means to introduce distinct yarns at spaced points; means relatively to reciprocate the needle carrier and cam carrier; means to transfer an end needle from one level to the other level temporarily, to cause it to function as a suture needle at said other level, means to cause on successive strokes of reciprocation one level of needles to knit at one yarn and the other level of needles to knit at the other yarn and the loops of the two groups to be interengaged as suture seams, and means to transfer another end needle from said other level to the first level thereby permanently to increase the number of needles at said first level and there to function as a suture needle.

10. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to rotate said parts to produce rotary work on the needles; means active at the end of rotary work to divide the circle of needles for reciprocating knitting into two groups having butts at a higher level and a lower level respectively; means to introduce distinct yarns at spaced points; means relatively to reciprocate the needle carrier and cam carrier; means to transfer an end needle from one group to the other group temporarily, to cause it to function as a suture needle at said other group, means to cause on successive strokes of reciprocation one group of needles to knit at one yarn and the other group of needles to knit at the other yarn and the loops of the two groups to be interengaged as suture seams and means to transfer another end needle from said other group to the first group thereby permanently to increase the number of needles at said first group and there to function as a suture needle.

11. A circular knitting machine comprising in combination a needle carrier and a cam carrier, said needle carrier having a circle of needles comprising consecutive long butts and consecutive short butts thus providing two series from which two groups may be formed; means relatively to rotate said parts to produce rotary work on the needles; means to divide the needles for reciprocating knitting into two groups of which certain needles may be changed from one group to the other group; means to introduce distinct yarns at spaced points; means relatively to reciprocate the needle carrier and cam carrier; means to cause on each of a series of successive strokes of such reciprocation one group of needles to knit at one yarn and the other group to knit at the other yarn and the loops of the two series to be interengaged as suture seams; and means to transfer needles from one of said groups to the other, thereby to vary the wale in which at least one of said suture seams is formed.

12. A circular knitting machine comprising in combination a needle carrier and a cam carrier, said needle carrier having a circle of needles comprising two series having contrasting formations, one of said series having jacks to participate in the transfer of needles of one series to a group wherein are needles of that series, thus effecting a re-groupment of the needles of the two series; means relatively to rotate said parts to produce rotary work on the needles; means to divide the needles into two groups for reciprocating knitting of which certain needles may be changed from one group to the other group; means to introduce distinct yarns at spaced points; means relatively to reciprocate the needle carrier and cam carrier; and means to cause on each of a series of successive strokes of such reciprocation one group of needles to knit at one yarn and the other group to knit at the other yarn and the loops of the two series to be interengaged as suture seams.

13. A circular knitting machine comprising in combination a needle carrer and a cam carrer, said needle carrier having a circle of needles comprising two series, one of said series of needles having jacks in the needle grooves below said needles but movable separately from said needles and thus participating in the re-groupment of the needles of both said series; means relatively to rotate said parts to produce rotary knitting on the needles; means to divide the needles into two groups for reciprocating knitting of which certain needles may be changed from one group to the other group; means to introduce distinct yarns at spaced points; means relatively to reciprocate the needle carrier and cam carrier; and means to cause on each of a series of successive strokes of such reciprocation one group of needles to knit at one yarn and the other group to knit at the other yarn and the loops of the two series to be interengaged as suture seams.

14. A circular knitting machine comprising in combination a needle carrier and a cam carrier, said needle carrier having a circle of needles comprising two series, one of said series of needles having jacks movable separately from the needles and picker means to move said jacks; means relatively to rotate said parts to produce rotary knitting on the needles; means to divide the needles into two groups for reciprocating knitting of

which certain needles may be changed from one group to the other group; means to introduce distinct yarns at spaced points; means relatively to reciprocate the needle carrier and cam carrier; and means to cause on each of a series of successive strokes of such reciprocation one group of needles to knit at one yarn and the other group to knit at the other yarn and the loops of the two series to be interengaged as suture seams.

15. A knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points, and to cause the needles to knit simultaneously in two series at both yarns respectively on each reciprocation, thus forming split work; each needle of one of said series having an element movable independently of its needle and functioning in the positioning of its needle in one series and its transfer to another series for re-groupment of the needles of the two series.

16. A knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points, and to cause the needles to knit simultaneously in two series at both yarns respectively on each reciprocation, thus forming split work; each needle of one series having in its groove a jack movable independently of its needle and means for sliding said jack in said groove for permissive re-groupment of that needle.

17. A knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points, and to cause the needles to knit in two series at both yarns respectively on each reciprocation, thus forming split work interengaged on each reciprocation, each needle of one series having in its groove a jack movable independently of that needle and means for sliding said jacks in succession in said grooves in the re-groupment of the needles of the two series.

18. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points, and to cause the needles to knit in two series at both yarns respectively on each reciprocation, thus forming split work; each needle of one series having a jack in its groove movable independently of that needle and jack picker means for moving said jacks in said grooves for the re-groupment of the needles of the two series.

19. A knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points, and to cause the needles to knit in two series at both yarns respectively on each reciprocation, thus forming a split work interengaged on each reciprocation; each needle of one series having a jack in its groove movable independently of its needle and means for moving said jacks in said grooves for re-groupment at another level of needles whose jacks are so moved.

20. A knitting machine comprising in combination, a needle carrier and a cam carrier; means to rotate said needle carrier to produce rotary work on the needles; means to reciprocate said needle carrier and to introduce distinct yarns at spaced points and to cause needles to knit at both yarns on each reciprocation of said needle carrier as two groups; selection-determining means moving bodily with the needles in each reciprocation of the needle carrier, whereby needles having said selection-determining means are thereby rendered selective as suture needles, and stationary means past which the needles are reciprocated to cause selective needles to shift to the other group.

21. A knitting machine comprising in combination, a needle carrier and a cam carrier; means to rotate said needle carrier to produce rotary work on the needles; means to reciprocate said needle carrier and to introduce distinct yarns at spaced points and to cause needles to knit at both yarns on each reciprocation of said needle carrier as two groups, selection-determining means individual to each of a number of needles and having movement independent of said needles, whereby needles having said selection-determining means are thereby rendered selective as suture needles; and stationary means past which the needles are reciprocated to cause selective needles to shift to the other group.

22. Mechanism for knitting a stocking upon a single series of needles, comprising in combination, a series of needles; a carrier therefor; a cam support; means relatively to rotate said carrier with its needles, and said support, to produce the stocking leg; means relatively to reciprocate said carrier with its needles and said support there by simultaneously to produce the opposite portions of the ankle area from distinct yarns; and means to unite, during the knitting operation, the said ankle portions by lines of suture loops extending obliquely to the wales.

23. A hosiery knitting machine comprising in combination, a needle carrier and a cam carrier; means to reciprocate said needle carrier and to introduce distinct yarns at spaced points and to cause needles to kit at both yarns on each reciprocation of said needle carrier as two groups, one of said groups including fashioning and non-fashioning needles for heel and toe work, and means to function said fashioning

needles as such; selection-determining means moving bodily with the needles in each reciprocation of the needle carrier, whereby needles having said selection-determining means are thereby rendered selective as suture needles, all of said fashioning needles having selection-determining means rendering them selective as suture needles; and stationary means past which the needles are reciprocated to cause selective needles to shift to the other group.

24. A hosiery knitting machine comprising in combination, a needle carrier and a cam carrier; means to reciprocate said needle carrier and to introduce distinct yarns at spaced points and to cause needles to knit at both yarns on each reciprocation of said needle carrier as two groups, one of said groups including fashioning and non-fashioning needles for heel and toe work, and means to function said fashioning needles as such; selection-determining means moving bodily with the needles in each reciprocation of the needle carrier, whereby needles having said selection-determining means are thereby rendered selective as suture needles, all of said fashioning needles and some of the non-fashioning needles having selection-determining means rendering them selective as suture needles; and stationary means past which the needles are reciprocated to cause selective needles to shift to the other group.

25. A hosiery knitting machine comprising in combination, a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit at both yarns on each reciprocation as two groups, one of said groups including fashioning and non-fashioning needles for heel and toe work and means to function said fashioning needles as such, each of a plurality of needles of at least one of said groups and including all of the fashioning needles having selection-determining means movable independently of its needle, whereby needles having said selection-determining means are thereby rendered selective as suture needles; and means past which the needles are relatively reciprocated on said reciprocating strokes to cause selective needles to shift to the other group.

26. A hosiery knitting machine comprising in combination, a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit at both yarns on each reciprocation as two groups, one of said groups including fashioning and non-fashioning needles for heel and toe work and means to function said fashioning needles as such, each of a plurality of needles of at least one of said groups and including all of the fashioning needles having selection-determining means movable independently of its needle in its groove, whereby needles having said selection-determining means are thereby rendered selective as suture needles; and means past which the needles are relatively reciprocated on said reciprocating strokes to cause selective needles to shift to the other group.

27. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause the needles to knit in two series at both yarns on each reciprocation, thus forming split work; one of said series including both fashioning needles and non-fashioning needles and means cooperating with said needles for forming the heel or toe pockets by narrowing and widening; and means to transfer needles from one of said series to the other thereby to vary the wales in which both of the suture seams are formed; the needles so transferrable from one of said series to the other including all of the said fashioning needles and including some at least of the non-fashioning needles.

28. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause the needles to knit in two series at both yarns respectively on each reciprocation, thus forming split work; one of said series including both fashioning needles and non-fashioning needles and means cooperating with said needles for forming the heel or toe pockets by narrowing and widening; and selection-determining means to transfer needles from one of said series to the other thereby to vary the wales in which both of the suture seams are formed; the needles so transferrable from one of said series to the other including all of the said fashioning needles and including some at least of the non-fashioning needles.

29. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause the needles to knit in two series at both yarns respectively on each reciprocation, thus forming split work; one of said series including both fashioning needles and non-fashioning needles and means cooperating with said needles for forming the heel or toe pockets by narrowing and widening; and selection-determining means movable in the needle grooves independently of the needles to transfer needles from one of said series to the other thereby to vary the wales in which both of said suture seams are formed; the needles so transferrable from one of said se-

ries to the other including all of the said fashioning needles and including some at least of the non-fashioning needles.

30. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause the needles to knit in two series at both yarns on respective reciprocating strokes, thus forming split work; one of said series including both fashioning needles and non-fashioning needles and means cooperating with said needles for forming the heel or toe pockets by narrowing and widening; and selection determining means movable in the grooves independently of the needles and pickers for acting upon said selection-determining means to transfer needles from one of said series to the other thereby to vary the wales in which both of said suture seams are formed; the needles so transferrable from one of said series to the other including all of the said fashioning needles and including some at least of the non-fashioning needles.

31. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause the needles to knit in two series at both yarns on respective reciprocating strokes, thus forming split work; one of said series including both fashioning needles and non-fashioning needles and means cooperating with said needles for forming the heel or toe pockets by narrowing and widening; and selection-determining means movable in the grooves independently of the needles and pickers and cams for acting directly upon the selection-determining means or jacks to transfer needles from one of said series to the other thereby to vary the wales in which both of said suture seams are formed; the needles so transferrable from one of said series to the other including all of the said fashioning needles and including some at least of the non-fashioning needles.

32. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit in two series at both yarns respectively on each reciprocation, thus forming split work; one of the said series of needles being nearly a complete circle of the entire circle of needles; and means to transfer terminal needles from the larger series to the smaller, thereby to vary the wales in which both of the suture seams are formed.

33. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit in two series at both yarns on each reciprocation, thus forming split work one of said series of needles being so nearly a complete circle of the entire circle of needles that its terminal needles are in closer proximity than the spread of a set of the stitch cams; and means to transfer terminal needles from the larger series to the smaller, thereby to vary the wales in which both of said suture seams are formed.

34. A circular knitting machine comprising in combination, a needle carrier and a cam carrier, means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit in two series at both yarns on each reciprocation, thus forming split work; one of the said series of needles being so nearly a complete circle of the entire circle of needles that a substantially triangular area is produced in the continued transfer of needles from the larger to the smaller group, the lateral walls of such triangular area extending across a multiplicity of the wales and substantially meeting for the apex.

35. A circular knitting machine comprising in combination, a needle carrier and a cam carrier, means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit in two series at both yarns on each reciprocation, forming split work, one of said series of needles being so nearly a complete circle of the entire circle of needles that a relatively small gap only exists between the terminal needles of that series; the other of said series of needles existing only at said gap, and means to transfer terminal needles from the larger series to the level of the needles of the gap, thereby to vary the wales in which both of the suture seams are formed; the needles of said gap and the successive enlargements of the gap through the transfer of terminal needles from the larger series, receiving and knitting in making a contrasting zone, only a yarn which is other than the yarn upon which said larger series of needles knits, said two yarns being interconnected along the resulting, varying suture lines.

36. A circular knitting machine comprising in combination, a needle carrier and a cam carrier including two sets of stitch cams, means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit in two series at both yarns on respective reciprocating strokes thus forming split work, one of the said series of needles being so nearly a complete circle of the entire series of needles that its terminal needles are in closer proximity than the spread of either cam set; and means to transfer terminal needles from the larger series to the smaller,

thereby to vary the wales in which both of said suture seams are formed.

37. A circular knitting machine comprising in combination a needle carrier and a cam carrier, means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit in two series at both yarns on respective knitting strokes, thus forming split work; one of said series of needles being so nearly a complete circle of the entire series of needles that a relatively small gap only exists between the terminal needles of that series; the other of said series of needles existing only at said gap, but lying at a different level from said nearly complete circle of needles, and means to transfer terminal needles from the larger series to the level of the needles of the gap, thereby to vary the wales in which both of said suture seams are formed; the needles of said gap and the successive enlargements of the gap through the transfer of terminal needles from the larger series, receiving and knitting in making a contrasting zone, only a yarn which is other than the yarn upon which said larger series of needles knits, said two yarns being interconnected along the resulting varying suture lines.

38. A circular knitting machine comprising in combination, a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit in two series at both yarns on respective knitting strokes, thus forming split work; the two series of needles in all re-groupments thereof respectively knitting only upon the two distinct yarns, only the suture needles knitting on both yarns, the larger of said series of needles embracing nearly a complete circle of the needles at its utmost extent; and means to transfer terminal needles at both ends from the larger series to the smaller, thereby to vary the wales in which both of said suture seams are formed.

39. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit in two series at both yarns respectively on each reciprocation, thus forming split work; the two series of needles in all re-groupments thereof respectively knitting only upon the two distinct yarns, only the suture needles knitting on both yarns, the larger of said series of needles embracing nearly a complete circle of the needles at its utmost extent; and means temporarily to transfer terminal needles of the smaller series to the larger series to form suture loops uniting the terminal loops formed upon said two series of needles.

40. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit in two series at both yarns respectively on each reciprocation, thus forming split work; the two series of needles in all re-groupments thereof respectively knitting only upon the two distinct yarns, only the suture needles knitting on both yarns, the larger of said series of needles embracing nearly a complete circle of the needles at its utmost extent; means temporarily to transfer terminal needles of the smaller series to the larger series to form suture loops uniting the terminal loops formed upon said two series of needles; and means to transfer terminal needles at both ends from the larger series to the smaller, thereby to vary the wales in which both of said suture seams are formed.

41. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit in two series at both yarns on each reciprocation, thus forming split work; the two series of needles in all re-groupments thereof respectively knitting only upon the two distinct yarns, only the suture needles knitting on both yarns, the larger of said series of needles embracing nearly a complete circle of the needles at its utmost extent; means including narrowing pickers temporarily to transfer terminal needles of the smaller series to the larger series to form suture loops uniting the terminal loops formed upon said two series of needles; and means including jacks and widening pickers acting upon said jacks to transfer terminal needles at both ends from the larger series to the smaller, thereby to vary the wales in which both of said suture seams are formed.

42. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause the needles to knit in two series at both yarns on each reciprocation, thus forming split work; the larger of said series including all the instep needles and all the heel fashioning needles; means cooperating with the heel fashioning needles for forming the heel pocket by narrowing and widening; and means consecutively to transfer said heel fashioning needles from the larger series to the smaller, thereby to vary the wales in which both of said suture seams are formed.

43. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause the needles to knit in two series at both yarns on each re-

ciprocation, thus forming split work; the larger of said series including all the instep needles, all the heel fashioning needles and some at least of the non-fashioning heel needles, means cooperating with the heel fashioning needles for forming the heel pocket by narrowing and widening; and means consecutively to transfer said heel fashioning needles from the larger series to the smaller, thereby to vary the wales in which both of said suture seams are formed.

44. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause the needles to knit at both yarns on each reciprocation; said needles being in two series arranged at two levels for knitting at said yarns respectively and thus forming split work; the larger of said series including all the instep needles and all the heel fashioning needles; means cooperating with the heel fashioning needles for forming the heel pocket by narrowing and widening; and means consecutively to transfer said heel fashioning needles from the larger series to the smaller, thereby to vary the wales in which both of said suture seams are formed.

45. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause the needles to knit in two series at both yarns on each reciprocation, thus forming split work; the larger of said series including all of the instep needles and all of the heel fashioning needles, means cooperating with the heel fashioning needles for forming the heel pocket by narrowing and widening; a jack for each of said heel fashioning needles movable independently of its needle and functioning in the positioning of its needle in one series and its transfer to the other series; and means to function said jacks in the transfer of said heel fashioning needles from the larger series to the smaller thereby to vary the wales in which both of said suture seams are formed.

46. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause the needles to knit in two series at both yarns on each reciprocation, thus forming split work; the larger of said series including all of the instep needles and all of the heel fashioning needles; means cooperating with the heel fashioning needles for forming the heel pocket by narrowing and widening; a jack for each of said heel fashioning needles movable independently of its needle and functioning in the positioning of its needle in one series and its transfer to the other series; and picker means for said jacks to transfer said heel fashioning needles from the larger series to the smaller thereby to vary the wales in which both of said suture seams are formed.

47. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause the needles to knit in two series at both yarns on each reciprocation, thus forming split work; the larger of said series including all of the instep needles and all of the heel fashioning needles; means cooperating with the heel fashioning needles for forming the heel pocket by narrowing and widening; jacks for each needle of one series and widening pickers for said jacks to transfer the needles of said jacks from one series to the other thereby to vary the wales in which both of said suture seams are formed.

48. A circular knitting machine comprising in combination, a needle carrier and a cam carrier, means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause the needles to knit in two series at both yarns on each reciprocation, thus forming split work, the larger of said series including all the instep needles and all the heel fashioning needles, means cooperating with the heel fashioning needles for forming the heel pocket by narrowing and widening, means including narrowing needle pickers for the temporary transfer of the end needles of one series to the other to act as suture needles in that other series, and means to transfer said heel fashioning needles from the larger series to the smaller series, thereby to vary the wales in which both of said suture seams are formed.

49. A circular knitting machine comprising in combination, a needle carrier and a cam carrier, means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause the needles to knit in two series at both yarns on each reciprocation, thus forming split work, the larger of said series including all the instep needles and at least all the heel fashioning needles, means cooperating with the heel fashioning needles for forming the heel pocket by narrowing and widening, means including jacks for at least all of said heel fashioning needles to transfer said heel fashioning needles from the larger series to the smaller series, thereby to vary the wales in which both of said suture seams are formed, and means to confine re-groupment action upon said jacks to selected ends of said series.

50. A circular knitting machine compris-

ing in combination a needle carrier and a cam carrier; means to rotate said needle carrier to produce rotary work on the needles; means to reciprocate said needle carrier and to introduce distinct yarns at spaced points and to cause needles to knit at both yarns on each reciprocation of said needle carrier; means to divide the needles into two groups for said reciprocating knitting, of which certain needles may be changed from one group to the other group; means to cause on successive strokes of reciprocation of the needle carrier one group of needles to knit at one yarn and the other group to knit at the other yarn and the loops of the two series to be interengaged as suture seams; and means to transfer needles from one of said groups to the other thereby to vary the wale in which at least one of said suture seams is formed.

51. The method of knitting a stocking throughout upon a single series of needles, which consists in producing the leg portion by rotary knitting; simultaneously producing opposite portions of the ankle area by reciprocating knitting; joining the simultaneously knitted ankle portions by oblique lines of suture loops; and knitting the heel, foot and toe.

52. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit in two series at both yarns on respective reciprocating strokes thereby to form split work; selection-determining means for each of certain needles of at least one series, said selection-determining means being located in the grooves thereof and movable independently of those needles; and picker means for acting directly upon said selection-determining means for participating in the re-groupment of the needles at two levels.

53. A circular knitting machine comprising in combination a needle carrier and a cam carrier; means to group the needles as two series at two levels respectively; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit in two series at both yarns on each reciprocation; selection-determining means for each of certain needles of at least one series; said means including jacks for each of certain needles located in the grooves thereof; and picker means to act upon said jacks to move them in one direction in said grooves for participation in the re-groupment of the needles at said two levels.

54. A knitting machine comprising in combination, a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit at both yarns on each reciprocation; said needles being in two series at different levels for knitting at said yarns respectively and thus forming split work; needle picker means acting to change needles temporarily from one level to the other so as to act as suture needles at the new level; and means to transfer needles permanently from one of said series to the other, thereby to vary the wale in which at least one of said suture seams is formed.

55. A knitting machine comprising in combination, a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit at both yarns on each reciprocation, said needles being in two series at different levels for knitting at said yarns respectively and thus forming split work; self-acting narrowing pickers acting upon the needles to change said needles temporarily from one level to the other so as to act as suture needles at the new level; and means to transfer needles permanently from one of said series to the other, thereby to vary the wale in which at least one of said suture seams is formed.

56. A knitting machine comprising in combination, a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit at both yarns on each reciprocation; said needles being in two series at different levels for knitting at said yarns respectively and thus forming split work; needle picker means acting to change needles temporarily from one level to the other so as to act as suture needles at the new level, and means including jacks and said narrowing pickers to transfer needles permanently from one of said series to the other, thereby to vary the wale in which at least one of said suture seams is formed.

57. A knitting machine comprising in combination, a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit at both yarns on each reciprocation; said needles being in two series at different levels for knitting at said yarns respectively and thus forming split work; needle picker means acting to change needles temporarily from one level to the other so as to act as suture needles at the new level, and means including said self-acting narrowing pickers, jacks and pickers acting upon said jacks for effecting re-groupment of said needles.

58. A knitting machine comprising in combination, a needle carrier and a cam carrier; means relatively to reciprocate said parts and to introduce distinct yarns at

spaced points and to cause needles to knit at both yarns on each reciprocation; said needles being in two series at different levels for knitting at said yarns respectively, and thus forming split work; needle picker means acting to change needles temporarily from one level to the other so as to act as suture needles at the new level, and means including self-acting pickers, jacks, and pickers and jack cams acting upon said jacks for effecting the re-groupment of said needles.

59. A knitting machine comprising in combination, a needle carrier and a cam carrier, means relatively to reciprocate said parts and to introduce distinct yarns at spaced points and to cause needles to knit at both yarns on each reciprocation; said needles being in two series at different levels for knitting at said yarns respectively and thus forming split work; needle picker means acting to change needles temporarily from one level to the other so as to act as suture needles at the new level, and means including said self-acting needle pickers, jacks operating in the needle grooves, and movable independently of the needles, jack pickers and jack cams operating upon said jacks to effect the re-groupment of said needles.

60. In a knitting machine, a circular series of needles; means to arrange them in two groups at upper and lower levels respectively; means to introduce distinct yarns at separated points simultaneously to said groups of needles, to cause said needles to knit partial courses of loops, means including pickers operating during the knitting of said partial courses to cause the terminal needles of one of said groups to move to the level of the other group to form suture loops, uniting said partial courses, and means including jacks and pickers operating exclusively upon said jacks gradually to transfer the terminal needles of one of said groups to the level of the other group, so as to form a suture seam extending across the longitudinal wales of the fabric section.

61. That method of knitting the leg and ankle portions of a stocking upon a series of needles which consists in producing the leg portion by rotary knitting; simultaneously producing from distinct yarns opposite portions of the ankle area by reciprocatory knitting and while knitting said ankle portions, joining them by lines of suture loops which cross wales of the fabric.

62. In a knitting machine, a circular series of needles, means to separate said needles into relatively large and small groups at different levels, means simultaneously to introduce distinct yarns respectively to said groups and to function said needles in the knitting of partial courses of loops, means including pickers acting upon the needle butts temporarily to transfer the terminal needles of the smaller group to the level of the larger group to form suture loops uniting the terminal loops of said partial courses, and means including jacks and pickers operating exclusively upon said jacks to transfer two needles at a time from opposite ends of the larger group to the level of the smaller group, thereby to form a suture seam extending across the longitudinal wales of a fabric section.

63. That method of knitting a stocking comprising knitting an upper leg portion by rotary work seamlessly to the top of the high splice; then knitting simultaneously from distinct yarns upon two sets of needles respectively in the same machine, the high splice and the front lower leg portion, and interconnecting the loops of the two yarns to form suture lines, and causing terminal needles of one set to be transferred to and to knit as suture needles and subsequently as regular needles in the other set, thereby causing said suture lines to be inclined to the direction of the wales of the stocking leg.

64. That method of knitting a stocking comprising knitting an upper leg portion by rotary work seamlessly to the top of the high splice; then knitting simultaneously from distinct yarns upon two sets of needles respectively, in the same machine, the high splice and the front lower leg portion, and interconnecting the loops of the two yarns to form suture lines, and persistently and throughout a prolonged number of consecutive needles transferring the terminal needles of one set to the other set, there to act as suture needles and thereafter to act in said other set as regular needles, thus causing said suture lines to cross wales of the fabric.

65. That method of knitting a stocking comprising knitting an upper leg portion by rotary work seamlessly to the top of the high splice; then knitting simultaneously from distinct yarns upon two sets of needles respectively, in the same machine, the high splice and the front lower leg portion, and interconnecting the loops of the two yarns to form suture lines; and causing terminal needles of one set to be transferred to the other set and there to act first as suture needles in that other set and then for a plurality of courses to knit as regular needles in that other set, whereby the suture lines are inclined to the direction of the wales of the fabric.

66. Circular knitting mechanism comprising in combination, a needle cylinder, a cam ring, a main set and an auxiliary set of knitting cams; a long butt set and a short butt set of needles, said needles being arranged in two groups, one of which contains needles of one length of butt and certain needles of the other length of butt;

main and auxiliary yarn feeds, the needles of one set being adapted to knit only at the main yarn feed and the needles of the other set being adapted to knit only at the auxiliary yarn feed but with cooperating means causing the loops of the two yarns to be interconnected to form suture seams; switch cam means to elevate one of said sets of needles to a higher level; and means periodically to transfer needles from that set which contains needles of both lengths of butts to the other set there to function as suture needles and thus modify the suture seam formation.

67. Circular knitting mechanism comprising in combination, a needle cylinder, a cam ring, a main set and an auxiliary set of knitting cams; a long butt set and a short butt set of needles, said needles being arranged in two groups, one of which contains needles of one length of butt and certain needles of the other length of butt; main and auxiliary yarn feeds; the needles of one being adapted to knit only at the main yarn feed and the needles of the other set being adapted to knit only at the auxiliary yarn feed but with cooperating means causing the loops of the two yarns to be interconnected to form suture seams; switch cam means to elevate the long needle butts to an upper level; and means periodically to transfer needles from their group which contains needles of both lengths of butts to the other group of needles there to function as suture needles and thus modify the suture seam formation.

68. Circular knitting mechanism comprising in combination, a needle cylinder, a cam ring, a main set and an auxiliary set of knitting cams; a long butt set and a short butt set of needles, said needles being arranged in two groups, one of which contains needles of one length of butt and certain needles of the other length of butt, main and auxiliary yarn feeds; the needles of one set being adapted to knit only at the main yarn feed and the needles of the other set being adapted to knit only at the auxiliary yarn feed but with cooperating means causing the loops of the two yarns to be interconnected to form suture seams, switch cam means to elevate one of said sets of needles to a higher level; and means periodically to transfer needles from that set which contains needles of both lengths of butts to the other set and there to function first as suture needles and then throughout each of a plurality of consecutive courses to function as regular needles in that set to which they have been thus transferred.

69. Circular knitting mechanism comprising in combination, a needle cylinder, a cam ring, a main set and an auxiliary set of knitting cams; a long butt set and a short butt set of needles, said needles being arranged in two groups, one of which contains needles of one length of butt and certain needles of the other length of butt; main and auxiliary yarn feeds; the needles of one set being adapted to knit only at the main yarn feed and the needles of the other set being adapted to knit only at the auxiliary yarn feed but with cooperating means causing the loops of the two yarns to be interconnected to form suture seams; switch cam means to elevate all the long butt needles to an upper level; and means periodically to transfer short butt needles from their temporary allotment in the long butt needle set to the other set there to function as suture needles and thus modify the suture seam formation.

70. Circular knitting mechanism comprising in combination, a needle cylinder, a cam ring, a main set and an auxiliary set of knitting cams; a long butt set and a short butt set of needles, said needles being arranged in two groups, one of which contains needles of one length of butt and certain needles of the other length of butt; main and auxiliary yarn feeds, the needles of one set being adapted to knit only at the main yarn feed and the needles of the other set being adapted to knit only at the auxiliary yarn feed but with cooperating means causing the loops of the two yarns to be interconnected to form suture seams, switch cam means to elevate the long butt needles to an upper level; and means periodically and persistently to transfer the terminal short butt needles from their temporary allotment in the long butt needle set to the other set and there to cause them to function first as suture needles in that other set and thereafter in a plurality of successive courses to act as regular needles in that other set.

71. Knitting mechanism including needles arranged in two series, and means to introduce distinct yarns to the two series respectively and to cause each series to knit only at its own yarn but to cause the two yarns to knit simultaneously and to be interconnected along spaced suture seams, a carrier for the needles having grooves in which the needles have independent sliding movement; jacks in the grooves of the needles of one series but distinct from and independent of said needles; and means to transfer jacks from a position in their grooves which establishes a level for the needles of that series to another level which is that of the needles of the other series, whereby the needles pertaining to the jacks so transferred knit with that other series of needles.

72. Knitting mechanism including needles arranged in two series and means to introduce distinct yarns to the two series respectively and to cause each series to knit only at its own yarn but to cause the two yarns to knit simultaneously and to be interconnected along spaced suture seams, a carrier for the needles having grooves in which the

needles have independent sliding movement; means to position the needles of one series at one level and to position the needles of the other series at another level, said means including jacks in the grooves of the needles of one series but distinct and independent from said needles; and means to transfer jacks from a position in their grooves which establishes the level for the needles of that series to the level of the needles of the other series, whereby the needles pertaining to the jacks so transferred knit with that other series of needles.

73. Knitting mechanism including needles arranged in two series and means to introduce distinct yarns to the two series respectively and to cause each series to knit only at its own yarn but to cause the two yarns to knit simultaneously and to be interconnected along spaced suture seams, a carrier for the needles having grooves in which the needles have independent sliding movement; means to position the needles of one series at one level and to position the needles of the other series at another level, said means including jacks in the grooves of the needles of one series but distinct and independent from said needles; and means to transfer consecutively and throughout a prolonged series jacks from a position in their grooves which establishes the level for the needles of that series to the level of the needles of the other series, whereby the needles pertaining to the jacks so transferred knit with that other series of needles.

74. In a knitting machine, a circular series of needles having long and short knitting butts, means to separate the two sets of needles for fashioning, additional means to separate said needles into two groups, one of said groups including all of the instep needles and at least some of the fashioning needles, means to introduce distinct yarns at spaced points, and to cause needles to knit at both yarns on each reciprocation to form split work, means including narrowing pickers to cause the terminal needles of one of said series of needles to be transferred to the other series to form suture loops, and means including jacks arranged in the grooves with said instep needles to prevent the regroupment of the needles of said instep series.

75. That method of knitting which consists in relatively rotating a circular series of needles and knitting cams to form circular courses of loops, then in separating said needles into relatively large and small groups, then in relatively reciprocating said needles and said cams and in introducing distinct yarns simultaneously and respectively to said groups of needles at spaced points to form partial courses of loops and, during the knitting of said partial courses, in transferring needles from one group of needles to the other to produce a suture seam extending obliquely to the longitudinal wales of the fabric sections from near the center of one of said sections to the side thereof.

76. That method of knitting which consists in relatively rotating two groups of needles and two sets of knitting cams to form circular courses of loops, then in separating said needles into relatively large and small groups, then in relatively reciprocating said needles and said cams and in introducing distinct yarns simultaneously and respectively to said groups of needles at spaced points to form partial courses of loops and, during the knitting of said partial courses, in transferring needles from one group of needles to the other to produce a suture seam extending obliquely to the longitudinal wales of the fabric sections from near the center of one of said sections to the side thereof.

77. That method of knitting split fabric which consists in relatively rotating a circular series of needles and two sets of knitting cams, then in separating said needles into two groups one of said groups not exceeding substantially one-sixth of the entire circle, then in relatively reciprocating said needles and said cams and in introducing distinct yarns simultaneously and respectively to said groups of needles at spaced points to form partial courses of loops and, during the knitting of said partial courses, in temporarily transferring the terminal needles from one of said groups to the other to produce suture loops and then in permanently transferring the terminal needles of one of said groups to the other group in selected succeeding courses until the two groups of needles are approximately equal in number to form suture seams extending obliquely to the longitudinal wales of the fabric sections.

78. A circular knitting machine comprising in combination, a circular series of needles and operating cams therefor, means relatively to operate said needles and cams for rotary knitting, means relatively to reciprocate said needles and cams, yarn supplies respectively for different groups of said needles, upon reciprocation, thereby to produce simultaneously a plurality of fabric portions, and means automatically to transfer needles from one to another of said groups to vary the number of the effective needles in each.

79. A circular knitting machine for knitting split work, comprising a needle cylinder with needle grooves; a cam carrier surrounding the same; there being at spaced points about the needle cylinder means to introduce distinct yarns for split work; a circular series of needles in said grooves, constituting two groups; said cam carrier having main and auxiliary sets of knitting cams respectively functioning to present the

needles of said two groups to said distinct yarns said sets of knitting cams being at substantially the same distance from the needle cylinder; each set of knitting cams including an advancing cam and a retracting cam both of which are close to the outer face of the needle cylinder; and both of which engage the needle butts in the grooves of the needle cylinder to reciprocate them therein; means relatively to reciprocate the needle cylinder and the cam carrier so as to cause the needles to take said yarns at each reciprocation in the production of split work with interengaged loops forming suture seams; and means to vary in selected succeeding courses the needle or needles upon which the suture seam or seams is formed, so as to cause said seam or seams to extend across a series of wales of the fabric.

80. A circular knitting machine for knitting split work, comprising a needle cylinder with needle grooves; a cam carrier surrounding the same; there being at spaced points about the needle cylinder means to introduce distinct yarns for split work; a circular series of needles in said grooves, constituting two groups; said cam carrier having main and auxiliary sets of knitting cams respectively functioning to present the needles of said two groups to said distinct yarns; said sets of knitting cams being at substantially the same distance from the needle cylinder; each group of knitting cams including an advancing and a retracting cam both of which are close to the outer face of the needle cylinder and both of which engage the needle butts in the grooves of the needle cylinder to reciprocate them therein; means relatively to reciprocate the needle cylinder and the cam carrier so as to cause one group of said needles to knit at one set of cams and to pass without knitting above the other set of cams; and the other group of needles to knit at said other set of cams but to pass without knitting below said first set of cams, terminal needles being caused to form interengaging loops constituting suture seams; and means to vary in selected succeeding courses the terminal needles upon which the suture seams are formed, so as to cause said seams to extend across two series of wales of the fabric.

81. A circular knitting machine for knitting split work, comprising a needle cylinder with needle grooves; a cam carrier surrounding the same; there being at spaced points about the needle cylinder means to introduce distinct yarns for split work; a circular series of needles in said grooves, constituting two groups; said cam carrier having main and auxiliary sets of knitting cams respectively functioning to present the needles of said two groups to said distinct yarns; said sets of knitting cams being at substantially the same distance from the needle cylinder; each group of knitting cams including an advancing and a retracting cam both of which are close to the outer face of the needle cylinder and both of which engage the needle butts in the grooves of the needle cylinder to reciprocate them therein; means relatively to reciprocate the needle cylinder and the cam carrier so as to cause the needles to take said yarns at each reciprocation in the production of split work with interengaged loops forming suture seams; and means for transferring needles of one group to the other group there to function first as suture needles and thereafter as regular needles, said means including a set of instrumentalities arranged in a curved series positioned for action upon the needles in substantially the curved plane of the outer face of the needle cylinder.

82. A circular knitting machine for knitting split work, comprising a needle cylinder with needle grooves; a cam carrier surrounding the same; there being at spaced points about the needle cylinder means to introduce distinct yarns for split work; a circular series of needles in said grooves, constituting two groups; said cam carrier having main and auxiliary sets of knitting cams respectively functioning to present the needles of said two groups to said distinct yarns; said sets of knitting cams being at substantially the same distance from the needle cylinder; each group of knitting cams including an advancing and a retracting cam both of which are close to the outer face of the needle cylinder and both of which engage the needle butts in the grooves of the needle cylinder to reciprocate them therein; means relatively to reciprocate the needle cylinder and the cam carrier so as to cause the needles to take said yarns at each reciprocation in the production of split work with interengaged loops forming suture seams; and means for transferring needles of one group to the other there to function first as suture needles and thereafter as regular needles, said means consisting of instrumentalities individual to selected needles and arranged in a curved series which is positioned for action upon the needles in substantially the curved plane of the outer face of the needle cylinder, and means to act upon said instrumentalities in sequence.

83. In a knitting machine a circular series of needles; two sets of knitting cams; means to effect cooperation between said needles and one set of knitting cams to produce rotary work and between two groups of said needles and both of said sets of knitting cams to produce split work; means to divide the needles into large and small groups for knitting said split work; and means simultaneously to introduce distinct yarns to

both groups of said needles during the knitting of said split work, one of said yarns constituting the yarn for said rotary work and one section of said split work, the other yarn composing the other section of said split work and means persistently to transfer in a series of courses, terminal needles from the larger to the smaller group, to effect the formation of suture seams extending obliquely to the longitudinal wales of the fabric.

84. In a knitting machine a circular series of needles; two sets of knitting cams; means to effect relative rotary movement between said needles and said cams and to cause the knitting of said needles with one set of said cams to produce rotary work; means to divide said needles into relatively large and small groups for knitting split work; means to introduce yarn to all of said needles during rotary work; means to effect relative reciprocatory movements between said groups of needles respectively and said knitting cam sets to produce split work; means to introduce distinct yarns simultaneously to said groups of needles during the knitting of said split work and to cause the interknitting of said two yarns to form suture seams; means to transfer the terminal needles of the smaller to the larger group to form suture loops uniting the terminal loops of the fabric sections; and means including jacks having movement independent of needles pertaining thereto, and pickers operating exclusively upon said jacks, to transfer the terminal needles from said larger to said smaller group to effect the formation of a suture seam extending obliquely to the longitudinal wales of a fabric section.

85. In a knitting machine, a circular series of needles; means to separate said needles into relatively large and small groups; means simultaneously to introduce distinct yarns respectively to said groups and to function said needles in the knitting of partial courses of loops; means including pickers acting upon the needle butts temporarily to transfer the terminal needles of the smaller group to the larger group to form suture loops uniting the terminal loops of said partial courses; and means including jacks having movement independent of needles pertaining thereto, pickers operating exclusively upon said jacks and cams for said jacks to transfer two needles from each end of the larger group to the smaller group thereby to form suture seams extending diagonally across the longitudinal wales of a fabric section.

86. Knitting mechanism including a circular series of needles operable as an entirety for rotary work but divided for separate knitting cam actuation into relatively small and large groups; primary and secondary knitting cams respectively arranged to function said groups of needles during reciprocating knitting to form split work one only of said cams functioning during rotary work; means to introduce distinct yarns at spaced points to said groups of needles for the production of split work; means including narrowing pickers and said secondary knitting cams to cause the leading needles of the smaller group to form suture seams; and means to transfer terminal needles at each end of the larger group to said smaller group thereby to vary the wales in which said suture seams are formed.

87. Knitting mechanism including a circular series of needles divided for separate knitting cam actuation into relatively small and large groups; primary and secondary knitting cams respectively arranged to function said groups of needles during reciprocating knitting to form split work; means to introduce distinct yarns at spaced points to said groups of needles for the production of split work; means including narrowing pickers and said secondary knitting cams to cause the leading needles of the smaller group to form suture seams; and means including jacks having movement independent of needles pertaining thereto, and pickers operating upon said jacks, to transfer needles from the larger group to the smaller group thereby to vary the wales in which the suture seams are formed.

88. That method of knitting a stocking throughout upon a single series of needles, which includes producing a leg portion by rotary knitting; simultaneously producing segmental portions of the stocking by reciprocating knitting, and during the production of said segmental portions joining simultaneously knitted segmental portions by oblique lines of suture loops.

In testimony whereof, I have signed my name to this specification.

ROBERT H. LAWSON.