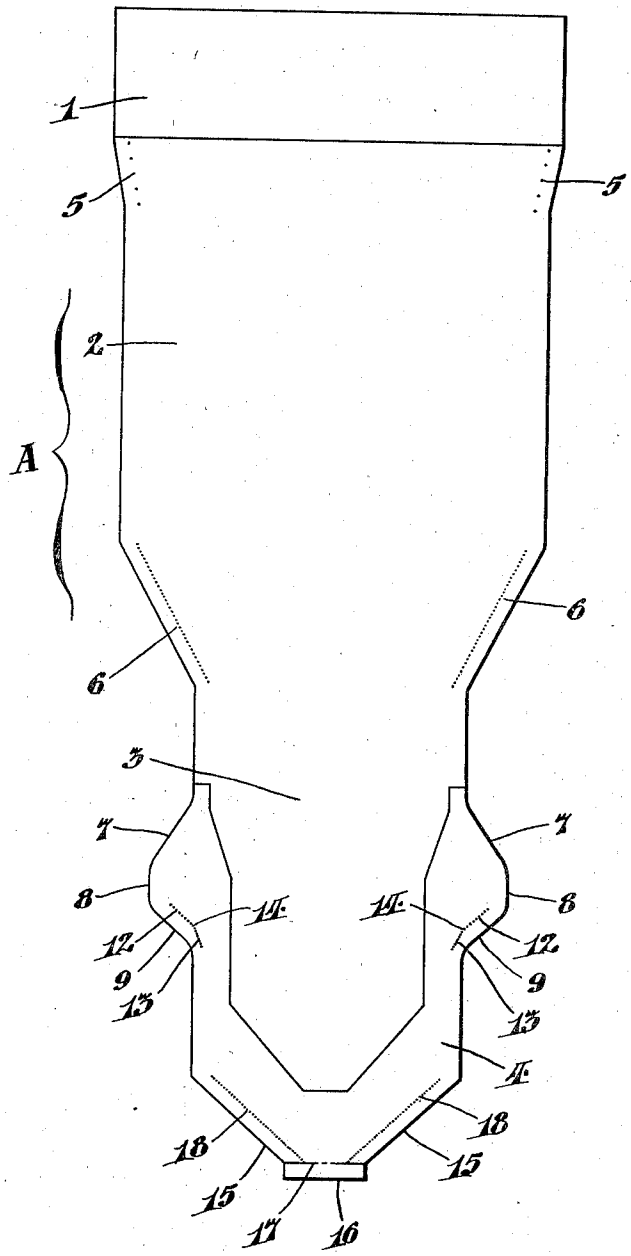
Sept. 14, 1948. J. HELD ET AL 2,449,477

KNITTING OF SHAPED FABRICS

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Fig. 1.



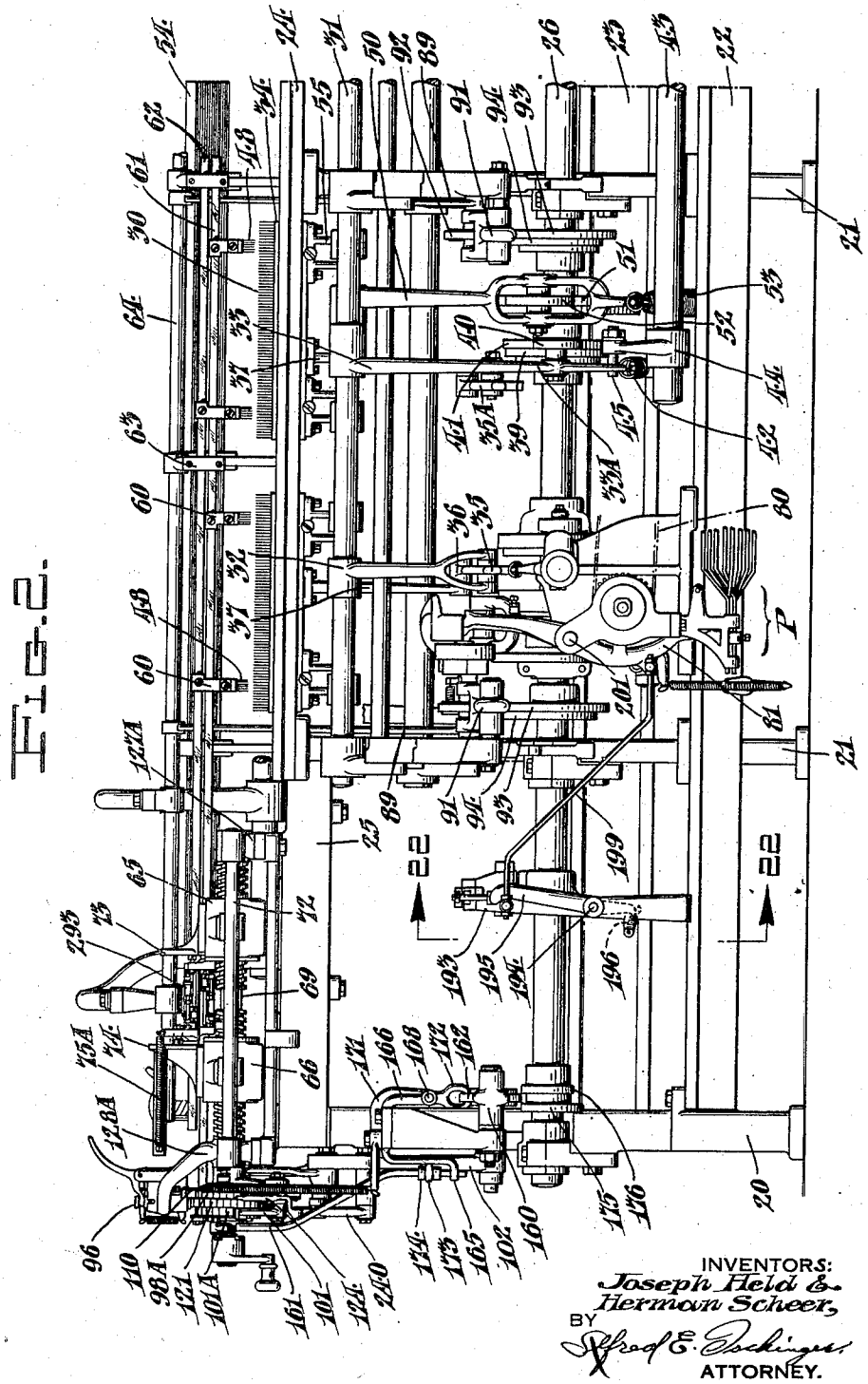
INVENTORS:
Joseph Held &
Hermon Scheer,
BY
Alfred E. Tschinger,
ATTORNEY.

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Fig. 2.

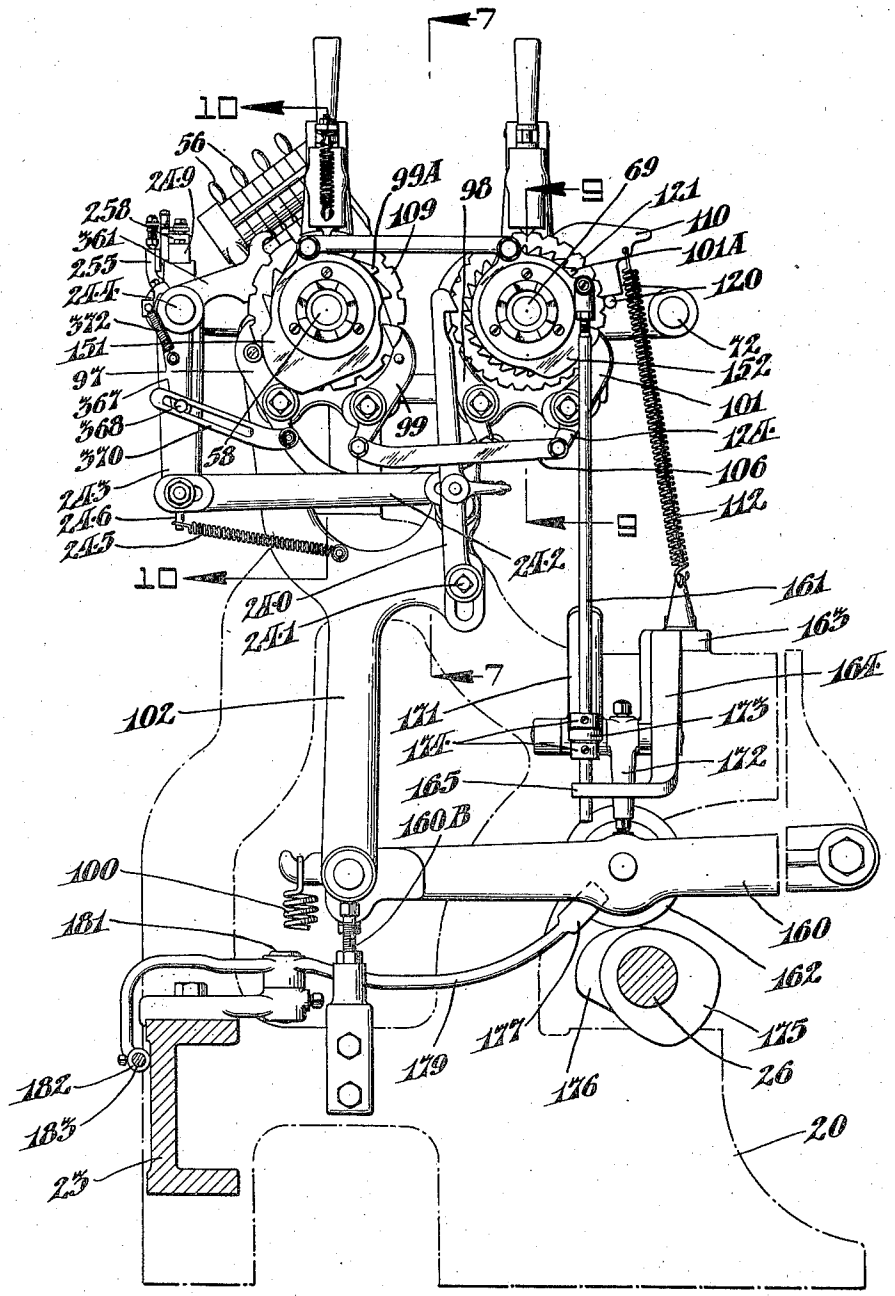


Sept. 14, 1948. J. HELD ET AL 2,449,477

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FIG. 3.



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Pfund & Pschinger
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KNITTING OF SHAPED FABRICS

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Fig. 4.

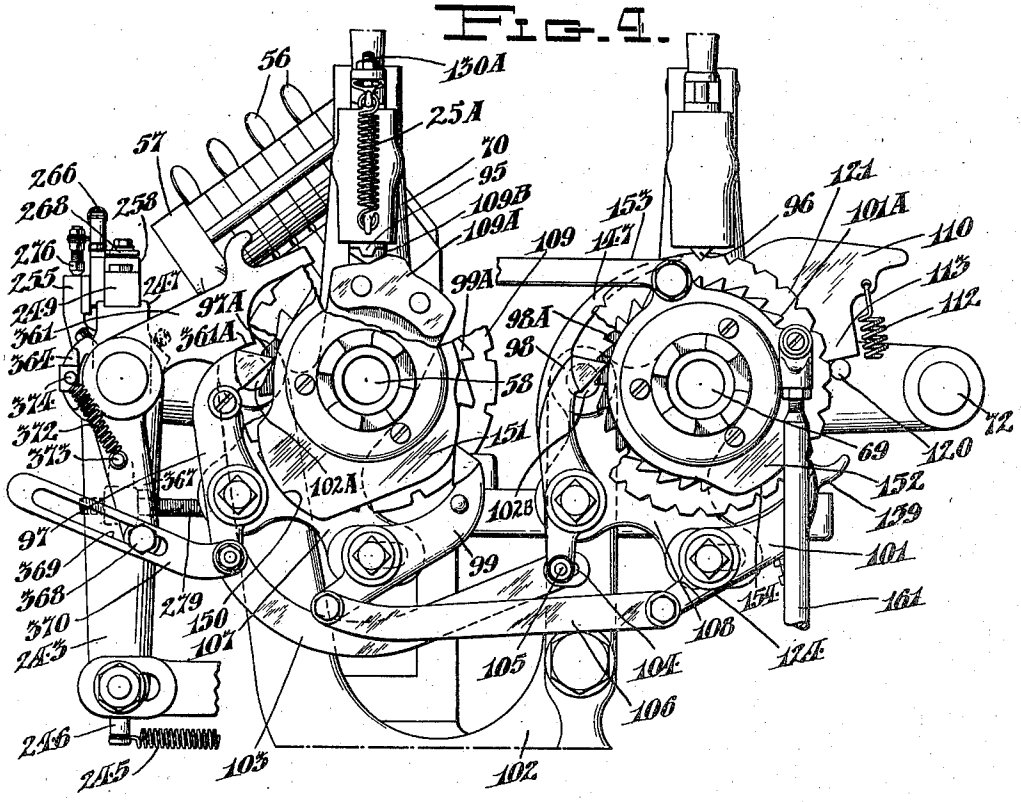
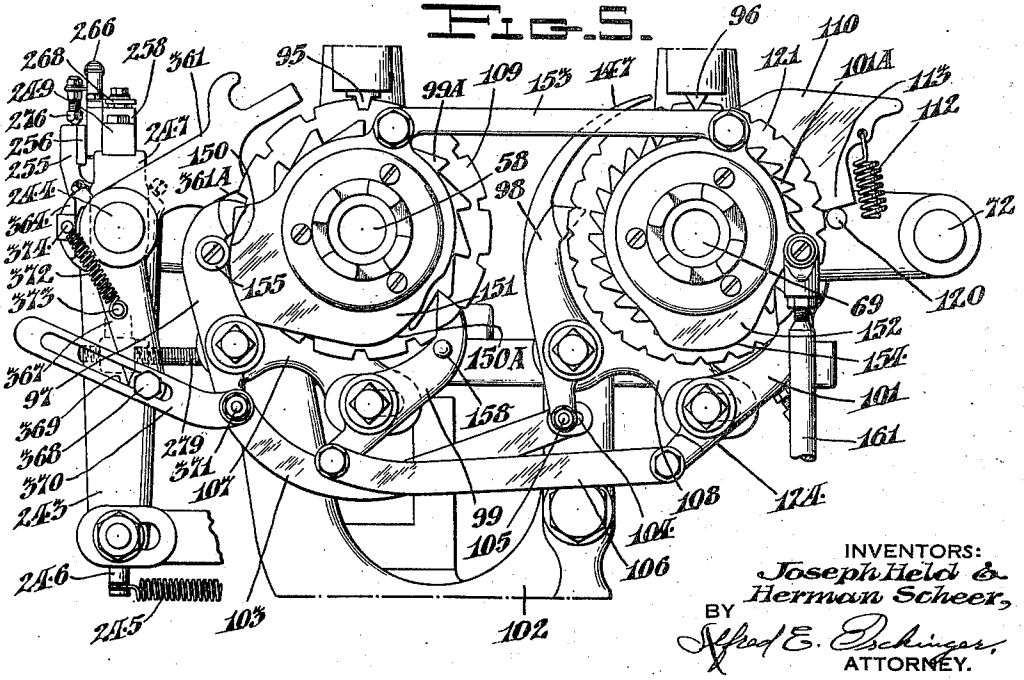


Fig. 5.



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KNITTING OF SHAPED FABRICS

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Fig. 6.

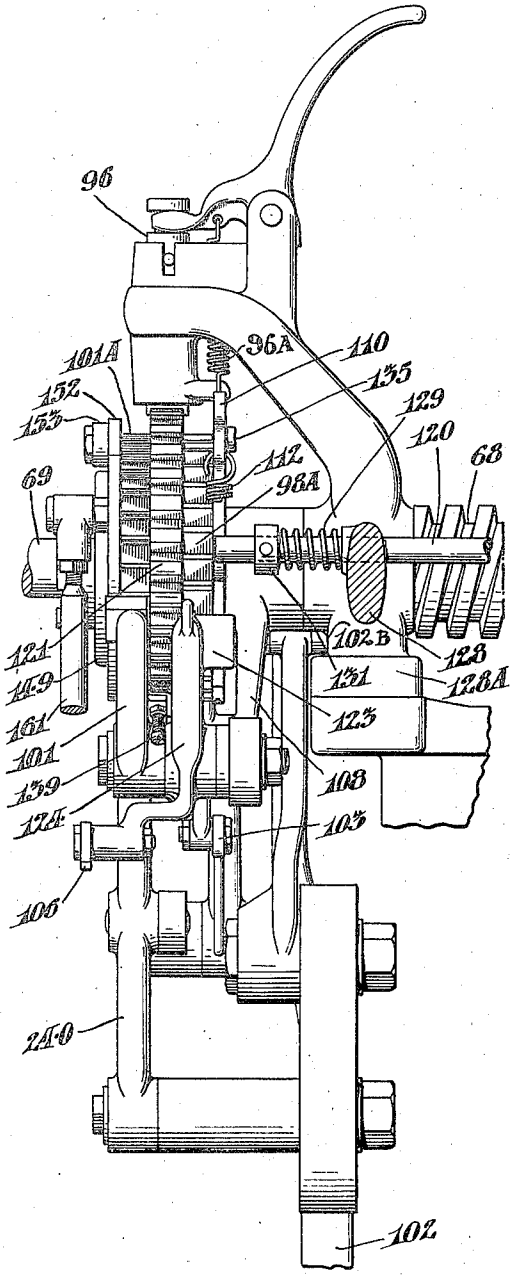
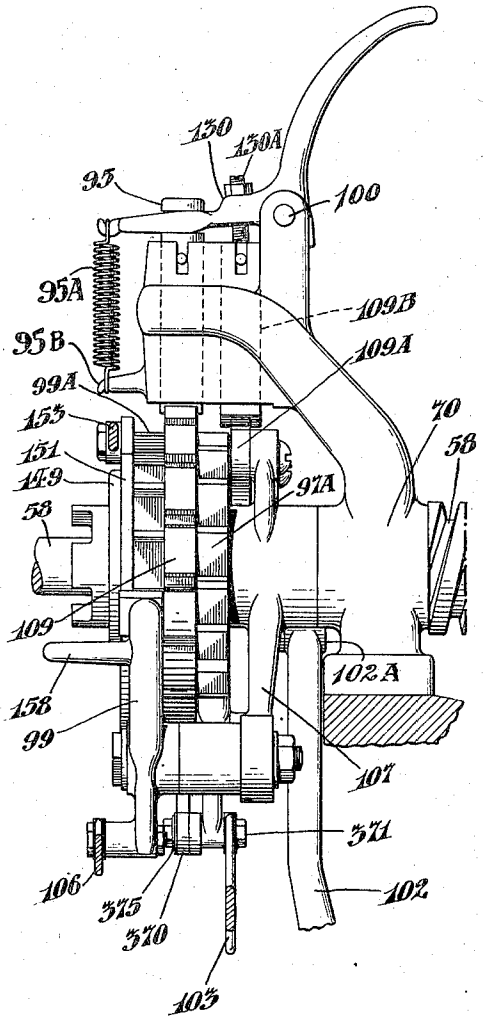


Fig. 7.



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Fig. 8.

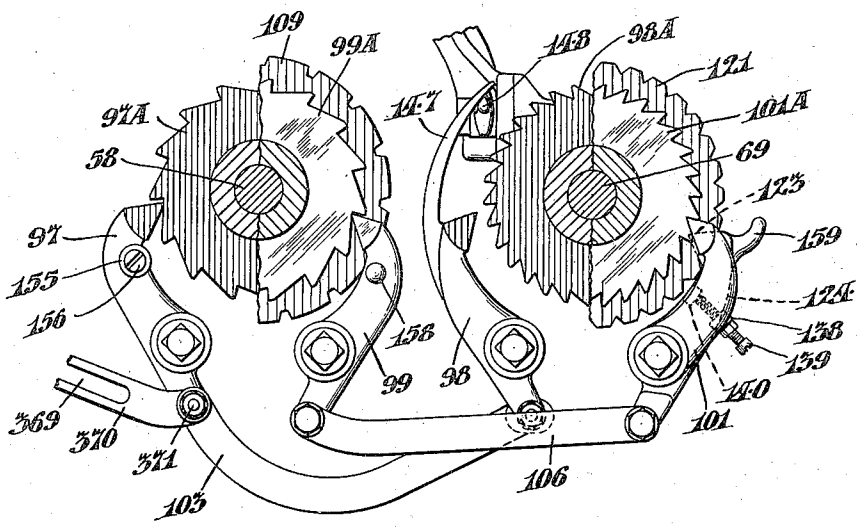


Fig. 9.

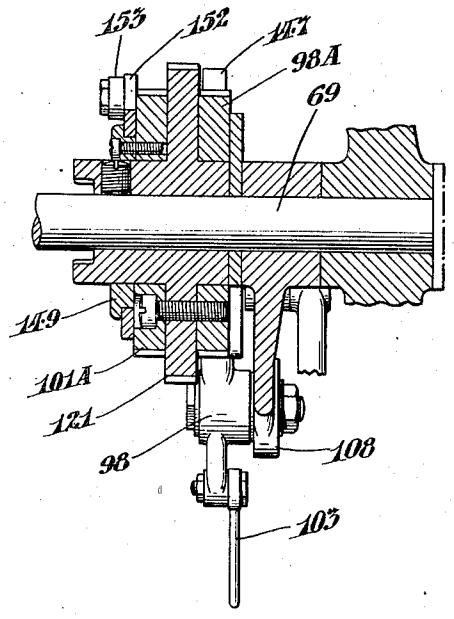
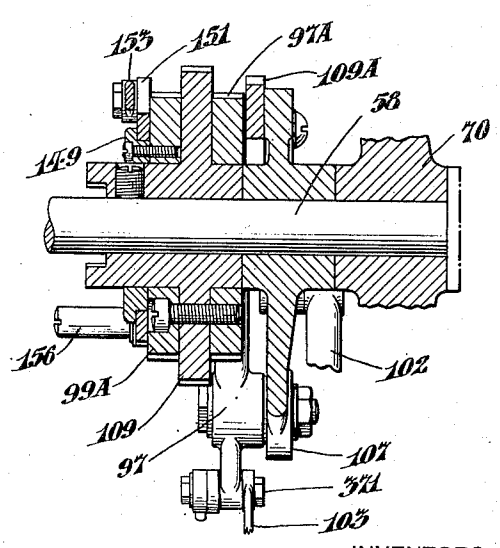


Fig. 10.



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Fig. 11.

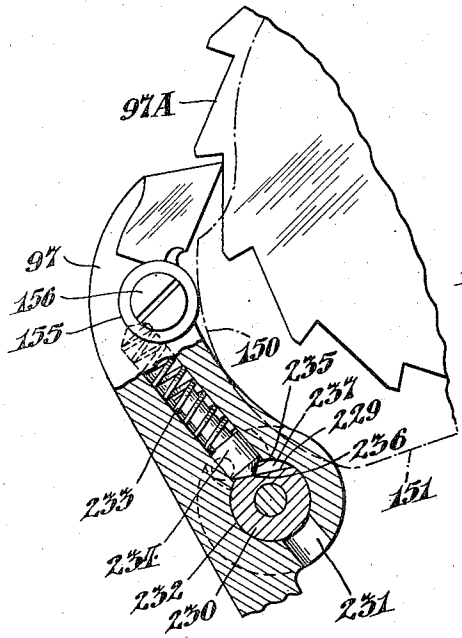


Fig. 12.

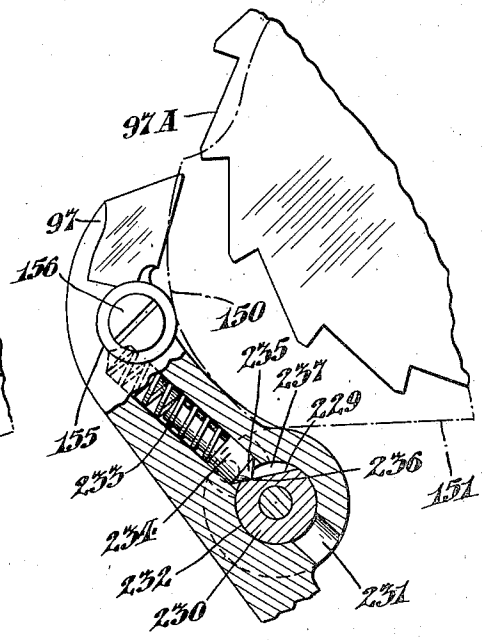


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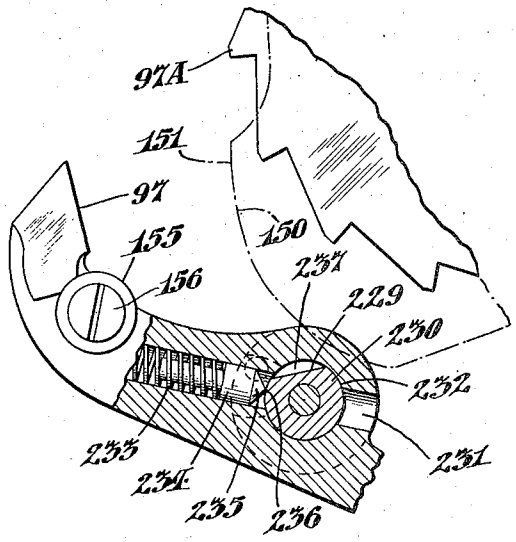
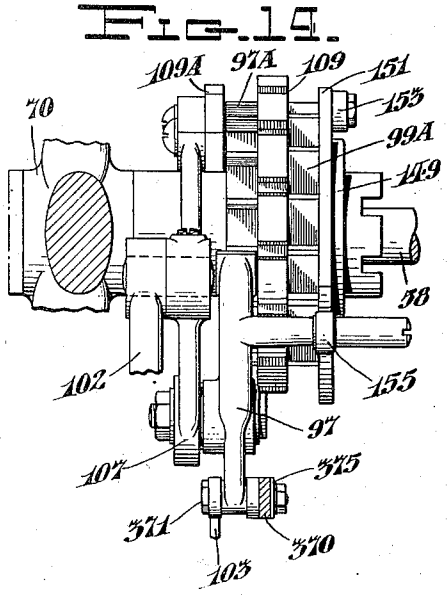


Fig. 14.



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Fig. 15.

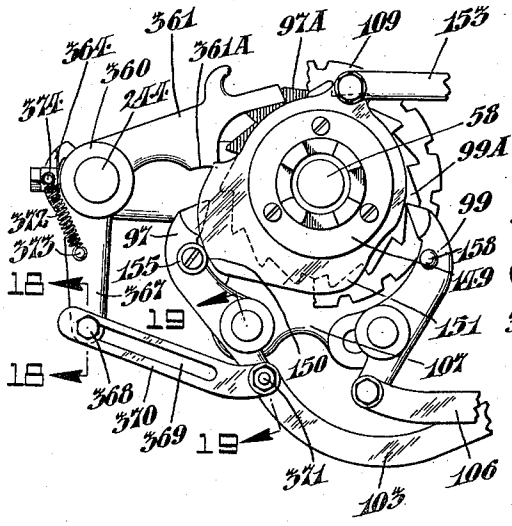


Fig. 16.

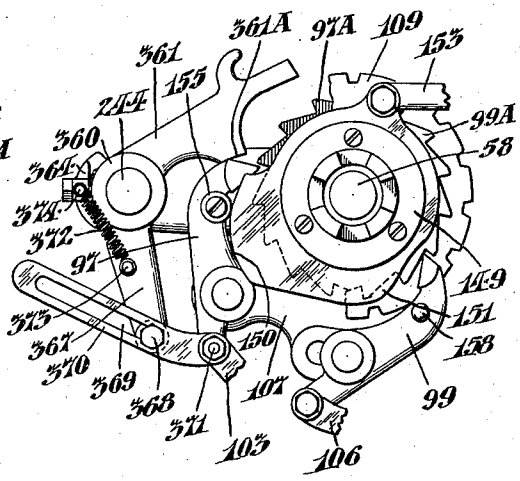


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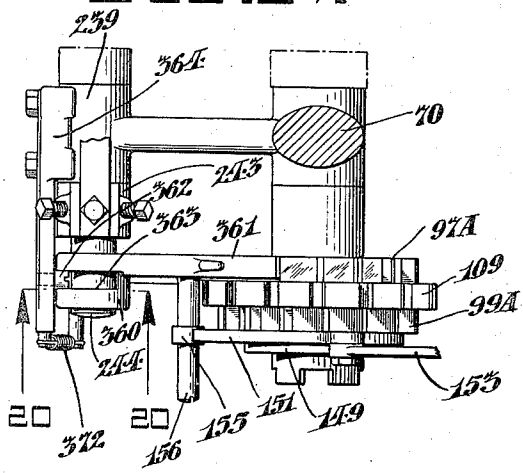


Fig. 18.

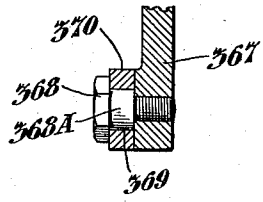


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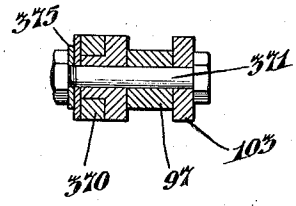
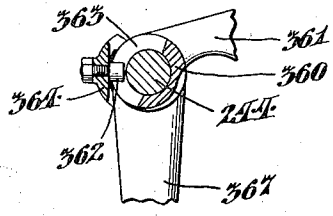


Fig. 20.



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Fig. 21.

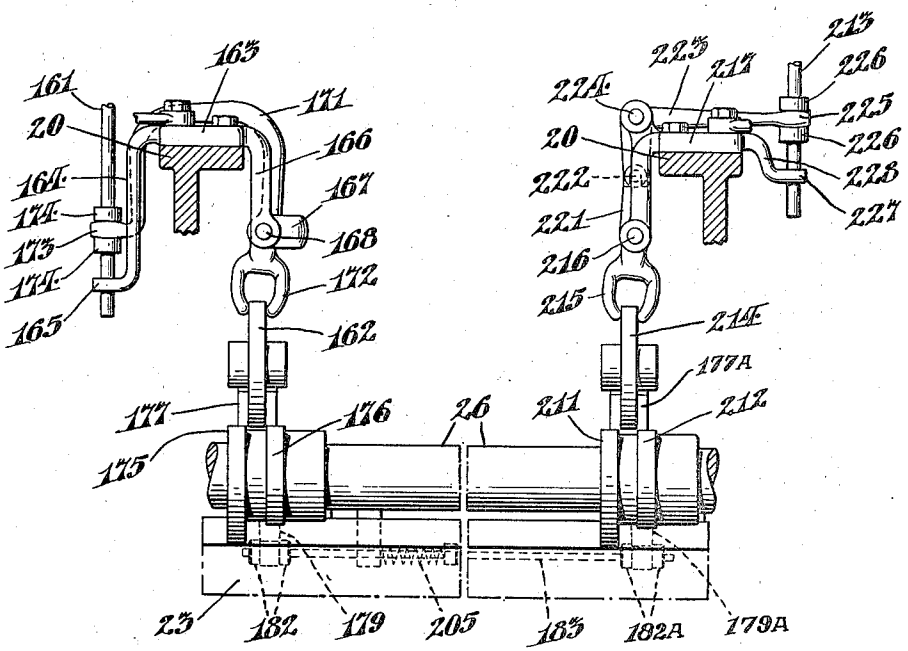


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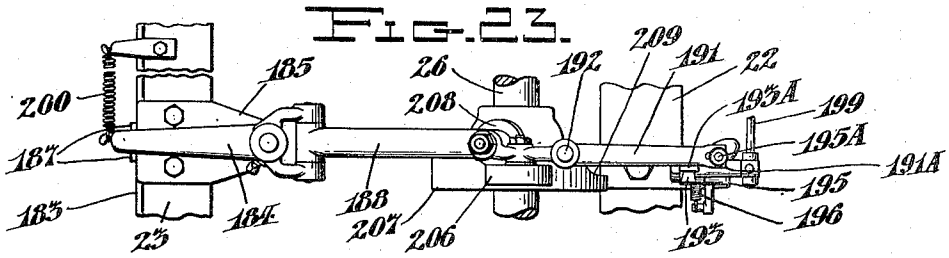
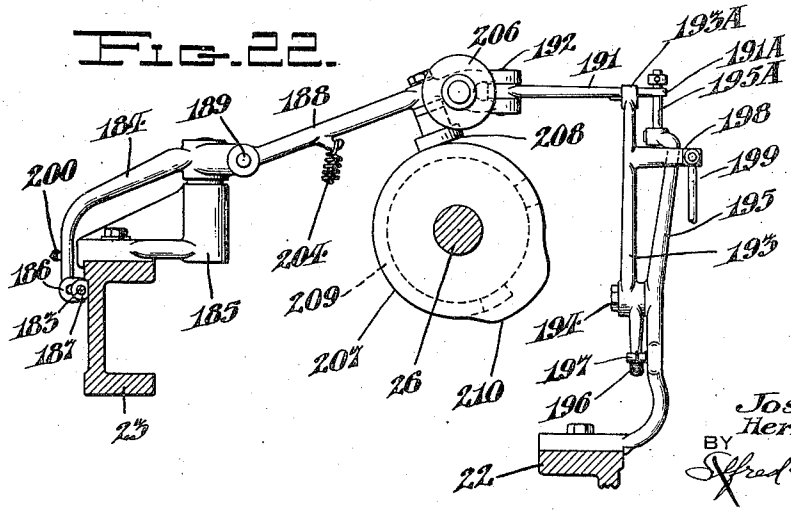


Fig. 22.



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Fig. 24.

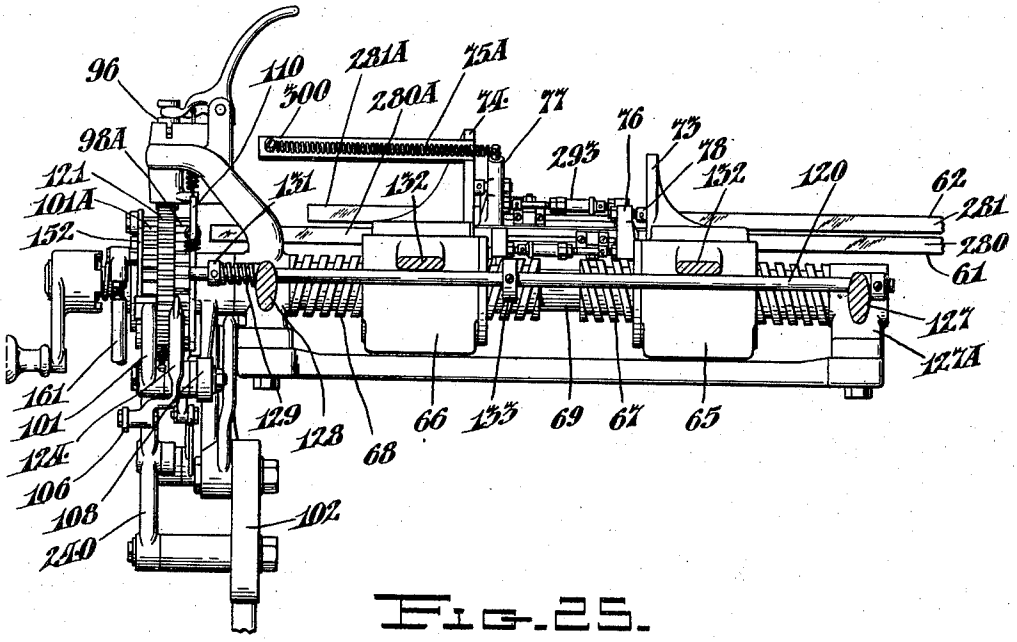


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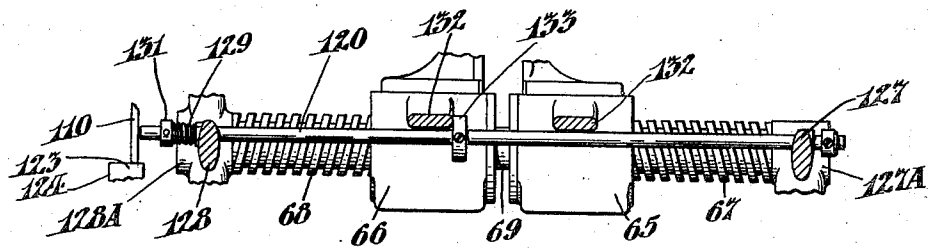
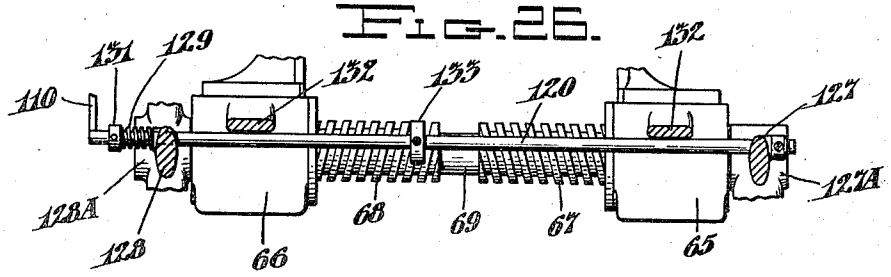


Fig. 26.



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Fig. 27.

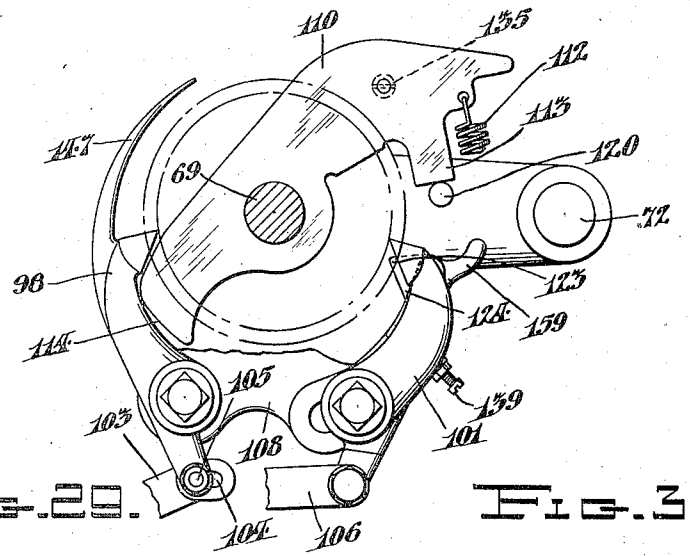


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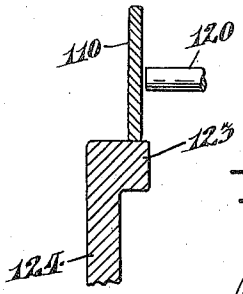


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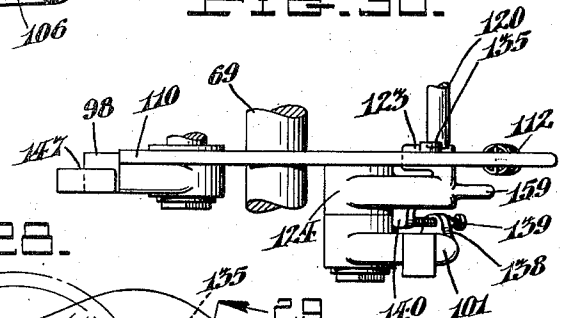
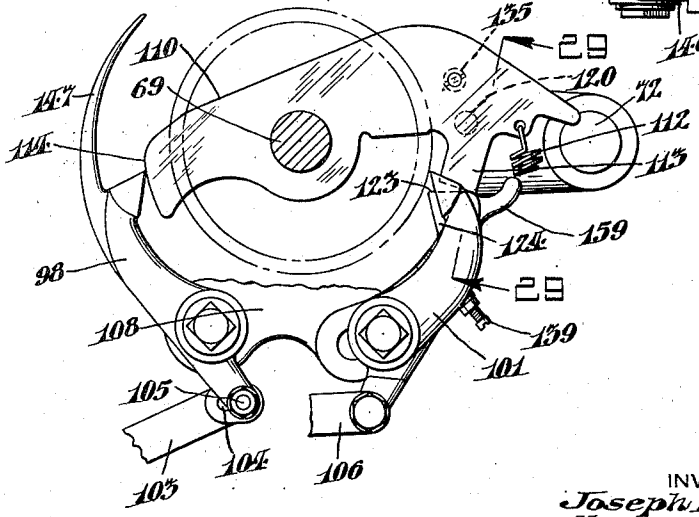


Fig. 28.



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KNITTING OF SHAPED FABRICS

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Fig. 31.

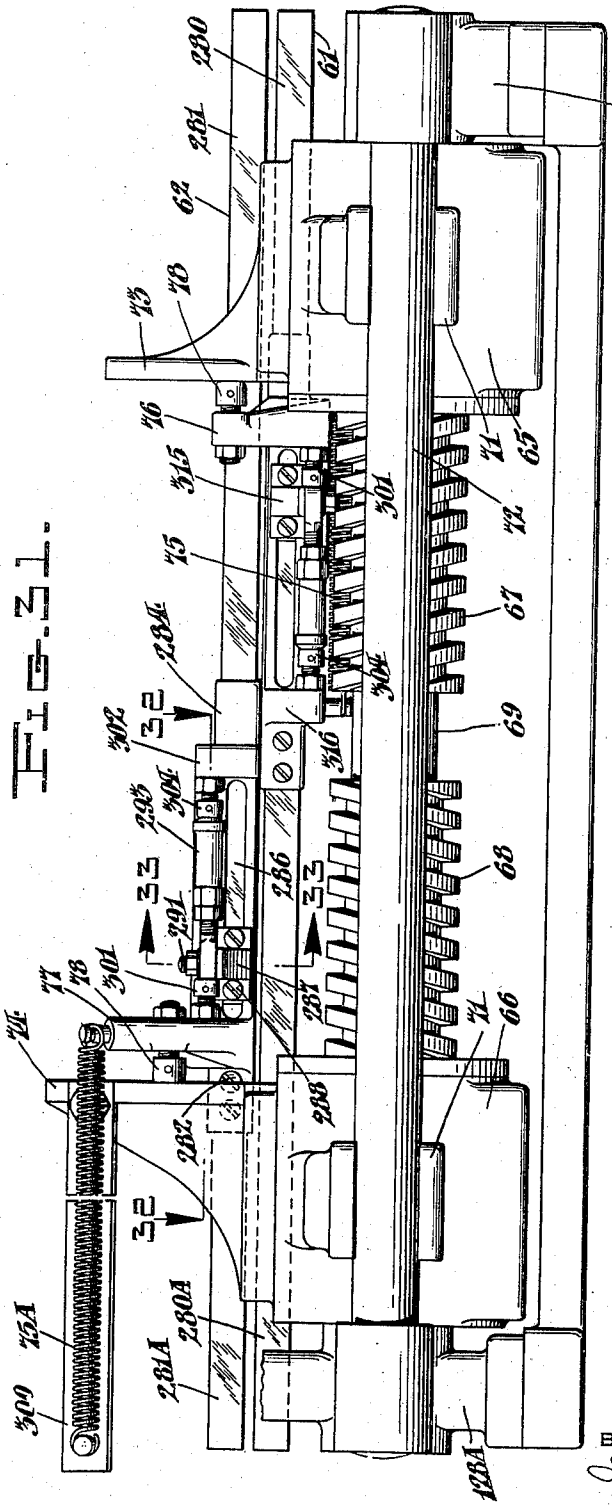


Fig. 33.

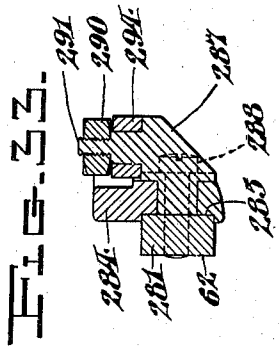
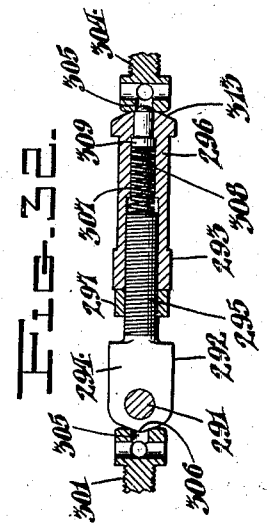


Fig. 32.



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Fig. 34.

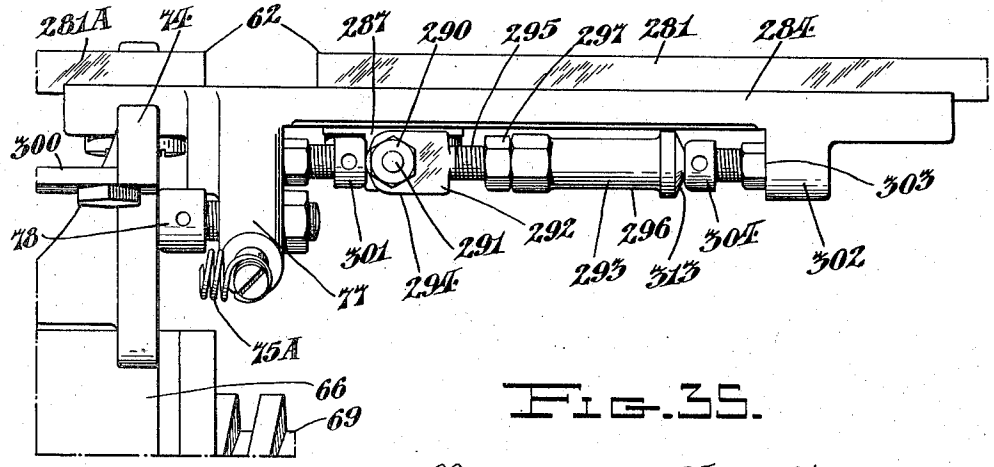


Fig. 35.

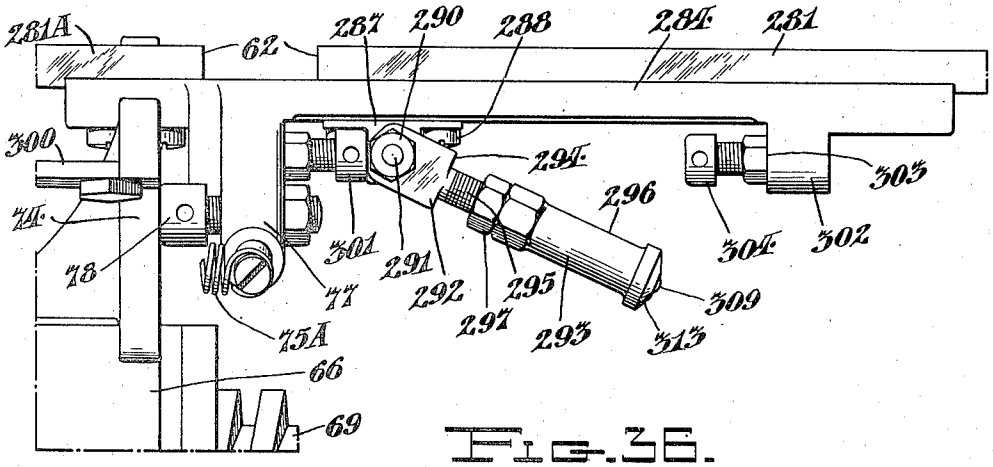
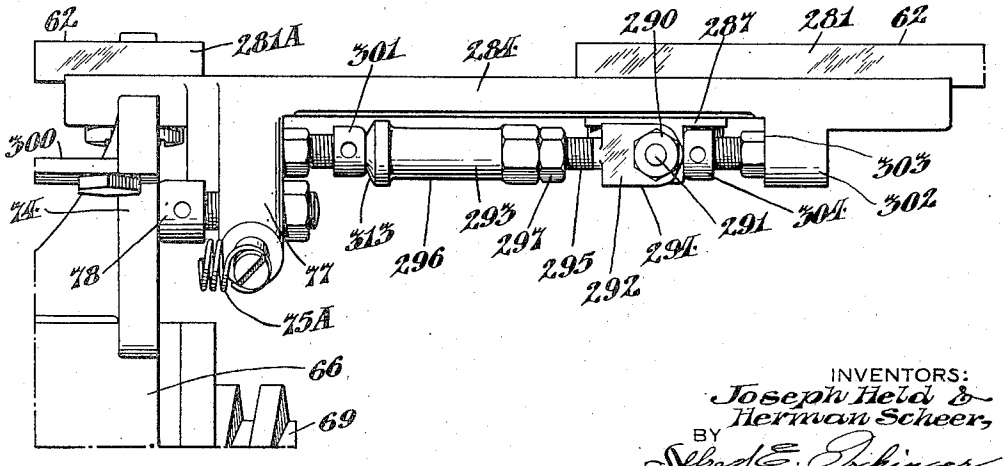


Fig. 36.



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Fig. 37.

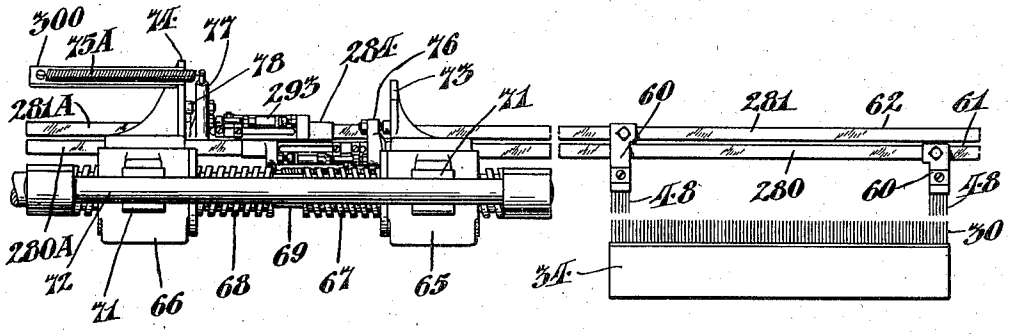


Fig. 38.

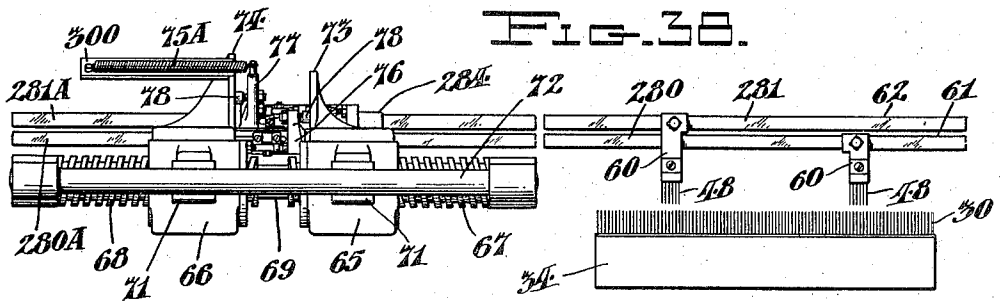


Fig. 39.

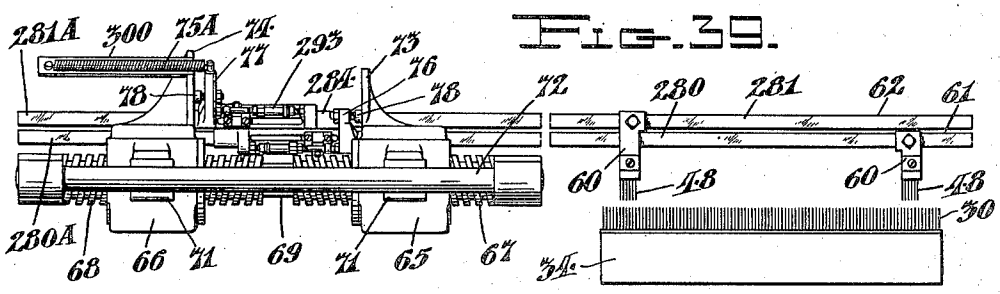
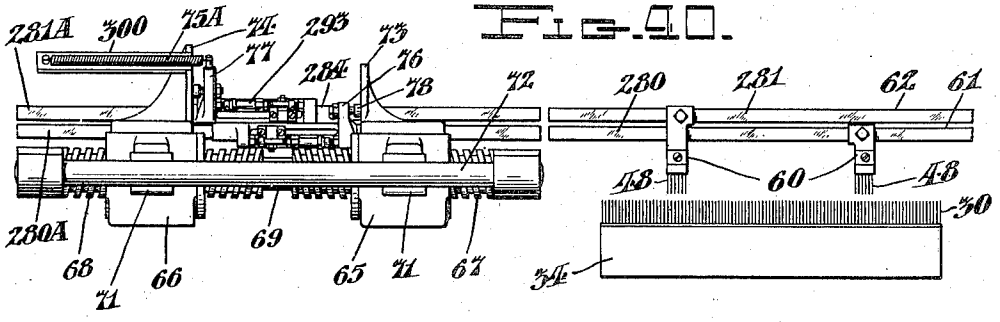


Fig. 40.



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KNITTING OF SHAPED FABRICS

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Fig. 41.

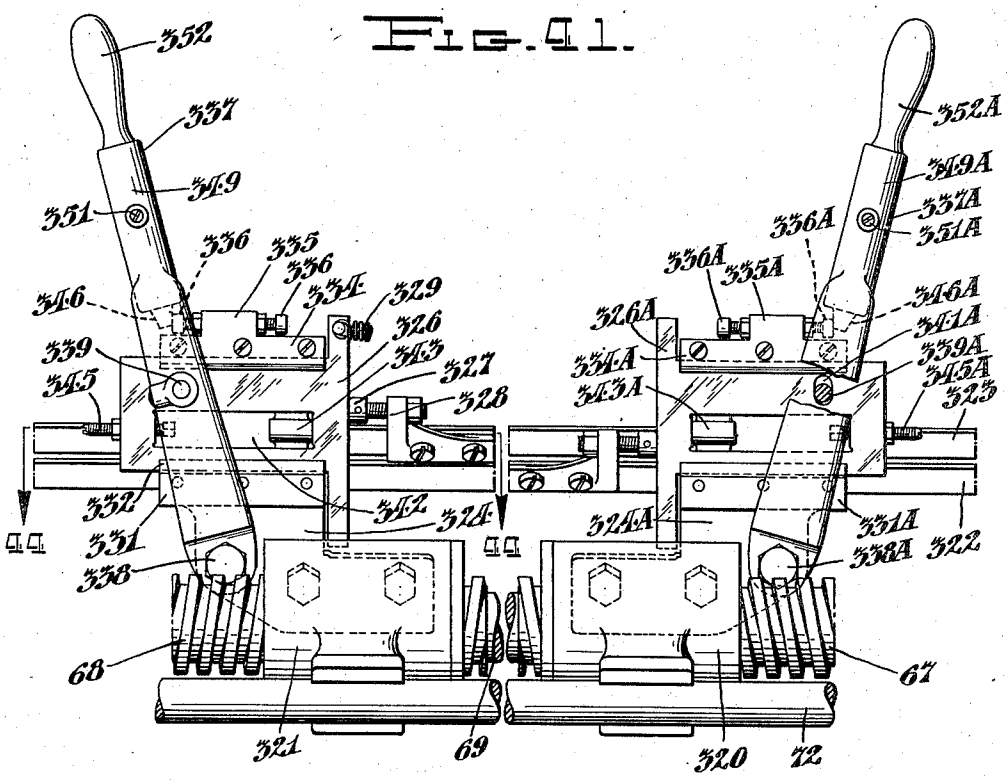
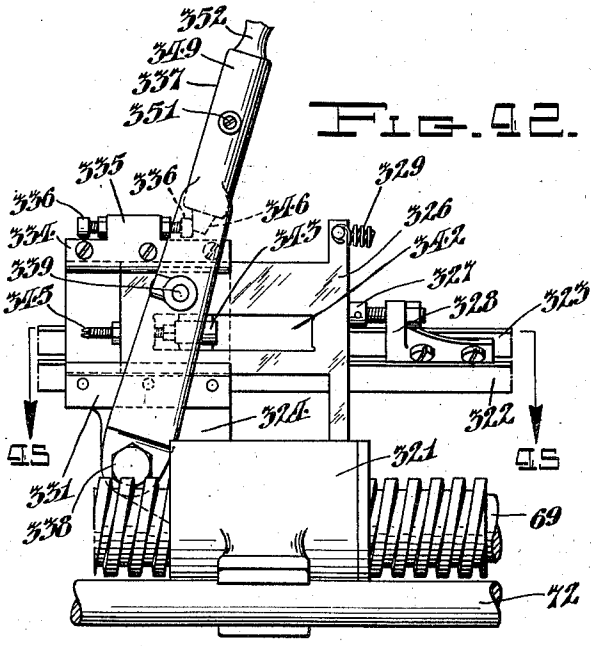


Fig. 42.



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Fig. 04.

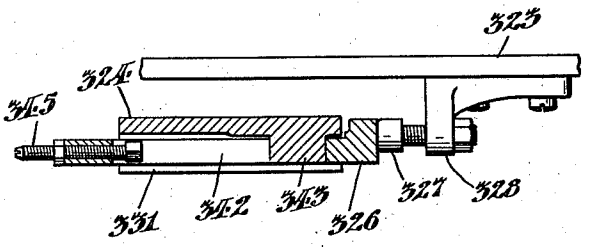


Fig. 03.

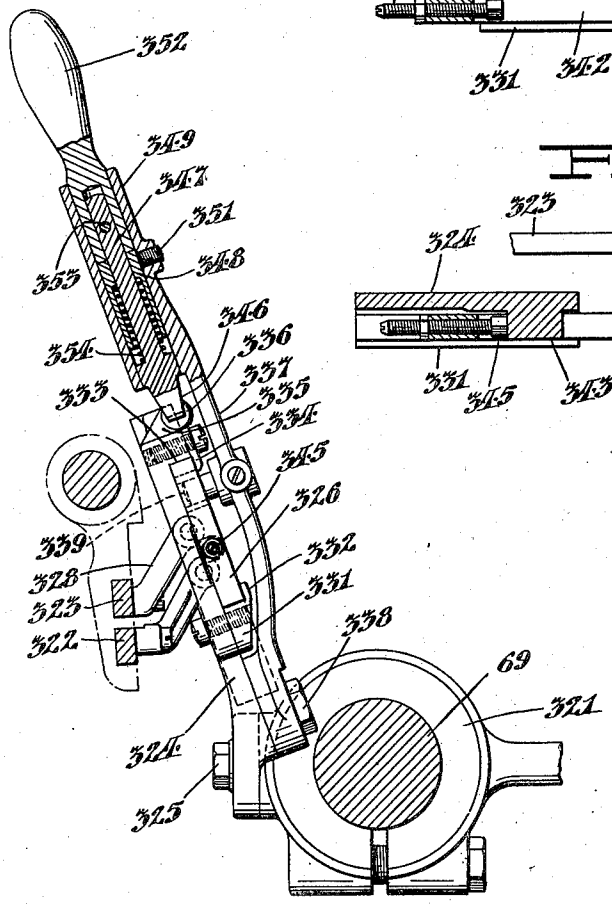
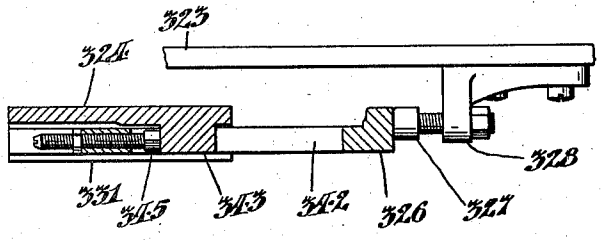


Fig. 05.



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Fig. 46.

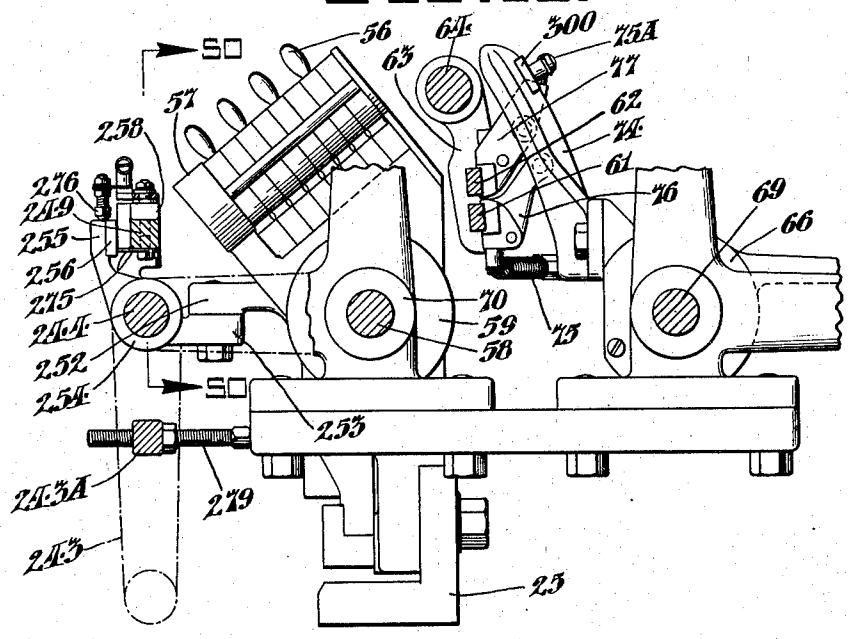
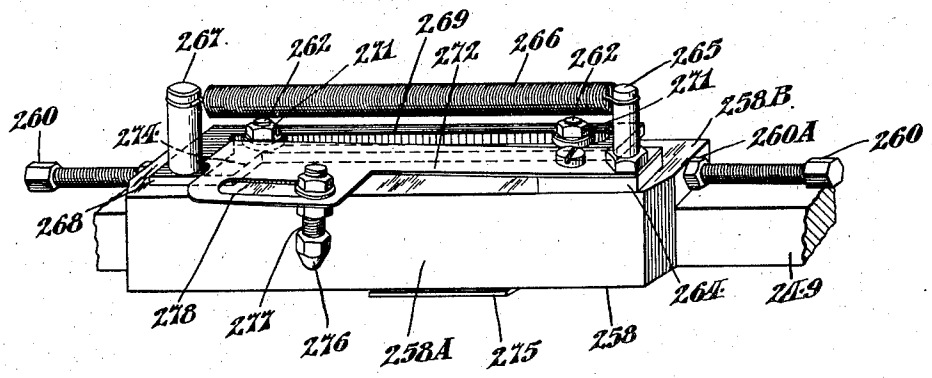


Fig. 47.



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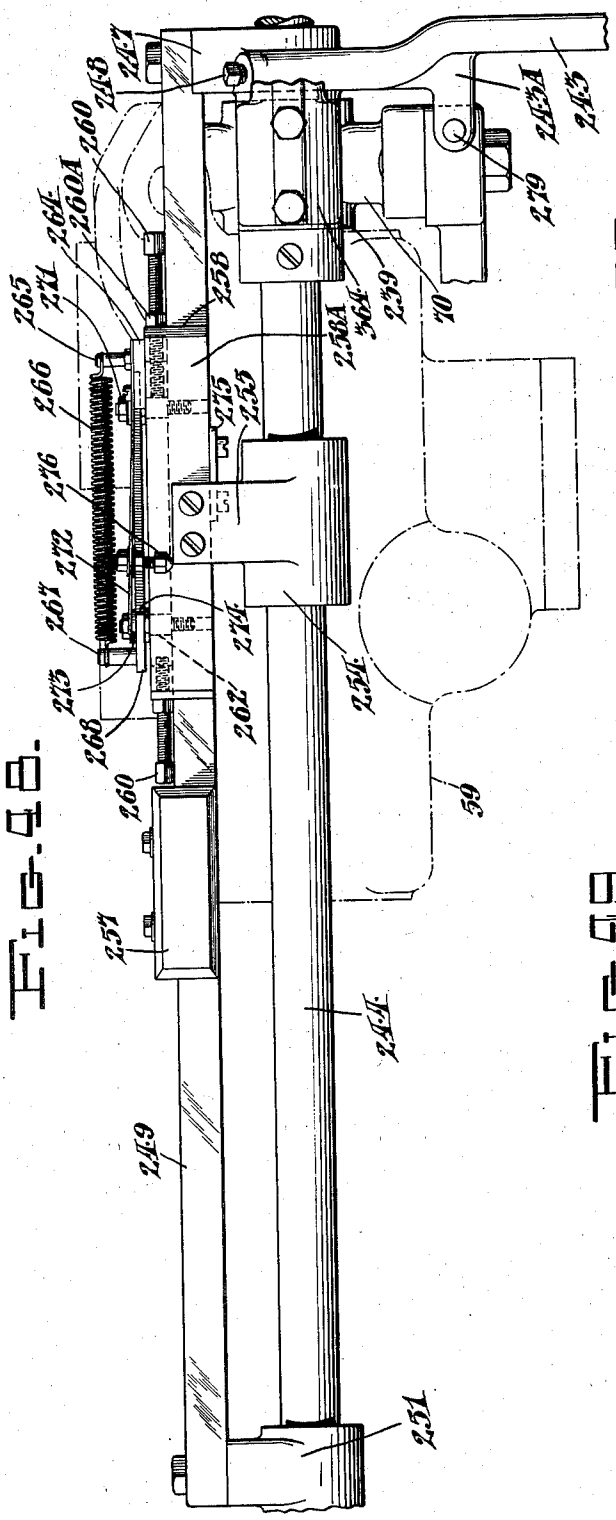


Fig. 48.

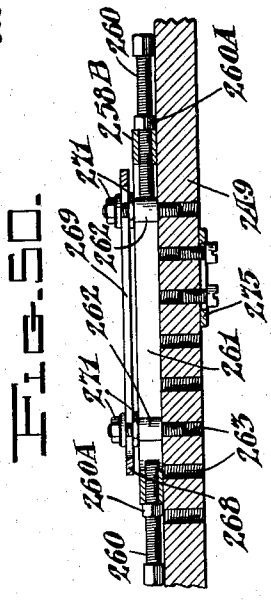


Fig. 50.

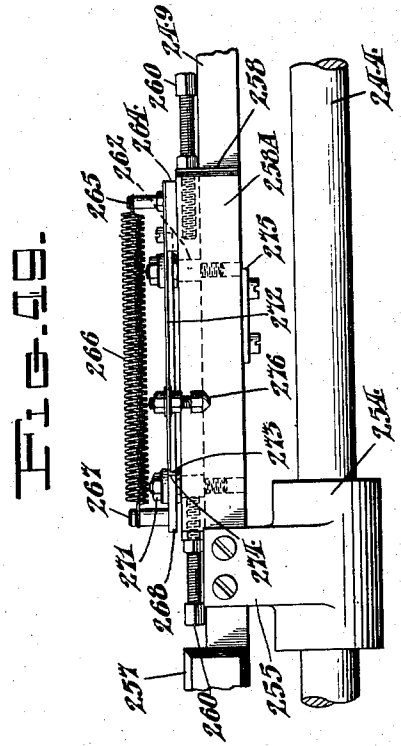


Fig. 49.

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Fig. 51.

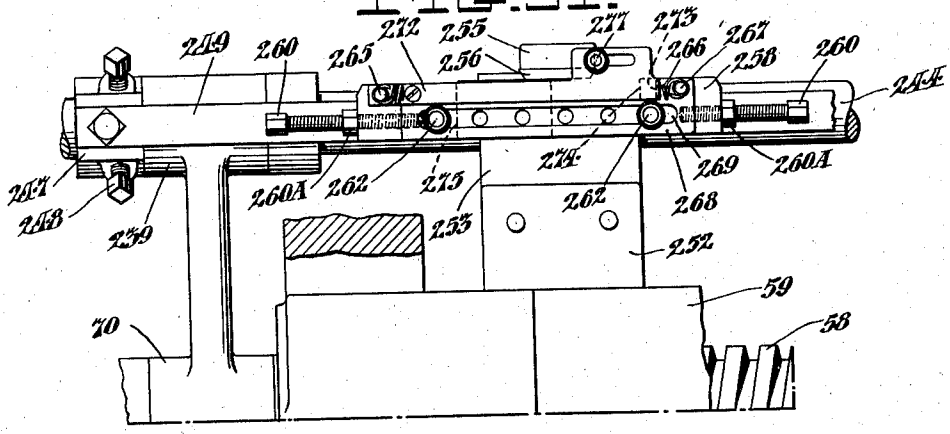


Fig. 52.

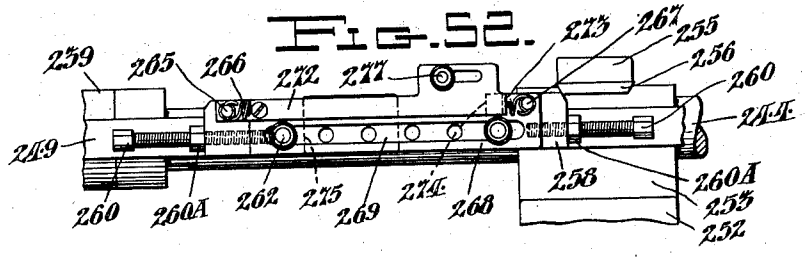


Fig. 53.

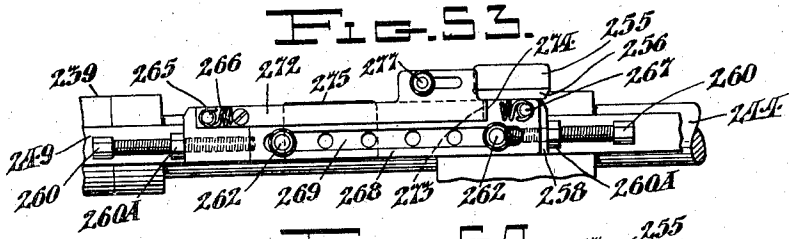


Fig. 54.

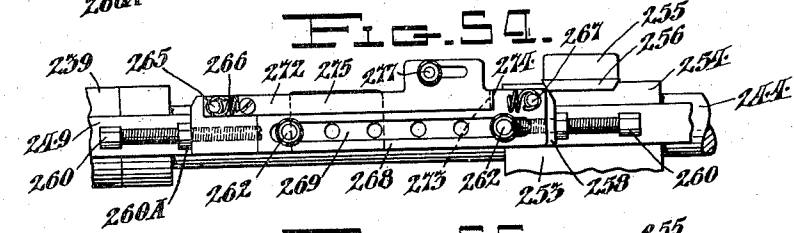
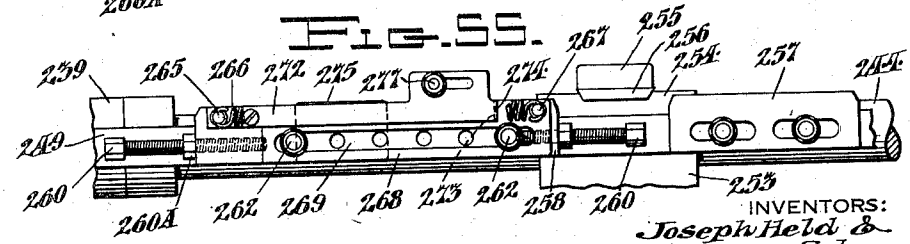


Fig. 55.



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2,449,477

KNITTING OF SHAPED FABRICS

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Application April 4, 1942, Serial No. 437,714

44 Claims. (Cl. 66—89)

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This invention relates to full-fashioned or other straight knitting machines, such as so-called "leggers," utilized for producing full-fashioned hosiery leg blanks, and more particularly to novel means for such machines which will enable them to produce other improved fashioned blanks, such as complete leg-and-foot, or single unit, blanks, by a new method.

The majority of blanks for full-fashioned stockings are made on two machines, a "legger" and a "footer," and large numbers of standard leggers are being operated in knitting mills in this country. These standard full-fashioned legger machines have threaded spindles capable of imparting to the stop nuts for the yarn carrier rods movements sufficient for single unit needs. However, these machines are not adapted to make both the leg and the foot portions of the blank for a stocking, one reason for this being that the means for moving the narrowing combs is not designed to permit said combs to travel a distance required to perform all the narrowing operations necessary to the production of a standard full-fashioned stocking. The threaded portions of the narrowing spindles, if used in the intended manner, are too short when operated to produce a complete leg-and-foot blank, and if the nuts for the narrowing combs are operated in an attempt to produce such a blank they may be accidentally moved beyond the limits to which these nuts are confined in the legger machine, with the result that the nuts are jammed and their precise adjustment is disrupted.

Full-fashioned hosiery machines of the "single unit" type, usually have longer frames as well as longer spindles for moving the narrowing combs, so that they can not always be installed in the space provided for leggers, even if the owners are willing to substitute one for the other, and sacrifice their investment in the leggers.

Further, the formation of a suitable heel pocket requires that the blank for the stocking be widened in the region of the heel. This has been done for single unit stockings in a number of well known ways. Heel pockets produced by widening and narrowing operations of a single unit machine have certain recognized advantages. The means for racking the end stop and narrowing spindles of the standard legger has not been considered well adapted for such a method of operation, and attempts to make blanks for full-fashioned stockings by widening and narrowing the heel areas on a legger machine have heretofore encountered difficulties in the way of improper racking, causing loss of time, or damage to the fabric, or both.

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It is an object of the present invention to provide novel means for operating the narrowing combs of an ordinary legger knitting machine to perform all the movements required in making complete leg-and-foot blanks for full-fashioned hosiery.

Another object is to provide such means capable of preventing the nuts on the narrowing spindle coming into contact during the production of single unit hosiery blanks.

A further object is to provide novel means for racking, and for controlling the racking of, the end stop and narrowing spindles of the ordinary legger, and particularly the means for controlling turning of said spindles in the widening or back-racking direction.

In connection with the making of single unit blanks by processes including widening and narrowing of the heel areas, the difficulty has arisen that relatively high tension knitted areas are formed near the angle in the selvage edge at the point where the heel selvage joins the sole selvage.

It is another object of the present invention to provide single unit hosiery and blanks free of portions having high loop tension in the heel pocket areas, by a novel method of production.

An additional object is to provide a mechanism adapted to automatically carry out the narrowing operations necessary for making a single unit hosiery blank free of areas having high loop tension.

It is also an object to provide a mechanism responsive to a widening or back-racking operation adapted to control the point at which the fashion marks made in narrowing begin to incline to the selvage.

Another object is to provide a mechanism whereby a reversal of the motion of the end stops of a full-fashioned knitting machine automatically changes the point in the path of the end stops at which the narrowing mechanism changes its action so as to make fashion marks in a line inclined to the selvage instead of parallel thereto.

A further object is to provide automatic means for throwing out of action, when desired, both the back-racking or widening pawls for the carrier rod end stop and narrowing spindles, while permitting both the narrowing pawls to operate and for throwing out of action when desired both the narrowing pawls while permitting both widening or back-racking pawls to operate.

It is also an object to provide operating means for the end stop and narrowing spindles so arranged that both pawls for operating the nar-

rowing spindle may be thrown out of operation by hand without disturbing the operation of the pawls for operating the end stop spindle together with means whereby either of the pawls for operating the end stop spindle may be put out of operation automatically when desired.

With these and other objects in view, which will become apparent from the following detailed description of the illustrative embodiment of the invention shown in the accompanying drawings, the present invention resides in the novel fabric blanks, hosiery and method of making the same, as well as the mechanisms, elements, features of construction and arrangement of parts in cooperative relationship, as hereinafter more particularly pointed out in the claims.

In the drawings:

Figure 1 is a view of a full-fashioned stocking blank made in accordance with the present invention;

Fig. 2 is a front elevational view of the left end portion of a full-fashioned knitting machine having mechanism applied thereto for effecting narrowing and widening operations in accordance with the present invention;

Fig. 3 is an end view taken from the left of Fig. 2 and enlarged relative thereto;

Fig. 4 is an enlarged detail view of the mechanism shown at the top of Fig. 3, certain of the parts being broken away and others shown in different positions relative to Fig. 3;

Fig. 5 is a view similar to Fig. 4, but showing the parts in still other positions;

Fig. 6 is an enlarged detail view of certain of the mechanism shown at the upper left end of Fig. 2;

Fig. 7 is a view taken substantially along the line 7—7 of Fig. 3 and enlarged relative thereto;

Fig. 8 is a detail view of the pawl and ratchet mechanism shown in Fig. 4, certain of the parts broken away and others shown in different positions;

Figs. 9 and 10 are cross-sectional views taken substantially along the lines 9—9 and 10—10, respectively, of Fig. 3 and enlarged relative thereto;

Fig. 11 is an enlarged detail view of a portion of the pawl and ratchet mechanism shown at the left of Fig. 8, partly in section and having a cam element associated therewith in dot-and-dash outline;

Figs. 12 and 13 are views similar to Fig. 11, but showing the parts in different relative positions;

Fig. 14 is a detail view of one of the pawl and ratchet devices, taken from the left of Fig. 3 and enlarged relative thereto;

Fig. 15 is a detail view of certain of the mechanism shown at the left of Fig. 4, with the parts in different positions relative thereto;

Fig. 16 is a view similar to Fig. 15 with the parts in different positions relative thereto;

Fig. 17 is a top view of the mechanism shown in Fig. 15;

Fig. 18 is a sectional view taken substantially along the line 18—18 of Fig. 15;

Fig. 19 is a sectional view taken substantially along the line 19—19 of Fig. 15;

Fig. 20 is a sectional view taken substantially along the line 20—20 of Fig. 17;

Fig. 21 is a detail view of a cam follower shifting mechanism shown at the lower left of Fig. 2, enlarged relative thereto, and including the corresponding mechanism at the right hand end of the machine (not otherwise shown);

Fig. 22 is a partial sectional view taken transversely of the machine and in the direction of the arrows 22—22 of Fig. 2, and enlarged relative to Fig. 2;

Fig. 23 is a top view of the mechanism shown in Fig. 22;

Fig. 24 is a view of certain of the mechanism shown at the upper left of Fig. 2, and enlarged relative thereto;

Figs. 25 and 26 are detail views showing certain of the mechanism of Fig. 24 in different relative positions;

Figs. 27 and 28 are enlarged detail views showing mechanism for preventing overtravel of the narrowing rod nuts of the machine, with the parts in different relative positions;

Fig. 29 is a sectional view taken substantially along the line 29—29 of Fig. 28;

Fig. 30 is a top view of the mechanism shown in Fig. 28;

Fig. 31 is a view of mechanism for increasing the effective length of the narrowing rod spindle shown at the upper left of Fig. 2 with the parts shown in different positions and enlarged relative thereto;

Fig. 32 is a sectional view taken substantially along the line 32—32 of Fig. 31;

Fig. 33 is a sectional view taken substantially along the line 33—33 of Fig. 31;

Figs. 34, 35 and 36 are a series of top views showing a portion of the mechanism shown at the left center of Fig. 31 but with the parts shown in different positions;

Figs. 37, 38 and 39 comprise a series of composite views showing the narrowing rods, combs and their operating means in the positions occupied thereby relative to the needles during sequential steps in the production of the stocking blank shown in Fig. 1 while the spindle lengthening means is inactive;

Fig. 40 is a view similar to Fig. 39 but with the spindle lengthening means in operation;

Fig. 41 is a view of a further form of mechanism within the invention for increasing the effective length of the narrowing spindles while inactive;

Fig. 42 is a view showing the spindle lengthening mechanism at the left of Fig. 41 in its active position;

Fig. 43 is a left end view of the mechanism as shown in Fig. 41, partly in elevation and partly in section;

Figs. 44 and 45 are partial sectional views, taken substantially along the lines 44—44 and 45—45 of Figs. 41 and 42, respectively;

Fig. 46 is an enlarged detail view with parts broken away and partially in section of certain of the mechanism shown in Fig. 3;

Fig. 47 is an enlarged perspective view of certain control mechanism shown at the left of Fig. 46 for changing the operation of the narrowing rod spindle;

Fig. 48 is an enlarged view taken from the left of Fig. 46, with certain parts omitted and others shown in dot-and-dash outline;

Fig. 49 is a detail view of a portion of the mechanism shown in Fig. 48, but with the parts in different positions;

Fig. 50 is a cross-sectional view taken substantially along the line 50—50 of Fig. 46;

Fig. 51 is a top view of certain of the mechanism shown in Fig. 46 but turned at right angles relative thereto; and

Figs. 52, 53, 54 and 55 are a series of views similar to and showing a portion of the mechanism of Fig. 51 but with the parts shown in se-

quential positions occupied thereby during the knitting of the stocking blank shown in Fig. 1.

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.

Referring to Fig. 1, we have shown therein a flat knitted single unit stocking blank A composed essentially of plain knitted loops and adapted to form, when the edges have been seamed, a full-fashioned stocking. Blank A comprises a welt 1, a leg portion 2, an ankle portion 3 and a foot portion 4. Said leg portion has therein a knee narrowing reducing the width of the blank just below the welt 1 and involving the production of inclined lines of fashion marks 5 parallel to the edges of the fabric, one on each side of the fabric. From the lower fashion mark of the knee narrowing, the fabric edges are straight and parallel for quite a distance in the direction from welt to toe and the leg or calf narrowing is then introduced. Said leg or calf narrowing involves the two inclined rows of fashion marks 6, one on each side of the fabric, the first or upper fashion mark in each of the rows 6 being in substantially the same vertical line as the last or lower fashion mark in the corresponding row 5. From the lower end of the fashion marks 6, the blank A has straight parallel edges throughout the ankle portion 3 extending into the high heel portion.

Not far from the upper edge of the heel reinforcement, the blank is widened, as shown, along outwardly diverging lines 7, widening being performed symmetrically at each side of the blank A. In the region of the heel, blank A has straight parallel sides 8 for a short distance following the widened edges 7 and then the blank is narrowed along line or edge 9, the narrowing along lines or selvage edges 9 being shown as covering the substantially same number of wales as the widening along line 7, the narrowing being also symmetrical as usual. Said narrowing along lines 9 involves the production of lines of fashion marks 12 and 13, lines 13 being a continuation of lines 12 but forming an angle therewith at 14 due to the fact that, as shown, lines of fashion marks 12 are parallel to the edges of the fabric while lines 13 are inclined thereto. The fabric provided by the widening along lines 7 with the following straight edged portions 8 and the subsequent narrowed portions 9 serves to form heel pockets when the blank has been seamed up. It has been found, moreover, that the inclined lines

of fashion marks 13 serve to relieve the tension in the loops and to thereby prevent the formation of inelastic spots or portions at the angle in the edges of the blank formed by edges 9 of the heel pocket areas and the parallel edges of the foot portion 4. It will be seen further that the angle 14 in the fashion marks is close to the angle in the selvage formed by edges 9 of the heel and said parallel edges of the foot portion.

From the last formed end of the inclined edges 9, the edges of foot portion 4 extend straight and parallel and then are narrowed along lines 15 to form the toe, the knitting being completed upon the formation of ravel courses 16. When ravel courses 16 are pulled out, a raw edge is formed at 17 along a line transverse to the wales of the knitting. After the blank A has been folded, the toe is finished by looping along lines 17.

It will be noted that not only are the first fashion marks in lines 12 in wales outside those of the last fashion marks in lines 6, but that the angles 14 at the junction of lines of fashion marks 12 and 13 are in wales outside those of the last marks in lines 6, and we have provided novel means whereby this result is obtained automatically.

It will be noted also that the lines of fashion marks 18 formed at the time the fabric is narrowed along the lines 15 converge to points at which they are spaced only a relatively short distance from each other along the line 17, thereby giving the foot the proper proportions, substantially the same as stockings formed on two machines. This result requires, however, that the narrowing points or combs have a greater traverse than in the standard legger or ordinary single unit machine and we have provided novel means of a simple character whereby said unusual traverse of the narrowing points or combs may be obtained. Also, we have provided means whereby any danger of over-running of the nuts for the narrowing spindles is eliminated.

In Figs. 2 to 55 inclusive, we have shown mechanism for making the blank A adapted to carry out, in part automatically, the novel method whereby said blank was made. In general, the machine shown in the drawings is of the well-known "Reading" type of full-fashioned knitting machine, said machine being more similar to the ordinary "legger" than to a "footer," but modified as compared to either so as to satisfactorily knit an entire stocking.

The general arrangement of said machine is best understood from Fig. 2, said machine comprising a frame including transverse end frames 20 and transverse center frames 21 and longitudinal members tying said frames together and including a front beam 22, a back beam 23, a front bed or table 24, a center bed 25 and a number of rods and shafts. The parts of the machine concerned in knitting operations are all operated directly or indirectly from a main camshaft 26 arranged longitudinally of the machine frame. The knitting needles 30 are arranged in groups, one for each knitting section, the needles in each group being all at the same level and held parallel to the camshaft 26 in generally vertical position being understood as of the spring beard type commonly used in full-fashioned knitting machines. During knitting, needles 30 are given both horizontal and vertical motions, their horizontal motions being provided by a presser shaft 31 which has depending levers 32 and 33 fixed thereto. Levers 32 serve merely as a portion of

the connections between shaft 31 and the bars 34 on which the needles 30 are mounted. The lower ends of levers 32 are pivotally connected to horizontal links 35 which extend rearwardly from the points of connection with levers 32 to pivotal connections at 36 with the lower ends of arms 37 which depend from the bottoms of the needle bars 34. Each lever 33 not only is connected to an arm 37 for swinging a needle bar 34 by a link 35A, but it has a downward extension 33A on which is fixed a horizontal pivot for a cam follower 40 which is held normally in contact with a cam 41 on shaft 26 by means of a spring 42 connected between the lower end of portion 33A and a fixed point on the frame of the machine. Cam 41 supplies the horizontal motions of the needles 30 at the time they go to press, but their horizontal position during the time of forming the loops is supplied from a regulating shaft 43 which has one or more arms 44 fixed thereto, arms 44 being short and extending in a generally upward and rearward direction, so that a horizontal pin 45 fixed in the upper end of arm 44 extends behind the lower end of the portion 33A of each lever 33 whereby motions of regulator shaft 43 caused by a regulating cam or regulating cams (not shown) may influence the horizontal positions of the needles at the time the loops are being formed to determine the length of the loops. A cam 39 on the cam shaft 26 is also provided for engagement with the follower 40 to control the horizontal motions of the needles when the camshaft is in narrowing position.

The vertical motions of the needles are caused by a needle shaft which runs horizontally just behind the presser shaft and therefore does not appear in the drawings. However, said needle shaft has fixed thereto depending levers, one of which appears at 50, and which are swung by cams such as 51 which are held in engagement with cam followers such as 52 by means of springs such as 53, followers 52 being shown as pivoted on lever 50. Springs 53 are connected between the lower ends of levers 50 and fixed points on the frame of the machine. Connections between said needle shaft and the needle bars 34 consist of horizontal arms (not shown) which extend rearwardly from the needle shaft and have at their rear ends upwardly extending short arms 55 which are pivoted to and support the needle bars. As the arms or levers 50 are oscillated by the cams 51, the needle shaft is also oscillated and the arms 55 raised and lowered to cause vertical motions of the needle bars 34 and needles 30. The result of the combined vertical and horizontal movements imparted to the needles 30 is that they move in paths somewhat similar to a figure 8 when viewed parallel to the camshaft 26 and draw each set of loops formed on their shanks down through the loops of a previous course. The means for forming the loops on the needle shanks, for pressing the needle beards at the time the new loops are drawn through the old ones and for knocking over the old loops are not shown, but are all assumed to be of ordinary construction.

As usual, knitting proceeds in the direction at right angles to the line of the needle rows and thread is laid in the weft direction parallel to the needle rows by carrier rods 54 which are operated in the usual manner.

The thread being laid parallel to the needle rows, the width of the fabric depends on the number of needles in use, that is, that have thread

laid to them. The number of needles receiving thread or having thread laid to them is determined by the length of travel of the yarn carrier rods 54. The length of the path of travel of the yarn carriers 54 is determined in turn by end stops 56, best shown in Figs. 3 and 4. Said stops are mounted in heads 57, one at each end of the machine, and each head 57 is connected to a nut 59 (Fig. 46) on a threaded spindle, one of which appears at 58 in Fig. 7 as journalled in bracket 70. By turning the spindles for stops 56 in one direction or the other, the fabric may be widened as shown in Fig. 1 along the edges 7 or narrowed as shown along the edges 9 and the edges 15, as well as other places. It is customary, also, at the time the stops 56 are moved inwardly to restrict the travel of the yarn carrier, to transfer one or more loops at each edge of the fabric inwardly, thereby causing the formation of fashion marks such as that shown in Fig. 1 at 5, 6, 12, 13 and 18. However, in accordance with the present invention, no loops need be transferred at a time of widening the fabric. For the purpose of transferring loops, a pair of narrowing combs 60 having points 48 are associated with each group of needles 30, one comb at each end of a needle row. Each comb 60 is attached to one or the other of a pair of narrowing rods 61 and 62, the combs at the right hand ends of the needle rows as viewed from the front of the machine being attached to the rod 61 and the combs at the left hand ends of the needle rows as viewed from the front of the machine being attached to the rod 62. Rods 61 and 62 extend half the length of the machine, there being two sets of such rods, one for each end of the machine. The narrowing rods shown are those for the left hand end of the machine and are perhaps best shown in Fig. 31. All the narrowing rods are mounted to move horizontally in brackets 63 which are fixed to and depend from a vertically movable shaft 64, known as the front narrowing shaft. Horizontal movement of the rods 61 and 62 is caused by narrowing nuts 65 and 66, respectively, which are mounted for horizontal movement caused by left and right hand threads 67 and 68 respectively, both formed on a horizontal spindle 69, the nuts being prevented from swinging about an axis of spindle 69 by laterally projecting forked ends 71 which embrace particularly a guide shaft or rod 72 which is fixed on the frame of the machine, ends 71 being the extremities of arms 132 extending from nuts 66 and 65, respectively, and which appear clearly in section in Figs. 24, 25 and 26 and which are utilized to assist in carrying out certain objects of the invention as hereinafter set forth. Each narrowing nut 65 and 66 has a standard or head portion thereon, the standard or head portion on nut 65 being designated as 73 and the standard on nut 66 being designated as 74. A spring is associated with each narrowing rod 61 and 62, one of which is shown at 75 and the other at 75A, said springs being connected each between a part fixed to a narrowing rod and a point fixed with relation to a nut, so as to draw the rods towards the corresponding standard or head portion 73 or 74 of nut 65 or 66. Each of rods 61 and 62 has connected thereto a stop element, one of which is designated 76 and one of which is designated 77, and each stop element 76 and 77 has threaded therein an adjustable contact screw 78 whereby the stop elements 76 and 77 are maintained in fixed relation to head portions 73 and 74 when once contact 78 has been set at the desired point in its stop element 76 and

77, the spring 75 or 75A for the rod pressing the stop or contact screw 78 against the corresponding head portion 73 or 74. Therefore, rods 61 and 62 are operated by said heads and springs to follow the nuts 65 and 66 in both directions, being pressed in one direction by the action of head portions 73 and 74 and drawn in the other direction by the action of springs 75 and 75A, and it will be seen that inward loop transferring movements cause combs 60, as well as nuts 65 and 66, to approach each other. Therefore narrowing transfers of loops can be repeated until combs 60 are about to touch provided means are used which enable the nuts 65 and 66 to be stepped often enough without the nuts coming too close together.

In carrying out a narrowing operation, ordinarily both the carrier rod stops 56 and the combs 60 are moved inwardly two needles, but said motion does not occur until the combs 60 have picked up the edge loops from the needles. For the purpose of picking up the edge loops, said front narrowing shaft 64 is operated, but not until after camshaft 26 has been shifted to the narrowing position, a position to the right of the one occupied by it when knitting is being done. Shifting the camshaft 26, as well as other operations of the machine, is under the control of the pattern mechanism P which includes the pattern chain 80 which is ordinarily racked or stepped one link in each revolution of camshaft 26. Said chain 80 has thereon a number of rows of buttons and the buttons of each row can be fixed at desired locations along the length of the chain so as to become active at a desired time. When at the active station or position, the buttons of each row on chain 80 cooperate with a series of levers, one of which appears at 81, to turn, in the clockwise direction as seen in Fig. 2, the levers 81 or other levers not herein specifically described but which are well known parts of the usual chain motion.

It will be understood that when said main camshaft 26 shifts from knitting to narrowing position, the driving connection between said shaft and the means for laying the yarn is interrupted, so that no yarn is laid to the needles in any revolution of said shaft in which it is in its narrowing position.

Also, during the period the shaft 26 is in its right hand or narrowing position, the knitting cams are automatically thrown out of operation because the shift of the camshaft throws them out of alignment with their cam followers. However, the narrowing cams are rendered operative by the same motion that throws the knitting cams out of action. Front narrowing shaft 64 is held up in the position in which it is shown in Fig. 2 by links 89, said links 89 extend downward substantially vertically from a pivotal connection with said shaft 64 to a pivotal connection with levers 91 which are pivoted near the front of the machine and which have cam followers 92 journalled in a bifurcated portion thereof. When shaft 26 is in its left or knitting position, followers 92 rest on round discs 93 which support shaft 64 in its upper position as shown in Fig. 2. When shaft 26 moves to the right, however, cams 94 on shaft 26 are brought into alignment with followers 92 and, as shaft 26 revolves, cams 94 permit the followers 92 to move downward, thereby also lowering the rear ends of levers 91 and lowering links 89 and front narrowing shaft 64. Cams 94 are so shaped that combs 60 are first lowered sufficiently to permit the points 48 to pick up loops at the edges of the fabric. Cams 94 then

lift links 89 somewhat so that the lower ends of points 48 are just above the tops of the usual knock-over bits (not shown). At this point in the cycle or revolution of the camshaft 26, said threaded spindles are racked to move both the carrier rod stops 56 and the narrowing rods 61 and 62 inwardly two needles. Combs 60 are thereby moved inwardly two needles so that the points 48 in the combs holding the end loops are brought above the needles previously the third ones from the edges. Cams 94 then cause links 89 and combs 60 to dip a second time to place the loops on the inner two points of each comb on needles already holding other loops. The sinkers (not shown) are then brought forward so that as cams 94 raise the links 89 and combs to their original position shown in Fig. 2, the loops on the combs are stripped therefrom and remain on the needles. At about this time or a little later in the revolution of the camshaft, the shaft 26 is shifted back to the left or knitting position, as previously described. Each narrowing operation performed during the knitting of blank A forms a fashion mark which is indicated on Fig. 1 of the drawing by a dot, said dots forming the rows or lines of fashion marks 5, 6, 12, 13 and 18 previously mentioned. At each narrowing operation, at the time each of said fashion marks is made, the space between the inner ends of the narrowing combs is decreased the distance of four needles. After a certain number of narrowing operations the space between nuts 65 and 66 will be reduced to such an extent that any further movement of the nuts will cause damage.

For preventing overracking of nuts 65 and 66 we provide an arrangement for controlling the two sets of racking pawls whereby said spindles are racked in one direction or the other. The racking pawls shown include a pawl 97 for cooperating with ratchet wheel 97A to rack spindle 58 for the end stops 56 in the narrowing direction (clockwise as viewed in Figs. 4 and 5), the pawl 98 for cooperating with ratchet wheel 98A to rack spindle 69 for the narrowing rods in the narrowing direction, the pawl 99 for cooperating with ratchet wheel 99A to rack spindle 58 in the widening or back-racking direction and the pawl 101 for cooperating with ratchet 101A to rack spindle 69 in the widening direction. Since the narrowing movements of the spindles are those most commonly used and knitting of a blank commonly begins at the widest point thereof, turning spindles 58 and 69 in the widening direction is commonly referred to as back-racking. Pawls 97, 98, 99 and 101 are all driven from an actuator 102, best shown in Fig. 3. A link 103, best snown in Figs. 4 and 5, is pivotally connected to pawl 97 and has a slot 104 therein providing with pin 105 a lost motion connection with pawl 98, said lost motion connection permitting pawl 98 to be thrown out of operating position without affecting pawl 97, as hereinafter set forth, but being so arranged that when pawl 97 is thrown out of operating position, link 103 acts to also throw pawl 98 out of operating position. The pawls 99 and 101 for causing counterclockwise rotation of spindles 58 and 69, respectively, are also so arranged that they both may be thrown out of operation when one is so thrown out, although pawl 101 may at times be thrown out of action without affecting pawl 99. Means for this purpose include a link 106 which has no lost motion connection at either of its ends. Link 106, moreover, is not connected directly to pawl 101,

although it is pivotally connected to pawl 99. The connection between link 106 and pawl 101, an indirect one, is more fully described hereinbelow and is best shown in Fig. 30, although it appears in Fig. 6. The pivotal mountings for pawls 97, 98, 99 and 101 are similar and all bias the pawls toward their ratchets so long as the pawls are not turned too far away from their ratchets but said mountings hold the pawls in inactive positions when once they have been turned a certain degree away from their active positions. After being so turned, they must be moved to or toward active position again by the operator. The mounting for pawl 97 is described in detail hereinbelow in connection with Figs. 11, 12, 13 and 14.

As is clear from Figs. 4 and 5, pawls 97 and 99 are both pivotally mounted on a lever member 107 which is mounted to turn readily on spindle 58 as an axis while pawls 98 and 101 are mounted on a similar lever member 108 which is mounted to turn readily on spindle 69. Actuator 102 is pivotally connected to both lever members 107 and 108 at points 102A and 102B respectively, the means for operating the actuator 102 being of well known type and forming no part of the present invention is described hereinbelow. As is clear from Figs. 4 and 5, spindles 58 and 69 have disks or dials 109 and 121, respectively, fixed thereto for ensuring that they will be accurately positioned after each operation, said dials being notched at their edges and there being vertical spring loaded plungers 95 and 96 cooperating with the notches in said dials 109 and 121, respectively, plunger 95 having a lever engaging groove therein in which is a portion of a lever 130 for raising and lowering plunger 95 and pivoted at its right end as viewed in Fig. 7 at a point 100. It has been the custom to make the notches in the dial 121 for spindle 69 V-shape and consequently no means is needed for lifting the holding plunger 96 for spindle 69 when the spindle is to be turned, although plunger 96 is spring-loaded similarly to plunger 95. As to spindle 58, however, the sides of the notches in the dial 109 have been shaped to effect a positive locking action in addition to accurately positioning the dial 109 after each operation and therefore a means has been provided for lifting the corresponding plunger 95. For this purpose, lever member 107 is extended upward nearly to the circumference of the dial and a cam piece 109A is attached to said upward extension of lever 107 and is adapted to raise a plunger 109B. The plunger 109B engages a stop screw 130A carried by the lever 130, one end of which is connected to the plunger 95 for dial 109. The plunger 95 is lifted when cam piece 109A engages the plunger 109B at the proper time to permit the pawls 97 and 99 to turn the spindle, the lifting movement of the plunger being resisted by a tension spring 95A connected between the forward end of lever 130 and a fixed arm 95B on the frame of the machine. When cam piece 109A has moved to the end of its stroke, spring 95A is able, acting through lever 130, to draw plunger 95 down into the next notch in dial 109 to ensure that the dial will be accurately located.

In order to produce the stocking blank of Fig. 1 in which many more narrowing operations, and consequently a greater effective movement of the units 65 and 66, is required than is needed to produce the leg portion of a usual stocking blank for which the narrowing spindles etc. were originally designed, means has been provided, as hereinafter explained, to condition the narrowing mechanism to perform such greater number of narrowings without having to increase the actual length of the operating spindles. However, in order that the narrowing units 65 and 66 will be prevented from jamming against each other when producing the extra narrowings required in a stocking blank such as shown in Fig. 1, in the event that the associated mechanism has not been first properly conditioned by the machine operator, safety means is provided in accordance with this invention for automatically disengaging the actuating pawl 98 from the associated ratchet wheel 98A. Such safety means generally comprises a pivoted member 110, best shown perhaps in Figs. 27 and 28, member 110 being loosely mounted on spindle 69. A tension spring 112 connected between the right end of member 110 and a fixed part of the machine tends to turn member 110 clockwise as viewed in Figs. 27 and 28. The pull of spring 112 is normally resisted by the end of rod 120, member 110 having a depending finger 113 adapted to rest on one end of rod 120 to hold member 110 against the pull of spring 112 in the position shown in Fig. 27 in which a cam surface 114 at the left end of member 110 is below pawl 98 and out of effective contact therewith. As is clear from Fig. 6, member 110 lies in the rear of the ratchet wheels employed in turning spindle 69, but an arrangement whereby movement of member 110 in the clockwise direction as viewed in Figs. 27 and 28 is transmitted to pawl 98 will presently be described. Finger 113 of member 110 is in line with and adapted to contact with upper end 123 of a false pawl 124, best shown in Figs. 6, 29 and 30, as hereinafter set forth. The pawl 124 is mounted to turn on the same axis as pawl 101 as viewed in Figs. 27 and 28. As spindle 69 is racked from time to time by the pawl 98 at the times narrowing is performed the nuts 65 and 66 approach each other. To assist in preventing their coming too close together, the rod 120 is mounted to slide longitudinally in bearings in fixed arms 127 and 128 of brackets 127A and 128A, respectively, which carry the spindle 69, perhaps best shown in Figs. 24, 25 and 26, connected to the frame of the machine, a compression spring 129 between arm 128 and a collar 131 on rod 120 serving to keep the rod normally in its left hand position as viewed in Figs. 6, 24 and 26 in which one end of rod 120 sustains finger 113. As nuts 66 and 65 approach each other, the arm 132 on nut 66 contacts a collar 133 adjustably fixed on rod 120 as shown in Fig. 25, moving rod 120 to the right to the position shown in Fig. 25 in which rod 120 has been withdrawn from under finger 113 of member 110 and thereby inaugurating a chain of movements preventing further racking of spindle 69. Collar 133 is, of course, set at a point such that the movement of nuts 65 and 66 in the narrowing direction may proceed until the nuts approach each other as close as desirable. As soon as rod 120 has been drawn from under portion 113 of member 110, spring 112 moves member 110 clockwise as viewed in Fig. 27 until the portion 113 engages the upper end 123 of pawl 124 or until a stop pin 135 on member 110 strikes the end of rod 120 to prevent further clockwise movement of the member 110. The parts are then in the position shown in Fig. 28 in which cam surface 114 of member 110 contacts narrowing pawl 98 and throws it out of action.

The false pawl 124 is adapted to throw widening pawl 101 out of action by means of details best shown perhaps in Fig. 30 and including a lug 140 projecting from the side of false pawl

124 toward the pawl 101 and a lug 138 projecting from the side of pawl 101 toward the false pawl 124, lugs 140 and 138 overlapping in the direction of the axis of the pawls of which they are parts. Lugs 140 and 138 are at about the same distance from the common axis of pawls 101 and 124, but lug 140 is on the edge of pawl 124 toward the spindle 69 and lug 138 is on the edge of pawl 101 away from the spindle 69. A screw 139 in lug 138 serves to maintain a relative position between lugs 140 and 138. Since narrowing pawl 98 for spindle 69 is connected by link 103 to narrowing pawl 97, when member 119 throws pawl 98 out of action, the lost motion at 104 in link 103 is taken up without affecting the position of the pawl 97.

In order to utilize the said lost motion at point 104 between pawl 98 and link 103, an arrangement is employed best shown in Fig. 8. In said arrangement pawl 98 has a curved extension 147 by which the pawl may be moved to and held in inoperative position whenever desired without affecting pawl 97. The position of the parts in which pawl 98 is inoperative but pawl 97 operative is shown clearly in Fig. 8. As is further shown in Fig. 8, we prefer to provide an arm 148 for holding extension 147 and pawl 98 in the position shown in Fig. 8. Arm 148 is mounted on a part fixed to the nut 66 on spindle 69, and projects generally parallel to spindle 69 toward the outer end of the spindle so that when the operator turns spindle 69 to move the combs 60 out of the knitting field and to maintain the combs in such position, as is usually done in lace making, extension 147 may extend over and rest on arm 148 to prevent racking spindle 69. The pawl 98 is also held in this position when the picot bar 15 is in position to produce the usual picot course, the combs being moved back into position to cooperate with needles 30 when the picot bar is again in inoperative position. Due to the slot 104 in link 103, the positioning of pawl 98 as shown in Fig. 8 will not affect the position of pawl 97. It is obvious also from the drawings that pawls 99 and 101 will always both be thrown out of racking position simultaneously when either pawl 99 or false pawl 124 is moved clockwise due to the link 106 connecting pawls 99 and 124. However, the pawl 101 may also be thrown out of racking position without affecting the position of the pawl 99 by turning pawl 101 clockwise to break the connection between the pawl 101 and the false pawl 124.

In order to provide for automatic control of the direction in which spindles 58 and 69 shall be racked and of the times at which the direction of racking shall be reversed, we have provided a mechanism under the control of the main pattern chain whereby the narrowing pawls 97 and 98, which are in active position during the greater part of the time, may be thrown out of the position in which they rack spindles 58 and 69 in the narrowing direction and simultaneously back-racking pawls 99 and 101 may be thrown into position for acting on spindles 58 and 69 through their ratchet wheels upon actuation by member 102. For so controlling said racking pawls, we have provided a mechanism shown in part in Figs. 4 and 5. In said figures, there appear a pair of annular plate cams 151 and 152 mounted to turn readily in annular recesses between ring members 149 and the front faces of the ratchet wheels 99A and 101A, respectively, for coacting with narrowing pawls 97 and 98 and back-racking pawls 99 and 101, said recesses furnished by shoulders on the inner faces of said rings as shown in Figs. 9 and 10. A link 153 is pivotally connected to both members 151 and 152 so that an angular movement of one will produce an equal movement of the other. Each of members 151 and 152 has a camming projection thereon for throwing one or another racking pawl into position in which it is disabled or prevented from actuating a spindle. Member 151 is shown as having a projecting portion with a camming edge 150 and a camming shoulder 150A and member 152 as having a projecting portion with a camming edge 154. The portion of member 151 having edge 150 thereon is adapted to contact a spool 155 rotatably secured to pawl 97 by a screw 156 (Figs. 11, 14 and 17). When edge 150 is in contact with spool 155, pawl 97 is out of action and so also is pawl 98 on account of the connection from pawl 97 to pawl 98 through link 103, this position of the parts being shown in Fig. 5 and is the one in which back-racking or widening is performed by pawls 99 and 101 which are then in their active positions. When member 151 is in the angular position to disable pawl 97, the portion of member 152 having the camming edge 154 is not in use. When, however, member 151 has been turned to free pawl 97 and to permit it to actuate spindle 58, member 152 is brought, at the same time, into position such that the portion having camming edge 154 thereon contacts with pawl 101 to throw pawl 101 out of the position in which it can rack spindle 69 the active edge of pawl 101 projecting into the plane of member 152 in order to permit such contact, as best shown perhaps in Fig. 6. This position of the parts is shown in Fig. 4 and is the one in which members 151 and 152 are maintained the large majority of the time and in which narrowing is performed. When pawl 101 is disabled by edge 154 and thereby is unable to affect spindle 69, pawl 99 is rendered also disabled or is unable to affect spindle 58, by virtue of the shoulder 150A on member 151 which contacts the active edge of pawl 99 so as to cause it to miss the nearest tooth on ratchet 99A so that pawl 99 rides idly on shoulder 150A as far as the next tooth on the ratchet. As the stroke of the pawl 99 is the same as the distance between two adjacent teeth, the common arrangement in the type of machine shown, pawl 99 does not affect the ratchet 99A whenever shoulder 150A acts on the pawl. The shoulder 150A can control pawl 99 because the active edge of pawl 99 projects into the plane of member 151 as perhaps is best shown in Fig. 7. It will be seen also that pawl 99 and false pawl 124 have thereon finger pieces 158 and 159 respectively whereby pawls 99 and 101 may be thrown out of action manually when desired, false pawl 124 acting on pawl 101 when turned clockwise as viewed in Fig. 4 in a way previously described. Also, pawl 101 is always thrown out of action whenever pawl 99 is thrown out of action because of the connection between pawl 99 and the false pawl 124 afforded by said link 106.

Means are provided for turning the members 151 and 152 as desired comprising a rod 161 the upper end of which is shown in Figs. 4 and 5 and the lower end of which is shown in Fig. 21. When rod 161 is in the raised position shown in Fig. 4, spindles 58 and 69 can be turned by their respective pawls 97 and 98 in the clockwise or narrowing direction. When rod 161 is in the lowered position shown in Fig. 5, spindles 58 and 69 can be turned by their respective pawls 99 and 101 in the widening or back-racking direction. In Figs. 21 and 22,

means are shown for controlling the position of rod 161 in accordance with the position of the cam follower 162 for moving the actuator 102 from the main camshaft 26, follower 162 being mounted, as perhaps best shown in Fig. 3, on an axis intermediate the ends of a lever 160 pivoted at its forward end to the end frame 20 at the left end of the machine and near its rear end to the lower end of actuator 102. A spring 100 attached to the rear end of lever 160 serves not only to draw actuator 102 downward after it has been raised by a cam but to hold the lower end of actuator 102 and the rear end of lever 160 against a stop 160B to prevent follower 162 from dropping below the low points of the cams with which it cooperates when standing in a plane intermediate said cams. Shown as forming part of said rod positioning means is a heavy plate 163 (Fig. 21) fixed on top of a shouldered portion of said end frames 20 and having an arm 164 projecting downward on one side of said frame and forming a guide for rod 161 at point 165. Plate 163 has also an arm 166 extending down on the other side of said frame and having a U-piece 167 at its lower end forming journals for a pivot pin 168 on which is mounted a U-shaped lever 171 which extends from a vertical fork 172 at its lower end near pivot pin 168 upwardly and laterally above frame 20 and then downwardly to a horizontal fork 173 embracing rod 161 on three sides thereof and lying between collars 174 on the rod. The said fork 172 embraces the edge of cam follower 162, so that the movement of fork 172 swings lever 171. In Fig. 21, the parts are shown in a position corresponding to one of these represented in Fig. 4, follower 162 being in an intermediate or neutral position and rod 161 is in its upper position, while camshaft 26 is in its left hand or knitting position. When camshaft 26 is shifted to the right as viewed in Fig. 21 to bring said shaft into its narrowing position, a cam 175 on the shaft is brought into the plane of follower 162, lever 171 and rod 161, however, both remaining stationary so that no change is made in the position of any part shown in Fig. 4. Actuator 102 is then reciprocated by cam 175 and cam follower 162 through connections shown in Fig. 3 and the spindles 58 and 69 are racked in the narrowing direction because pawls 97 and 98 are in their active positions as shown in Fig. 4. When, however, it is desired to rack the spindles 58 and 69 in the opposite direction, an impulse or impulses is or are imparted to actuator 102 while shaft 26 remains in the knitting position shown in Fig. 21. For this purpose, follower 162 is shifted to the right as viewed in Fig. 21 due to the engagement between follower 162 and a fork 177 (Fig. 3) to bring said follower into the plane of a cam 176 on shaft 26. By so shifting follower 162, U-shaped lever 171 is shifted counterclockwise about its axis 168 to lower its forked end 173 and to lower rod 161, thereby shifting cam members 151 and 152 to the position shown in Fig. 5 and permitting back-racking pawls 99 and 101 to become effective while narrowing pawls 97 and 98 are ineffective for reasons given hereinabove.

It will be seen therefore that we have provided pawl and ratchet means for the threaded spindles for moving the end stops and narrowing rods so arranged that one of the pawls will be thrown out of action automatically when there is danger of the associated spindle overrunning, that both widening pawls may be thrown out of action without affecting either of the narrowing pawls, that the narrowing pawl for the spindle for moving the narrowing rods may be thrown out of action without disturbing the narrowing pawl for the end stop spindle, that the widening pawl for the spindle for moving the narrowing rods may be thrown out of action without disturbing the widening pawl for the end stop spindle, that either the narrowing pawls or the widening pawls may be automatically thrown into active position as a group at the same time the widening pawls or the narrowing pawls are thrown out of action, and that the pawls are biased toward active position except when they have been turned on their pivots a sufficient degree from their active positions, after which they must be returned to active position by the operator.

Means for shifting cam follower 162 when desired is shown in Figs. 2, 3, 21, 22 and 23. The edge of follower 162 is embraced at one point on its circumference by a fork 177 shown in Fig. 3 as forming the end of a lever 179 pivoted at 181 on a pin fixed to a portion of the frame of the machine. Lever 179 extends generally rearwardly of the machine from follower 162 past pivot 181 and is forked at its rear end to embrace a rod 183 which extends longitudinally of the frame of the machine parallel to shaft 26 and to the back beam 23 of the machine frame, collars 182 being fixed on rod 183 one on each side of lever 179 so that rod 183 may swing lever 179 either one way or the other in accordance with longitudinal movements of the rod. Rod 183 runs along to the right from collars 182 as viewed in Fig. 21 to a connection with the rear end of a lever 184, best shown in Fig. 22. Lever 184 is pivoted in a journal 185 which has a vertical axis and the rear end of lever 184 is forked at 186 to embrace rod 183 at a point between two collars 187 fixed to the rod 183. Just forward of journal 185, lever 184 has an extension 188 pivoted thereto on a horizontal axis 189. At the forward end of extension 188, it has a second extension 191 pivoted thereto on a vertical axis 192. When lever 184 is in the position shown in Fig. 22, the position occupied by it for the greater portion of the time, the forward end of extension 191 is supported in the position shown in Fig. 22 by the upper end of a lever 193 which is pivoted at point 194 on a horizontal axis supported by a bracket 195 fixed to the front beam 22 of the machine frame.

A spring 196 is connected between a point on the lever 193 and a pin 197 fixed to bracket 195, to maintain the upper end of lever 193 normally at the right as viewed in Fig. 2 and therefore beneath extension 191 of lever 184. A horizontal arm 198 is fixed at one end to the upper part of lever 193 and extends forwardly beyond bracket 195 to a connection with a rod 199. Rod 199 has somewhat of a Z form as seen in Fig. 2 and extends from its connection with arm 198 of lever 193 to the right and downwardly as viewed in Fig. 2 to a connection with one of said levers 81 of the pattern mechanism P at a point below the axis 201 of said lever 81. The spring 196 also serves to bias said lever 81 in the counterclockwise direction about its pivot as viewed in Fig. 2, through the rod 199 when said spring biases lever 193 beneath the extension 191. At predetermined times, a button on said pattern chain 80 turns said lever 81 clockwise about its axis 201 as viewed in Fig. 2 thereby turning said lever 193 counterclockwise about its axis 194 because rod 199 crosses the line between axis 194 and axis 201. When lever 193 turns counterclockwise as viewed in Fig. 2, it moves out from

under extension 191, thereby permitting both extensions 191 and 188 of lever 184 to drop, the effect of the weight of the parts being increased by the action of a tension spring 204 the upper end of which is attached to extension 188 and the other end of which is attached to a point (not shown) on or fixed to the frame. Further, a spring 205 on the rod 183 (shown dotted in Fig. 21) and a spring 200 fixed to the lever 184 and the back beam 23 serves to hold rod 183 and therefore follower 162 and lever 184 normally in the positions shown in Figs. 21, 22 and 23 and in which a follower 206 journalled on a horizontal axis at the forward end of extension 188 lies in the same vertical plane as a cam 207 fixed on camshaft 26. When lever 193 is moved by the pattern mechanism P out from under extension 191, follower 206 is free to drop onto the edge of said cam 207. When follower 206 moves on to cam 207, a second follower 208, also carried by extension 188 near the forward end thereof but journalled on a vertical axis, drops down to a level below the edge of cam 207. The movement of the pattern mechanism P is so timed that lever 193 frees extension 191 at a time follower 206 is in contact with the edge of cam 207 at a high point 210 at which point the cam 207 is relatively thin so that follower 206 then follows the contour of cam 207 downward and follower 208 drops down alongside the edge of cam 207 as far as permitted by follower 206. Furthermore, cam 207 has a lateral or axial cam face 209 shown in Fig. 22 in dotted lines and followers 206 and 208 are so placed relatively to each other that when follower 206 contacts the axial face of cam 207, follower 206 holds follower 208 at the level of face 209. Therefore, as cam 207 revolves after follower 206 has contacted the edge of cam 207 and high point 210 moves out from under cam 206, the side cam face 209 acts on follower 208 to thrust follower 208 toward the right end of the machine, the said movement of follower 208 acting to turn extension 188 and lever 184 to thereby thrust rod 183 to the left as viewed in Fig. 21. As is clear from Fig. 3, movement of rod 183 to the left as viewed in Fig. 21 swings the forward end of lever 179 to the right, so that fork 177 moves follower 162 to the right as viewed ing Fig. 21. Camshaft 26 being in its knitting position as shown in Fig. 21, movement of follower 162 to the right brings it into the plane of the back-racking cam 176. At the same time that lever 179 moves follower 162, the movement of follower 162 swings U-lever 171 to lower rod 161 and thereby to swing cam members 151 and 152 into the position shown in Fig. 5 in which back-racking pawls 99 and 101 are enabled to act on spindles 58 and 69 while narrowing pawls 97 and 98 are prevented from doing so. As soon thereafter as pattern chain 80 of mechanism P is racked another step, the button which initiated the movement of follower 162 passes out of contact with the lever 81 of mechanism P through which it delivered its impulse and, at the same time, the high point 210 of cam 207 lifts follower 206 so that follower 208 is above the edge of cam 207 and the springs 196, 200 and 205 are free to throw the parts back into the positions shown in Figs. 21 and 23 unless another button is provided on chain 80 to continue the back-racking movement.

The bracket 195 is provided with a pin or bolt 195A which extends through a forked portion 191A of extension 191 to maintain said extension in position to be engaged by the lever 193 when the button on chain 80 is moved from beneath lever 81 and the lever 193 moved in a clockwise direction by the spring 196.

Although only the spindles for operating the end stops and narrowing rods for the left half of the machine are shown, it will be seen from Fig. 21 that there are two cams 211 and 212 fixed on main camshaft 26 relatively near its right end as viewed from the front of the machine, cams 211 and 212 corresponding in function to cams 175 and 176 respectively. A vertical rod 213 is provided at the right hand end of the machine which corresponds in function to rod 161 in controlling cams for throwing out and in the pawls for actuating the spindles for the end stops and narrowing rods at the right end of the machine. However, the same rod 183 extends far enough along the machine to control not only cam follower 162 whose shift motion when actuated by said rod actuates rod 161 but also cam follower 214 whose shift motion actuates rod 213. Cam follower 214 is shifted by a forked end 177A of a lever 179A the other end of which embraces the rod 183 between collars 182A, fixed to the rod 183 in the same manner that lever 179 is connected to the rod 183. Moreover, as it is necessary to lower rod 213 when follower 214 is moved to the right and as rod 213 is on the right of follower 214 instead of on the left, it is necessary to use a different form of connection between cam follower 214 and rod 213 than that used at the left end of the machine. As shown, said connection comprises a fork 215 pivoted at 216 at the lower end of a bracket arm 217 which is fixed to and depends from a shouldered portion of an end frame 20. Said fork 215 forms the lower end of a generally vertical lever 221, the upper end of which has a pin and notch connection at 222 with a bell crank lever 223 pivoted also on said bracket 217 as shown at 224. The lever 223 has a vertical arm which cooperates with said lever 221 and a horizontal arm which ends in a fork 225 which embraces rod 213 between two collars 226 fixed to the rod. Also, rod 213 is guided by a fork 227 at the lower right hand end of an arm 228 which is an integral part of the bracket 217. It is clear, therefore, that cam follower 214 will be raised and lowered by cam 211 when main camshaft 26 is in the right hand or narrowing position to thereby narrow the fabric, but the cam follower 214 will be raised and lowered by cam 212 when the main camshaft is in its left hand or knitting position as shown in Fig. 21 and the follower 214 has been shifted to the right by rod 183. The spindles for operating the end stops and narrowing rods at the right end of the machine are therefore moved inwardly and outwardly at the same time as the corresponding spindles at the left end of the machine.

We have shown two means for acting on the racking pawls for spindles 58 and 69, one for shifting the pawls from narrowing to back-racking operation and the reverse and the other for stopping racking action of pawl 98 for a time, and it is therefore necessary that there be means whereby the racking pawls shall automatically revert to their original position when the shifting means stops acting on the pawls and when the stop means ceases acting on pawl 98. It is desirable also that the pawls be so mounted that they will remain inactive as long as desired when turned to a certain position by hand. As best shown in Figs. 11, 12 and 13, the mountings for pawls 97, 98, 99 and 101 whereby they may so

act, only one of which is shown in said figures, comprise fixed pins such as that shown at 230. Pivot pin 230 is of generally cylindrical form but has a segmental groove 237 therein, the bottom surface of which is indicated at 229. As shown in connection with pivot pin 230, pawl 97 has a longitudinal bore 231 therein and a bore 232 for said pivot which intersects said bore 231 at right angles. In the upper end of said longitudinal bore 231 is a compression spring 233 which presses a plunger 234 toward said pivot, usually against the surface 229 of said groove 237. The plunger 234 has a conical portion 235 at its lower end and the bottom surface 229 of groove 237 is so set that when pawl 97 is in position to rack its ratchet wheel, said conical portion is in contact with surface 229 for almost its entire length. Also, the angle of bottom surface 229 is such that the reaction between the plunger 234 and the pivot 230 presses pawl 97 toward its ratchet wheel so long as conical portion 235 is in contact with the surface 229. Now when cam member 151 moves pawl 97 to the position shown in Fig. 12, while some of the conical surface of portion 235 is drawn away from surface 229, a material part of the conical surface is still on said surface and the action of spring 233 continues to press pawl 97 toward its ratchet wheel. Therefore, when cam member 151, has moved out of contact with pawl 97, the pawl will be automatically moved back into racking position. However, if pawl 97 is moved by hand into the position shown in Fig. 13 and in which the point or apex 236 of conical portion 235 rests on the cylindrical surface of pivot pin 230, the spring 233 applies sufficient friction between point 236 and the cylindrical surface of pivot pin 230 to hold the parts in the neutral position shown in Fig. 13 until they are again moved by hand so that point 236 enters groove 237 and spring 233 will again tend to turn the pawl toward its ratchet wheel. Evidently also, after one or more of the pawls 97, 98, 99 and 101 has or have been thrown by hand to the position corresponding to that of pawl 97 in Fig. 13, it or they must be moved from said position by hand before either or both spindles 58 and 69 can be racked. It is to be noted that either of pawls 99 or 101 may be thrown into a neutral position such as that shown in Fig. 13.

Movement of pawl 97 to the position of Fig. 13 will also move pawl 98 to a corresponding position. Likewise, movement of either the pawls 99 or 124 to a position corresponding to the position of pawl 97 in Fig. 13, will also correspondingly position pawl 101. However, pawl 101 may be held in such position without affecting the position of pawls 98 and 124.

In addition to the pawls 97, 98, 99 and 101 mentioned hereinabove for operating spindles 58 and 69, we have shown in Fig. 3 a back stepping pawl 240, the purpose of which is to produce a so-called French narrowing in which the rows of fashion marks, such as 13, are inclined to the selvage, such as 9. The motion of actuator 102 produced by cams 175 and 176 is such that its upstroke is adapted to turn spindles 58 and 69 enough to move the end stops and narrowing rods two needles. Therefore, pawls 97 and 98 move their spindles the same two needle distance at each operation and the fashion marks made by the end points in the narrowing combs are usually equal distances from the selvage, producing lines of fashion marks parallel to the selvage as is shown at 5, 6, 12 and 18 in Fig. 1. When it is desired, as in said French narrowing, that a line of fashion marks shall incline toward the selvage, a narrowing point is thrown out of action immediately after each fashion mark has been made by stepping spindles 69 outward one needle. For this purpose, spindle 69 is turned by pawl 240 to produce a one needle movement of the narrowing rods 61 and 62 in the widening or back-racking direction soon after each two needle movement of the narrowing rods in the narrowing direction and it is known to throw pawl 240 into and out of action automatically. We have shown an arrangement for this purpose which not only throws pawl 240 into and out of action automatically but also automatically shifts the point in the path of nut 59 on end stop spindle 58 at which pawl 240 becomes active, so that the beginning points of subsequent rows of fashion marks (rows 13 for instance) may be outside the lower ends of previously formed rows of fashion marks (such as rows 6). As shown, pawl 240 is quite long and is pivoted to actuator 102 at 241 at the lower end of the pawl and some distance below the axis of spindle 69. Intermediate its ends, pawl 240 is pivoted to a link 242 which extends substantially horizontally to a pivotal connection with an arm 243 which depends from a rod 244 to which it is fixed, as by screws 248 (Fig. 48) rod 244 being carried in journals supported from the frame and one of which appears at 239 and extends from the bracket 70 in Fig. 48. A tension spring 245 connected between a point on actuator 102 and a pin 246 at the lower end of lever 243 urges link 242 and pawl 240 toward its operative position, which is toward the right from the position shown in Fig. 3. Lever 243 has an upper portion 247, shown in Figs. 4, 5 and 48 to which is connected a bar 249 which extends parallel to rod 244 in spaced relation thereto for some distance and has its other end fixed to a collar 251 which is also fixed to rod 244. Further, the nut 59 on end stop spindle 58 has an arm 252 (Fig. 46) fixed thereto which extends horizontally to a connection with an arm 253 fixed to a collar 254 slidably mounted on rod 244 and arranged to permit rod 244 to turn therein. The collar 254 being connected to the nut 59, both the collar and the nut are prevented from turning and are limited to longitudinal movement on the rod 244 and the spindle 58 respectively. Moreover, the collar 254 is utilized in the arrangement shown for operating said pawl 240. For this purpose, collar 254 has an upstanding arm 255 fixed thereto which projects upward to the level of the bar 249 and to the rear or side thereof away from the spindle 58 and the body of the machine. At its upper end, arm 255 has a vertical plate or block 256 fixed thereto as shown in Fig. 46. Plate 256 lies between the upper end of arm 255 and the bar 249 and serves as a contact member acting in cooperation with parts mounted on rod 244 to determine the angular position of rod 244 and therefore the angular position of lever 243 and pawl 240. Said parts for cooperating with plate 256 comprise vertical block 257 (Fig. 48) and angular plate or block 258 (Figs. 46, 47 and 48), both having camming functions. Vertical block 257 is fixed to the side of bar 249 toward the plate 256 and arm 255 longitudinally somewhat nearer collar 251 than journal 239, while angular block 248 is nearer journal 239 and is mounted to have a limited movement longitudinally of bar 249 and has a vertical section 258A and a horizontal section 258B, section 258A functioning much the same as block 257. Horizontal section 258B is

slotted as shown at 261 in Fig. 50, there being two vertical bolts 262 shown as upstanding from bar 249 and projecting through said slot. Also, said bolts are spaced apart a less distance than the length of said slot 261 and the portion 258B has two horizontal bolts 260 therein which project therethrough in alignment with said bolts 262 so as to contact therewith to determine the distance block 258 may slide on bar 249. Further, bar 249 has, as shown, a series of threaded holes 263 adapted to receive bolts 262 so that the extent and center of movement of block 258 may be adjusted, within limits, as desired, while the extent of movement of block 258 may also be adjusted when desired by adjusting bolts 260, jam nuts 260A being provided on bolts 260 whereby they may be fixed in adjusted positions. The movement of block 258 on bar 249 is automatic and the means for controlling the movement of block 258 comprises a small block 264 fixed on top the block 258 at or near the right end thereof, as viewed in Figs. 48 and 49, block 264 being fixed to block 258 by a bolt 265 the upper end of which projects upward from block 264 and has connected thereto one end of a tension spring 266. Spring 266 tends to draw block 258 to the left as viewed in Figs. 48 and 49, its left end being attached to a post 267 which is adjustably connected to bar 249 by means of a plate 268 and bolts 262. Plate 268 is L-shaped in plan, one leg thereof extending longitudinally of bar 249 just above section 258B of block 258 and having a slot 269 therein through which the upper ends of bolts 262 extend. Nuts 271 on bolts 262 serve to hold the plate 268 in fixed position relative to the bar 249, the slot 269 being long enough to permit adjustment of the plate 268 on bolts 262. The other leg of plate 268 extends transversely of the bar 249 to the free side of portion 258A of block 258, thereby providing a vertical edge at point 274 the purpose of which will presently appear. Fixed to the top face of block 264 is a thin resilient plate 272 which extends toward the left end of block 258 and the left end of which, as viewed in Figs. 48 and 49 is turned down into a flange 273. The natural resiliency of plate 272 tends to hold flange 273 down below the top surface of plate 268 so that the flange will engage the plate as shown in Fig. 49 and hold block 258 in its right hand position against the pull of spring 266. When, however, plate 272 has been sprung up into the position shown in Fig. 48, spring 266 draws block 258 toward the left, and flange 273 rides up on the top of plate 268 as shown in Fig. 48, the slidable block 258 being thereby brought closer to the fixed block 257 than when the flange 273 is in contact with the edge 274 and the arm 255 thereby maintains contact with block 258 longer and also maintains bar 249 toward the right and pawl 240 toward the left as viewed in Figs. 3 and 46 for a longer time. A plate 275 is fixed to the bottom of bar 249 by means, best shown perhaps in Fig. 50, providing for some adjustment of the plate with respect to the bar, plate 275 cooperating with arm 255 for purposes that will presently appear. Also, as best shown in Fig. 47, plate 272 has adjustably fixed thereto a tappet piece 276 which forms the lower end of a bolt 277 adjustably mounted in a slot 278 in the plate 272. Said piece 276 is adapted to contact the arm 255 and plate 256 to raise the latching plate 272 and flange 273 to the position shown in Fig. 48 to permit spring 266 to move block 258 to the left.

After finishing a blank A, the plate 256 on arm 255 is in contact with block 257 which is fixed with relation to bar 249. The spindles 58 and 69 are then operated either by hand or automatically until the end stops and narrowing combs are racked or turned out to their extreme positions preparatory to starting the next stocking. During the said racking out plate 256 on arm 255 moves to the right and bears against portion 258A of block 258 but does not move the block because block 258 is latched in its extreme right hand position. However, as the arm 255 continues to the right as viewed in Figs. 48 and 49, it contacts and lifts the tappet 276 and, as soon thereafter as plate 256 rides onto the plate 275 so as to throw bar 249 somewhat farther away from plate 256, the block 258 being thereby relieved of frictional contact with said plate, spring 266 again draws the block 258 to the left to the position shown in Fig. 48. However, movement of arm 255 is continued until it is in the position of Figs. 48 and 51. In this position of the parts, the knitting of the welt 1 of a blank such as A is begun. The arm 255 moving from right to left as viewed in Fig. 48 and from left to right as viewed in Fig. 51 during all the narrowings, nothing occurs prior to knitting the heel tending to disturb the position of block 258 from that shown in Fig. 48 in which it is held by its right stop bolt 260. Also, in the position of the parts shown in Fig. 48, the block 258 controls arm 255 so that auxiliary back-racking pawl 240 is prevented from acting on its ratchet wheel. Therefore the fashion marks 5 of the knee narrowings are parallel to the selvage. Further, the block 258 is now so far to the left as viewed in Figs. 48 and 50 that block 258 controls arm 255 clear to the end of the leg narrowing which produces fashion marks 6, the marks 6 also being parallel to the selvage because pawl 240 is out of action. The last narrowing operation in making the leg fashion marks 6 carries the plate 256 actually far enough along so that bar 249 slips toward the arm 255, but this has no effect on the fashion marks because no narrowing operation is then performed until after plate 256 has been moved or racked back so that it pushes bar 249 to the right again as viewed in Fig. 46. After the leg narrowing, however, block 258 and arm 255 being in the positions shown in Figs. 49 and 52, the pattern chain causes the end stops and narrowing combs to be racked out again during the widening of the fabric for the production of portions for forming the heel pocket. During this period, therefore, arm 255 moves from left to right as viewed in Figs. 48 and 49 (right to left as viewed in Fig. 52) and first far enough to move block 258 to the position shown in Fig. 49 in which the block is held by flange 273 of snap plate 272, but not far enough to contact tappet piece 276, the positions of the parts at the end of the widening steps being shown in Fig. 53. When the motion of arm 255 is the reversed during the making of the heel narrowings forming fashion marks 12, the block 258 remains as shown in Fig. 49 and plate 256 drops off the block 258, as shown in Fig. 54, before the narrowing combs have been racked inwardly as far as in making the fashion marks 6 for leg narrowings, thereby permitting spring 245 to turn shaft 244 counterclockwise as viewed in Figs. 3 and 46 and to throw arm 243, link 242 and pawl 240 toward narrowing spindle 69 so as to cause the pawl 240 to engage its ratchet on the down stroke of actuator 102 and turn spindle 69 in the widening direction half the distance it was turned in the narrowing direction by pawl 68 on the pre-

ceding upstroke of actuator 102. It will be understood pawl 240 must not approach too close to spindle 69 or else the pawl 240 may turn spindle 69 back or in the widening direction farther than desired. To prevent this result, the movement of pawl 240 toward spindle 69 is limited by a screw 279 shown in Fig. 46. Screw 279 is carried in a lug 243A which is fixed to lever 243 and which holds screw 279 in position to strike a frame portion to limit the movement of lever 243 and pawl 240. The pawls for spindle 58 for the end stops, however, are not affected by the change in position of shaft or rod 244 and spindle 58 continues to turn enough to move the end stops two needles in the narrowing direction at each upstroke of the actuator 102. Therefore, after pawl 240 begins to act, the lines of fashion marks produced by the narrowing combs incline toward the selvages and the fashion marks in line 13 make an angle at point 14 with the fashion marks in line 12. At the end of the fashion marks in line 13 the parts are in the relative positions shown in Fig. 55.

The parts being so adjusted that the plate 256 is midway between the block 257 and block 258 at the end of the heel narrowings, before the first movement of spindles 58 and 59 for the toe narrowings, the attendant turns spindle 69 by hand to move plate 256 against block 257 to turn shaft or rod 244 clockwise as viewed in Figs. 3 and 46 and thereby to throw pawl 240 out of operation. The lines of fashion marks 18 are therefore parallel to the selvages, this being the preferred construction in the toe area.

The threaded portions on the narrowing spindles 69 of ordinary leggers are only of a length needed to move the narrowing combs in the narrowing direction sufficiently to make the knee, leg and the heel narrowings, the narrowings in the sole and toe of the foot portions being then made on the footer machines. Therefore, difficulty has been encountered in trying to make single unit stockings on ordinary legger machines because such method of operation has called for a greater range of narrowing than the narrowing spindles of the ordinary leggers have permitted. The full-fashioned knitting machine herein disclosed is, except as otherwise indicated, a typical "Reading" legger and has narrowing spindles of the ordinary length. In order, however, that we may make stockings of the type shown, in Fig. 1 on machines having narrowing spindles 69 as shown, we have provided means for increasing the range of travel of the narrowing combs 60 in comparison to the length of the threaded portions of spindles 69. Further, we have shown herein two forms of such means, one form being shown in Figs. 31 to 40, inclusive; and the other form being shown in Figs. 41 to 45.

In the arrangement shown in Figs. 31 to 40, narrowing rods 61 and 62, operated from narrowing nuts 65 and 66 respectively are each made in two sections, the left hand sections 280A and 281A, in each case, being the ones directly operated by the nuts. Sections 280A and 281A are shown as adjustably connected to the main portions or comb carrying sections 280 and 281 of the rods 61 and 62 by means permitting them to be readily disconnected, thereby permitting the nuts to be moved while the main sections 280 and 281 of the rods are stationary. Therefore, when nuts 65 and 66 have moved as close together as is desirable to the position shown in Fig. 38, the section 280 may be disconnected from section 280A and the section 281 disconnected from

the section 281A and the nuts 65 and 66 moved farther apart while the sections 280 and 281 and the combs 60 fixed thereto remain stationary, the sections of rods 61 and 62 being then connected together again. The connecting and disconnecting means between sections 280 and 280A is essentially the same as that between sections 281 and 281A and, in general, is best shown in Fig. 31. However, as detail views Figs. 32 and 33 are sections through parts of the connecting and disconnecting arrangement for rod sections 281 and 281A, the arrangement for adjustably connecting section 281A with section 281 will be described in detail and the structure of the equivalent adjustable connecting means between sections 280A and 280 will be largely obvious therefrom.

As shown in Fig. 31, rod section 281A has fixed thereto, by screws 282, a frame 284 which is grooved on its rear face as shown at 285, Fig. 33, to receive some of the front or forward portion of narrowing rod section 281. Also, frame 284 has a longitudinal slot 286 therein in which is adjustably mounted a block 287 which has end sections T-shaped in cross-section and which extends through the slot 286 from front to rear of frame 284 into contact with the front face of rod section 281, screws 288 extending through said T-shaped sections of block 287 from the front side or face of the block to the rear of it and into rod section 281 so as to draw block 287 and hold it tightly against the rod section 281. However, the stem of the T of block 287 is slightly longer than the thickness of the frame 284 so that block 287 is not clamped to the frame and, except when otherwise held as shown in Fig. 31, it may slide readily in slot 286 to permit adjustment of the position of section 281 relative to frame 284, section 281A and associated parts and, therefore, relative to nut 66. The central portion of block 287 projects forward somewhat away from the front face of frame 284 and is turned up into a short axle 291 on which is rotatably mounted an arm 292 forming part of a composite spacer 293. Arm 292 has an enlarged head 294 which surrounds axle 291 and is suitably held thereon as by a nut 296. Head 294 is at one end of spacer 293 and the axle 291 passes through head 294 adjacent the rounded end thereof. A second part of arm 292, of reduced sectional area compared to head 294, is in the form of a bolt 295 which extends into and has threaded engagement with an extension sleeve 296, a jam nut 297 being provided to retain sleeve 296 in adjusted position on part 295.

The standard or head 74 on nut 66 pushes section 281A during the narrowing movements of nut 66 in somewhat the usual way, there being a standard 77 forming part of frame 284 and therefore fixed to rod section 281A by screws 282. An adjustable stop or contact screw 78 in standard 77 holds section 281A of rod 62 in the desired position with respect to head 74, a tension spring 75A connected between the top of standard 77 and a point on a horizontal bar 300 fixed to standard 74 serving to hold screw 78 firmly against the vertical face of standard 74 during movement of the head in either direction. Standard 77 pushes section 281A of rod 62 to correspond with narrowing movements of head 74 and pushes section 281 through spacer 293 and block 287. For this purpose, standard 77 has a threaded hole therein (not shown) for receiving a bolt 301 which is held in adjusted position in standard 77. Also, frame 284, of which standard 77 is a part, transmits a widening pull to section 281 of rod 62 through

spacer 293 and block 287. For this purpose, frame 284 has a forwardly projecting flange 302, perhaps best shown in Figs. 34–36 having a vertical face 303 transverse to the rod 62 and having therein a bolt 304 in longitudinal alignment with bolt 301. When spacer 293 lies in alignment with bolts 301 and 304 as shown in Fig. 34, bolt 301 pushes rod 62 in one direction and bolt 304 pushes rod 62 in the other direction.

As shown in Fig. 32, the bolt 291 which serves as an axis for spacer 293 is close to one end of the spacer. Therefore, if the ends of the spacer 293 are reversed, the position of block 287 and rod section 281 is changed relative to section 281A and nut 66. As shown in Fig. 31, when nuts 65 and 66 are set for the beginning of a welt and are the greatest distance apart, spacer 293 has the greatest portion of its length on the right side of its pivot bolt 291. If now, successive narrowing operations have brought nuts 65 and 66 as close together as is desirable that they should be, spacer 293 may be swung out of the line of bolts 301 and 304 as shown in Fig. 35 and, after the parts have been shifted with relation to each, spacer 293 may be swung back into alignment with bolts 301 and 304 as shown in Fig. 36 but with the greater portion of the length of spacer 293 on the opposite side of the bolt 291. It will be understood that while Fig. 36 shows the nut 66 in the same place as in Fig. 34 and the rod section 281 farther to the right in Fig. 36 than in Fig. 34, the parts have been so shown merely as a matter of convenience so as to keep nut 66 on the sheet and that, in practice, the rod section 281 will be held stationary and the nut 66 moved out or to the left as viewed in Figs. 31, 34, 35 and 36 as an accompaniment to reversing the spacer 293. The narrowing rod 61 having an adjusting means generally similar to that already described in connection with rod 62 and the nuts 65 and 66 necessarily moving in and out together, the position of the nut 65 is naturally adjusted with respect to comb carrying section 280 at the same time that nut 66 is adjusted with respect to comb carrying section 281. The nuts 65 and 66 having been thus moved farther apart while the combs have not been moved, further narrowing operations can then be performed.

In order that spacer 293 may not slip out from between bolts 301 and 304 accidentally when the rods 61 and 62 are in use, we have so formed the nuts and spacer that the spacer engages the nuts to hold itself in place when in use. For this purpose, we have shown nuts 301 and 304 as having axial bores 305 (Fig. 32) and portion 294 of spacer 293 has a slight projection 306 which is adapted to project slightly into one of bores 305 when spacer 293 is in operative position. Also, the sleeve member 296 has a relatively reduced axial bore 307 extending from the threaded bore for receiving bolt 295 to the end of the sleeve farther from axis 291 and a spring 308 and plunger 309 are so arranged in bore 307 that the spring 308 presses against the end of bolt 295 at one end and against the plunger 309 at the other to press the plunger toward the free end of the bore 307. The end of sleeve 296 is rounded as shown at 313 so that it will not catch against nut 301 or 304 but will permit the plunger 309 to be pressed back into bore 307 by a moderate lateral pressure so that the position of the spacer 293 may be readily reversed when desired.

The arrangement shown in Fig. 31 for changing the spacer relationship of section 280 of rod 61 to nut 65 is similar to the corresponding arrangement for rod 62 except that the block 315, corresponding to block 287, is inverted and the flange 316, corresponding to flange 302, is also inverted. Also, the spring 75, corresponding to spring 75A, is connected between flange 316 and a point, not shown, on nut 65. Standard 76, corresponding to standard 77, is not as long as standard 77. However, as indicated hereinabove, the general arrangement and functions of the parts for adjusting section 280 with respect to nut 65 are the same as described for adjusting section 281 with respect to nut 66 and the arrangement and functions of the parts for section 280, with respect to nut 65 will be obvious from the foregoing.

The second form of means for adjusting the nuts 65 and 66 with respect to the combs on the narrowing rods is shown in Figs. 41 to 45 inclusive. The arrangement shown in Figs. 41 to 45 comprises a guide rod 72 and narrowing nuts 320 and 321 of different form but of substantially identical functions as nuts 65 and 66. Nuts 320 and 321 are shown as connected to narrowing rods 322 and 323 respectively through adjustable drive means which are identical except that one is left-handed with respect to the other. As the connecting means between nut 321 and rod 323 is shown in detail in Figs. 42, 43, 44 and 45, it will be described in detail and the arrangement and operation of the companion connecting means will thereupon be obvious with only a minimum of description.

Nut 321 has a standard or plate 324 fixed thereto as by a bolt 325 (Fig. 43). Also, as best shown in Fig. 43, plate 324 is inclined rearwardly toward the plane of rods 322 and 323 to facilitate delivering impulses to the rods. Plate 324 has a plate or head 326 slidably mounted thereon and arranged to cooperate with a contact screw 327 to deliver driving impulses to the rod 323 in the narrowing direction through a dog 328 fastened to the rod by screws or other suitable means. Also head or slider 326 imparts impulses to rod 323 in the widening or racking out direction by means of a spring 329 attached to one end to the head and at the other end to a point (not shown) on the rod 323. Slidable head 326 rests in a slot whose longitudinal edges are parallel to rods 322 and 323 and to the spindle 69, the lower edge of said slot being formed by a narrow plate 331 fastened to plate 324 and which is a little thicker along its upper edge than the head 326 so as to provide an upwardly extending lip 332 contacting the front face of the head along its lower edge to hold it against plate 324. Along its upper edge, plate 324 is thicker than along its lower edge forming a shoulder 333 which acts to guide the upper edge of head 326, a thin narrow plate 334 fixed to the plate 324 along its upper edge being wide enough in the vertical direction to overlap the upper edge of head 326 and to hold it in place against plate 324.

On the top of the plate 324 is a boss 335 in which are threadedly mounted two coaxial contact bolts 336 arranged parallel to rods 322 and 323 and forming part of a means for holding the slider or head 326 in adjusted position. Cooperating with contact bolts 336 is a hand lever 337 pivoted to plate or standard 324 on a pin 338 and extending thence upwardly. Intermediate pivot pin 338 and its upper end, lever 337 has a pin and slot connection with slider 326, the pin for such connection being shown at 339 and the slot

being vertical but not being shown in slider **326**, the one associated with nut **321**, but a similar slot being shown in the slider associated with nut **320** at **341A** in Fig. 41. Therefore, when lever **337** is moved around its pivot, head or slider **326** is moved with it as is shown by a comparison of Figs. 41 and 42. In order, however, to set proper limits to the movement of the slider **326** and handle **337**, slider **326** has an elongated aperture **342** therein parallel to rods **322** and **323** but closed at both ends and the plate or standard **324** has a laterally projecting boss **343** fixed thereon and fitting in said slot. When handle **337** is moved to the left, slider **326** also moves to the left and boss **343** contacts with the right hand end of said slot to limit the movement of the slider and hand lever to the left as shown in Fig. 41. In the positions of the parts shown in Fig. 41, the slider **326** is relatively toward the left end of spindle **69** as viewed from the front of the machine. When now the nuts **320** and **321** have been moved as close together as is desirable and it is desired to move the rods **322** and **323** so as to bring the narrowing combs thereon still closer to each other, lever **337** is moved over to the right or clockwise as viewed in Fig. 42, its companion lever **337A** being thrown to the left or counterclockwise. Before levers **337** and **337A** are moved clockwise and counterclockwise, respectively, spindle **69** is turned to move nuts **320** and **321** correspondingly outwardly to the right and left respectively as viewed in Figs. 41 and 42, the spring **329** for rod **323** and the corresponding spring for the rod **322** (not shown) maintaining the rods **323** and **322** in contact with the nuts **321** and **320**, respectively. The lever **337** is then moved until boss **343** is in contact with an adjustable stop screw **345** threaded through the left end of slider **326** so as to project into slot **342**, and the lever **337A** is correspondingly moved, which action moves the rods **323** and **322** back to the positions occupied before moving the nuts **321** and **320** outwardly.

In whichever limiting position lever **337** is placed, it and the connected parts are then rigidly connected together by latching the lever **337** at one or the other end of its arc of movement, the said screws **336** cooperating for this purpose with latch means on the lever itself. Said latch means comprises a plunger or latch member **346** in the form of a truncated wedge which is adapted to contact either of screws **336** on the side of member **346** toward the center of its arc of movement to hold lever **337** at one end or the other of its path or arc of movement. Slider **326** is thereby held rigid with plate or standard **324** at one end or the other of the path of the slider, movement in the direction away from the center of movement being prevented in each case by contact of boss **343** with the inner face of the slider or with bolt **345**. In order that member **346** may be released from one or the other of screws **336** when it is desired to adjust slider **326** with respect to nut **321** and standard **324**, latch member **346** is formed as shown in Fig. 43 as an enlargement at the lower end of a stem **347** which extends upwardly through a bearing in a cyindrical member **348** which is mounted in and generally toward the lower end of a tubular portion **349** of lever **337** at the upper end of said lever, screw **351** holding member **348** securely in the tubular portion **349**. The upper end of stem **347** extends into a bore in the lower end of a handle member **352** forming part of lever **337** and is secured thereto by a cross-pin **353**. A coil spring **354** surrounding stem **347** and compressed between an internal shoulder in member **348** and a shoulder on latch portion **346** normally presses member **346** downwardly until the lower end of handle member **352** contacts the upper end of member **348**. In this position of the parts, latch portion **346** is in contact with one of screws **336** in boss **335** and the slide **326** is held rigidly against movement relative to the nut **321** because it is held against movement in one direction on plate or standard **324** by the boss **343** and against movement in the other direction on said plate or standard by pin **339** on lever **337**. Therefore, movements of nut **321** are directly transmitted to narrowing rod **323** when handle member **352** and latch **346** are down, but the nut **321** may be readily adjusted with respect to rod **323** by raising handle member **352** and latch member **346** and then moving slider **326** compensatively by means of the handle and lever **337** and finally latching the lever at the other end of its path.

The means for adjusting or permitting the adjustment of nut **320** with respect to the narrowing rod **322** being identical with that permitting such adjustment with respect to nut **321** and rod **323** except that the two are respectively right and left, the parts in said means associated with nut **320** have been given the same reference numerals as corresponding parts in the means described in detail hereinabove but with the addition of the letter A in each case. Thus, the left handle in Fig. 41 is numbered **337** and the right handle in Fig. 41 is numbered **337A**. This being understood, the operation of the adjusting means associated with nut **320** will be obvious without further description.

It will be seen that both arrangements disclosed hereinabove for increasing the travel of the narrowing combs involves increasing the effective length of the threaded portions **67** and **68** of the narrowing spindle **69** and its counterpart at the right hand end of the machine. In other words, the mechanisms or devices shown in Figs. 31 to 40, inclusive, and in Figs. 41 to 45, inclusive, act to increase the effective length of the narrowing rods.

The machine speed is usually slowed at the time spindles **58** and **69** are turned in the narrowing direction and therefore no difficulty is experienced from overrunning by the spindles during narrowing but, due to the back-racking action occurring in the regular knitting cycle during which the machine is operating at a high speed, it has been found that the spindle **58** has a tendency to overtravel or turn through a greater angle in a counterclockwise direction than intended for a given stroke of the racking pawl **99**, as viewed in Figs. 15 and 16, while back-racking and, accordingly, means are provided in the apparatus herein disclosed for preventing such overtravel. For this purpose, there is provided a lever **360** pivotally mounted on shaft **244** and having an arm **361** for engaging the teeth of the ratchet wheel **97A**, as shown in Fig. 15. The lever **360** is prevented from moving axially along the shaft **244** by means of a pin **362** which engages a slot or groove **363** in the lever, as shown in Figs. 17 and 20. The pin **362** is carried in a bracket **364** screwed to the journal **239** of the bracket **70** for spindle **58**. The lever **360** has a second arm **367** which carries a stud **368** having a portion **368A** (Fig. 18) for sliding engagement with a slot **369** in a link **370**. The link **370** is shown as pivotally connected to the lower end of pawl **97** as by bolt **371** shown in Fig. 19 and which serves also to connect pawl **97** to link **103**. In operation,

cam 151 being in the position in which pawl 97 is ineffective or disabled and pawl 99 is effective or active, both pawls 97 and 99 rise and fall alternately as the lever member 107 to which they are pivoted oscillates on spindle 58 as an axis in response to up and down movements of actuator 102, pawl 97 moving up as pawl 99 moves down and vice versa. As pawl 99 moves down to obtain contact with a fresh tooth on ratchet wheel 99A, pawl 97 moves up so that it comes into contact with a surface 361A on the underside of the lever arm or holding pawl 361 and lifts it so that lever arm 361 is entirely free of ratchet wheel 97A. As member 107 then reverses the direction of its swing, pawl 99 moves up and acts on its ratchet wheel 99A to turn spindle 58 in the widening or back-racking direction, pawl 97 simultaneously moving downward as pawl 99 moves upward and thereby lowering lever arm 361 so that it is in contact with ratchet 97A and checks it at the upper end of the stroke of pawl 99, the parts being then in the positions shown in Fig. 15. The lifting action of pawl 97 on lever arm 361 turns the lever in the counterclockwise direction as viewed in Figs. 15 and 16. As it does so, a tension spring 372 is extended, said spring being connected between a pin 373 on arm 367 and a pin 374 at one end of bracket 364 so that it assists gravity in moving lever arm 361 down into the position shown in Fig. 15 in which arm 361 holds ratchet wheel 97A and spindle 58 against turning in the counterclockwise or back-racking direction. The downward movement of pawl 97 is so coordinated with the upward movement of pawl 99 that arm 361 is prevented from stopping ratchet wheel 97A too soon, its lower edge contacting first the outer end of the tooth just ahead of the one with which the end of lever arm 361 is to make firm contact. The lever arm 361 therefore rides into the position shown in Fig. 15 as the pawl 99 comes to the end of its stroke.

When, however, it is desired to turn spindle 58 in the widening or back-racking direction by hand, both pawl 97 and lever arm 361 must be prevented from interfering with the rotation of the spindle. As has been mentioned herein, pawl 97 can be thrown into neutral or inoperative position by hand, it being afterward necessary to throw it into active position manually when it is desired to use it to turn spindle 58 in the narrowing direction. For the purpose of throwing lever arm 361 out of action at the same time as pawl 97, I have provided said link 370, which, together with stud 368 and bolt 371, provides a sliding connection or lost motion connection between lever arm 367 and pawl 97. Slot 369 is so placed that stud 368 is at the end of the slot 369 farther from bolt 371 when lever arm 361 is in contact with wheel 97A and pawl 97 is held away from wheel 97A by cam 151, both as shown in Fig. 15. When pawl 97 is at the top of its stroke but still held away from its ratchet wheel 97A by cam 151, stud 368 is at the end of slot 369 nearer bolt 371, as shown in Fig. 16. Link 370 therefore does not hamper the movements of lever 360 when spindle 58 is being operated in the back-racking direction by pawl 99. When, however, pawl 97 is turned to the neutral position shown in Fig. 13, bolt 371 draws link 370 far enough to the right as viewed in Fig. 15 to engage the left end of slot 369 with stud 368 and thereby draw lever arm 367 to the right as viewed in Fig. 15, thereby also lifting lever arm 361 out of the path of the teeth of ratchet wheel 97A and permitting spindle 58 to be readily turned by hand in the back-racking direction. To ensure that link 370 shall be securely held on bolt 371, and stud 368, a nut and washer arrangement 375 best shown in Fig. 19 is provided for bolt 371 and an enlarged head is provided for stud 368.

The operation of the various mechanisms comprising the apparatus hereinabove described for producing the stocking blank of Fig. 1 is summarized as follows:

At the start of the stocking blank the narrowing nuts 65 and 66 for the narrowing rods 61 and 62 and the spacer 293 of the means for increasing the effective travel of the nuts 65 and 66 are positioned as in Figs. 31 and 34, the nut 59 for the end stops 53 for the carrier rods 54 and the plate 256 on arm 255 is in the position relative to block 258, shown in Fig. 51, the narrowing pawl 91, as shown in Fig. 4, is in position to turn the spindle 58 for the nut 59, the pawl 98, as shown in Fig. 8, for the spindle 69 for the nuts 65 and 66 is held out of engagement with the ratchet wheel 98A by the arm 146, and the member 110 and associated parts for preventing overtravel of the nuts 65 and 66 in the narrowing direction are positioned as in Figs. 26 and 27.

The machine is now operated in the usual manner to knit the welt portion 1 after which the narrowing nuts 65 and 66 are manually moved from the position of Fig. 31 to the position of Fig. 37 in which position the narrowing combs 69 are in the field of the needles 30, as shown in Fig. 37, this manual action moving the arm 146 from beneath the extension 147 of pawl 98 to permit the pawl to engage the ratchet wheel 98A. Knitting is continued in the leg portion 2 to form the fashion marks 5, the straight portion of the leg and the fashion marks 6, the fashion marks 5 and 6 being produced in the usual manner as controlled by the pattern mechanism P, Fig. 2, which effects shifting of the cam shaft 26 to align the cam 175 with the cam follower 162 to cause the actuator 102 and pawls 97 and 98 to turn the spindles 58 and 69 in the narrowing direction. At the last fashion mark 6 the plate 256 has been moved to the right beyond the block 258 to drop off of the same, as shown in Fig. 52. Knitting is continued in the straight portion of the ankle 3 to the start of the widening lines 7 in the heel portions.

In order to widen the heel portions along line 7 a button on the pattern chain 60 of the pattern mechanism P, shifts the lever 193 from beneath the end 191 of level 184 to cause the rod 183 to shift the follower 162 to the right, as viewed in Fig. 21, into alignment with the cam 176 which cam causes operation of the cams 150 and 152 on the spindles 58 and 69, respectively, to prevent pawls 97 and 98 from turning the spindles 58 and 69 in the narrowing direction and permitting pawls 99 and 101 to turn sprindles 58 and 69 in the back-racking or widening direction during each widening operation of the machine. During the widening operation the nuts 65 and 66 are moved away from each other and the nut 59 and arm 255 thereon are moved to the left, as viewed in Fig. 52 whereby the plate 256 moves the block 258 to the left until the screw 260 engages the bolt 262 and the flange 273 of the plate 272 engages the edge 274 of plate 268 to hold the block 258 in the position shown in Fig. 53 whereupon widening operations causes the plate to again engage the surface 258A of block 258 and move therealong to the position of Fig. 53, which

position corresponds to the last widening operation.

After the straight portions 8 have been produced, the pattern mechanism again effects shifting of the cam shaft 26, to again turn the spindles 58 and 69 in the narrowing direction by preventing operation of the widening pawls 99 and 101 and again permitting the narrowing pawls 97 and 98 to function to produce the lines of fashion marks 12. At the last of the fashion marks 12, the plate 256 has again been moved to the left to drop off of the block 258. This action causes the arm 243 shown to turn in a counterclockwise direction to permit pawl 240 (Fig. 3) to engage the teeth of the ratchet wheel 101A to turn the spindle 69 in the back-racking direction a distance of one needle after each two needle movement in the narrowing direction during formation of the fashion marks 13, whereby the fashion marks 13 extend on a line toward the selvage edge of the blank A from the point 14.

After the last fashion mark 13, the nuts 65 and 66 and the narrowing rods 61 and 62 having reached the positions shown in Figs. 38, the nuts and combs are moved away from each other to the position of Fig. 39. In this position the member 293 which is positioned between the stops 301 and 304 on the section 281 of the narrowing rod 62 is now swung outwardly as shown in Fig. 35, the section 281 is moved away from the section 281A and the member 293 again placed between the stops 301 and 304, but pointing in the opposite direction as shown in Figs. 36 and 40 the position of combs 60 in Fig. 40 corresponding to the position of the combs in Fig. 38, so that in effect, this resetting of the nuts 65 and 66 does not change position of the combs. The member, corresponding to member 293 for the narrowing rod 61 is also repositioned, in the same manner as member 293. Where the mechanism of Figs. 41 to 45 is substituted for the member 293 and associated parts, the resetting of the nuts 320 and 321 is effected in a similar manner to nuts 65 and 66, and the levers 337 and 337A are shifted in a clockwise and counterclockwise direction respectively, to return the narrowing combs 60 to the position shown in Figs. 38 and 40. The spindle 69 is then manually turned in the narrowing direction to move the combs into position for the start of the fashion marks 18 which moves the plate 256 into engagement with the block 257 to again cause the fashion marks 18 parallel to the edge of the blank. Knitting continues to form the straight part of the foot to the start of the fashion marks 18 in the toe portion. The fashion marks 18 are produced in the manner hereinbefore set forth for producing the fashion marks 5, 6 and 12 and the ravel courses are formed completing the stocking blank A.

If accidentally the operator fails to reset the nuts 65 and 66 and reposition the member 293 for the rod 62 and the corresponding member for the rod 61, when the nuts 65 and 66 have reached the position shown in Fig. 25, the arm 132 on the nut 66 engages the collar 133 and moves rod 120 from beneath the member 110 to disengage the pawl 98 from the ratchet 98A to thereby prevent movement of the nuts 65 and 66 toward each other beyond the position shown in Fig. 25.

It is to be understood that although only the operation of the left narrowing mechanism is shown and described, that the operation of the narrowing mechanism at the right end of the machine is the same.

From the foregoing description of the operation of the mechanism it will be seen that the stocking blank is produced by first knitting and turning the welt 1, knitting the leg 2 by forming fashion marks 5 for the knee narrowing, forming the straight portion of the leg 2, forming the fashion mark 6 for the calf narrowing, forming the straight portion of the ankle 3, widening the heel pockets along the line 7, forming the straight or parallel portions 8 of the blank, forming the fashion marks 12 which extend parallel to the edges 9, forming the line of fashion marks 13 which extend at an angle to the fashion marks 12 and toward the selvage edge 9 of the blank, the last fashion mark 13 being in substantially the same wale as the last fashion mark 6, knitting the straight or parallel edges of the foot and forming the fashion marks 18 to narrow the fabric along the lines 15 to form the toe, which fashion marks 18 start at a wale inwardly of the wale in which occurs the last fashion mark 13 and forming the ravel course to complete the stocking.

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

What we claim is:

1. A mechanism for controlling the width of fabric made on a straight knitting machine comprising a spindle having oppositely threaded portions with nuts threaded one on each portion, a pair of combs operated by said spindle, and connections between said nuts and said combs for moving said combs responsive to movements of the nuts including means for adjusting the distance between said nuts and said combs under loop transferring conditions.

2. In a straight knitting machine, the combination of a threaded narrowing spindle, a narrowing rod having one or more narrowing points thereon, an operating connection between said narrowing spindle and rod including a nut on said spindle and adapted to operate said rod when said nut is in either one of two positions relative to said narrowing point or points, and means for automatically limiting the travel of said nut in the narrowing direction to prevent disturbing the adjustment of said nut by overtravel.

3. In a straight knitting machine, a two-part narrowing rod, the parts of which are fastened together in use, a point attached to one part of said rod and adapted to operate on a knitted loop, means coacting with the other part of said rod for moving said rod, and means on said rod whereby the relative position of the portion of said rod to which said point is attached may be adjusted to different positions with respect to said moving means for different loop transferring movements.

4. In a straight knitting machine, the combination of end stops and narrowing rods, a pair of threaded spindles, one spindle for moving the end stops at one end of the machine and one spindle for moving the narrowing rods at said end of the machine, oppositely acting sets of pawls and ratchets for both of said spindles, means for actuating said pawls, pattern controlled means for rendering either of said sets of pawls ineffective, and means whereby said actuating means may operate said spindles in either direction at the same time or may operate said stop spindle in either direction while said narrowing spindle

is stationary, and in which the narrowing spindle is arranged to move members lengthwise of itself and has means associated therewith for preventing the action of the actuating means thereon after the narrowing spindle has moved said members to certain points.

5. In a straight knitting machine, a narrowing mechanism including a narrowing comb, means for operating said comb to produce fashion marks parallel to the selvage or inclined thereto comprising a threaded spindle, a nut on said spindle connected to said comb, means for racking said spindle to move said nut in the narrowing direction, a means acting after each action of said first racking means for racking said spindle to move said nut in the widening direction by a portion only of the amount it has been moved in the narrowing direction, a means for preventing the action of said means for racking in the widening direction during certain portions of the path of said nut, and means shifting said preventing means from one portion of the path of said nut to another.

6. In a straight knitting machine, a pair of parallel threaded spindles, an end stop driven from one of said spindles, a narrowing nut driven from the other of said spindles, means for racking said spindles in either direction, means controlled by the position of said end stop adapted to change the effective motion in the narrowing direction of said nut compared to the motion of said stop, and means responsive to a change in direction of the motion of said stop for altering the point in the path of the end stop at which said motion changing means becomes effective.

7. In a full-fashioned knitting machine, a mechanism including a narrowing comb, means for operating said comb to produce fashion marks parallel to the selvage or inclined thereto comprising a threaded spindle, a nut on said spindle connected to said comb, means for racking said spindle to move said nut in the narrowing direction, means for racking said spindle in the widening direction a portion only of the amount it had been moved in the narrowing direction, an end stop, a second threaded spindle arranged to move said stop in either the narrowing or widening direction, a traveller connected to said end stop, connections between said traveller and said second racking means, adapted when said traveller is in a certain position relative to said second spindle to prevent the operation of said second racking means, a pivoted cam means extending generally parallel with said second spindle and having its angular position determined by the position of said traveller, and means responsive to a movement of said stop in the widening direction for changing the point in the path of said stop at which said traveller and connections prevent the operation of said second racking means.

8. In a full-fashioned knitting machine, a mechanism as set forth in claim 7 and in which the means responsive to a movement of the end stop forms a part of the cam means.

9. In a straight knitting machine, the combination of a narrowing spindle, a pawl for turning said spindle in one direction, a cam piece journaled on said spindle and adapted to throw said pawl out of operation when desired, means for urging said cam piece in a direction to throw said pawl out of operation, and a rod arranged parallel to said spindle and movable into position in which it holds said piece in a position to permit said pawl to operate, and means responsive to the movement of said spindle for moving said rod out of said holding position to permit said urging means to move said piece to act on said pawl.

10. In a straight knitting machine having end stops and narrowing points, the combination of a spindle for moving the end stops, and a spindle for moving the narrowing points, a pair of pawls for each of said spindles, one pawl of each pair acting at a time and moving its spindle in the opposite direction from the other pawl for the spindle, means for operating said pawls including an actuator, a main camshaft adapted to occupy either a knitting or a narrowing position, a cam on said shaft for operating said actuator at times when it is in knitting position, a cam on said camshaft for operating said actuator at times when said camshaft is in narrowing position, a pair of connected cam members journaled on said spindles and adapted to throw out of action either the pawls for turning said spindles in one direction or the pawls for turning said spindles in the other direction and means for shifting said cams for throwing out one set of pawls or the other depending on whether said actuator is to be operated by one or the other of said cams on the main camshaft.

11. In a straight knitting machine, the combination of a narrowing spindle, an end stop spindle, a pair of pawls for each of said spindles arranged to act one at a time to turn said spindles in one direction or the other, a back-racking pawl for said narrowing spindle, a false pawl pivoted on the same axis as the one of said pair of pawls which turns said narrowing spindle in the back-racking direction, lost motion connections between said false pawl and said back-racking pawl whereby said false pawl may move said back-racking pawl out of operating position, and a link pivoted both to said false pawl and to the pawl for said stop spindle for moving the stop spindle in the back-racking direction whereby said false pawl may move both said back-racking pawls out of operating position simultaneously.

12. In a full-fashioned knitting machine, the combination of a narrowing rod section having one or more narrowing points thereon, a second narrowing rod section in alignment with said first section, a frame fixed to one of said sections and adapted to slide on the other section, means whereby said other section may be slidably connected to said frame, spacer means pivotally connected to said connecting means and adapted to contact parts on said frame to determine the position of said connecting means, the pivot of said spacer means being relatively near one end thereof whereby reversing its position on its pivot requires a change in the position of said connecting means and therefore the narrowing point or points with respect to said frame, and means for moving said section having the frame thereon in either direction.

13. In a full-fashioned knitting machine, the combination of a narrowing rod having one or more narrowing points thereon, a threaded spindle having a nut thereon for moving said rod and means intermediate said nut and rod adapted to permit adjustment of the relative position of said nut and rod when driving relation comprising a standard fixed to said nut, a slider adjustable on said standard parallel to said spindle and rod, means for limiting the movement of said slider on said standard in either direction, and a lever for moving said slider, said lever pivoted to said standard and having a pin and slot connection to said slider,

and means for latching said lever in the position assumed by it when said slider is at one or the other end of its path.

14. In a straight knitting machine, the combination of a narrowing spindle, means for racking said spindle in the narrowing direction, means adapted to step said spindle back after each narrowing movement thereof for a portion only of the movement in the narrowing direction, a pawl for causing said back stepping action, a member controlling the time at which said back stepping means is operated, and means adjusting said member longitudinally of said spindle during the operation of the machine.

15. In a straight knitting machine, the combination as set forth in claim 11 together with means responsive to the motion of the narrowing spindle for moving the false pawl into position in which both the back-racking pawls are moved out of operating position, a link pivoted to both of the pawls for turning said spindles in the narrowing direction, means for actuating all said pawls, and means associated with said actuating means for automatically throwing out the narrowing pawl for the end stop spindle and thereby also through said link throwing out the narrowing pawl for the narrowing spindle and adapted also to throw out the back-racking pawls for both said spindles by direct action.

16. In a straight knitting machine, the combination as set forth in claim 14 in which the means for adjusting the position of the member is automatic.

17. In a full-fashioned knitting machine, the combination of a narrowing spindle, an end stop spindle parallel to said spindle, a member mounted to move parallel to said spindles and responsive to the motion of said end stop spindle, a back stepping pawl, means including a cam contacted by said member for holding said pawl out of action, a mounting for said cam permitting it to slide a limited distance parallel to said spindles, a spring means for urging said cam toward one end of its path, means for automatically latching said cam against the action of said spring means when said cam is in a certain position, and means whereby said member releases said latching means in one position and moves said cam into position to be latched when the member moves in a certain direction starting from another position.

18. The method of operating a full-fashioned knitting machine having an end stop spindle and a narrowing spindle, means for operating both said spindles in the narrowing and back-racking directions and means for back-stepping said second spindle intermediate successive narrowing movements thereof comprising operating said spindles in the narrowing direction simultaneously to cause narrowing of the fabric simultaneously with the production of fashion marks, operating both said spindles in the widening or back-racking direction to widen the fabric without the production of fashion marks, again operating both said spindles in the narrowing direction to narrow the fabric with the production or narrowing marks and operating said back stepping means in the latter portion only of the narrowing operations which immediately follow said widening operation, the last fashion mark of the group made following said widening operation being thereby somewhat nearer the edge of the fabric than the last fashion mark in the group produced in the next preceding narrowing operation, operating said machine

without widening or narrowing for a time following the production of said last group of fashion marks, turning said narrowing spindle in the narrowing direction without changing said end stop spindle, and operating both said spindles in the narrowing direction to produce a row of fashion marks beginning at a point inward of the inner end of either of the previous rows of fashion marks.

19. In a straight knitting machine, the combination of a threaded end stop spindle, a threaded narrowing spindle, a narrowing rod having one or more narrowing points supported therefrom, an operating connection between said narrowing spindle and rod including a nut on said spindle and adapted to operate said rod when said nut is in either one of two positions relative to said narrowing point or points, and means for driving said spindles in either direction as desired including pawls, cam means for controlling the positions of said pawls, a main camshaft, two actuating cams on said shaft, a cam follower adapted to coact with either of said actuating cams and means responsive to the position of said follower for determining the position of said control means.

20. In a straight knitting machine, the combination of a narrowing spindle, a rod operated by said spindle having one or more narrowing points supported therefrom, means for changing the angle of the fashion marks made by said points to the wales of the fabric, an end stop spindle, and means for operating said spindles in either direction as desired including control means adjacent said spindles, a main camshaft, two actuating cams on said shaft, a cam follower adapted to coact with either of said actuating cams, and means responsive to the position of said follower for determining the position of said control means.

21. In a full-fashioned knitting machine, the combination of a threaded narrowing spindle, a threaded end stop spindle, a narrowing rod having one or more narrowing points thereon, an operating connection between said narrowing spindle and rod including a nut on said spindle and adapted to operate said rod when said nut is in either one of two positions relative to said point or points, means for automatically limiting the travel of said nut to prevent damage from overtravel, and means for operating said spindles in either direction as desired including control means adjacent said spindles, a camshaft, two actuating cams on said shaft, a cam follower adapted to coact with either of said actuating cams, and means responsive to the position of said follower for positioning said control means.

22. In a full-fashioned knitting machine, a mechanism for controlling the width of the fabric comprising a threaded spindle, a pawl and a ratchet wheel for turning said spindle in one direction, a second pawl and a second ratchet wheel for turning said spindle in the other direction, means for holding one of said pawls in a position in which it is ineffective when the other pawl is effective, and means acting on the ratchet wheel for the ineffective pawl and controlled by said ineffective pawl to prevent overrunning of the spindle after the thrust of the effective pawl has ended.

23. In a full-fashioned knitting machine, a mechanism as set forth in claim 22 and in which the means for preventing the overrunning of the spindle includes a lever arm adapted to contact the ratchet wheel of the ineffective pawl as the

effective pawl nears the end of its racking stroke.

24. In a full-fashioned knitting machine, a mechanism as set forth in claim 22 and in which the means for preventing the overrunning of the spindle includes a lever arm which is lifted by the ineffective pawl from the ratchet wheel of the ineffective pawl to permit the spindle to respond to the action of the effective pawl at the beginning of its racking stroke.

25. In a full-fashioned knitting machine, a mechanism for controlling the width of the fabric as set forth in claim 22 and in which the means for preventing overrunning of the spindle includes a lever arm adapted to contact the ratchet wheel of the ineffective pawl as the effective pawl nears the end of its racking stroke, the pawls having mountings permitting them to be thrown into neutral positions, and a lost motion connection between the lever arm and the ineffective pawl adapted to permit the lever arm to operate while the ineffective pawl is so held and adapted to swing the lever arm away from the ratchet wheel when the effective pawl is moved into its neutral position.

26. A mechanism for controlling the width of fabric made on a straight knitting machine comprising a spindle having oppositely threaded portions with nuts threaded thereon, point combs operated by said spindle, and connections between said nuts and said combs for moving said combs responsive to movements of the nuts including means for adjusting the distance between said nuts and said combs without affecting the relation between the combs.

27. A mechanism according to claim 26 and in which the means for adjusting the distance between the nuts and the combs is carried on the connections.

28. A mechanism according to claim 26 and in which the means for adjusting the distance between the nuts and the combs is carried on the nuts.

29. In a straight knitting machine, the combination of a threaded narrowing spindle, narrowing rods having one or more narrowing points thereon, driving connections between said narrowing spindles and rods including a nut on said spindle for each of said rods and means for adjusting the distance between said nuts and rods without affecting the relation between said rods, and means for automatically limiting the travel of said nuts in the narrowing direction to prevent disturbing the adjustment of said nuts by overtravel.

30. In a straight knitting machine, the combination of a threaded end stop spindle, a threaded narrowing spindle, narrowing rods having one or more narrowing points supported thereon, a driving connection between said narrowing spindle and rods including a nut for each rod on said spindle and means for adjusting the distance between said nuts and said rods without affecting the relation between the rods, means for driving said spindles in either direction as desired including pawls, cam means for controlling the position of said pawls, a main camshaft, two actuating cams on said shaft, a cam follower adapted to coact with either of said actuating cams and means responsive to the position of said follower for determining the position of said control means.

31. In a straight knitting machine, the combination of a narrowing spindle, a rod driven by said spindle having one or more narrowing points supported therefrom, means for changing the angle of the fashion marks made by said points to the wales of the fabric including a member for controlling the position of the points during production of certain of the fashion marks and means adjusting said member longitudinally of said spindle during operation of the machine, an end stop spindle, and means for driving said spindles in either direction as desired including control means adjacent said spindles, a main camshaft, two actuating cams on said shaft, a cam follower adapted to coact with either of said narrowing cams, and means responsive to the position of said follower for determining the position of said control means.

32. In a full-fashioned knitting machine, the combination of a threaded narrowing spindle, a threaded end stop spindle, narrowing rods having one or more narrowing points thereon, a driving connection between said narrowing spindle and rods including a nut for each of said rods, and means for adjusting the distance between said nuts and said rods without affecting the relation between said rods, means for automatically limiting the travel of said units to prevent damage from overtravel, and means for driving said spindles in either direction as desired including control means adjacent said spindles, a camshaft, two actuating cams on said shaft, a cam follower adapted to coact with either of said actuating cams, and means responsive to the position of said follower for positioning said control means.

33. In a straight knitting machine, the combination of a threaded end stop spindle, a threaded narrowing spindle, narrowing rods having one or more narrowing points supported thereon, an operating connection between said narrowing spindle and rods including a nut for each of said rods, means for operating said spindles in either direction as desired including pawls, a main camshaft, two actuating cams on said shaft, a cam follower adapted to shift to coact with either of said actuating cams, and means having a cam portion pivotally mounted coaxially with one of said spindles and acting simultaneously with a shift of said follower for determining the direction of drive of said pawls.

34. The method of operating a knitting machine having a knitting mechanism and a fashioning mechanism including threaded spindles and narrowing rods and means permitting changing the effective length of the threaded portions of said spindles comprising knitting a leg portion of a full-fashioned stocking blank on said machine with lines of fashion marks in the knee and calf regions, knitting a foot portion integrally with said leg portion with lines of fashion marks in the heel and toe sections, and increasing the effective length of the threaded portions of said spindles subsequent to making said heel narrowings.

35. The method of operating a knitting machine having a knitting mechanism and a fashioning mechanism including narrowing rods and means permitting changing the effective length of said rods comprising knitting a leg portion of a full-fashioned stocking blank on said machine with lines of fashion marks in the knee and calf regions, knitting a foot portion integrally with said leg portion with lines of fashion marks in the heel and toe sections, and increasing the effective length of said narrowing rods subsequent to making said calf narrowings.

36. In a full-fashioned knitting machine, the combination of narrowing mechanism including

threaded spindles having nuts thereon and a safety means for preventing over-travel of said nuts including a rod mounted for longitudinal movement in the same transverse portion of the machine as one of said spindles and means including said rod for preventing further racking of said one spindle when said nuts have approached each other to within a certain distance.

37. In a full-fashioned knitting machine, the combination of narrowing mechanism including threaded spindles having nuts thereon and a safety means for preventing over-travel of said nuts including a rod mounted for longitudinal movement in the same transverse section of the machine as one of said spindles and means including said rod and a member cooperating therewith and pivoted on said one spindle for preventing further racking of the one spindle when said nuts have reached a certain position beyond which it is desired that they should not move.

38. In a Cotton's patent or other straight bar knitting machine, screw-racking mechanism comprising the screw, a forward-racking and a back-racking clawker wheel connected to the screw to rack it forwards and backwards, said clawker wheels being co-axial, a clawker-support oscillatable about said axis, a connection for oscillating said support, a forward-racking clawker and a back-racking clawker carried by said support for racking the respective clawker wheels during opposite strokes of the support, bluffing means for bluffing either clawker selectively, a notch wheel connected to the clawker wheels, a spring-loaded plunger releasably engaging the notch wheel to lock it against rotation, a release abutment connected to the plunger, and a cam connected to the clawker-support and oscillatable therewith for engaging said abutment at each stroke and for thereby releasing the plunger during a portion of each stroke.

39. In a straight bar knitting machine, screw-racking mechanism comprising pawl-and-rack-wheel mechanism for racking the screw forwards or backwards as required, a pawl-moving member movable to-and-fro to produce a forward rack by movement in one direction and a back rack by movement in the other direction, a bluff for selectively bluffing the last-said mechanism to produce a forward or a back rack as required, spring-loaded locking mechanism for locking the screw in any selected one of a plurality of positions; and means for releasing the locking mechanism during each racking stroke, which means comprises a releasing member movable to-and-fro with the pawl-moving member.

40. The method of operating a knitting machine having a knitting mechanism including yarn carrier rods, and a fashioning mechanism including stops for said rods, point combs, worms and nuts for moving said stops and combs, pawl means for turning said worms to position the stops and combs to fashion the fabric, back stepping pawl means to give the combs idle movements in the direction the reverse of narrowing, and a control means for said back stepping pawl means including a member moving synchronously with said carrier rod stops comprising knitting a leg portion of a full-fashioned stocking blank on said machine while at times transferring loops by said combs to narrow the fabric and to form lines of fashion marks in the upper and lower leg portions, widening the fabric, narrowing the fabric by said combs to form lines of fashion marks in the widened portions of the fabric and thereby setting said control means to permit said back stepping pawl means to operate and continuing to operate said combs to form lines of fashion marks at angles to said last lines and beginning adjacent thereto but inclining toward the selvages.

41. The method of operating a knitting machine having a knitting mechanism including yarn carrier rods and a fashioning mechanism including stops for said rods, point combs, worms and nuts for moving said stops and combs, pawl means for turning said worms to position said stops and combs for fashioning the fabric, back stepping pawl means to give the combs idle movements in the direction the reverse of narrowing, and a control means for said back stepping means including a member moving synchronously with said carrier stops comprising knitting a leg portion of a full-fashioned stocking blank on said machine while at times transferring loops with said combs to form lines of fashion marks in the upper and lower leg regions, widening the fabric, narrowing the fabric by said combs to form lines of fashion marks in the widened portions of the fabric and thereby setting said control means to permit said back stepping pawl means to operate and continuing to operate said combs to extend the lines of fashion marks in the widened portion so as to form angles between the first and last portions thereof and so the last portions incline toward the selvage, and again forming lines of fashion marks, by the combs but spaced from said last portions and while the back stepping pawl means is idle whereby the lines are parallel to the selvage.

42. The method as set forth in claim 41 and in which the last parallel lines of fashion marks begin in wales which are inward from the wales containing the last marks of the inclined portions.

43. The method of operating a knitting machine having a knitting mechanism including yarn carrier rods and a fashioning mechanism including stops for said rods, point combs, worms and nuts for moving said stops and combs, pawl means for turning said worms to position the stops and combs to fashion the fabric, back stepping pawl means to give the combs idle movements in the direction the reverse of narrowing and a control means for said back stepping means including a member moving synchronously with said carrier stops comprising knitting a leg portion of a full-fashioned stocking blank on said machine while at times transferring loops by said combs to narrow the fabric and to form lines of fashion marks in the upper and lower leg portions, widening the fabric at both sides by the fashioning means, narrowing the fabric by said combs to form lines of fashion marks in the widened portions of the fabric, extending said lines in the widened portions and by which said control means is set so that said back stepping pawl means is positioned for operation, and continuing to operate said combs to form angles in the lines of marks in the widened portions having vertices near the wales containing the last fashion marks in the lines in the lower leg portion.

44. The method of operating a knitting machine having a knitting mechanism including yarn carrier rods and a fashioning mechanism including stops for said rods, point combs, worms and nuts for moving said stops and combs, pawl means for turning said worms to position the stops and combs to fashion the fabric, back stepping pawl means to give the combs idle movements in the

direction the reverse of narrowing and a control means for said back stepping means including a member moving synchronously with said carrier stops comprising knitting a leg portion of a full-fashioned stocking blank on said machine, thereafter widening the fabric at both sides by said fashioning means, narrowing the fabric by said combs to form lines of fashion marks in the widened portions of the fabric and to set said control means so that said back stepping pawl means is positioned for operation, and continuing to operate said combs to form angles in the lines of marks in the widened portions.

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