Nov. 22, 1949 E. W. KAUL ET AL 2,489,141

FASHIONING MECHANISM FOR KNITTING MACHINES

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Fig. 1.

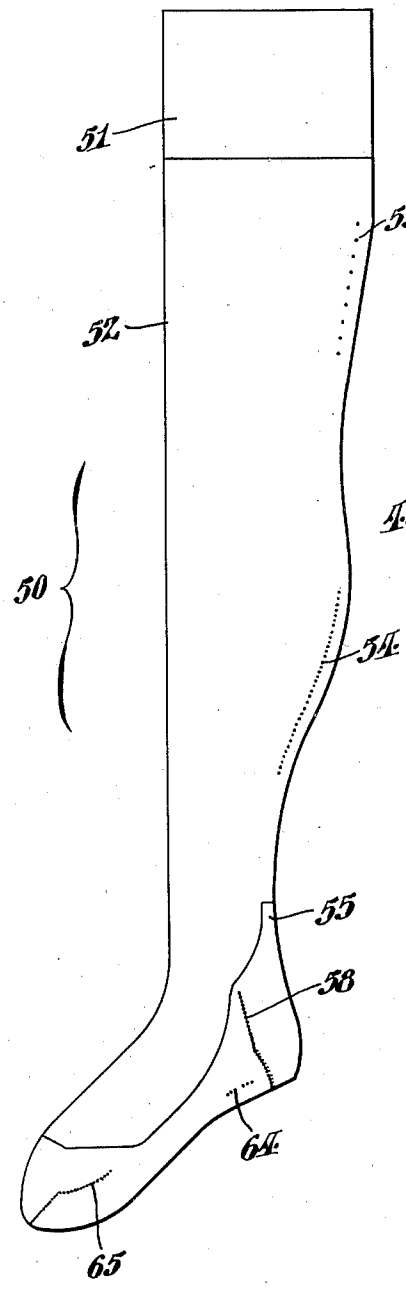
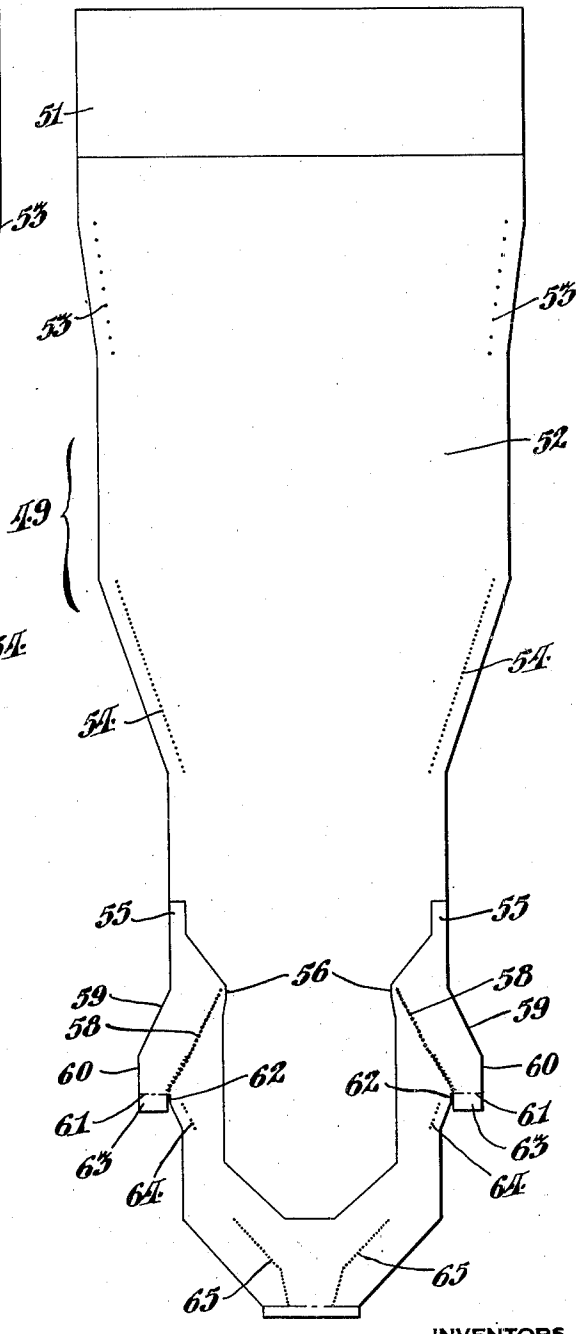


Fig. 2.



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FASHIONING MECHANISM FOR KNITTING MACHINES

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FIG. 3.

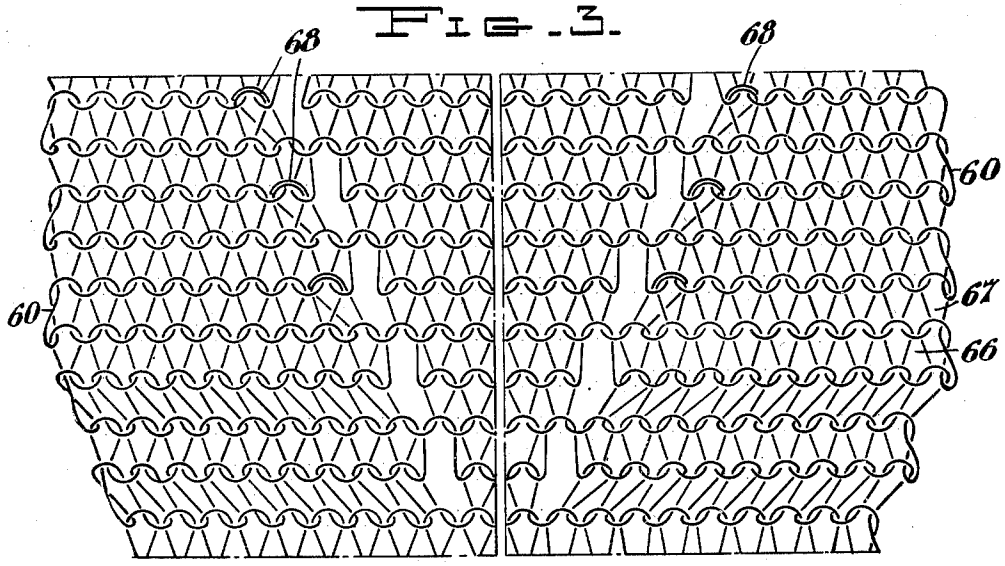


FIG. 4.

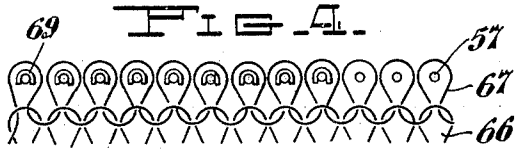


FIG. 5.

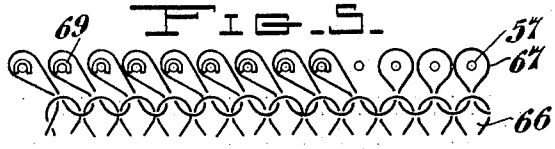


FIG. 6.

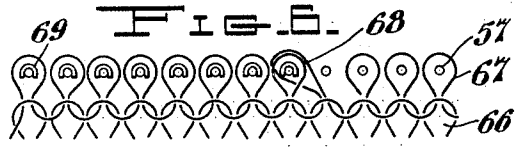


FIG. 7.

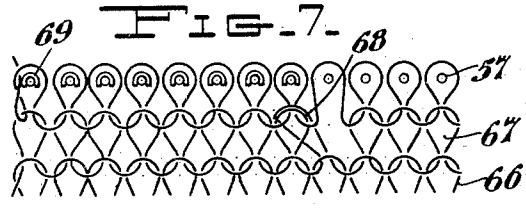
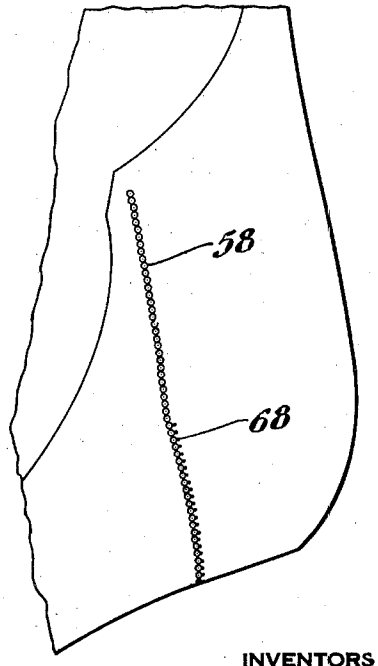


FIG. 8.



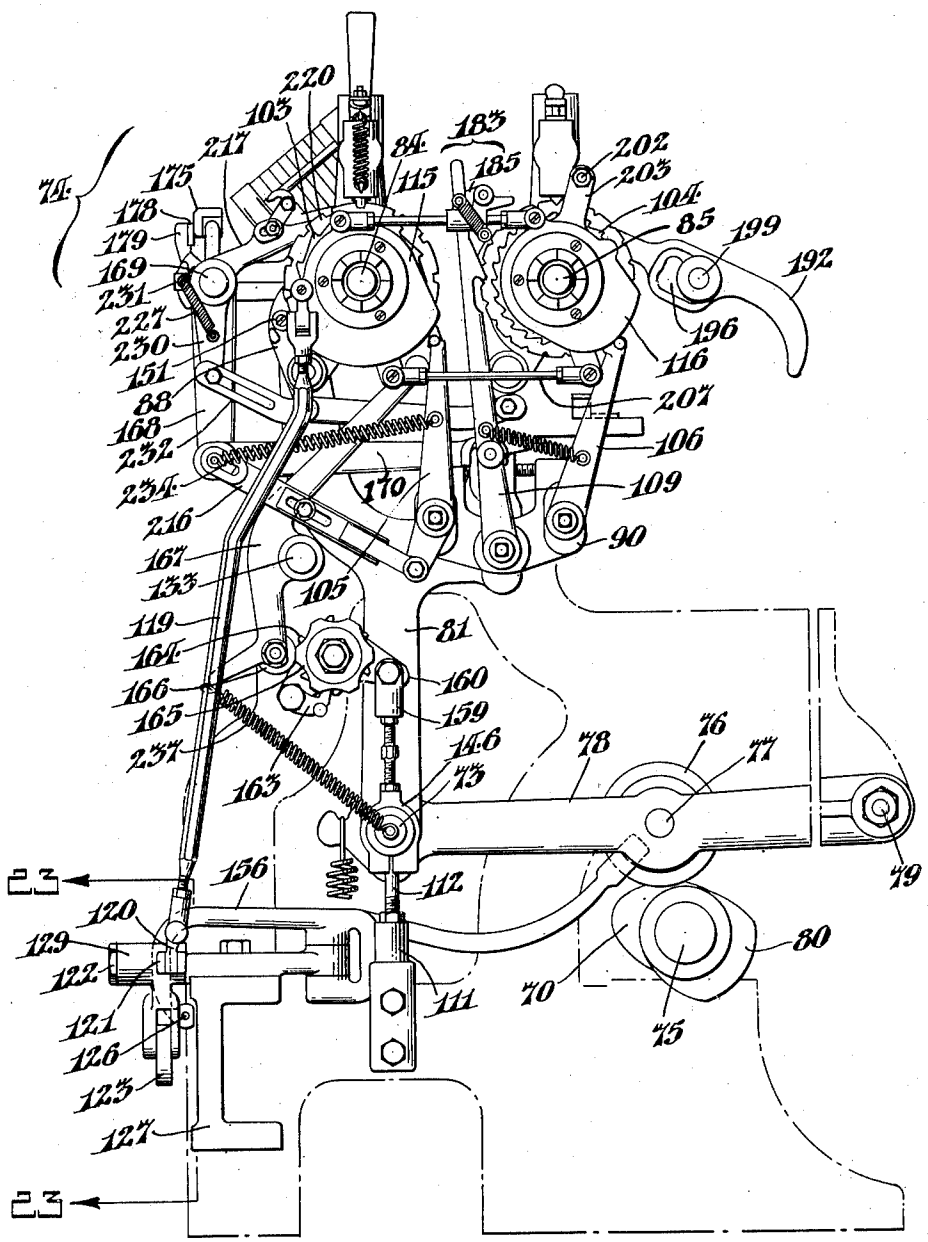
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FASHIONING MECHANISM FOR KNITTING MACHINES

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FIG. 8.



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Fig. 10.

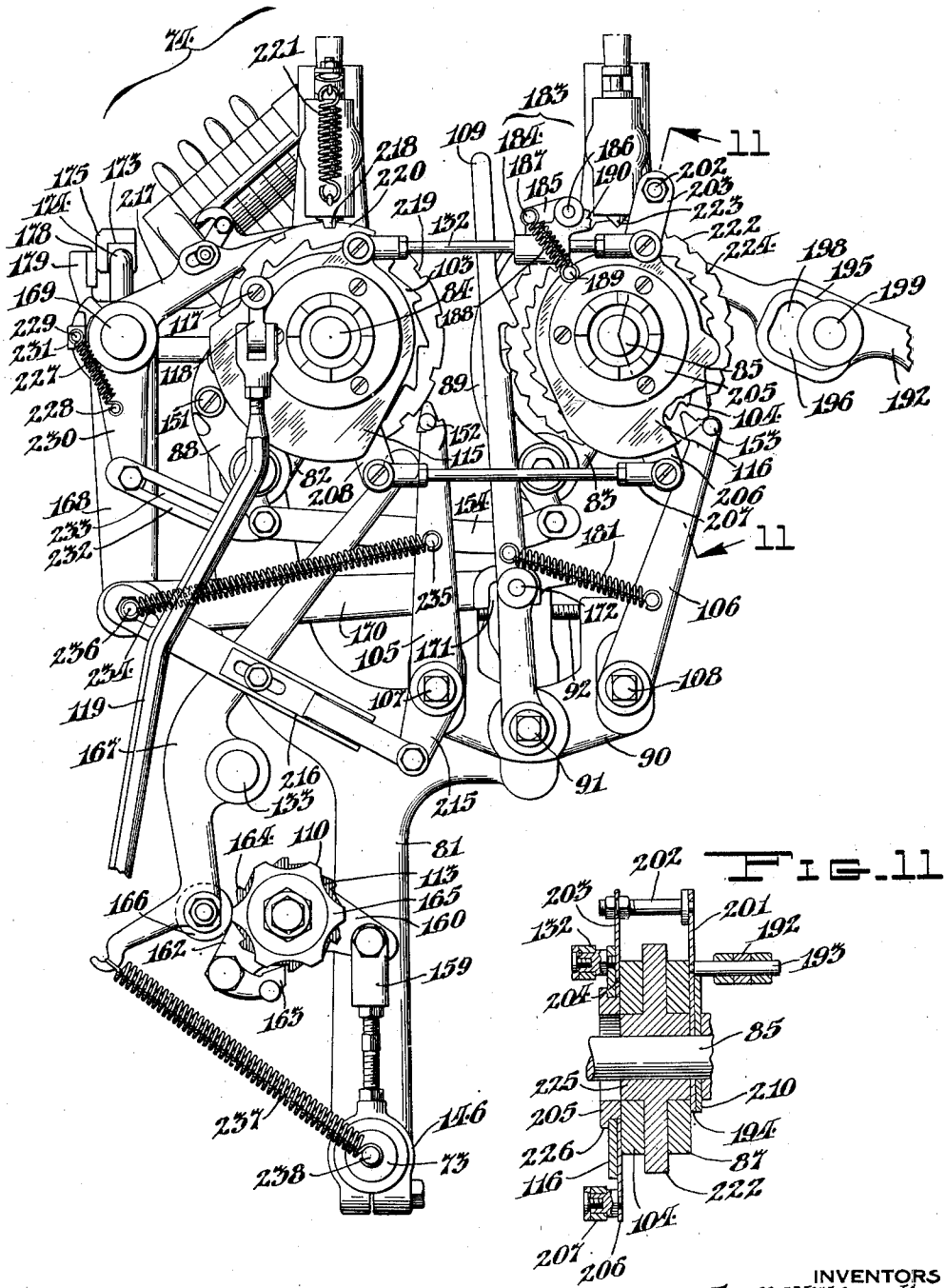


Fig. 11.

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FASHIONING MECHANISM FOR KNITTING MACHINES

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Fig. 12.

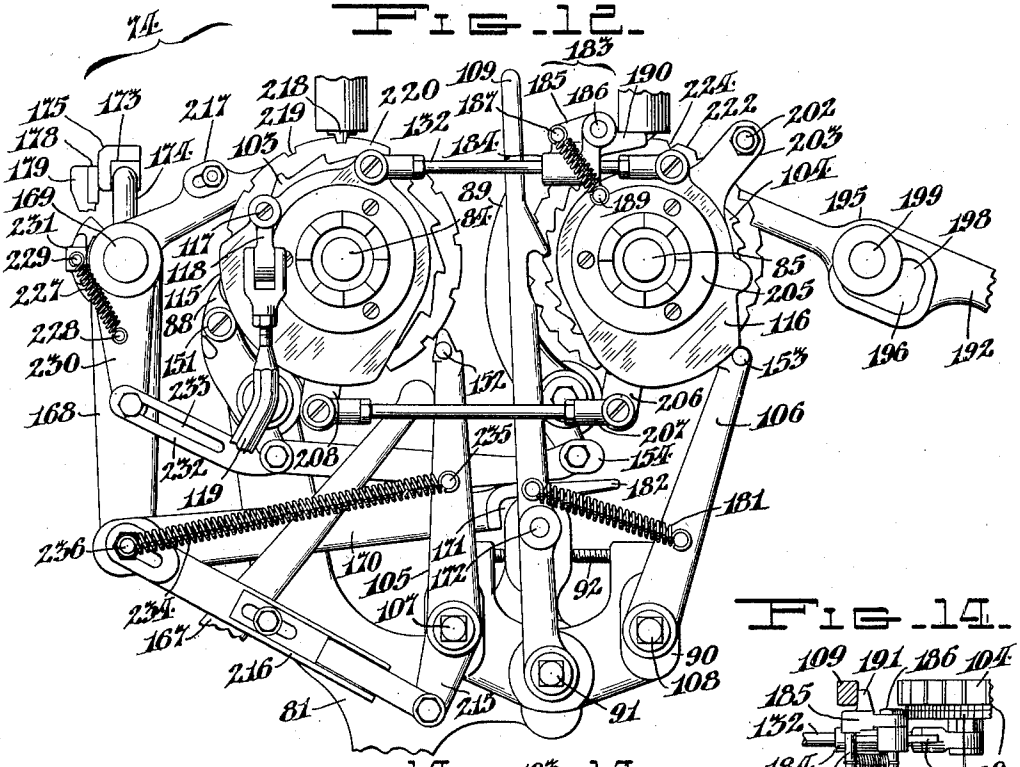
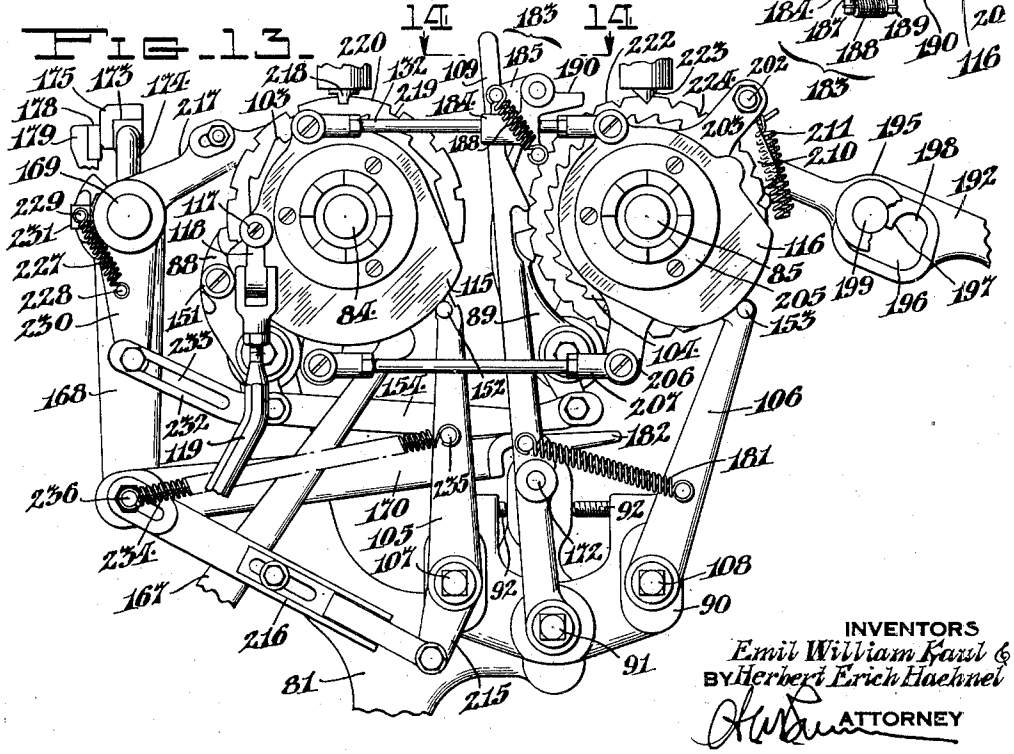


Fig. 14.

Fig. 13.



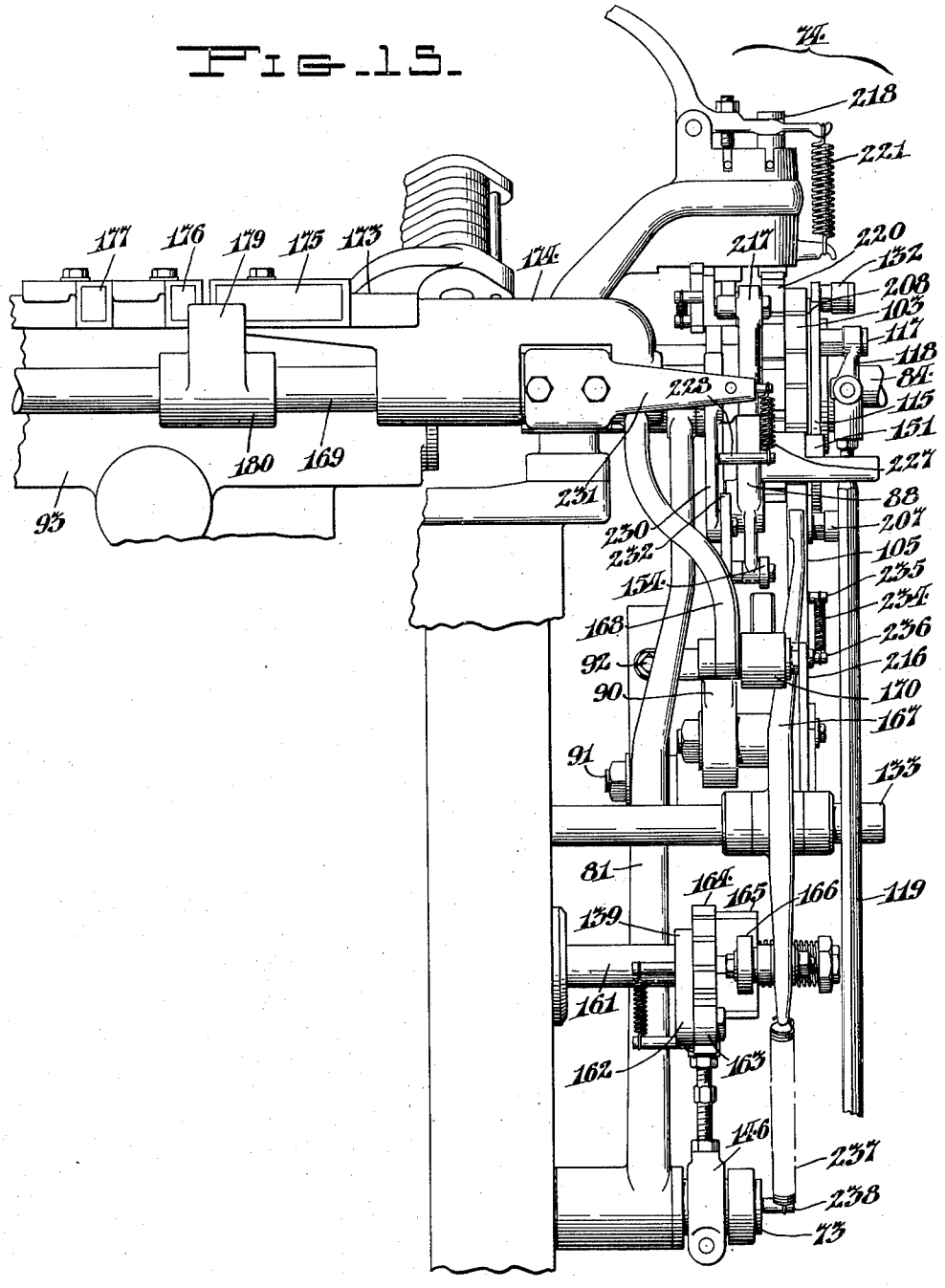
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FASHIONING MECHANISM FOR KNITTING MACHINES

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Fig. 15.



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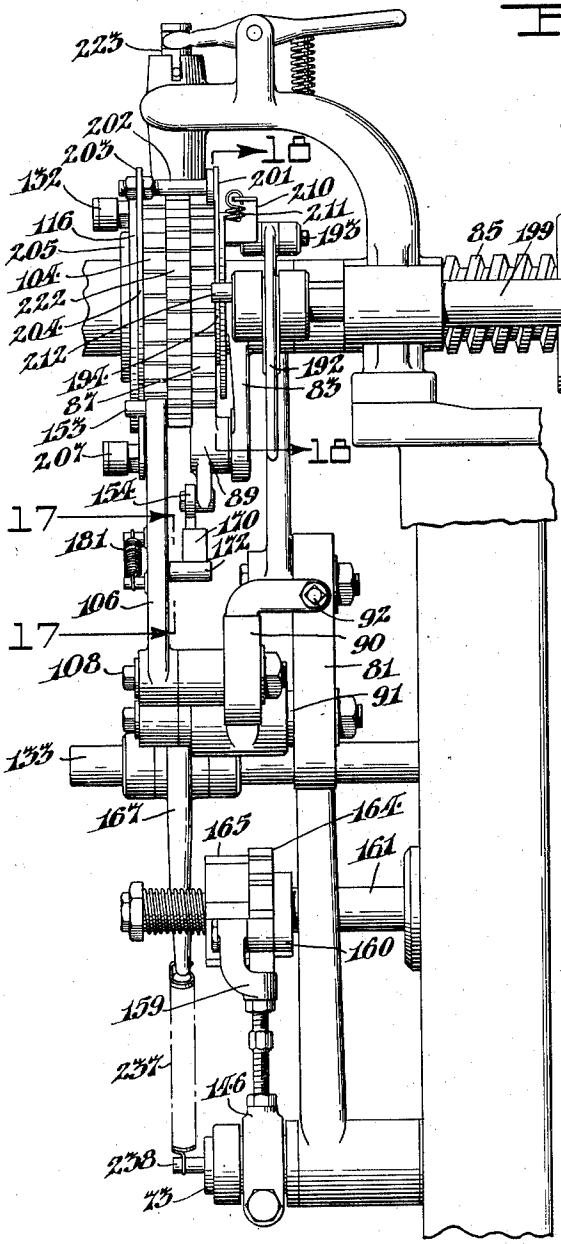


Fig. 16.

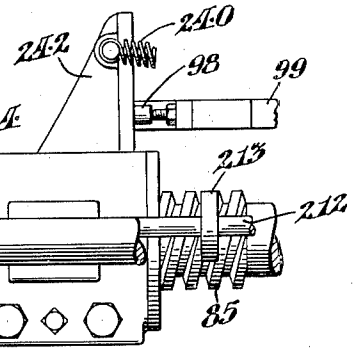


Fig. 17.

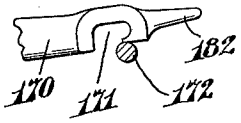
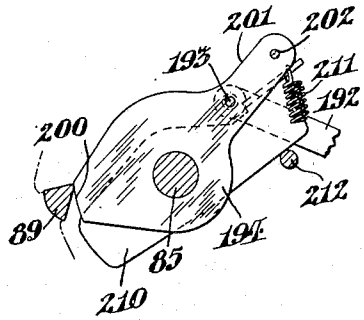


Fig. 18.



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FASHIONING MECHANISM FOR KNITTING MACHINES

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Fig. 19.

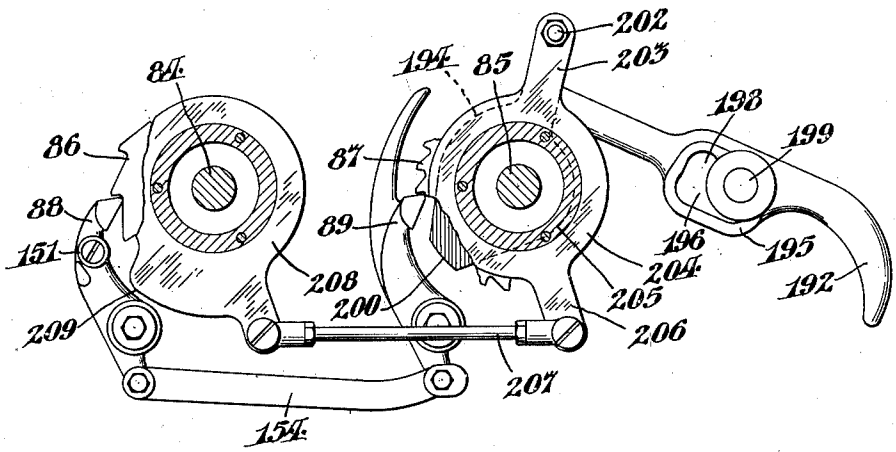


Fig. 20.

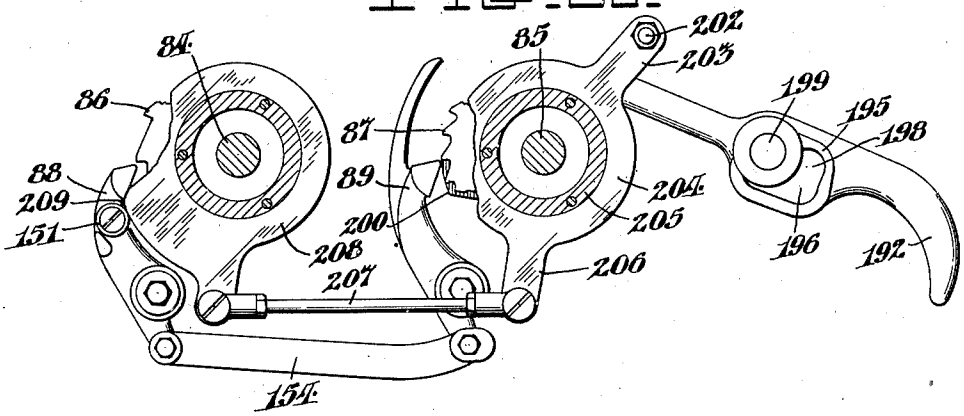
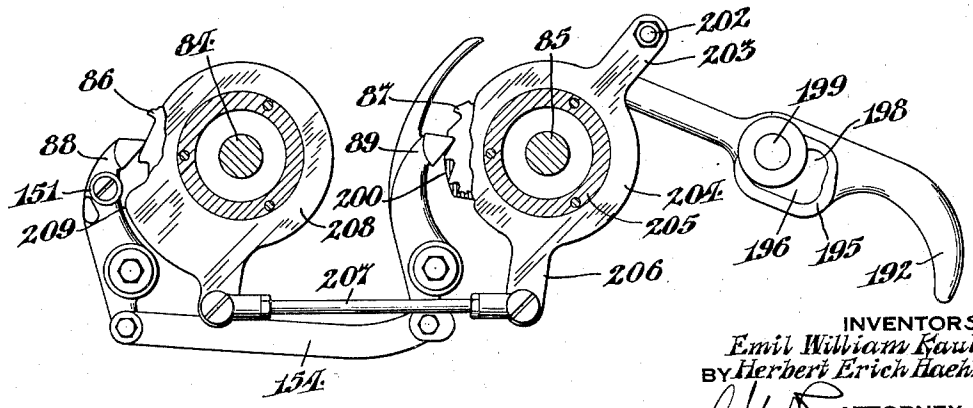


Fig. 21.



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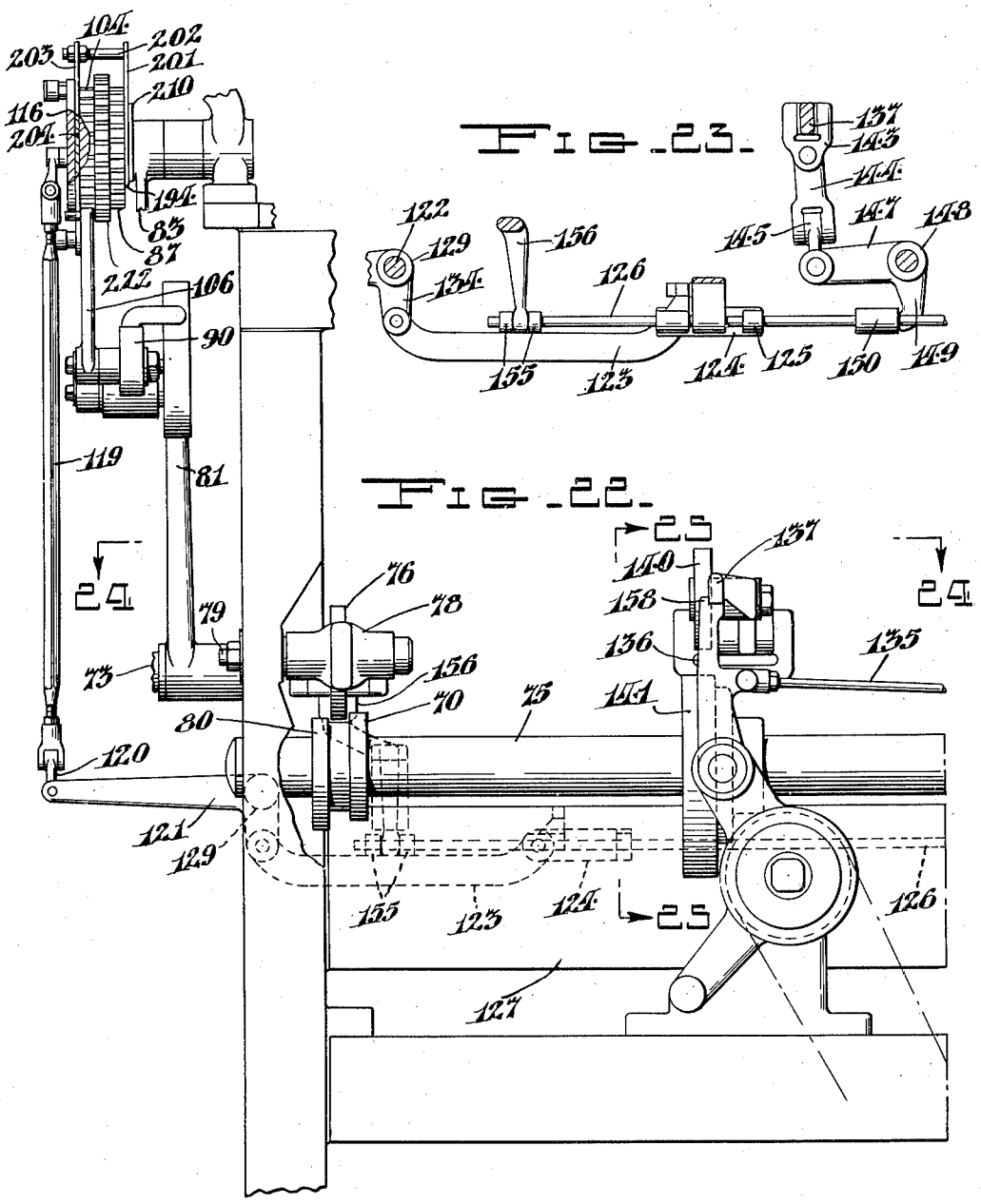


Fig. 23.

Fig. 22.

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FASHIONING MECHANISM FOR KNITTING MACHINES

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Fig. 24.

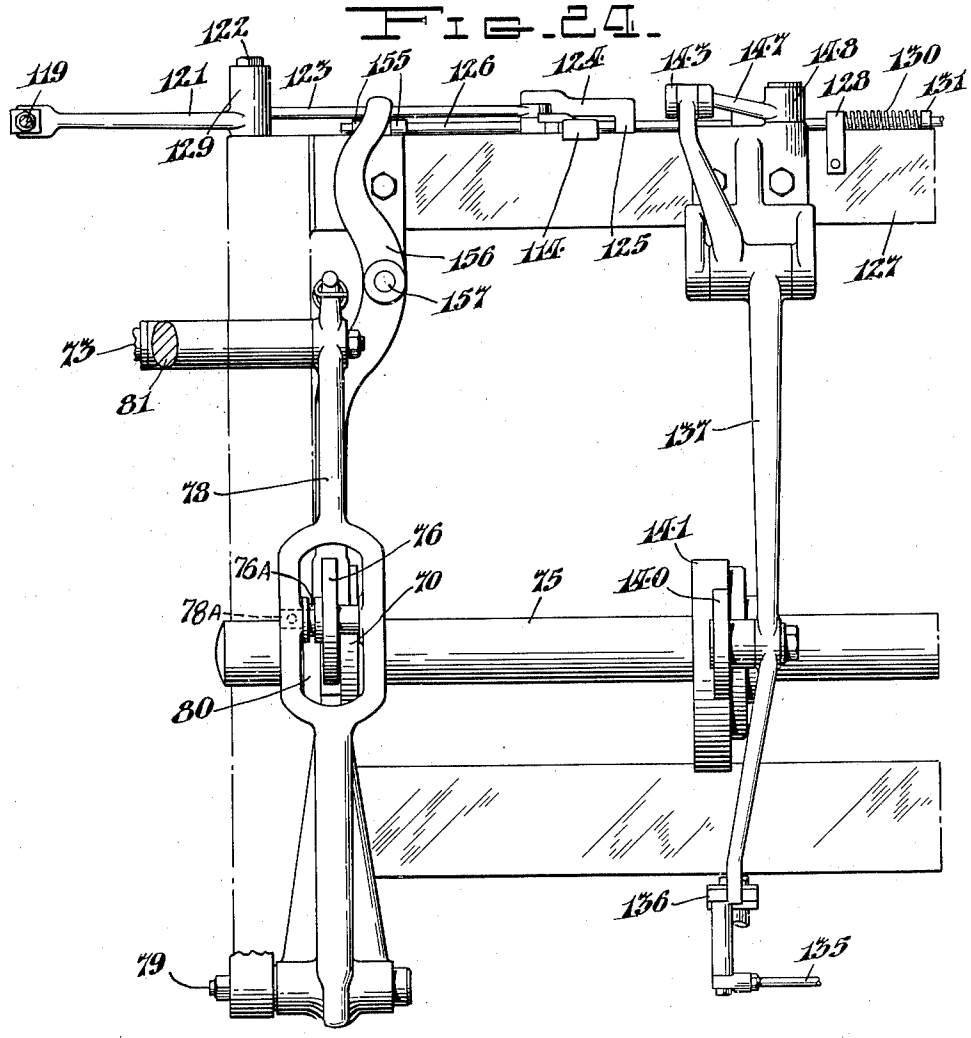
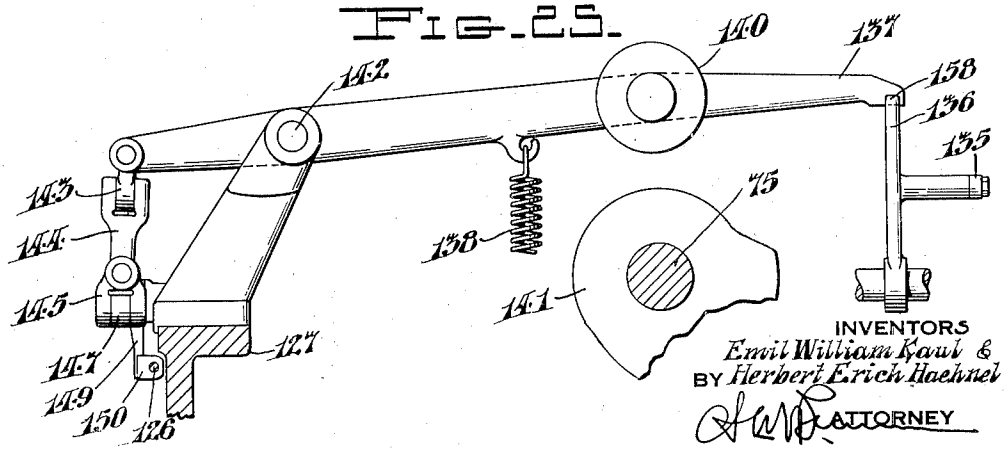


Fig. 25.



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FASHIONING MECHANISM FOR KNITTING MACHINES

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FIG. 26.

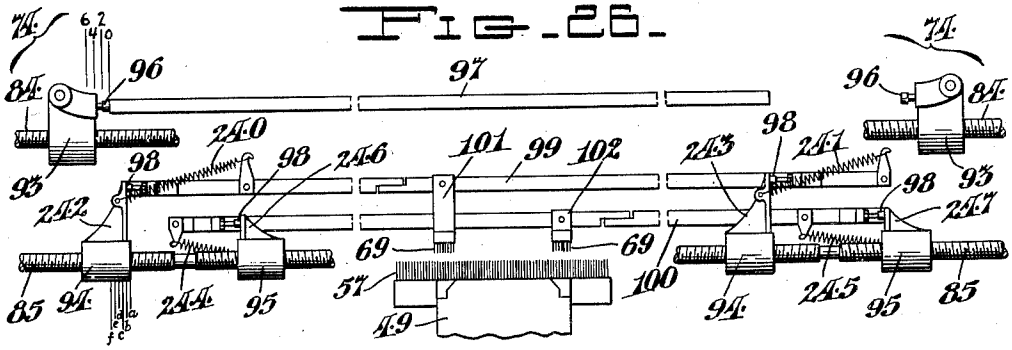


FIG. 27.

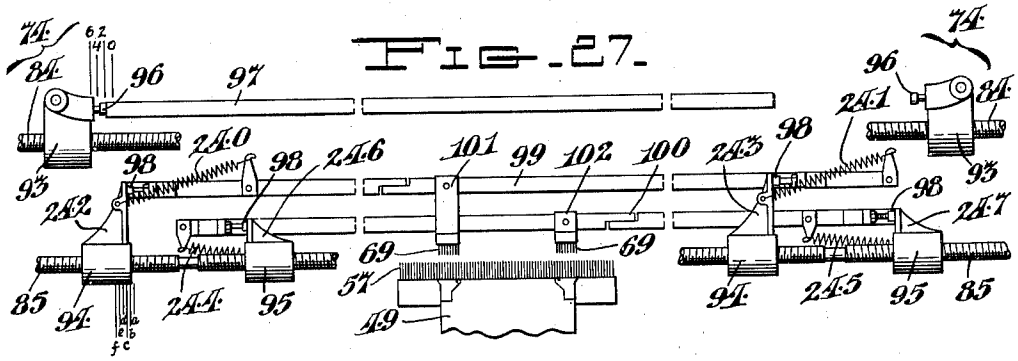


FIG. 28.

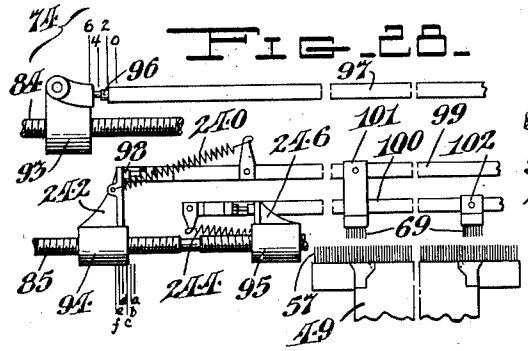


FIG. 29.

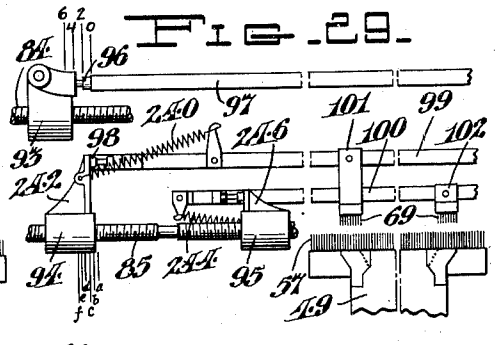


FIG. 30.

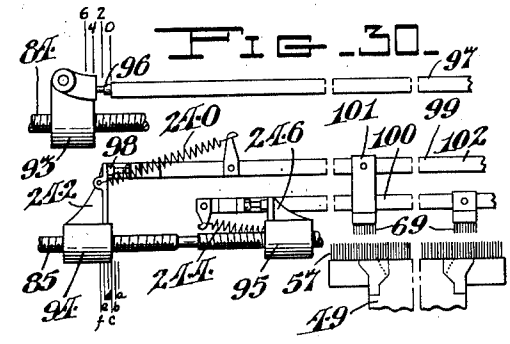
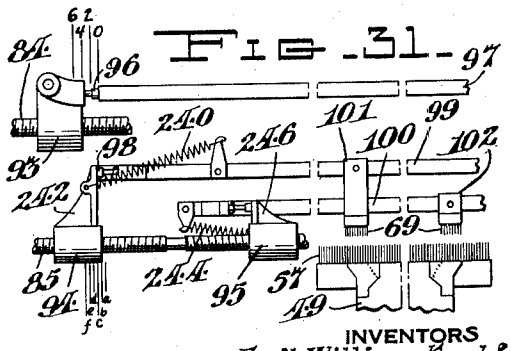


FIG. 31.



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FASHIONING MECHANISM FOR KNITTING MACHINES

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FIG. 32.

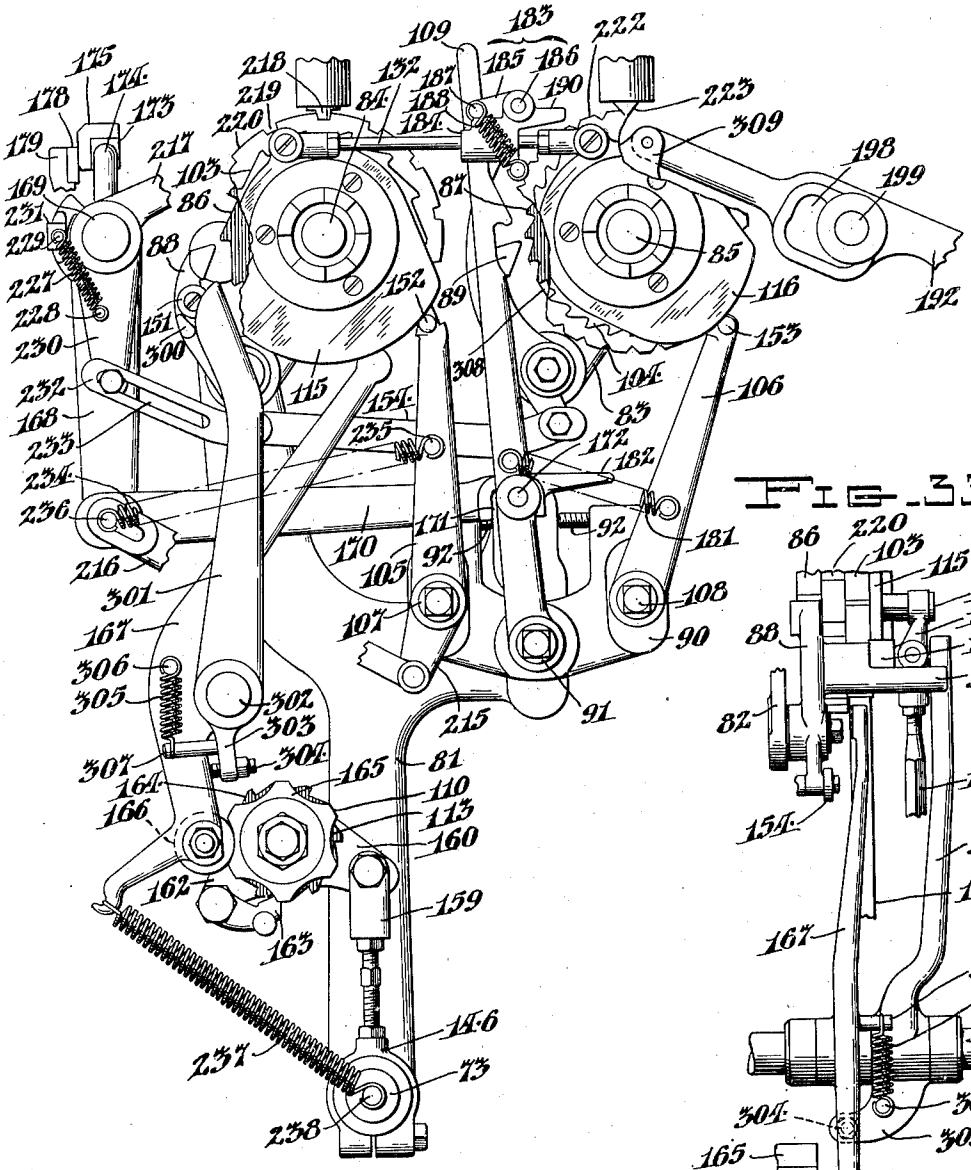


FIG. 33.

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Patented Nov. 22, 1949

2,489,141

UNITED STATES PATENT OFFICE

2,489,141

FASHIONING MECHANISM FOR KNITTING MACHINES

Emil William Kaul, Wyomissing, and Herbert Erich Haehnel, West Reading, Pa., assignors to Textile Machine Works, Wyomissing, Pa., a corporation of Pennsylvania

Application July 17, 1945, Serial No. 605,530

21 Claims. (Cl. 66—89)

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The present invention relates to knitted fabrics, a method of, and a mechanism for producing the same, and particularly to such fabrics, method and mechanism in relation to full-fashioned stockings for providing novel selvage and loop arrangement of special utility in single unit stockings.

It has been attempted with the standard forms of full-fashioned knitting machinery to produce single unit stockings having an upper heel portion widened by points to make lines of lace openings parallel to the selvages and to follow the widened portions by portions having parallel sides and having the lines of lace openings extending thereinto, but difficulties have been encountered through the inadequacies of such equipment. In practicing these aforesaid methods, unless special mechanism is employed for making closed selvages along said parallel sided portions, runs very readily start in the parallel sided portions before they can be seamed, giving rise to undue numbers of seconds or menders. In fact, at times, runs starting in the parallel sided portions escape from the seam and ruin a stocking the first time or two it is worn, even when the stocking has passed the usual factory inspection.

It is an object of the present invention to provide a novel loop arrangement for parallel sided widened portions of flat knitted fabric containing lace openings, which will result in closed selvages in such fabric and thereby avoid the possibility of runs in the heel zones.

Another object of the invention is to provide a novel knitting method including both widening and forming of parallel sided fabric areas having lace openings and closed selvages therein, and which will require a minimum of changes in or additions to the fashioning mechanism now on a standard full-fashioned unit knitting machine.

Another object of the invention is to provide a novel method of forming the heel portions of a stocking in which certain loops of a course are transferred outwardly and certain of such outwardly transferred loops in the same course are transferred inwardly.

In the method according to the invention, it is desired to operate the point spindle three times between the knitting of two immediately successive courses without movement of the end stop spindle, and it is accordingly another object of the invention to provide means whereby this may be readily accomplished.

A further object of the invention is to provide

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means to operate the point spindle to transfer the loops outwardly in forming lace openings, to idly reposition the transferring means outwardly and to transfer all of the loops inwardly except the outwardly transferred loops forming the lace openings to restore said loops to their original positions.

In narrowing full-fashioned stockings, it has been common to employ so-called two needle narrowing, that is to transfer loops in a narrowed course two needle spaces inwardly at one step, and it is desired to retain this method of narrowing in making the large majority of the fabric in a stocking as being more expeditous while also generally satisfactory, but it is also desired to employ single needle narrowing at times, especially in the heel portions of stockings within the invention, and it is therefore a further object of the invention to provide novel means whereby the action of the more usual mechanism for two needle narrowing may be quickly and conveniently modified to carry out single needle narrowing when and for such times as desired.

A still further object of the invention is to provide convenient and novel means whereby a mechanism for shifting the narrowing points and the end stops each two needle spaces simultaneously may be changed to shift the narrowing points only one needle space and maintain the end stops stationary.

A further object of the invention is to provide means whereby the loops of the certain courses of the heel portions are transferred outwardly a distance of one needle and certain of the outwardly transferred loops in the same course are transferred inwardly a distance of one needle.

With these and other objects in view, which will become apparent from the following detailed description of the illustrative embodiment of the novel heel arrangement shown in the accompanying drawings, the invention resides in the novel method of forming single unit heels, and the new heel arrangement resulting therefrom, as well as the new elements, features of construction and arrangements of parts in cooperative relationship as hereinafter more particularly pointed out in the claims.

In the drawings:

Figure 1 is an elevation of a finished full-fashioned stocking within the invention;

Fig. 2 is a plan view of a flat knitted blank from which the stocking shown in Fig. 1 was made by looping and seaming the edges together;

Fig. 3 is a diagrammatic view illustrating the

loop formation of portions of the widened and parallel sided parts of the heel zones of the blank of Fig. 2 as it appears in knitting;

Figs. 4, 5, 6 and 7 are diagrammatic fragmentary views of the loop formations and showing the steps taken in providing lace marks in the parallel sided parts of the heel zones shown in Fig. 3;

Fig. 8 is a detail view on an enlarged scale of a heel zone of the stocking shown in Fig. 1;

Fig. 9 is an elevational view of the narrowing head at the left end of a full-fashioned knitting machine equipped with means to carry out the novel method within the invention, portions of the end frame of the machine being removed and the remainder shown in dot and dash outline;

Fig. 10 is a view of a portion of Fig. 9 but on an enlarged scale, certain control parts being shown in different positions;

Fig. 11 is a sectional detail view taken substantially on the line 11—11 of Fig. 10, looking in the direction of the arrows;

Figs. 12 and 13 are detail views of a part of Fig. 10, the parts being shown in different relative positions.

Fig. 14 is a detail view in plan of the parts indicated by the arrows 14—14 in Fig. 13;

Fig. 15 is a rear elevation of the parts shown in Fig. 10;

Fig. 16 is a front elevation of the parts shown in Fig. 10;

Fig. 17 is a fragmentary view partly in section, taken on the line 17—17 of Fig. 16, looking in the direction of the arrows;

Fig. 18 is a fragmentary view, partly in section taken on the line 18—18 of Fig. 16 looking in the direction of the arrows;

Fig. 19 is is a fragmentary view of a portion of Fig. 10 showing the parts in the positions assumed during ordinary two needle narrowings;

Fig. 20 is a view similar to Fig. 19 but showing the parts in the positions for the beginning of a single needle movement of the fashion points without any movement of the end stops;

Fig. 21 is a view similar to Fig. 20 but with the parts in different relative positions;

Fig. 22 is a front elevational view of certain of the spindle mechanism and control means therefor shown in Fig. 9, parts being broken away, and including other control mechanism within the invention;

Fig. 23 is a fragmentary elevational view taken substantially on the line 23—23 of Fig. 9, looking in the direction of the arrows;

Fig. 24 is a plan view of the lower portion of Fig. 22 taken substantially on the line 24—24 of Fig. 22, parts being omitted for clearness of illustration;

Fig. 25 is a fragmentary sectional view taken substantially on the line 25—25 of Fig. 22;

Figs. 26 and 27 are diagrammatic views showing the positions of the narrowing head mechanism at both ends of the machine and associated carrier rod and narrowing points at different times during the execution of certain of the method steps according to the invention;

Figs. 28, 29, 30 and 31 are views similar to the left end portion of Figs. 26 and 27 but showing other method steps according to the invention;

Fig. 32 is an end elevation similar to Fig. 10 of a modified form of narrowing head within the invention; and

Fig. 33 is a detail view of certain parts appearing in Fig. 32 and as viewed from the left of said figure.

In the drawings and description, only the means necessary to a complete understanding of the invention have been specifically set forth; further information as to the construction and operation of other related, usual and well known knitting machine elements, mechanisms, etc., may be found in one or more of the following publications:

1. Pamphlet entitled—Full-Fashioned Knitting Machines—published and copyrighted by the Textile Machine Works, Reading, Pennsylvania, in 1920.

2. Three Catalogs entitled—The "Reading" Full-Fashioned Knitting Machine Parts Catalog —published and copyrighted by the Textile Machine Works, in 1929, 1935, and 1940, respectively.

3. Booklet entitled—The "Reading" High-Production Full-Fashioned Knitting Machine—which forms a supplement to the above noted 1940 Parts Catalog of the Textile Machine Works, and which booklet is a publication of the Textile Machine Works, and was copyrighted by the latter in 1940.

4. Pamphlet entitled—Knitting Machine Lectures—published by the Wyomissing Polytechnic Institute, Wyomissing, Pennsylvania, in 1935.

A single unit full-fashioned stocking within the invention includes heel zones having widened portions or areas in which are fashioned lace lines generally parallel to the selvages, said widened portions followed by parallel sided portions, into which the lace lines continue from the widened portions and in the same general direction, and which has closed selvages composed of all wale-wise lying loops. In other words, all the edge loops in the parallel sided portions are knitted on the same needles. Between the edge loops and the lace openings in the parallel sided portions are narrowing or fashion marks, one fashion mark to each lace opening, each such fashion mark including a loop formed on a needle and a loop transferred outwardly to such needle when forming the lace opening. In the arrangement shown, the fashion mark lies next outside a lace opening, but the invention is not limited to this.

A method within the invention includes forming a parallel sided portion of a single unit heel zone by transferring outward a group of loops including an edge loop, thereby forming a lace opening, and then transferring inward a lesser group of loops including the edge loop but for the same distance, thereby forming a fashioning mark at the point at which the innermost loop of said lesser group was restored to the needle on which it was formed.

The novel mechanism herein disclosed for carrying out the aforesaid method includes a means for transferring a group of loops including the edge loops outward in the widening direction and a means for transferring the edge loop inwardly an equal distance to restore it to the needle on which it was formed. Preferably the loops transferred outwardly in any course number only one more than those transferred inwardly so that a fashion mark and a lace opening are formed alongside each other and this is repeated in a number of courses to provide a fabric portion in the heel cheeks of special appearance and one having parallel selvages.

Referring to the drawings more in detail, a blank 49 is shown in Fig. 2, from which a stocking 50 shown in Fig. 1 is formed. Said blank and stocking each comprises a two ply welt 51 followed by a single ply portion 52 which constitutes the major portion of the stocking and

which has therein lines of fashion marks 53 one on each side of the back seam, resulting from the upper leg narrowing and lines of fashion marks 54 resulting from the lower leg or calf narrowings. Below the narrowing lines 54 and beginning at about the level of the ankle is a reinforced region which extends inwardly from each selvage part way of the width of the stocking until near the lower or forward end thereof, from which point to the end the reinforcement extends from selvage to selvage. The upper portions of said reinforced region are commonly known as the high heels 55 which are relatively narrow and below which the inner edges of the reinforced zone incline inwardly to points 56 just above the course at which it is desired to begin making the region in which the heels are included. As an incident to making said region, the selvages of the flat blank 49 from which stocking 50 is made are widened by groups of fashioning points held in the usual "narrowing" combs or fingers and so used as to step out the edge loops of every other course for a number of courses along with a wide group of loops with each edge loop so that the selvages are widened gradually, the stepping or transferring movement being only one "needle space" for each comb at each widening operation, a needle space being understood as the distance between two next adjacent ones in a row of needles 57. Further, the innermost point of each group necessarily makes a lace opening at each widening operation and thereby forms one opening of a pair of widening or gore lines 58 which run parallel to the selvages. In order that the outward transfer of the edge loops may be effective to widen the fabric, the end stops for the yarn carrier rods must also be moved outward enough to permit the yarn carriers to lay yarn to the needles to which the edge loops have been transferred by the fashion points. However, as the points are moved only one needle space at each edge per transfer while the carrier rod end stops are necesarily moved two needle spaces each time their position is changed, provision is made whereby the end stops are moved only once for every two operations of the points.

The said widening operations result in definite heel cheeks 59 which project beyond the lines of the selvages along the high heels. Enough outward transfers of the edge loops having been made by the points to widen the heel fabric to the desired degree, the edge loops are formed on the same needles for a time, the fabric thereby being formed of uniform width as knitted until the heel portions have been completed and the parallel selvage edges 60 thereby result. The lower ends of each heel portion is marked by a course 61 shown in dot and dash in Fig. 2. Below the courses 61, the selvages are reduced sharply in width and short walewise or parallel selvage edge portions 62 are formed immediately following the courses 61. Also, ravel course sections 63 are provided immediately below the courses 61, said sections 63 being separate from the selvage edges 62 so that sections 63 can be ravelled out when desired, this being necessary prior to looping the courses 61 together. The toe portion is also looped in the usual manner after which the remainder of the selvage edges are seamed together to complete the stocking 50. Just below the selvage edges 62 the foot portion is shown as having lines 64 of fashion marks formed in conjunction with a gusset narrowing. This is a common feature in full-fashioned

stockings. The remainder of the foot portion of blank 49 and stocking 50 is formed in any known or desired way. Instead of diamond point narrowings, a feature largely used in two unit stockings, the toe narrowings are shown as composed of single lines 65 of fashion marks. This form of toe narrowing is used because the legger or single unit machine on which the stocking and blank shown are made possesses only one comb on each side of each knitting section instead of a pair on each side as is necessary to make the diamond point type of toe.

It will be observed that the lines 58 of lace marks continue beyond the course at which the parallel selvage edges 60 begin, said lines being shown as extending practically to the course 61 in each heel portion. Said lines 58 are continued or extended as shown partly for appearances and partly to maintain the loop tension in the lower portions of heel cheeks 59 more nearly the same as in the upper portions of the cheeks. The method of making the lace openings in the portions bounded by the parallel selvage edges 60 will be best understood from Figs. 3 to 8 inclusive. In Fig. 3 are shown a few of the courses in the lower or forward portions of the widened heel cheeks 59 and a few of the courses in the adjacent parallel selvage edge portions 60.

Fabric and method

Following the last course in which the heel cheeks 59 are permanently widened is a plain course 66 which marks the beginning of the parallel selvage edge portions 60. Next following the plain course 66 is a course 67 which contains the first of a series of fashion marks 68 each of which includes a loop which has been transferred outwardly in the process of making an opening in the line 58 and a loop which has been first transferred outwardly and then returned to its original position so that it and the other loop contained in the fashion mark are on the needle on which said returned loop was formed. As appears in Fig. 4, after the loops of course 67 have been knitted but while they are still on needles 57, groups of fashioning points 69 are brought down into contact with the needles holding groups of loops thereon, the edge loops being included in said groups and there being two groups of points one at each side of the fabric of which only the one at the left side is shown in Figs. 4, 5, 6 and 7. Points 69 are pressed down between the loops and their needles in known manner as indicated in Fig. 4 and the points are then lifted while the needles are down, thereby taking the groups of loops from the needles to the points. The points are then shifted outward one needle space, the distance between two adjacent needles, and the points again pressed into contact with the needles so that the loops, needles and points occupy the positions shown in Fig. 5 in which the edge loop shown has been stepped out to widen the fabric and the loop engaged by the innermost point 69 has been stepped outward away from its neighbor on the right to make a lace opening between the two. The sinkers are now brought forward above the fabric and the points are raised while the needles are rising so that the loops are stripped down on the shanks of the needles and free of the points which are raised faster than the needles so as to elevate the points to their normal stationary positions above the needles. The points are now shifted outwardly another needle space so that the innermost point 69 is two needle spaces outside the position in

which it is shown in Fig. 4. The points having been brought down between the loops and the needles again, the points are used to transfer the loops one needle distance inward instead of outward, so that the edge loop is restored to the needle on which it was formed, as shown in Fig. 6. Also, the other loops which had been transferred outward are restored to their original needles except the innermost one, the one whose displacement is the cause of the lace opening. However, as the loop which was moved outward to make the lace opening remains on the needle next outward from the one on which it was formed, the restoration of the next loop to its original needle brings two loops onto the same needle. When the next course is then knitted, the two loops are cast off the same needle resulting in a fashion mark 68 as shown in Fig. 7. As is clear from Figs. 6 and 7, as well as from that which has been said, the fashion mark 68 in course 67 includes the loop which originally occupied the lace opening; therefore, the fashion marks is next adjacent the lace opening in course 67. After the formation of another plain course, the routine followed in making the lace opening and fashion mark in course 67 is repeated and this method is thereupon continued to the end of the heel cheeks, at the course 61, to continue the lines 58 of lace openings substantially to the end of cheeks 59 and to make a line of fashion marks 68 alongside the lines of lace marks in the portions having parallel selvage edges 60. The resulting overall effect is perhaps best shown in Fig. 8 which shows the appearance of a portion of the stocking which includes the courses shown in Figs. 4, 5, 6 and 7 after the blank has been folded and the edges of the fabric seamed together.

Apparatus

The apparatus employed in producing the above described stocking 50 and the method of making it is shown in Figs. 9 to 31, inclusive, and includes a narrowing head 74, Fig. 9. It will be understood that two narrowing heads are used, one at each end of the machine, the one at the left end being shown in detail while parts of both heads are shown diagrammatically in Figs. 26 and 27. The mechanism of the narrowing head is operated from a main cam shaft 75 by means including a cam follower 76 which is mounted both to revolve and to slide on a pin shaft 77 fixed in a lever 78, the forward end of which is pivoted to the frame of the machine at a point 79. When it is desired to operate the narrowing head, the follower 76 is maintained or brought into such position on its shaft 77 that it is affected by a cam 80 or by a cam 70 by either of which follower 76 is adapted to be operated. The lever 78 is part of a train of parts including an actuator 81, the lower end of which is pivotally connected to lever 78 near the rear end thereof by means of a pin 73 and the upper end of which is forked and pivotally connected in the usual manner, to two levers 82 and 83, Fig. 10 (connection not shown) pivoted to spindles on the narrowing head, lever 82 on an end stop or carrier rod spindle 84 and lever 83 on a narrowing rod spindle 85. Spindles 84 and 85 are threaded and have ratchet wheels fixed thereto whereby in cooperation with suitable racking elements, said spindles on head 74 may be turned in either direction in response to oscillating movements of lever 78.

For turning spindles 84 and 85 in the narrowing direction, ratchet wheels 86 and 87, Figs. 19, 20 and 21, are racked by pawls 88 and 89 respectively, which are pivoted on levers 82 and 83 on spindles 84 and 85, the connection of pawl 89 with lever 83 being shown in Fig. 16. The levers 82 and 83 and therefore the pawls 88 and 89 are lifted when actuator 81 is lifted by either of said cams 70 or 80. Pawls 88 and 89 are normally in contact with the teeth of ratchet wheels 86 and 87 respectively and the arrangement is such that the throw of cam 70 or of cam 80 is sufficient to give pawls 88 and 89 a movement, unless the natural action of the pawls is modified in some way, which moves spindles 84 and 85 enough so that nuts on threaded parts of the spindles are given a two needle movement each time the actuator is lifted.

The spindle 84 of each narrowing head has one nut such as 93, Figs. 26 to 31, inclusive, thereon while the spindle 85 of each narrowing head has two nuts 94 and 95 thereon. Each nut 93 has end stops such as 96 thereon the position of which determines the throw of yarn carrier rods such as 97 and therefore the number of needles to which the yarn carrier can lay yarn and the width of the fabric courses as knitted. The nuts 94 and 95 on each spindle 85 are arranged to adjust the position of bolt stops 98 on pairs of narrowing rods 99, 100, said rods having narrowing fingers 101 and 102 thereon respectively, there being a finger 101 and a finger 102 for each knitting section. Fingers 101 and 102 have the fashioning points 69 therein and fingers 101 are arranged to act on the left selvage of a piece of fabric being knitted while the fingers 102 are arranged to act on the right selvage.

For turning spindles 84 and 85 in the widening direction, said spindles have fixed thereon additional ratchet wheels 103 and 104, respectively. The teeth of ratchet wheels 103 and 104 are inclined oppositely to those of ratchets 86 and 87 and racking pawls 105 and 106 may be pivotally connected directly to actuator 81 but as shown in the drawings are mounted on a bracket 90 at points 107 and 108, respectively, and extend upwardly therefrom so that they are adapted, on an upward movement of actuator 81, to rack the ratchet wheels 103 and 104 in the widening direction, the counterclockwise direction as viewed in Figs. 9, 10, 12 and 13. The bracket 90 is carried on a stud 91 in the actuator 81, Fig. 16, and is adjustable relative to said actuator by screws 92 as shown in Figs. 10, 12 and 13. With the arrangement shown the movement of the actuator 81 is sufficient to turn both of spindles 84 and 85 sufficient to move their nuts two needle spaces provided the natural action of the pawls is not interrupted or modified. Further, ratchet 103 has teeth of a length corresponding to a two needle movement while ratchet 104 has teeth only half as long to permit a one needle widening movement when desired. Also, a pawl 109 is pivoted on the stud 91 on actuator 81 and arranged to turn ratchet 104 and spindle 85 in the widening direction on a downward movement of the actuator. Unless its action is interrupted, pawl 109 is adapted to turn spindle 85 an amount equal to a one needle movement of the nuts 94 and 95. Pawl 109 is used at times as a pull-back to move the fashioning fingers toward the selvage edges after a narrowing operation to produce lines of fashion marks inclined toward said selvage edges. Also it is used in carrying out the novel method hereinabove described to step the fashioning fingers outward each one needle distance to the desired positions for making fashion marks

68 after the fingers have completed widening movements for making lace openings in lines 58.

Both automatic and manually operated means are shown for interrupting or modifying the action of the pawls for racking spindles 84 and 85. One automatic means is coordinated with the longitudinal or shogging movements of the cam shaft to ensure that the widening pawls 105 and 106 are disabled or thrown out of racking position when the follower 76 is to cooperate with the narrowing cam 80 to move points 69 to narrow the fabric and the narrowing pawls 88 and 89 are disabled or thrown out of racking position when follower 76 is to cooperate with narrowing cam 80 to move points 69 to widen the fabric. An automatic means for preventing the pull-back pawl 109 from operating during the times certain parts of the stocking are being narrowed is also provided together with a means whereby said pawl 109 is permitted to operate when desired to modify the inclination of the lines of fashion marks.

Also, means is provided for preventing pawl 109 from operating during certain movements of actuator 81 and means whereby said pawl is permitted to operate to increase the movements of the fashioning fingers in the widening direction when desired to assist in carrying out the method of the present invention. A manually operated means is also provided which restricts the action of narrowing pawl 89 so that it racks point spindle 85 only one needle space at each operational cycle of actuator 81. Said manual means also includes an arrangement for preventing a racking action by narrowing pawl 88 on spindle 84 when pawl 89 is performing a single needle movement. Further, an automatic means is provided whereby widening pawl 105 for end stop spindle 84 is prevented from acting to rack the spindle at certain times when pawl 106 is active to permit the point spindle 85 to be turned without a corresponding movement of the end stop spindle and to thereby assist in carrying out the novel method herein disclosed.

It will be understood that the cam shaft 75 is shogged to the right from the position shown in Figs. 22 and 24 each time the actuator 81 is to be operated, the cam shaft being shown in its left hand or knitting position whereas its right hand position is the one in which the narrowing machine is operated. It will be seen that when shaft 75 is in the knitting position the cam follower 76, unless shifted, lies in a position intermediate the planes of the narrowing cam 80 and the widening cam 70. When a fashioning operation is to be performed by the narrowing machine and the combs on the rods operated by spindle 85, the shaft 75 is shogged longitudinally by a known cam shaft shifting means, not shown, under the control of the well-known pattern chain or equivalent means, also not shown. If the fabric is to be narrowed or widened by transfer of loops by the combs and spindle 85, follower 76 is permitted to remain in the position shown in Fig. 22. The shift to the right of shaft 75 thereupon brings cam 80 and follower 76 into the same vertical plane to give the actuator 81 an up and down motion starting from a position as shown in which the weight of the actuator is suported on a bracket 111 by a bolt 112 fixed to the bracket and contacting at its upper end the actuator 81 in the usual manner (not shown). In case of an ordinary narrowing motion, one in which spindles 84 and 85 both turn enough to move their nuts two needle spaces, automatic control means associated with spindles 84 and 85 permits the narrowing pawls 88 and 89 to operate normally while preventing the widening pawls 105 and 106 from affecting their ratchets. Said control means includes two plate cams 115 and 116 pivoted on spindles 84 and 85, respectively. Unless positively moved therefrom, cams 115 and 116 stand in the positions shown in Figs. 9 and 13, being held normally in such positions by a spring associated with connections running from a pin 117 fixed on cam 115. Said connections include as shown, a short link 118 pivoted at its upper end on pin 117. At its lower end link 118 is pivoted to a long link 119 on a pivot whose axis is at right angles to that of pin 117 so that link 118 acts as a universal joint between link 119 and cam 115. Link 119 runs downwardly and rearwardly and is pivotally connected at its lower end with a short link 120 which is pivoted in turn at its lower end to one arm 121 of a bell crank lever 129. As is perhaps best shown in Fig. 22, the pivot between link 120 and link 119 is at right angles to the pivot between link 120 and arm 121 so that link 120 acts as a universal joint between long link 119 and member 121. The bell-crank lever 127 is pivotally carried on a pin 122 secured to the frame of the machine, Fig. 24. The bell-crank lever 129 is provided with a second arm 134 pivotally connected to one end of a link 123, Fig. 23, the other end of which is pivotally connected to a fork 124 best shown in Fig. 24. Fork 124 has an eye or collar part 125 at its right hand end which is connected to a rod 126. Rod 126 runs parallel and close to a back beam 127 which is part of the framework of the machine and rod 126 is supported from said beam by brackets 114 one of which is shown in Fig. 24. A spring 130 acting in compression between a bracket 128 an a collar 131 presses rod 126 toward the right as viewed in Fig. 24, and serves to hold said cams 115 and 116 normally in the positions in which narrowing movements of the spindles 84 and 85 may be carried out. Rod 126 runs the entire length of the machine so that it also controls cams corresponding to cams 115 and 116 in the narrowing head at the right end of the machine. It will be seen further that cams 115 and 116 are connected at a level above spindles 84 and 85 by a link 132, the ends of which are pivotally connected to cams 115 and 116 so that the two are maintained in a definite angular relation one to another. Cams 115 and 116 being under the control of spring 130 and therefore in the position shown in Figs. 9 and 13 in which the spindles 84 and 85 may be racked in the narrowing direction, whenever the pattern means causes shaft 75 to be shogged to the right, cam 80 is brought beneath follower 76 and a narrowing action results. Such actions are those which produce lines of fashion marks such as lines 53 and 54, the spindles 84 and 85 both being turned so as to move their nuts two needle spaces at each operation and the lines of fashion marks being formed parallel to the selvages unless additional means are used to produce a different result.

When now it is desired that spindles 84 and 85 shall cause widening action of the fashioning points in the combs operated by spindle 85, at the same time the pattern means causes cam shaft 75 to be shifted to the right, the pattern means also operates a control rod 135, Figs. 22 and 24, so as to set in motion a means to shift cams 115 and 116 from the positions shown in

Figs. 9 and 13 to those shown in Fig. 12. Said rod 135, is shown in Fig. 22 in its right hand position in which the parts controlled by it are stationary. When the pattern means acts on rod 135, the rod is moved to the left as viewed in Fig. 22 against the pressure of a spring (not shown). Rod 135 is pivotally connected to a lever 136 which is pivoted at its lower end to a bracket fixed on the frame of the machine. At its upper end lever 136 normally supports the front end of a lever 137, best shown perhaps in Figs. 22 and 25. A spring 138 serves to draw the front end of lever 137 downward against the free end of lever 136 so long as the lever 136 is in the vertical plane of lever 137 but when the pattern means has moved lever 136 out from beneath lever 137, spring 138 draws lever 137 down so that a cam follower 140 pivoted on the lever rests on a cam 141 fixed on the main cam shaft 75. Lever 137 being pivoted at 142 intermediate its ends, its rear end moves up as its front end moves down and the upward movement of the rear end of lever 137 is employed to move said rod 126 against its spring 130. For this purpose, three short links 143, 144 and 145 are pivotally connected in a chain between the rear end of lever 137 and the end of a horizontal arm 147 of a bell-crank lever 148, Fig. 23, which is pivoted on the rear face of the back-beam 127 in a vertical plane at right angles to the plane of lever 137 the links 143, 144 and 145 being arranged to act as a universal joint to permit the movement of lever 137 to be transmitted to the bell-crank lever 148. Lever 148 has a vertical arm 149 which projects downwardly from the axis of rotation of the lever so that, as arm 147 is raised, the lower end of arm 149 is moved toward the left as viewed in Fig. 23 and arm 149 thereupon carries with it a collar 150 on rod 126, best shown in Fig. 23, to move the rod to the left against the pressure of spring 130. The leftward movement of rod 126 is thereupon transmitted through said members 123, 129, 120, 119 and 118 to cam 115 and through link 132 from cam 115 to cam 116. Cams 115 and 116 thereby are moved from the positions shown in Fig. 9 in which they throw out of action the widening pawls to the positions shown in Fig. 10 in which cams 115 and 116 throw out of action the narrowing pawls while the widening pawls, so far as these cams are concerned, are free to act. As is clear from the drawings, narrowing pawl 88 and widening pawls 105 and 106 have pins or follower members 151, 152 and 153, respectively, thereon which project into the vertical plane of cams 115 and 116 so that the edges of the cams may contact the pins and move the pawls in the desired manner. Narrowing pawl 89 for spindle 85, however, is not provided with a pin but pawls 88 and 89 are connected by a link 154 whereby pawl 89 is thrown out of operation at the same time as pawl 88, this whether pawl 88 is moved by cam 115 or by other means. However, although it is the more common thing to widen the fabric at points in cooperation with the narrowing machine and the comb spindle 85 when the main cam shaft has been shogged, this is not essential and fabric is sometimes widened during the couliering portion of a knitting cycle or revolution. In this case, at the same time rod 126 moves cams 115 and 116 to throw pawl 88 out of action, it also moves cam follower 76 so that it will cooperate with the widening cam 70, whereby also an up and down movement of the actuator 81 is caused but at a different point in the revolution of shaft 75 than that caused by cam 80. For this purpose, rod 126 has a pair of collars 155 thereon which lie one on one side and one on the other of a forked and downturned end of a generally horizontal lever 156 which is pivoted at 157 on a vertical pivot. Except when widening is to be done during couliering and at which time the carrier rods only are used, one of collars 155, the one on the side of lever 156 toward spring 130 and which would therefore transmit a thrust to a lever 156 when rod 126 is moved to the left, is left loose on the rod or set otherwise so that there is a lost motion between the rear end of lever 156 and rod 126. The lever 156 is not affected by the movement of rod 126 when the rod is shifted preliminary to a shift of the main cam shaft followed by use of cam 80 for lifting the actuator. To prevent accidental and undesired displacement of follower 76 from the position shown in Figs. 9 and 22 while the lower end of lever 156 is thus free to move relatively to rod 126, the hub of follower 76 has a groove 76A therein and a plate 78A is shown dotted in Fig. 24 and removably fixed to lever 78, plate 78A having an offset extending into said groove to hold the follower against movement longitudinally of its shaft so long as said collar is loose on rod 126. When now it is desired to shift follower 76 to cooperate with cam 70, plate 78A is removed from the machine and said collar 155 tightened on the rod 126 to hold lever 156 in the position relative to the rod shown in Figs. 22 and 23. The cams 70 and 80 and the lever 156 form, however, no part of the present invention and are not claimed herein. When now rod 126 is moved by arm 149 of bell-crank lever 148, one of collars 155 pushes against said rear end of lever 156 to turn the lever in the counterclockwise direction as viewed in Fig. 24. The forward end of lever 156 is forked to embrace the edge of cam follower 76 so that when lever 156 is turned counterclockwise, the follower 76 is moved rightward to cooperate with cam 70. As shown, widening and narrowing cam 80 is in a different angular position on cam shaft 75 from widening cam 70. This is because it has been found necessary to operate the spindle 84 at a different time in the revolution of the cam shaft when widening during a knitting cycle than when narrowing or widening during a "narrowing" cycle or revolution in which the main cam shaft is shifted out of knitting position. Therefore, it will be understood that while the narrowing machine and associated narrowing fingers are not operated to affect the fabric when the cam 70 is to be employed and when plate 78A is removed from engagement with the hub of the follower 76A, the fingers are normally shifted laterally by the spindle 85 to maintain them in predetermined relation to the end stops when the spindle 84 operates said end stops and carrier rods to widen the fabric. The use of the narrowing machine is, however, essential to the formation of lace openings such as are shown in Figs. 1–3 and 5–8, so that it will be further understood that the description of cam 70 and its operation is given herein merely to explain the use of parts shown and commonly installed on the machine of the type shown.

The narrowing positions of cams 115 and 116 is assumed to be the normal one and these cams are therefore returned to the positions shown in Fig. 9 after each widening operation. To this end, cam 141 has a high point and when such high point comes beneath follower 140, cam 141 lifts lever 137 to a point such that rod 135 swings

lever 136 back beneath lever 137 and all the parts then return to the positions shown in Figs. 9, 22 and 25 under the influence of spring 130 and remain in such positions until another movement of rod 135 under the influence the pattern means initiates another movement of lever 137. It will be noted that lever 136 has a projection 158 at one side of its upper end which is adapted to catch on the left side of the front end of lever 137 as viewed in Fig. 22 to prevent lever 136 from being drawn past the plane of lever 137 by the spring which actuates rod 135 in the return direction.

It is the standard practice to step the fashioning points two needle spaces at each narrowing operation but it has been found necessary to move the fashioning points only one needle space in widening operations. Therefore, cam 116 is so formed that pawl 106 can move its ratchet only one needle space at any given widening operation. Pawl 105, however, moves its ratchet two needle spaces per widening operation, so far as cam 115 is concerned. Therefore, when the parts are in the widening positions shown in Fig. 10, each operation of end stop spindle 84 moves the end stop one needle ahead of the positions to which the spindle 85 moves the point carrying fingers. Therefore, unless some means were taken to prevent it, the lines 58 of lace openings made by the fashioning points would tend to diverge from the selvage edge lines. However, it is desired that the lines of lace openings remain generally parallel to the selvage edges. Therefore, a means is provided for causing, when desired, the widening pawl 105 for spindle 84 to operate at only every other stroke of actuator 81 when cams 115 and 116 are in their widening positions. For this purpose a split collar 146 is placed around the end of the pin 73 and collar 146 is provided with an upward extension formed of a bolt threaded into the collar at its one end and into a connecting member 159 at its other end, connecting member 159 being pivotally connected to an arm 160 of a bell-crank lever 139, Fig. 15, pivotally mounted on a fixed pin or bolt 161 and which has another arm 162 which carries a racking pawl 163 pivotally connected thereto. Also pivoted on pin 161 is a ratchet wheel 164, Figs. 9 and 10. Fixed to the ratchet wheel 164 on pin 161 is a star wheel cam 165 which is rotated in step-by-step fashion by the action of pawl 163 on the teeth of ratchet wheel 164. Cam 165 is provided with alternate high and low portions 112 and 113, respectively. The surface of cam 165 is in contact with a cam follower 166 pivotally mounted near the lower end of a lever 167 which is pivotally mounted on a pin 133 carried on the frame of the machine, the upper end of lever being adapted to engage pawl 105 as hereinafter set forth. As the high points 110 of star cam 165 act on the follower 166, the cam throws the upper end of lever 167 to the right so that it contacts pawl 105 to prevent pawl 105 from racking its spindle 84 every other widening movement of actuator 81. The end stops are thereby maintained in step with the fingers or combs holding the fashioning points to maintain the selvage edges and lace lines parallel. The pawl 163 for the star cam can be thrown out of operation manually when it is desired that the selvages diverge from the lines of lace openings when widening. In this case the pawl is thrown out of action at a time the follower 166 is on a low point of the star cam which permits the pawl 105 to rack the spindle 84 each widening movement.

The pull-back or auxiliary widening pawl 109 acts, when permitted, to turn the point spindle 85 enough to move its nuts each one needle space at each down stroke of the actuator. However, the major part of the time, it is desired to prevent pawl 109 from acting on its ratchet 104. Two means are shown for this purpose. One of the means shown for preventing racking action of pawl 109 is generally similar to apparatus found in the standard "Reading" full-fashioned knitting machines and comprises a lever 168 journalled at its upper end on a rod 169 which extends along the rear of the machine parallel to spindle 84 and is fixed to the frame of the machine. Lever 168 depends from the rod 169 and the lever is pivoted at its lower end to a link 170 which has a hook recess 171 near its free end adapted to drop onto a pin 172 which is fixed to and projects from pawl 109. It is clear from the drawing that when link 170 is drawn toward the left as viewed in Fig. 10, the link will draw pawl 109 away from its ratchet wheel so that the pawl will not affect spindle 85. For operating link 170 to draw pawl 109 leftward, lever 168 has an extension 174 in Figs. 10 and 15, and which is provided with a portion 173 which extends above and parallel to rod 169. As shown in Fig. 15 portion 173 has fixed cam pieces 175, 176 and 177 thereon which are adapted to be contacted by a slider piece 178 held at the upper end of an arm 179 which extends downwardly and then horizontally to the right beneath portion 173 to a connection (not shown) with the nut 93 on spindle 84 in the usual manner. At the angle between the vertical and horizontal parts of arm 179, it is formed into a sleeve 180 shown in Fig. 15 which slides on rod 169 and by which arm 179 is guided and partly supported on the shaft. As the nut 93 moves along spindle 84, slider or contact piece 178 on arm 179 comes in contact with first one and then another of fixed cam pieces 175, 176 and 177. Cam pieces 175, 176 and 177 all are high enough to cause arm 179 to swing shaft 169 and lever or arm 168 clockwise far enough, recess 171 being in engagement with pin 172, to draw pawl 109 into an ineffective position with respect to ratchet 104. Cam piece 176 is lower than cam pieces 175 and 177 for a purpose which will presently appear. At times, however, it is desired that pawl 109 shall operate ratchet wheel 104 when link 170 is being held by lever 168 in a horizontal position normally preventing the pawl from so doing. In such a case, a nose portion 182 of hook link 170, Fig. 17, manually raised so that a spring 181 may draw pawl 109 toward its ratchet whereby link 170 rests on pin 172 as shown in Fig. 17 and will not affect the action of pawl 109.

At times it is desired that the pawl 109 shall not operate spindle 85 during periods when narrowing is carried out even if lever 168 and link 170 are in position to permit it and therefore a means 183 is provided which is shown as associated with link 132 and which comprises a collar 184 fixed to link 132 and having a lever 185 pivoted on a pin 186 carried on the collar 184. The lever 185 is provided with a pin 187 fixed near the free end thereof and projecting laterally therefrom in the direction toward the observer when viewed as in Fig. 10. A tension spring 188 connected between pin 187 and a pin 189 fixed to collar 184 below pin 186 gives lever 185 a snap-over action, holding pin 187 yieldingly against the top of collar 184 or against the top of a horizontal finger 190 which forms an extension of collar 184 projecting toward the vertical plane of

spindle 85, depending on whether the operator throws lever 185 to the left or to the right. Lever 185 also has a lug 191 thereon projecting from its other face in the direction opposite to said pin 187. Lug 191 extends into the plane of pawl 109 as shown in Fig. 14 so that when pin 187 is in its left hand position as viewed in Figs. 9 and 10 and link 132 is moved to the left as viewed in Fig. 9 due to cam 115 and 116 having been turned counterclockwise, lug 191 pushes pawl 109 to the left to render it ineffective to rack spindle 85. When now it is desired to permit pawl 109 to operate to rack spindle 85 during narrowing operations of actuator 81, lever 185 is thrown over so that pin 187 thereon rests on nose 190 and the lug 191 is thereby placed in a position in which it permits pawl 109 to turn ratchet 104 one tooth on the down stroke of the actuator.

Usually, a narrowing operation involves a movement of the point combs or fingers equal to two needle spaces. This is the case, for instance, in making the fashion marks forming lines 53 and 54. However, in carrying out certain steps in the hereinabove-described method, it is necessary that the points move only one needle space in the narrowing direction. Such a step occurs at the times of forming the fashion marks 68. To this end, a manually operated means is provided whereby narrowing pawl 89 is prevented from racking spindle 85 more than one tooth, an angular distance equivalent to a movement of one needle space by the points, at each upstroke of actuator 81. Further, as no change in the width of the fabric is desired at the time of said one needle narrowing action by pawl 89, said manually operated means has associated therewith also a means whereby pawl 88 may be prevented from affecting spindle 84. As shown, said manually operated means includes a handle member 192 which is pivotally connected to a pin 193 shown in Fig. 11, one end of said pin is fixed to a plate or cam 194, best shown in Fig. 18, pivoted on spindle 85. Handle member 192 has an enlargement 195 intermediate its ends in which is an aperture 196. About midway of its length, the upper edge of aperture 196 curves downwardly to form a projection 197 separating the upper part of the aperture into two sockets 198.

One end of a shaft 199 projects through the aperture 196 and has guide collars thereon spaced at opposite sides of handle member 192 to facilitate keeping the handle member 192 in a desired vertical plane when it is shifted longitudinally. Owing to the weight of handle member 192 the shaft 199 remains in whichever socket 198 it is placed, whereby in effect the handle member may be releasably latched in either a right hand or a left hand position as viewed in Figs. 9, 10, 19, 20 and 21. When handle member 192 is moved from the left hand position in which it is shown in Fig. 19, to the right hand position in which it is shown in Figs. 20 and 21, plate 194 is turned clockwise. Plate 194 is provided with a cam portion 200, as appears clearly in Fig. 18. When handle piece 192 is in its left position, Fig. 19, the shaft 199 being in the right hand socket 198, cam portion 200 lies below the point of racking pawl 89 when the pawl is about to begin its upward movement and the pawl will therefore turn spindle 85 a distance equal to two teeth of ratchet 87. When it is desired to produce only a one tooth movement of ratchet 87 by pawl 89, handle member 192 is drawn toward the right from the position as viewed in Fig. 19, so that shaft 199 will occupy the left hand socket 198 as shown in Fig. 20. Cam 200 now occupies a position in which its upper corner prevents pawl 89 from engaging the first tooth of ratchet wheel 87 covered by its arc of movement. The pawl, however, is free to drop into engagement with the ratchet 87 as soon as it has missed said first tooth and therefore engages the second tooth in its two needle arc of movement to rack the spindle 85 during the last half of its traverse to move the narrowing points only one needle space. Moreover, in carrying out the novel method within the invention, it is desired that narrowing pawl 88 shall be prevented from acting to rack end stop spindle 84 at the same time that pawl 89 is limited to a one needle effect. For this purpose plate 194 has an arm 201 (Fig. 18) thereon, which projects radially outward from the spindle 85 opposite cam portion 200. At its outer end arm 201 is connected by a bolt 202, with a similar arm 203 on a plate 204 outside of ratchet 104 and of generally ring-like form pivotally mounted on a collar 205 surrounding spindle 85. Therefore, when plate 194 is moved by handle member 192, plate 204 is turned also a like degree. Plate 204 has a second arm 206 integral therewith which is pivotally connected by a link 207 with a plate or cam 208 pivotally mounted on spindle 84. Last mentioned plate 208 has a cam portion 209 integral therewith which, when handle member 192 is in its right position, holds narrowing pawl 88 in the position shown in Fig. 20 so long as the actuator 81 is in its lowest and idle position and in which position pawl 88 will miss the tooth on ratchet 86 with which the pawl would otherwise engage. As soon as pawl 88 has moved slightly from the position in which it is shown in Fig. 20, it falls against its ratchet 86 as shown in Fig. 21. However, as each of the teeth on ratchet 86 covers an arc equal to a two needle movement of the end stops and is therefore equal to the arc of movement of pawl 88, the upper end of the pawl comes to a stop just before or just as it engages the next tooth of ratchet 86 and therefore spindle 84 is not moved when handle member 192 is in the position shown in Figs. 20 and 21. It will be seen that the plates 204 and 208 need to be positioned quite exactly to ensure that pawls 88 and 89 shall just miss engaging the teeth nearest them when starting their upward movements.

A plate 210, Figs. 16 and 18, is provided for disengaging the pawl 89 from the ratchet wheel 87 to limit the movement of the nuts 94 and 95 toward each other. The plate 210 is biased by means of a spring 211, one end of which is connected to the plate and the other end to the machine frame (not shown), into engagement with a rod 212 which is slidably carried in a portion of the machine frame, said rod 212 having a collar 213 adapted to be engaged by the nut 94 when the nuts 94 and 95 have been moved to a predetermined position toward each other. Engagement of the nut 94 with the collar 213 removes the rod 212 from beneath the plate 210 whereby the plate is biased in a clockwise direction, Fig. 18, to a position beneath the pawl 89 thereby preventing further action of said pawl. The plate 210 and associated parts acts in a well known manner and, forming no part of the present invention, is not described in further detail.

In addition to controlling the pull-back pawl 109 as hereinabove described, the lever 169, slider 178 and cams 175, 176 and 177 control the widening pawl 105 for end stop spindle 84 during considerable portions of the period needed for mak-

ing a complete stocking. To this end, the pawl 105 is extended below its pivot to form an arm 215 which is pivotally connected by a link 216 with the lower end of arm 168 whereby pawl 105 is held out of action when contact piece 178 is on fixed cam 175 or fixed cam 177 on portion 173 but is permitted to operate ratchet wheel 103 when contact piece 178 is on the intermediate fixed cam 176, cam 115 being also in the position to permit this.

The spindle 84 is provided with a notched disk 220, the notches 219 of which are engaged by a locking plunger 218 biased into engagement with the notches 219 by a spring 221 for maintaining the spindle in a definite position between indexing operations of the spindle either for narrowing or widening. The locking plunger 218 is raised out of the notch 219 in well known manner during said indexing operations. A pawl 217, pivotally mounted on the shaft 169, is also provided for engagement with the ratchet wheel 86 to prevent the displacement of the spindle when the carrier rods strike the end stops, which occurs at the time the locking plunger 218 has been lifted out of engagement with its associated notch 219 in the disk 220 during an indexing operation.

Spindle 85 also has a notched disk thereon. This is indicated at 222 in Figs. 10 and 11. Disk 222 acts in conjunction with a plunger 223 as a detent means to maintain the fashioning points in proper register with the needles. However, as the notches 224 in the edge of disk 222 are V-shaped instead of nearly square, no means are required for lifting plunger 223 to permit disk 222 to be racked.

The ratchet wheels and notched disks for spindles 84 and 85 are arranged the same way for each spindle, the arrangement being best shown perhaps in Fig. 11. As shown, a notched disk such as 222 has a hub 225 fixed to the spindle and which extends laterally from both sides of the disk part proper, thereby providing bearing portions on which the ratchet wheels 87 and 104 are mounted along either side of disk 222, the ratchet wheels being fixed to the disk 222. Further, a collar 205 is fixed to the outer or end ratchet by screws or other suitable means and has a flange 226 at its outer end forming an annular recess in which two cam plates or disks such as 116 and 204 may be pivotally mounted as described.

A spring 227 is arranged to urge pawl 217 toward the ratchet 86. For this purpose spring 227 is shown as connected between two pins 228 and 229. Pin 228 is fixed on an arm 230 which forms a downward extension of pawl or lever 217 while pin 229 is part of an arm 231 best shown in Fig. 15 and which is fixed to the frame of the machine. A link 232 is connected to the arm 230 and to the pawl 88 at the same point as link 154 said link having a slot 233 to provide both a pivotal and a lost motion connection between arm 230 and link 232. With this arrangement the pawl 217 will not interfere with the pawls 88 and 89 but pawl 217 will be moved out of engagement with the ratchet 86 when the pawls 88 and 89 are moved to inoperative position which occurs when the spindle 84 is being reset. Also, a spring 234 is provided for widening pawl 105, spring 234 being under tension and connected at one end to a pin 235 fixed to the pawl about midway of its length and a bolt 236 fixed to the lower end of lever 168 and forming the pivot of link 170 as well as the point of attachment for the rear end of link 216. Further, a spring 237 is provided for urging the lower part of lever 167 and follower 166 toward the star wheel cam 165, such spring 237 having one end connected to an extension of lever 167 below the pivot of follower 166 and its other end connected to a pin 238 at the axis of the pivot of actuator 81. In addition to the springs heretofore mentioned, springs 240 and 241 are employed as shown in Figs. 26 and 27 to hold stop members 98 on rod 99 against heads 242 and 243 on nuts 94, 94, and springs 244 and 245 to hold stops 98, 98 on rod 100 against heads 246 and 247 on nuts 95, 95, whereby the point fingers or combs are maintained in proper relation to the nuts 94 and 95.

Operation

In forming a stocking blank such as 49, the welt is knitted and turned and the leg portion is knitted, including the upper and lower leg narrowings are formed in the usual manner. During the knitting of the part of the leg portion of blank 49 between the welt and the lower end of lines of fashion marks 54, the slider contact piece 178 on arm 179 is on the cam 175 which is high enough to cause link 170 to hold pull-back pawl 109 definitely out of effective position irrespective of other means provided for affecting the position of pawl 109 with respect to its ratchet. Lines of fashion marks 53 and 54 are therefore parallel to the selvage edges as usual. Near the lower ends of the lines 54 arm 179 carries slider 178 off of cam 175 and onto cam 176 which is relatively lower, so that widening pawl 105 is free to act. At the start of widening in the heel the narrowing spindle is manually racked in the narrowing direction to move the points at the inner edges of the point combs close to the inside edges of said reinforced area. During each widening action plate cam 115 holds the narrowing pawls 88 and 89 out of action, but plate cam 116 permits widening pawl 106 for the point comb spindle 85 to move the combs outwardly a distance of one needle. Widening pawl 105 moves end stop spindle 84 a distance of two needles every other operation of the narrowing head. However, cam 176 is itself high enough to hold link 170 in position to prevent pawl 109 from acting on its ratchet. Therefore, when the heel cheeks 59 are being made, the widening lines 58 of lace openings will parallel the selvage edges even though the lug 191 shown in Fig. 14 is carried out of the way of the upper end of pawl 109 at each widening action of the narrowing head as is clear from Fig. 12. At the end of widening of the heel cheeks the slider piece 178 is in engagement with the cam 175 which again prevents the pawl 105 from engaging the ratchet wheel 103, although the cam 115 has been moved from beneath pawl 105, and also prevents the pawl 109 from engaging the ratchet wheel 104 and it is then desired to maintain the selvage edges parallel to each other as shown in fabric parts 60 in Fig. 2. It is therefore necessary to perform narrowing operations to form the fashion marks 68 shown in Figs. 6, 7 and 8 (and which will be understood as present in Fig. 2, although not shown because of the difficulty of showing them on so small a scale), the cam plates 194 and 208 on spindles 85 and 84, see Figs. 18 and 19, are manually positioned to render the narrowing pawl 88 for the end stop spindle ineffective and the narrowing pawl 89 for the comb spindle 85 ineffective for one tooth of its usual movement, as shown in Figs. 20 and 21. Also, the end 182 of link 170 is manually raised so that spring 181 pulls pawl 109 to the position in which

it is shown in Fig. 17 in which pin 172 on the pawl holds the link 170 in inoperative position. The pawl 109 is now free to rack the ratchet 104 one tooth on the down-stroke of actuator 81 to step the fashioning points outward one needle space after each widening action of the points in making the remaining lace marks in lines 58 but the lug 191 is still active on narrowing movements of actuator 81 as shown in Figs. 9, 21 and 22 to prevent the pawl 109 from acting during narrowing operations of the narrowing head and the fashion points consequently remain in transverse alinement with the needles on which they deposited the loops at the time of making fashion marks 68 until a fashioning operation is performed on a subsequent course.

It will be clear from the foregoing that, in making the parallel sided portions 60, two fashioning operations are necessary between two immediately successive knitting cycles. To this end, the plate 78A operates, as hereinbefore described and as shown in Fig. 24, to maintain the follower 76 in the proper position with respect to lever 78 so that follower 76 will cooperate with the regular narrowing cam 80 each time the main cam shaft 75 is shogged to the right while at the same time the right hand collar 155 is left loose or so set that rod 126 may shift to the left, as viewed in Fig. 24, without affecting the lever 156. With the pull-back pawl 109 and narrowing pawl 88 and widening pawl 105 held inactive as previously explained, it is only necessary for the pattern means of the machine to cause the camshaft 75 to shift twice between consecutive knitting revolutions to thereby produce two consecutive narrowing cycles and also to shift the lever 136 out from under lever 137 to cause the rod 126 to lift rod 119 at the beginning of the first narrowing cycle to thereby cause plate cam 116 to throw the narrowing pawl 89 out of action but not at the beginning of the second of said narrowing cycles. The result is then that the widening pawl 106 acts in the first of the two narrowing cycles to cause the fashioning points to produce lace openings 58 and the narrowing pawl 89 acts in the second of the two consecutive narrowing revolutions or cycles to produce a fashion mark 68 in the same course as the lace opening 58, it being understood that the pull-back pawl 109 steps the combs out each a one needle distance in the latter part of the first of the two narrowing revolutions so that the following narrowing operation of the combs produces fashion marks 68 alongside the lace openings 58 instead of simply filling up the lace openings. The pull-back pawl 109, however, does not operate in the second narrowing cycle of the pair because the lever 185 has been moved to the position shown in Figs. 13 and 14 which holds lever 109 ineffective in cycles in which narrowing pawl 89 is effective to cause the fashioning points to make fashion marks 68.

After all the fashion marks 68 desired have been made, the point combs are moved inwardly by manually rotating the spindles 85 to position the points properly for making the sole or gusset narrowings. The cams 194 and 208 are manually moved to inoperative positions relative to the narrowing pawls and the pin 172 is again positioned in the recess 171 in link 170 and the link thereupon controls the pawl 109 during the making of the lines 64 of fashion marks made during the gusset narrowings. After making lines 64 of fashion marks the slider piece 178 runs off of cam 176 onto cam 177 which is of the same height as cam 175, so that pawl 109 remains away from ratchet 104. After marks 58 and 68 have been finished, the lever 185 is manually turned to the position in which the pin 187 engages the finger portion 190 so that lug 191 can no longer affect pawl 109. Thereupon, the slider 178 being arranged to run off cam 177 when a portion of the lines 65 of fashion marks have been completed, the pawl 109 takes effect during narrowing the remaining operations and the latter parts of lines of fashion marks 65 extend at an angle to the selvage edge to the end of the toe as shown. This feature however, forms no part of the present invention.

The relationship of the yarn carrier rods 97, the end stop nuts 93, the points 69 on narrowing rods 99 and 100, and the nuts 94 and 95 for operating the points throughout the period of making lace openings 58 and fashion marks 68 is shown in Figs. 26 to 31, inclusive. In Fig. 26, a yarn carrier rod 97 is shown in contact with its stop 96 just after the carrier has completed laying yarn for the first course intended to contain lace openings in lines 58, the narrowing rods 99 and 100 for point combs 101 and 102 being shown in corresponding positions. In vertical alinement with the left end of rod 97 in Fig. 26 is shown a line marked 0 and following line 0 to the left thereof are lines parallel thereto and marked 2, 4 and 6, respectively. The distances between adjacent marks are the same and are proportional to two needle spaces. At the inner edge of narrowing nut 94 and running vertically downward therefrom is a line marked *a* which indicates a position of the left nut on the spindle 85 in the narrowing head at the left end of the machine which position corresponds to the position of the yarn carrier rod 97 indicated by line 0. Following said line *a* are several lines parallel to it and marked *b*, *c*, *d*, *e* and *f*, respectively. The distance between each of lines *a*, *b*, *c*, *d*, *e* and *f* and the next is the same and is proportional to one needle space. At the first operation of the narrowing machine and actuator 81 following the positions shown or indicated by lines 0 and *a*, the nut 93 is moved to the left two needle spaces so that the left end of rod 97 when against its stop will be at line 2. The the same time, nut 94 is moved to the left only one needle space, due to the guiding effect of plate cam 116 on pawl 106, so that the right end of the nut is at the line *b* and the left end of narrowing rod 99 held by its stop will be one needle distance farther to the left than before. At the same time, nut 95 and rod 100 are moved to the right an equal distance. The parts are shown in their new positions in Fig. 27, which also shows the first lace openings in lines 58. Upon the next operation of the narrowing machine and the actuator 81, an operation occurring in the second course following the one having the first lace openings therein, nuts 93 remain stationary because of the action of lever 167 in holding widening pawl 105 out of action as shown in Fig. 10. Nuts 94 and 95, however, are again moved one needle distance in the widening direction so that the right hand edge of nut 94 is in alinement with the line *c* and therefore one needle distance to the left of line *b*. The operation whereby nut 94 reaches line *c*, as shown in Fig. 28, produces a second pair of lace openings and completes a "repeat" of the operations used in making the openings in lines 58 during the period the selvages of heel cheeks 59 are being widened. The cycle shown in Figs. 26, 27 and 28 is then repeated without variation until it is desired to continue lines 58 of lace openings

while maintaining the selvage edges parallel by making fashion marks 68.

The cycle used in making the parts with parallel selvage edges parts 60, is illustrated in Figs. 29, 30 and 31 in which initial and successive positions of nuts 93 and 94 are represented by two new sets of parallel lines marked respectively 0 to 6 and *a* to *f*. The positions of the parts shown in Fig. 29 are those just after knitting of the first course 67 (Figs. 3 to 7) in which it is desired to make fashion marks 68 as well as lace openings. Assuming that this course is one at which the cam 175 through lever 168 acts on pawl 105 and to prevent nuts 93 from being moved in the widening direction and the plate cam 208 preventing movement of the nuts 93 in the narrowing direction. Therefore, assuming that the nut 93 is in a zero position, as shown in Fig. 29, it will remain in such position throughout the parallel selvage edge portions 60. However, the nuts 94 and 95 for moving the fashioning points are moved one needle space apiece on the upstroke of actuator 81 to make lace openings, Fig. 5, and to change the position of nut 94 from that of line *a* to line *b* while these nuts are again moved one needle space in the widening direction by the pull-back pawl 109 on the downstroke of the actuator so that the right hand end of nut 94 is in transverse alinement with line *c* as shown in Fig. 30. Thereupon, before yarn is laid for another course, the narrowing machine and actuator 81 are operated a second time in the same course but to move nuts 94 and 95 inward instead of outward to thereby restore the edge loop to its original needle and make a fashion mark 68 alongside of a lace opening, Fig. 6, at the same time that nut 94 is moved back into the position of line *b* as shown in Fig. 31. The cycle represented by Figs. 29, 30 and 31 is then repeated in every other course until the heel cheeks have been completed.

Modification

In Figs. 32 and 33, there is shown a mechanism operating to carry out the identical functions as the one shown in Figs. 3 to 31, inclusive, except that it may be set to perform either "single needle" narrowing or "two needle" narrowing as desired. In other words, when making the upper leg narrowings, the lower leg narrowings, the gusset narrowings and the toe narrowings, represented in Figs. 1 and 2, by lines 53, 54, 64 and 65 respectively, the mechanism shown in Figs. 32 and 33 may be set to control the displacing of the loops a distance equal only to that between one needle and the next to create only one fashion mark per narrowed course instead of two. As shown, this is accomplished by the addition of certain parts and the elimination and modification of others of the parts shown in Figs. 9 to 31, inclusive, the number and arrangement of the remaining parts and the reference characters for the same shown in Figs. 9 to 31, inclusive, being otherwise unchanged in the arrangement shown in Figs. 32 and 33.

In order that the narrowing head shown in Fig. 32 shall perform single needle narrowing instead of two needle narrowing, means are provided whereby spindle 84 is racked two needle spaces but only at every second racking of spindle 85, which is moved one needle space at each narrowing operation of actuator 81, said means including a lateral extension or integral arm 300 on the narrowing pawl 88. Arm 300 extends outward in the longitudinal direction from pawl 88 into a vertical plane outside the planes of movement of all the movable links, pawls and levers shown in Figs. 9 to 25, inclusive, and into the plane of movement of a lever 301 which is pivoted on a pin 302 similar to the pin 133 for the lever 167. Lever 301 has a downward extension 303 which, as best shown in Fig. 33, curves inwardly into the plane of the lower part of lever 167 and a bolt 304 is arranged in part 303 so as to bear against lever 167, a tension spring 305 being shown between a pin 306 on lever 167 and a pin 307 on lever 301 to hold the end of bolt 304 against the edge of lever 167 so that levers 167 and 301 normally move as one. The upper end of lever 301 is bent toward arm 300 so that when, as shown in Fig. 32, the follower 166 on lever 167 is on a low point on cam 165, lever 301 strikes arm 300 to throw pawl 88 some distance away from its ratchet wheel 86. At the same time, the link 154 transmits the movement of pawl 88 to pawl 89 to throw pawl 89 away from its ratchet wheel 87. Therefore, as actuator 81 begins an upward movement from a position such as that shown in Fig. 32, the tip of pawl 88 misses the end of the nearest tooth on ratchet wheel 86 and the tip of pawl 89 misses the end of the nearest tooth on ratchet wheel 87. The upper end of lever 301, however, curves toward the ratchet wheel 86 so that once the tip of pawl 88 has passed the end of the tooth, the pawl moves against the face of the ratchet wheel and slides along it. The teeth on ratchet wheel 86 having a length equal to the full stroke of pawl 88, this pawl then rides up on the ratchet wheel the full length of its stroke without affecting spindle 84. In the meantime, pawl 89 follows a somewhat parallel path, but, as the teeth on ratchet wheel 87 are only half as long as those on ratchet wheel 86, pawl 89, after missing the first tooth, engages a tooth on the ratchet wheel 87 when midway of its stroke and turns the ratchet wheel one tooth, thereby moving nuts 94 and 95 one needle space. The reciprocation of actuator 81 having at the same time moved star wheel cam 165 so that follower 166 is on a high point of the cam, lever 301 is now held to the right of the position in which it is shown in Fig. 32. Therefore, at the next operation of actuator 81, cams 115 and 116 being in the position for narrowing operations, pawl 88 will engage the nearest tooth on ratchet wheel 86 to turn spindle 84 to move the end stop nut 93 two needle spaces. Spindle 85, however, should again be turned only an angle equivalent to one needle space, whereby the end stops and point combs are both moved two needle spaces in each pair of movements of actuator 81 and are maintained in their original relationship so that the narrowing lines formed are parallel to the selvage edges. To accomplish this, a cam portion 308 of a plate member 309 is moved by handle 192 to the position corresponding to the position of cam portion 200 shown in Figs. 18 and 20 and maintained in such position when single needle narrowing is to be performed. Also, the cam 208, link 207 and plate 204 are not required because the lever 301 supplements lever 167 to fill their places when it is desired to make the parallel sided portions 69 of heel cheeks 59 and parts 204, 207 and 208 have been omitted from Figs. 32 and 33.

For making the parallel selvage edge portions 60, it is necessary that the spindle 84 be prevented from turning throughout the entire period of making of the parts 60. To this end, the fol-

lower 166 should be on a low spot on the star wheel cam 165 when plate cam 115 is at the right as viewed in Fig. 32. Also, link 170 is disengaged from pin 172 at the beginning of portions 60. It is, however, necessary that the first operation of the narrowing machine in the cycle of making portions 60 shall result in a lace opening and therefore follower 166 must be on a high spot on cam 165 and cams 115 and 116 must be in their left positions while the upper end of lever 167 is in engagement with pawl 105. Plate cam 115 being at the left as viewed in Fig. 32 when actuator 81 makes its first upstroke in making portions 60, cam 115 holds the narrowing pawl 88 for the end stop spindle 84 out of action and, follower 166 being on a high point of cam 165, lever 167 holds pawl 105 out of action so that spindle 84 remains stationary. Cam 115 being in its left position, plate cam 116 is also in its left hand position and narrowing pawl 89 is held out of action. Also, cam 165 will be rotated to bring a low point under follower 166 to position levers 167 and 301 for the next operation of the narrowing machine. During this action widening pawl 106 is free to act to turn point spindle 85 one tooth of ratchet wheel 104 in the widening direction to make a lace opening, pawl 106 being limited to a one tooth movement by the cam 116. As the cam 115 and 116 are in the widening position as shown in Fig. 12, the pull-back pawl 109 is free to operate so that the points are moved out one needle space after the formation of each lace opening. In the part of the complete stocking cycle in which the parallel sided portions 60 of the heel cheeks are made, the pattern means throws the narrowing machine alternately into the narrowing and widening positions. Therefore, at the next operation of the narrowing machine, the plate cams will be in their right positions as shown in Figs. 13 and 32, the narrowing position, so that widening pawls 105 and 106 are thereby held out of action while narrowing pawl 88 for end stop spindle 84 will be held by lever 301 so that it misses the first tooth on ratchet wheel 86 whereby pawl 88 will then slide along the tooth on ratchet wheel 86 and spindle 84 again will not be racked. Narrowing pawl 89 for point spindle 85, however, is free to act so far as plate cam 116 is concerned, but is held away from its ratchet wheel by the link 154 and cam portion 308 to cause it to miss the first tooth on its ratchet wheel and only engage the second tooth of the normal two tooth movement of ratchet wheel 87 to turn spindle 85 to move the points one needle space, thereby making a fashion mark 68. The plate cams 115 and 116 with their connecting link 132 being in their narrowing positions the pull-back pawl is kept idle by lug 191. A plain course is then knitted. The cycle is then repeated to make lace openings and fashion marks alongside each other in the same courses with plain courses alternating with the courses containing transferred loops until the desired courses have been completed to finish the fabric portions 60. During the period of making the widened portions 59 by the mechanism shown in Figs. 32 and 33, the link 170 holds the pull-back pawl 109 so that it cannot act. As previously noted, when portions 60 are begun, however, link 170 is raised by hand to release pin 172 on the pawl 109 from recess 171 so that pullback pawl 109 can operate. Pin 172 is restored to recess 171 as soon as portions 60 have been completed. The portions of the foot following course 61 are then completed as before with the pull-back pawl 109 coming into action again in the latter part of the toe narrowings.

Of course, the improvements specifically shown and described, by which the above described results are obtained, can be changed and modified in various ways without departing from the invention herein disclosed and hereinafter claimed.

We claim:

1. In a full-fashion knitting machine having a point positioning spindle and an end stop positioning spindle, a narrowing head having means for turning the said point spindle to move points in use one needle space in the widening direction in a loop transferring movement, means to then turn said point spindle to move points in use one needle space in the widening direction in a non-loop transferring movement, means to then turn said point spindle to move points in use one needle space in the narrowing direction in a loop transferring movement and means whereby said end stop spindle is caused to be stationary during said three movements of the point spindle.

2. In a full-fashioned knitting machine having a point positioning spindle and an end stop positioning spindle, a narrowing head having means for turning the said point spindle to move points in use one needle space in the widening direction in a loop transferring movement, means to then turn said point spindle to move points in use one needle space in the widening direction in a non-loop transfering movement, means to then turn said point spindle to move points in use one needle space in the narrowing direction in a loop transferring movement, and means whereby said end stop spindle is caused to be stationary during said three movements of the point spindle including a plate cam mounted to oscillate on the end stop spindle, a pivoted lever mounted to oscillate on its pivot and means for swinging the effective portions of said plate cam and lever oppositely to cause first one and then the other to prevent movement of the end stop spindle in a given direction.

3. In a full-fashioned knitting machine having a point positioning spindle and an end stop positioning spindle, a narrowing head having means for turning the said point spindle to move points in use one needle space in the widening direction in a loop transferring movement, means to then turn said point spindle to move points in use one needle space in the widening direction in a non-loop transferring movement, means to then turn said point spindle to move points in use one needle space in the narrowing direction in a loop transferring movement, and means whereby said end stop spindle is caused to be stationary during said three movements of the point spindle including a plate cam mounted to oscillate near the end of the end stop spindle and having effective portions, a cam controlled means mounted to oscillate and having two effective portions spaced and moving in unison in adjacent paths, and means for swinging the effective portions of said plate cam and cam controlled means oppositely to cause one active portion of the plate cam to prevent movement of the end stop spindle in one direction and one active portion of the cam controlled means to prevent movement of the end stop spindle in the other direction at one time and to cause another active portion of the plate cam to prevent movement of the end stop spindle in said other direction and the other active portion of the cam controlled means to prevent movement of the end stop spindle in said one direction at another time.

4. In a full-fashioned knitting machine having a point positioning spindle and an end stop positioning spindle, a narrowing head having means for turning the said point spindle to move points in use one needle space in the widening direction in a loop transferring movement, means to then turn said point spindle to move points in use one needle space in the widening direction in a non-loop transferring movement, means to then turn said point spindle to move points in use one needle space in the narrowing direction in a loop transferring movement, and means whereby said end stop spindle is caused to be stationary during said three movements of the point spindle including a plate cam mounted to oscillate near the end of the end stop spindle and having effective portions, a cam controlled means mounted to oscillate and having two effective portions spaced and moving in unison in adjacent paths, and means for swinging the effective portions of said plate cam and cam controlled means oppositely to cause one active portion of the plate cam to prevent movement of the end stop spindle in one direction and one active portion of the cam controlled means to prevent movement of the end stop spindle in the other direction at one time and to cause another active portion of the plate cam to prevent movement of the end stop spindle in said other direction and the other active portion of the cam controlled means to prevent movement of the end stop spindle in said one direction at another time together with means whereby the point spindle is prevented from turning more than a one needle distance per individual operation when desired.

5. In a full-fashioned knitting machine having a point positioning spindle and an end stop positioning spindle, a narrowing head having means for turning the said point spindle to move points in use one needle space in the widening direction in a loop transferring movement, means to then turn said point spindle to move points in use one needle space in the widening direction in a non-loop-transferring movement, means to then turn said point spindle to move points in use one needle space in the narrowing direction in a loop transferring movement, and means whereby said end stop spindle is caused to be stationary during said three movements of the point spindle including a plate cam mounted to oscillate near the end of the end stop spindle and having effective portions, a cam controlled means mounted to oscillate and having two effective portions spaced and moving in unison in adjacent paths, and means for swinging the effective portions of said plate cam and cam-controlled means oppositely to cause one active portion of the plate cam to prevent movement of the end stop spindle in one direction and one active portion of the cam controlled means to prevent movement of the end stop spindle in the other direction at one time and to cause another active portion of the plate cam to prevent movement of the end stop spindle in said other direction and the other active portion of the cam controlled means to prevent movement of the end stop spindle in said one direction at another time together with means whereby the point spindle is prevented from turning more than a one needle distance in a given direction per individual operation when desired but in which the last means is a cam pivotally mounted on the point spindle and maintained in active position or in inactive position for desired periods each including several complete courses.

6. In a full-fashioned knitting machine having a point positioning spindle and an end stop positioning spindle, the combination of a cam mounted on the point spindle adapted to restrict the point spindle to a one needle movement in the narrowing direction, automatic means for restricting the point spindle to a one needle movement in the widening direction, automatic means to prevent movement of the end stop spindle in the widening direction on alternate operations of the point spindle, and a cam pivoted coaxially with the end stop spindle for preventing operation of the end stop spindle in the narrowing direction.

7. In a full-fashioned knitting machine having a point positioning spinde and an end stop positioning spindle, the combination of a cam mounted on the point spindle adapted to restrict the point spindle to a one needle movement in the narrowing direction, automatic means for restricting the point spindle to a one needle movement in the widening direction, automatic means to prevent movement of the end stop spindle in the widening direction on alternate operations of the point spindle, and a means including a cam rotatably mounted coaxially of the end stop spindle and controlled simultaneously with said cam on the point spindle for preventing operation of the end stop spindle in the narrowing direction, said cam on the point spindle lying inwardly of the plane of the cam on the end stop spindle, a plate member rotatably mounted coaxially of the point spindle, a link connection between said plate member and the cam coaxial with the end stop spindle, and a releasable bolt connection between said plate member and said cam on the point spindle.

8. The method of operating a knitting machine having a main cam shaft, a set of knitting needles and a narrowing head operated thereby, said head including an end stop spindle, a point spindle, and racking pawls for turning said spindles in either direction as desired, comprising forming a course of loops on the needles, next racking the point spindle to cause the formation of a lace opening due to the transfer of a loop from one needle to the next, racking said point spindle in the same direction without transferring any loop, racking said point spindle to cause the formation of a fashion mark in said course between said lace opening and the selvage nearer thereto, and maintaining said end stop spindle stationary throughout said cycle of movements of the point spindle.

9. The method of operating a knitting machine having a main cam shaft, a set of knitting needles operated from said shaft, and a narrowing head also operated from said shaft and including an end stop spindle, a point spindle and means for racking said spindles in either direction as desired, comprising forming a course of loops on the needles, racking the point spindle to cause the formation of a lace opening due to the transfer of a loop from one needle to the next, next racking said point spindle again an equal distance in the same direction without transferring any loop, racking said point spindle in the opposite direction to cause the formation of a fashion mark in said course adjacent to said lace opening, and maintaining said stop spindle stationary throughout said cycle of movements of the point spindle.

10. In a full-fashioned knitting machine, the combination of a point positioning spindle, an end stop positioning spindle, an actuator hav-

ing an up and down reciprocating movement, pawls connected to said actuator adapted to rack said spindles in either direction, pivoted lever means adapted to hold the pawls for moving said end stop spindle in one direction or the other out of action, a cam operated from said actuator acting to shift said lever means to hold first the pawl for racking the end stop spindle in one direction out of action and then the pawl for racking the end stop spindle in the other direction out of action in successive reciprocations of said actuator, a cam shaft adapted to occupy either a knitting or a fashioning position, a pattern means controlling the position of said cam shaft, means whereby said actuator is operated at each fashioning revolution of the cam shaft, means including a cam and controlled by said pattern means for determining the period in the revolution of said cam shaft in which said actuator is reciprocated, means operated by the cam of said last means including oscillatable cams and one of which acts when swung in one direction to throw out of action the pawl for racking said end stop spindle in the narrowing direction and also the pawl for racking the point spindle in the narrowing direction while another of said oscillatable cams acts when swung in the other direction to limit the point spindle to single needle widening, and a separately controlled cam acting to limit the point spindle to single needle narrowing.

11. In a full-fashioned knitting machine having a point positioning spindle and an end stop positioning spindle, a narrowing head having means for turning the said point spindle to move points in use one needle space in the widening direction in a loop transferring movement, means to then turn said point spindle to move points in use one needle space in the widening direction in a non-loop-transferring movement, means to then turn said point spindle to move points in use one needle space in the narrowing direction in a loop transferring movement, and means whereby said end stop spindle is caused to be stationary during said three movements of the point spindle including a cam.

12. In a full-fashioned knitting machine having a point positioning spindle and an end stop positioning spindle, a narrowing head having means for turning the said point spindle to move points in use one needle space in the widening direction in a loop transferring movement, means to then turn said point spindle to move points in use one needle space in the widening direction in a non-loop-transferring movement, means to then turn said point spindle to move points in use one needle space in the narrowing direction in a loop transferring movement, including a cam, and means whereby the end stop spindle is caused to be stationary during certain movements of the point spindle including a separately controlled cam.

13. In a full-fashioned knitting machine having a point positioning spindle and an end stop positioning spindle, a narrowing head having means for turning the said point spindle to move points in use one needle space in the widening direction in a loop transferring movement, means to then turn said point spindle to move points in use one needle space in the widening direction in a non-loop-transferring movement, means to then turn said point spindle to move points in use one needle space in the narrowing direction in a loop transferring movement, a cam, and means whereby the end stop spindle is caused to be stationary during certain movements of the point spindle including a cam connected to operate together with said first cam.

14. In a full-fashioned knitting machine having a point positioning spindle and an end stop positioning spindle, the combination of means acting when fully effective to rack said point spindle to cause a two needle narrowing action, a cam operating to restrict said means so that it causes only a single needle narrowing action, means acting when effective to rack said end stop spindle to cause a narrowing movement thereof, a second cam operating to prevent movement of said end stop spindle in the narrowing direction, and means connecting said cams to cause them to move in unison.

15. In a full-fashioned knitting machine having a point positioning spindle and an end stop positioning spindle, the combination of means acting when fully effective to rack said point spindle to cause a two needle narrowing action, a cam operating to restrict said means so that it causes only a single needle narrowing action, means acting when effective to rack said end stop spindle to cause a narrowing movement thereof, a second cam operating to prevent movement of said end stop spindle in the narrowing direction, and means connecting said cams to cause them to move in unison, said restricting and preventing cams being rotatably mounted on the spindles.

16. In a full-fashioned knitting machine having a point positioning spindle and an end stop positioning spindle, the combination of a controlled cam mounted on the point spindle adapted to restrict the point spindle to a one needle movement in the narrowing direction and maintained in active position or in inactive position for desired periods each including several complete courses, automatic means for restricting the point spindle to one needle movement in the widening direction, an automatic means to prevent movement of the end stop spindle in the widening direction on alternate operations of the point spindle and a controlled cam rotatably mounted coaxially of the end stop spindle and controlled simultaneously with said cam on the point spindle for preventing operation of the end stop spindle in the narrowing direction.

17. In a full-fashioned knitting machine having a point positioning spindle and an end stop positioning spindle and operating mechanisms therefor, a cam mounted on the point spindle adapted to restrict the point spindle to a one needle movement in the narrowing direction and maintained in active position or in inactive position for desired periods, means for restricting the point spindle to a one needle movement in the widening direction, automatic means to prevent movement of the end stop spindle in the widening direction on alternate operations of the point spindle, and means including a cam mounted coaxially with the end stop spindle and controlled simultaneously with said cam on the point spindle to prevent operation of the end stop spindle in the narrowing direction, a plate member mounted coaxially of the point spindle, a link connection between said ring member and the cam coaxial with the end stop spindle, and a releasable bolt connection between said plate member and said cam on the point spindle.

18. In a full-fashioned knitting machine having a point positioning spindle and an end stop positioning spindle, a narrowing head having means for turning the said point spindle to move points in use one needle space in the widening

direction in a loop transferring movement, means to turn said point spindle to move points in use one needle space in the widening direction in a non-loop-transferring movement, means to turn said point spindle to move points in use one needle space in the narrowing direction in a loop transferring movement, including a cam maintained in active position or in inactive position for desired periods and means whereby the end stop spindle is caused to be stationary during certain movements of the point spindle including a separately controlled cam.

19. In a full-fashioned knitting machine having a point positioning spindle and an end stop positioning spindle, a narrowing head having means for turning the said point spindle to move points in use one needle space in the widening direction in a loop transferring movement, means to turn said point spindle to move points in use one needle space in the widening direction in a non-loop-transferring movement, means to turn said point spindle to move points in use one needle space in the narrowing direction in a loop transferring movement, including a controlled cam maintained in active position or in inactive position for desired periods, and means whereby the end stop spindle is caused to be stationary during certain movements of the point spindle including a controlled cam connected to operate together with said first controlled cam.

20. In a fashioning head for a full-fashioned knitting machine, an end stop moving spindle, reciprocating pawls adapted to turn said spindle oppositely to shift the stops in opposite directions, and means for inactivating said pawls at times comprising a star cam having an intermittent motion and two levers of the first class whose pivots at least approximately coincide and follower means for said levers biased to coact with said star cam and so that the free ends of the levers removed from said follower means act one on one pawl and one on the other pawl in alternation.

21. The method of operating a full-fashioned knitting machine having point combs for fashioning the fabric, spindle means for moving said

combs and pawl means including a pull-back pawl for operating said spindle means in either the narrowing or widening directions, which comprises lifting groups of loops including the edge loops on the points of said combs, turning said spindle means by said pawl means to move the combs and loops thereon outwardly one needle space and placing said groups of loops on the needles again to widen the fabric temporarily and to form a lace opening, turning said spindle means an additional needle space outwardly by said pull-back pawl on the return stroke of the combs after the loops have been placed on the needles in the new position, and, before knitting another course, lifting the same groups of loops less one loop in each group on the points of the combs, turning said spindle means by said pawl means to move the combs and loops thereon one needle space inwardly and placing the loops on the needles again to form fashion marks alongside said lace openings.

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